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John L. Gittleman, Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Associate Vice Chancellor and
Dean of The Graduate School

THE UTILITY OF CHEMICAL SIGNALS AS CHARACTERS IN PHYLOGENETIC STUDIES: EXAMPLES FROM THE FELIDAE

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Denise M. Decker
May 1996

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Acknowledgments

I am grateful to my major advisor, John L. Gittleman, for his guidance and assistance throughout my graduate career, and for the many ideas and suggestions he provided for this project. Thanks to my committee members, Drs. Gordon Burghardt, Gary McCracken, and David White, for their advice and assistance during my graduate career and for their valuable suggestions on this dissertation.

Without the kindness of Dr. David White, who graciously allowed me to use his laboratory and facilities, this study would not have been possible. Also, thanks to Dr. White for taking the time to answer many questions I had concerning lipid biochemistry. I am indebted to David Ringleberg who assisted me extensively in identifying the lipids, and who was very patient with me when I insisted on trying to identify every compound, even the smallest ones. I would also like to thank David Ringleberg and Julia Stair for assisting me with various technical aspects of this project.

I am grateful to Dr. Georges Guichon, Professor of Chemistry, for the time he took out of his busy schedule to discuss lipid biochemistry with me. Special thanks to Hang-Kwang Luh for assisting me with the spatial autocorrelation and autoregressive statistical analyses.

This research was partially funded by research grants from Sigma-Xi and the American Society of Mammalogists. The following zoos kindly provided samples for this study: Atlanta Zoo, Binder Park Zoo, Bronx Zoo, Central Florida Zoo, Cheyenne Mountain Zoo, Dallas Zoo, Detroit Zoo, Granby Zoo, John Ball Zoo, Kings Dominion, Knoxville Zoo, Lake Superior Zoo, Louisville Zoo, Lowry Park Zoo, Miller Park Zoo,

Oakland Zoo, Pittsburgh Zoo, Riverbanks Zoo, Seneca Park Zoo, Sacramento Zoo, San Antonio Zoo, San Francisco Zoo, Santa Ana Zoo, Sunset Zoo, Toledo Zoo, Topeka Zoo, and Tulsa Zoo.

Thanks to my parents, Joyce and Louis Decker for their encouragement and financial support throughout my graduate career. Also thanks is extended to the many graduate students with whom I shared discussions, drinks, and fun, especially the Gittlepeople - Andrea Bixler, Greg Anderson, Jeff Smith, Roland Kays, and Sarah Cates, and our volleyball team Terry Flum, Jim Minesky, Paula Minesky, Phil Heice, and Glen Gerber. A special thanks to my husband, Terry Flum, for his encouragement and support when I was very stressed and when the completion of this document seemed hopeless.

Abstract

Anal sacs of felids are relatively large and secrete chemicals for communication. These chemicals vary intraspecifically and are used in recognition of status, such as individual, species, sexual, reproductive, and dominance. In addition, chemical signals are used in species recognition, and therefore, may potentially be used for phylogenetic study. Chemical secretions that are explicitly tied to species recognition attributes may be more informative characters for phylogenetic reconstruction when morphological or molecular characters lack resolution. Furthermore, these chemicals vary considerably in size and structure among species, suggesting their functional significance in interspecific communication.

Anal sac secretions from species within the Felidae were chemically analyzed to assess intraspecific variation and to determine whether these chemical signals were potentially useful for recognition of individual, species, sexual, reproductive, and dominance status (Chapter 3). This study further investigates the utility of chemical signals as systematic characters. I apply phylogenetic analyses of scent secretions among species within the Family Felidae (Order Carnivora) to test four competing hypotheses about phylogenetic relationships within this family (Chapter 4). Phylogenies currently based on molecular and morphological data are posed as hypotheses for testing species relationships using biochemical analyses of anal sac secretions. This study, therefore, examines phylogenetic relationships within the Felidae using an independent character set to evaluate current phylogenies for this group. Finally, the volatility of chemical signals in relation to their functional significance is

evaluated by assessing the correlations between relative volatility and several ecological, morphological, and life history traits (Chapter 5).

Results of this study show a large number of chemical compounds in the anal sacs of species within the Felidae. Minor compounds comprise the majority of the chemical compounds, with fewer major components. The compounds vary quantitatively among individuals within a species, but each species possess a unique set of compounds that are identical among individuals. Chemical signals among individuals within a single species are quantitatively found to be used in recognition of individual, species, sex, and reproductive status. There are no apparent differences in chemical composition between right and left anal sacs of Panthera pardus (leopard), P. leo (lion), and P. tigris (tiger), suggesting no functional difference between the two. Additionally, the chemical profile of leopards and tigers remains stable over a one year time interval, suggesting their potential for individual recognition. The lion and P. uncia (snow leopard) have a unique set of compounds that differ quantitatively between reproductive and non-reproductive individuals, suggesting their potential for recognition of reproductive status. Similarly, reproductive male lions, snow leopards, tigers, and Acinonyx jubatus (cheetah) have a unique set of chemicals that differ quantitatively from reproductive females of those species, and suggests their potential for recognition of sexual status. Dominant lion males and females and dominant snow leopard females have a unique chemical profile that is quite different from that of subordinate individuals, suggesting the ability for individuals to discriminate among dominant and subordinate individuals.

The phylogenetic analysis reveals consistent relationships among felid species with that proposed by other authors based on morphological and molecular data, and resolves some of the relationships that are unclear with these other data sets. For example, the cheetah is placed as the most primitive branch on the phylogenetic tree, a position that is not resolved in phylogenies based on morphological and molecular data sets. Furthermore, this analysis resolves the relationships among the Panthera species, placing the leopard and lion as most closely related taxa and placing Panthera onca (jaguar), tiger, and snow leopard as sister taxa to this group. However, the position of Felis concolor (puma) remains unresolved as its relationship with other felid species switches depending upon the type of chemical data used (i.e., glycolipids, neutral lipids, phospholipids, or the combined data set). The topology of the trees from this study agrees most closely with that presented by Collier and O'Brien (1985) based on molecular data. This study illustrates the species-specific nature of chemical signals, and their usefulness as phylogenetic characters.

Cross-taxa correlations between relative volatility of chemical compounds in a scent mark and various ecological (population density, home range size), morphological (body weight, olfactory bulb size, body length, orbit area), and life history (litter size, inter-birth interval) characters are investigated. Litter size is larger in felid species that produce scent of higher volatility, and smaller in those species that produce less volatile scent marks. Additionally, there is a trend for felid species with large olfactory bulbs to possess low volatile compounds and those with small olfactory bulbs to have highly volatile compounds. Overall, the functional significance of the

volatility of the chemical compounds in relation to various ecological, morphological, and life history traits remains unclear. For example, felid home range size is not directly correlated with volatility, suggesting that there are other strategies used to communicate spatial patterns among conspecifics. Similarly, population density, inter-birth interval, and orbit area are not significantly correlated with relative volatility. A significant correlation is found between both head and body length and body weight with medium volatility, suggesting that there is no cost associated with sequestering compounds. Results of this study also reveal that species who live in open grassland areas have more highly volatile scents than those that live in forests, suggesting that the scent deposited by forest species needs to remain for a longer period of time to ensure that the intended receivers perceive the signals.

In summary, this study demonstrates that the chemical compounds present in the anal sacs of felid species do not vary qualitiatively among individuals within the same species, suggesting their importance as species specific attributes and useful phylogenetic characters. However, the chemicals do vary quantitatively among individuals within a single species and are used in recognition of individual, reproductive, and sexual status.

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Chapter 1

Introduction

Classical systematic studies rely primarily on morphological features. While these characters often elucidate phylogenetic relationships, other characters may help resolve ambiguous phylogenetic relationships. For example, the use of molecular data from mitochondrial DNA are increasingly prevalent in systematic studies (e.g., Cronin, 1991; Lehman et al., 1991; Wayne and Jenks, 1991). The molecular data often reveal alternate patterns of evolutionary relationships than those based on morphological characters. Biological chemicals, other than DNA, are also used as phylogenetic characters. For example, in plants, the utility of secondary compounds (e.g., Bate-Smith, 1968; Harborne, 1968), and biochemical characters such as serological (Hammond, 1955), photosynthetic variation (Brown and Smith, 1975), and hormonal variation (Sponsel et al., 1979) are also recognized as important phylogenetic characters.

Behavioral characters often are regarded as too labile to be of systematic value. However, more recent studies show that behavioral features are useful indicators of phylogenetic affinity (De Queiroz and Wimberger, 1993; Gittleman and Decker, 1994) and that behavioral studies can resolve phylogenetic relationships that are unclear with traditional systematic characters (Brooks and McLennan, 1991). Along these lines, characters which function in species recognition should remain conservative (i.e., should not vary considerably among individuals within a species). Otherwise, animals

could not consistently communicate with one another. Therefore, these species-specific characters should have high systematic value. Indeed, many behavioral traits in general (Whitman, 1898; Heinroth, 1911; Emerson, 1938; Lorenz, 1939, 1941/1970; Tinbergen, 1951, 1959; Andrew, 1956; Mayr, 1958; Darwin, 1859; Alexander, 1962; Lauder, 1986; Burghardt and Gittleman, 1990), and species-specific communicator signals in particular (e.g., bird song: Becker, 1982; Anuran calls: Colgan, 1983) are important phylogenetic characters despite their presumed plasticity as compared with morphological traits. Many studies show that olfactory cues are species-specific and used for species recognition (e.g., King, 1963; Dagg and Windsor, 1971; Beauchamp et al., 1979; Wellington et al., 1979; Jonge, 1980; Randall, 1981). More recently, behavioral characters are among those included in phylogenetic analyses (e.g., Greene and Burghardt, 1978; McLennan et al., 1988; Prum, 1990; Brooks and McLennan, 1991).

Although many morphological and molecular characters are species-specific and important for phylogenetic analyses, there are some instances where chemical signals are more useful. For example, several species of insects are morphologically uniform (Jacobson et al., 1970), and are distinct with respect to their chemical signals. Vane-Wright et al. (1992) used chemical signals for phylogenetic study of Anauris butterflies with results that were consistent with a well established phylogeny based on morphological characters. Other studies, for example, in bees (Kullenberg et al., 1970) and ants (Brand et al., 1973a, b; Buschinger, 1975) show that closely related taxa share

more chemical compounds than more distant relatives. More importantly, these chemicals confirmed well established phylogenetic trees based on morphological features. Furthermore, Bergstrom et al. (1981) concluded that marking pheromones of bees are important species recognition cues. Another study (Haverty et al., 1988) suggested revising a genus of termites based on pheromones. Despite a considerable literature on the identification and function of mammalian pheromones, only one study has considered the utility of pheromones in mammalian systematic studies. Brinck et al. (1983) overlayed chemical compounds from the anal sacs onto a well established phylogeny of the skunk family (Family Mustelidae) and found that the evolution of the chemical compounds agreed with the phylogeny based on morphology. In summary, analysis of chemicals produced by a species and used in communication among individuals within a species can be used in establishing phylogenetic relationships among taxa.

Recent studies emphasize the relative merits of different types of data sets (i.e., molecular, morphological, behavioral) in determining which ones are useful in phylogenetic studies. Perhaps phylogeneticists should focus on those traits which are important to the animal (specific mate recognition traits) rather than certain types of data sets (e.g., molecular, morphological, behavioral). Indeed, Paterson (1978) proposed a concept of species that is based on the fact that species are tied together by a common communication system, a specific mate recognition system (SMRS). Elements of the specific mate recognition system

are species-specific characters, and therefore, should be useful phylogenetic characters. For example, in animals which use non-morphological cues in the recognition of conspecific mates, speciation can occur without any accompanying divergence in morphology. In this case, morphology would not be important in distinguishing the species. Depending upon the predominant communication channel (visual, chemical, auditory) that the species use in mate recognition, there are varying degrees of importance for morphological, molecular, and behavioral data sets as phylogenetic characters.

Several studies show that semiochemicals produced by a species are used in the mate recognition system among individuals within a species and can be used in establishing phylogenetic relationships among taxa (Kullenberg et al., 1970; Birch, 1974; Buschinger, 1975; Brinck et al., 1983; Lofstedt and Van der Pers, 1985; Linn et al., 1987; Vane-Wright et al., 1992). For example, in the Noctuidae chemicals released in large amounts are most similar among closely related species and diverge among more distant relatives (Birch, 1974). Similarly, Manning (1959) noted a direct correlation between phylogeny and courtship behavior in Drosophila, suggesting their species-specific behavior.

Mammals have a variety of scent glands that secrete chemicals which are used for communication. Anal sacs are particularly common in carnivores, with the exception of some bears, the raccoon dog, and sea otter (Asa, 1993). They consist of paired invaginations with ducts that open just inside the anus, and are

surrounded by a muscular layer which allows the animal to expel the sac contents at will. Felids, in particular, have relatively large anal sacs that secrete chemicals for communication (MacDonald, 1985). These chemicals can be analyzed and compared across species.

Although some earlier studies focused on felid anal gland secretions (Lindemann, 1953; Erickson, 1955), more recent studies emphasize urine marking in felids (Eaton, 1970; Eaton and Craig, 1973; Bailey, 1974; Geertsema, 1985; Ilany, 1986; Emmons, 1987). However, Asa et al. (1985a) emphasized the importance of communication with anal sac secretions for most carnivores.

Chemical Signals and Felid Systematics

Although the systematics of the Felidae are well studied, considerable debate still exists concerning the relationships of species within the family. The use of semiochemicals in establishing relationships among species of the Family Felidae is particularly useful, considering the fact that the relative positions of some species are ambiguous (e.g., Hemmer, 1978; Herrington, 1983; Collier and O'Brien, 1985; Salles, 1992). The general aim of this dissertation, therefore, is to analyze the chemical composition of the anal sacs of species across the Felidae and to apply these species specific traits to phylogenetic analysis.

In order to assess trait variation in chemical signals across species it was first necessary to examine intraspecific variability. Chemicals from anal sacs vary

intraspecifically and often are used in recognition. Behavioral studies show these recognition cues to be important in delineating dominance status (e.g., Carr et al., 1970; Epple, 1986), reproductive status (e.g., Mellen, 1993), and sexual status (e.g., Epple et al., 1993). Following a general description of methods for collecting and analyzing anal sac secretions (Chapter 2), Chapter 3 examines the intraspecific variation in chemical composition among individuals within a single species as this variation relates to these recognition attributes.

Following an analysis of intraspecific variability, Chapter 4 investigates the importance of chemical signals as phylogenetic characters by determining whether semiochemicals in felid species are qualitatively consistent among individuals within a single species, and whether these qualitative characters can be used to establish a phylogeny which is reasonable in light of other phylogenetic studies of the Felidae (Hemmer, 1978; Herrington, 1983; Collier and O'Brien, 1985; Salles, 1992). This comparison is a direct analysis of the recognition concept of species by establishing the consistency of chemical constituents and, in turn, their usefulness as phylogenetic characters. However, it should be noted here that the semiochemicals from the anal sacs of felids are only a part of the species recognition system, and other characteristics likely play a role in species recognition also.

Even though chemical signals may be useful for phylogenetic analysis, this does not preclude their functional importance. In fact, volatility of the chemical

signals relates to their functional significance. For example, scent marks which function in short term signaling (e.g., alarm signals) are highly volatile so they do not remain at detectable levels for too long after their function is served (Wilson, 1970). On the other hand, compounds that serve a long term function (e.g., territory marking) have low volatility so they persist long enough to broadcast the message to many receivers (Davies et al., 1988; Alberts, 1992). Chapter 5 addresses the functional significance of felid chemical signals by assessing the relationship between volatility and various ecological, morphological, and life history traits.

Chapter 2

General Methods

This chapter presents general collection and chemical methods which are applicable to the remaining chapters. They are given here to avoid redundancy in subsequent chapters. Methods which are specific to each chapter will be discussed therein.

Collection of Anal Sac Secretions

Details of the following methodology for collection and analysis of scent secretions are based on prior work (Decker et al., 1992). Anal sac secretions were collected from species of the family Felidae housed in zoos primarily in the United States. Due to the endangered status of felid species, it was only possible to collect a few samples from zoos outside of the United States (Table 2-1). Because of the opportunistic nature of sample collection (samples were collected only when animals were anesthetized for medical purposes), sample sizes are uneven for each species. Secretions were collected by curators or veterinarians at their respective zoos by swabbing the inside surface of the anal sac with a sterile cotton swab. Alternatively, the anal sac was squeezed and the secretion was exuded outside of the sac for collection. Crump (1980) found no differences in anal sac secretions between ferrets that were caught in the wild and those that were reared in captivity. Therefore, the fact that samples were collected from captive felid species should not effect the chemical compounds found in the anal sacs.

Table 2-1.--List of samples collected from zoos with information for each species on sex, age, dominance status, and reproductive status.

Species	Zoo	Sex	Age	Dominance Status	Reproductive Status
Acinonyx jubatus	Binder Park Zoo	M	9 yrs.	Subordinate	Reproductive
Acinonyx jubatus	Binder Park Zoo	M	6 yrs.	Subordinate	Reproductive
Acinonyx jubatus	Binder Park Zoo	M	8 yrs.	Subordniate	Reproductive
Acinonyx jubatus	Louisville Zoo	F	7 yrs.	Subordinate	Reproductive
Acinonyx jubatus	Sacramento Zoo	F	1 yr.	Subordinate	Pre-Repro.
Acinonyx jubatus	Sacramento Zoo	F	1 yr.	Subordinate	Pre-Repro.
Acinonyx jubatus	San Antonio Zoo	F	10 yrs.	Subordinate	Reproductive
Acinonyx jubatus	Toledo Zoo	M	10 yrs.	Dominant	Reproductive
Acinonyx jubatus	Toledo Zoo	F	9 yrs.	Subordinate	Reproductive
Felis bengalensis	Bronx Zoo	F	7 yrs.	Dominant	Reproductive
Felis bengalensis	Bronx Zoo	F	1 yr.	Subordinate	Pre-Repro.
Felis caracal	Central Florida Zoo	F	8 yrs.	Dominant	Reproductive
Felis caracal	Dallas Zoo	M	1 yr.	Subordinate	Pre-Repro.
Felis caracal	San Antonio Zoo	F	3 yrs.	Dominant	Reproductive
Felis caracal	San Antonio Zoo	M	8 yrs.	Subordinate	Reproductive
Felis concolor	Central Florida Zoo	F	13 yrs.	Dominant	Reproductive
Felis concolor	Lowry Park Zoo	M	6 yrs.	Subordinate	Reproductive
Felis concolor	Topeka Zoo	F	13 yrs.	Subordinate	Reproductive
Felis geoffroyi	Bronx Zoo	M	6 yrs.	Subordinate	Reproductive
Felis geoffroyi	Sacramento Zoo	F	5 yrs.	Subordinate	Reproductive
Felis manul	Bronx Zoo	M	5 yrs.	Dominant	Reproductive
Felis margarita	Granby Zoo	M	2 yrs.	Subordinate	Pre-Repro.
Felis pardalis	Cheyenne Mt. Zoo	M	6 yrs.	Dominant	Reproductive
Felis pardalis	Cheyenne Mt. Zoo	F	4 yrs.	Subordinate	Reproductive
Felis pardalis	Dallas Zoo	F	1 yr.	Subordinate	Pre-Repro.
Felis rufus	San Francisco Zoo	M	7 yrs.	Subordinate	Reproductive
Felis serval	Sacramento Zoo	F	12 yrs.	Subordinate	Reproductive
Felis serval	Santa Ana Zoo	F	10 yrs.	Subordinate	Reproductive
Felis temminicki	San Antonio Zoo	M	7 yrs.	Dominant	Reproductive
Panthera leo	Dallas Zoo	M	7 yrs	Dominant	Reproductive
Panthera leo	Dallas Zoo	F	12 yrs.	Subordinate	Reproductive
Panthera leo	Detroit Zoo	M	9 yrs.	Subordinate	Reproductive
Panthera leo	Detroit Zoo	F	9 yrs.	Dominant	Reproductive
Panthera leo	Detroit Zoo	F	9 yrs.	Subordinate	Reproductive
Panthera leo	Detroit Zoo	M	2 yrs.	Subordinate	Pre-Repro.
Panthera leo	Detroit Zoo	F	1 yr.	Subordinate	Pre-Repro.
Panthera leo	Detroit Zoo	F	2 yrs.	Subordinate	Pre-Repro.
Panthera leo	John Ball Zoo	F	4 yrs.	Subordinate	Reproductive
Panthera leo	Kings Dominion	F	3 yrs.	Subordinate	Reproductive
Panthera leo	Kings Dominion	F	3 yrs.	Subordinate	Reproductive
Panthera leo	Kings Dominion	F	3 yrs.	Subordinate	Reproductive
Panthera leo	Kings Dominion	F	3 yrs.	Subordinate	Reproductive
Panthera leo	Kings Dominion	M	6 yrs.	Dominant	Reproductive
Panthera leo	Kings Dominion	M	6 yrs.	Subordinate	Reproductive
Panthera leo	Kings Dominion	M	6 yrs.	Subordinate	Reproductive
Panthera leo	Louisville Zoo	M	14 yrs.	Dominant	Reproductive
Panthera leo	Oakland Zoo	F	3 yrs.	Subordinate	Reproductive
Panthera leo	Riverbanks Zoo	F	20 yrs.	Dominant	Reproductive

Table 2-1.--(continued)

Species	Zoo	Sex	Age	Dominance Status	Reproductive Status
Panthera leo	Riverbanks Zoo	M	20 yrs.	Dominant	Reproductive
Panthera leo	San Francisco Zoo	M	12 yrs.	Subordinate	Reproductive
Panthera leo	San Francisco Zoo	F	22 yrs.	Subordinate	Reproductive
Panthera leo	San Francisco Zoo	F	12 yrs.	Subordinate	Reproductive
Panthera leo	Seneca Park Zoo	F	14 yrs.	Dominant	Reproductive
Panthera leo	Topeka Zoo	F	4 yrs.	Subordinate	Reproductive
Panthera leo	Topeka Zoo	F	6 yrs.	Subordinate	Reproductive
Panthera leo	Topeka Zoo	F	6 yrs.	Subordinate	Reproductive
Panthera leo	Topeka Zoo	F	4 yrs.	Subordinate	Reproductive
Panthera leo	Zoo Atlanta	F	6 yrs.	Dominant	Reproductive
Panthera leo	Zoo Atlanta	M	6 yrs.	Dominant	Reproductive
Panthera leo	Zoo Atlanta	F	6 mos.	Subordinate	Pre-Repro.
Panthera leo	Zoo Atlanta	F	1 yr.	Subordinate	Pre-Repro.
Panthera onca	Sacramento Zoo	F	15 yrs.	Dominant	Reproductive
Panthera onca	Sacramento Zoo	M	3 yrs.	Subordinate	Reproductive
Panthera onca	Zoo Atlanta	F	19 yrs.	Dominant	Reproductive
Panthera pardus	Knoxville Zoo	M	26 yrs.	Dominant	Reproductive
Panthera pardus	Lowry Park Zoo	M	3 yrs.	Subordinate	Reproductive
Panthera pardus	Lowry Park Zoo	M	7 yrs.	Dominant	Reproductive
Panthera pardus	Miller Park Zoo	F	8 yrs.	Subordinate	Reproductive
Panthera pardus	Toledo Zoo	M	14 yrs.	Subordinate	Reproductive
Panthera tigris	Bronx Zoo	M	16 yrs.	Subordinate	Reproductive
Panthera tigris	Bronx Zoo	F	12 yrs.	Dominant	Reproductive
Panthera tigris	Central Florida Zoo	F	17 yrs.	Subordinate	Reproductive
Panthera tigris	Cheyenne Mt. Zoo	M	16 yrs.	Dominant	Reproductive
Panthera tigris	Dallas Zoo	M	6 yrs.	Subordinate	Reproductive
Panthera tigris	Detroit Zoo	M	10 yrs.	Dominant	Reproductive
Panthera tigris	Knoxville Zoo	F	5 yrs.	Dominant	Reproductive
Panthera tigris	Lowry park Zoo	F	15 yrs.	Subordinate	Reproductive
Panthera tigris	Miller Park Zoo	M	2 yrs.	Subordinate	Pre-Repro.
Panthera tigris	Miller Park Zoo	F	16 yrs.	Subordinate	Reproductive
Panthera tigris	Pittsburgh Zoo	M	6 yrs.	Subordinate	Reproductive
Panthera tigris	Pittsburgh Zoo	F	11 yrs.	Subordinate	Reproductive
Panthera tigris	Pittsburgh Zoo	M	18 yrs.	Dominant	Reproductive
Panthera tigris	San Francisco	M	11 yrs.	Subordinate	Reproductive
Panthera tigris	San Francisco Zoo	F	19 yrs.	Subordinate	Reproductive
Panthera tigris	Seneca park Zoo	F	9 yrs.	Subordinate	Reproductive
Panthera tigris	Sunset Zoo	F	7 yrs..	Subordinate	Reproductive
Panthera tigris	Sunset Zoo	M	10 yrs.	Dominant	Reproductive
Panthera tigris	Sunset Zoo	F	8 yrs.	Subordinate	Reproductive
Panthera tigris	Toledo Zoo	M	13 yrs.	Subordinate	Reproductive
Panthera tigris	Topeka Zoo	M	16 yrs.	Subordinate	Reproductive
Panthera tigris	Zoo Atlanta	M	9 yrs.	Subordinate	Reproductive
Panthera uncia	Dallas Zoo	F	16 yrs.	Dominant	Reproductive
Panthera uncia	Lake Superior Zoo	F	3 yrs	Subordinate	Reproductive
Panthera uncia	Miller Park Zoo	M	12 yrs.	Subordinate	Reproductive
Panthera uncia	Miller Park Zoo	M	8 yrs.	Subordinate	Reproductive
Panthera uncia	Sacramento Zoo	F	3 yrs.	Subordinate	Reproductive
Panthera uncia	Sacramento Zoo	M	5 yrs.	Subordinate	Reproductive

Table 2-1.--(continued)

Species	Zoo	Sex	Age	Dominance Status	Reproductive Status
Panthera uncia	San Francisco Zoo	M	10 mos.	Subordinate	Pre-Repro.
Panthera uncia	San Francisco Zoo	M	15 yrs.	Dominant	Reproductive
Panthera uncia	San Francisco Zoo	F	10 mos.	Subordinate	Pre-Repro.
Panthera uncia	Toledo Zoo	F	3 yrs.	Subordinate	Reproductive
Panthera uncia	Toledo Zoo	F	3 yrs.	Dominant	Reproductive
Panthera uncia	Tulsa Zoo	F	12 yrs.	Subordinate	Reproductive

Once the sample was collected, it was immediately placed in a Teflon-lined screw cap test tube and placed on dry ice. A control swab was also collected at the same time by waving a sterile cotton swab in the air and following the procedure as described above for the sample. Samples were transported to the Center for Environmental Biotechnology, The University of Tennessee for chemical analyses. The procedure for transporting samples has been shown effective for retaining the heavier lipids (C12-C30) which are of interest in this study (Decker et al., 1992).

Chemical Analysis of Anal Sac Secretions

All chemical analyses were conducted in the laboratory of Dr. David C. White at the Center for Environmental Biotechnology. Many of the chemical methods used in this study were developed by Dr. White (White et al., 1979). The applicability and feasibility of the following chemical methods in revealing a large number of compounds present in the anal sacs of carnivore species has previously been demonstrated (Decker et al., 1992).

Once the sample reached the laboratory it was extracted with a modified Bligh and Dyer solvent system (White et al., 1979) which consists of chloroform, methanol, and a phosphate buffer in a ratio of 1:2:0.8. The sample was left in the solvent system for a minimum of 4 hr. Subsequently, equal amounts of water and chloroform were added to the samples separating them into aqueous and organic phases. The upper aqueous layer was discarded and the lower organic (lipid containing) phase transferred

to Teflon lined screw cap test tubes and dried under a stream of nitrogen at room temperature.

Lipid Separation and Methylation

Silicic acid columns were prepared using 0.5 g Unisil (100-200 mesh, Clarkson Chemical Co., Inc., Williamsport, PA), activated at 100°C for 60 minutes and pre-extracted with chloroform. Total lipid was applied to the top of the columns in a minimal volume of chloroform. Sequential washes of 5 ml of chloroform, acetone, and methanol eluted the neutral, glyco-, and phospholipids. Each fraction was then dried under a stream of nitrogen. The mild alkaline methanolysis procedure (White et al., 1979) was utilized to prepare methyl esters of the ester-linked fatty acids of each lipid fraction.

Gas Chromatography (GC)

Dry methyl esters of neutral, glyco- and phospholipids were dissolved in iso-octane containing the internal standard of methyl nonadecanoate. Samples of 1 ul were injected onto a 50 m nonpolar, cross-linked methyl silicone fused silica capillary column (0.2 mm i.d., Hewlett Packard) in a Shimadzu GC-9A GC. A 30 s splitless injection at 270°C was used. Hydrogen at a linear velocity of 35 cm/s was the carrier gas with a temperature program starting with an initial temperature of 100°C. The temperature was then increased at a rate of 10°C/min to 150°C. At 150°C the temperature was increased 3°C every 5 minutes until the temperature peaked at 282°C. An equal detector response was assumed for all components. Peak areas were

quantified with a programmable laboratory data system (Nelson Analytical 3000 Series Chromatography Data System, Revision 3.6). Tentative component identification prior to GC/MS was based on comparison of the retention time data or co-elution with authentic standards.

Mass Spectrometry (MS)

GC/MS analysis was performed on a Hewlett Packard 5996A GC/MS fitted with a direct capillary inlet utilizing the same chromatographic system except for use of a helium carrier gas and the temperature program, which started at 100°C and increased to 280°C at 3° C/min for a total analysis time of 60 min. The electron multiplier voltage was between 1800 and 2000 V, the transfer line was maintained at 300°C, the source 280°C and analyzer 250°C, and the GC/MS was autotuned with DFTPP (decafluorotriphenylphosphine) at m/z 502 with an ionization energy of 70 eV. The data were acquired using the Hewlett Packard 6/VM data system. Compounds were identified using the GC-MS library, which provided an 80% or greater probability of being correct for all compounds.

Chapter 3

Intraspecific Variation of Semiochemicals Within Felid Species

Introduction

Semiochemicals consist of a complex mixture of chemicals that can be expelled from an animal's body and be used in communication between species and among conspecific individuals. These scents can originate from a variety of sources including anal sacs, urine, modified specialized glands, saliva (Jannett, 1984), vaginal secretions (Michael et al., 1975), and sebaceous glands (Jannett, 1984). Of these, urine marking is studied most in carnivores due to associated stereotypical behaviors (Asa et al., 1985a). Thus, many authors simply dismiss the importance of faeces and anal gland secretions. For example, Kleiman (1966) observed no evidence for faeces or anal gland scent marking in a study of captive wolves. However, more recent field studies (Peters and Mech, 1975) indicate that these types of marking tend to be common, concentrated at trail junctions, rendez-vous sites and conspicuous objects, suggesting that they most likely play an important role in olfactory communication. Furthermore, Hediger (1944) and Ortmann (1960) demonstrate that faeces most likely serve as a substrate for scent marking with anal gland secretions. Additionally, Asa et al. (1985a) suggests that faeces and anal gland secretions emit more volatile compounds than does urine and could serve as a more visually salient signal.

Studies of chemical communication in felids particularly focus on urine (Acinonyx jubatus - cheetah - Eaton, 1970; Eaton and Craig, 1973; Felis rufus - bobcat

- Bailey, 1974; F. pardalis - ocelot - Emmons, 1987; F. serval - serval - Geertsema, 1985; Panthera pardus - leopard - Ilany, 1986), with little mention of marking with anal gland secretions. Felid species (bobcat - Bailey, 1974; serval - Geertsema, 1985; ocelot - Emmons, 1987) squirt small amounts of urine on trailside vegetation, rocks, bushes, and snow banks as they travel about their home ranges. Leopards mark ground depressions, which they visit frequently to re-mark (Ilany, 1986).

Studies focusing on anal gland secretions indicate that felids tend to mark stones and tree stumps in spaces between territories (Erickson, 1955; Lindemann, 1953). Furthermore, F. lynx (lynx) tend to use anal gland markings in areas that are later sought during the mating period (Lindemann, 1953). Similarly, male F. rufus (bobcat) tend to establish anal gland marking sites in female home ranges, near temporary dens of females, and on frequently traveled trails (Wemmer and Scow, 1977).

Numerous studies demonstrate that semiochemicals are used for different functions and at different levels of recognition, i.e., species, subspecies, group, kin, sexual, individual. Mackintosh and Grant (1966) demonstrate that semiochemicals function in individual recognition. They showed that two male mice previously housed together became more aggressive toward each other if one of the males is covered with the scent of an unfamiliar individual. Conversely, they demonstrated that a strange male was attacked less if he wasis treated with odor of one of the two resident males. Several other studies also demonstrate the ability of individuals to distinguish other individuals by scent (e.g., Harrington, 1976; Epple et al., 1993; Doty, 1986).

Sexual recognition and the recognition of reproductive status are also important functions of scent marking. For example, Saguinus fuscicollis (saddle-back tamarins) can discriminate between scents from male and female conspecifics under a variety of experimental conditions (Epple et al., 1993). Similarly, reproductive female laboratory rats (Rattus norvegicus) distinguish between reproductive and non-reproductive males (Krames, 1970). Studies of felid scent marking in relation to sexual and reproductive behavior are scanty. However, a study on cheetahs indicated that males tend to mark more frequently than females, and that the marking frequency of both sexes increased dramatically during the mating season (Grittinger and Peneski, 1984). This study suggests the potential importance of scent in the recognition of sex and reproductive status across felids.

Semiochemicals are also important for the establishment, maintenance, and demonstration of dominance hierarchies (Carr et al., 1970; Epple, 1986). In several species, the scent marking activity of socially dominant males and females in established groups tended to be higher than that of non-dominant group members (Epple et al., 1993). Studies by Rylands (1990) on several species of primates indicated that high social rank and aggressive motivations are communicated by the frequency of marking and by a specific scent quality. Since dominant males often show more scent marking than subordinate males, discrimination might be based on quantitative cues (Epple, 1974).

Other studies report characteristic odors of a social group. Petaurus breviceps (Sugar glider) males rub their frontal glands against the sternal glands of females in

their group, thus producing a clan-specific odor (Muller-Schwarze, 1974). Furthermore, Helogale parvula (African dwarf mongooses) mark one another with their anal glands, which has importance for maintenance of social bonds (Rasa, 1973). Male lions rub their cheeks in areas previously marked by other group members, suggesting that the pride acquires a distinctive group odor (Schaller, 1972).

Numerous studies demonstrate the importance of semiochemicals in conspecific recognition. Species-specific chemical signals are known for Mus musculus (house mouse - Bowers and Alexander, 1967), Peromyscus species (Moore, 1965; Doty, 1972, 1973; Drickamer, 1984); Cavia species (Beauchamp et al., 1979); Meriones species (Dagg and Windsor, 1971), Apodemus sylvestris (Old World wood mouse - Stoddart and Smith, 1984); Microtus species (DeJonge, 1980); and Mastomys species (Apps et al., 1990). Epple et al. (1993) demonstrated that several primate species can discriminate between conspecific and heterospecific scents from a distance, although material in which they physically contacted with their muzzle was more attractive. Belcher et al. (1988, 1990) suggested that contact with the scent material was necessary for the perception of its full biological activity. The species specificity of semiochemicals that function in specific mate recognition are believed to play an important role in ensuring that mates come together, especially when they are sympatric with closely related species (Roelofs and Carde, 1974; Tamaki, 1985). Many sympatric species have geometric isomers as their sex semiochemicals (Tamaki, 1985). If a single semiochemical is shared between two sympatric species, different release rates of the semiochemical can become a species-specific cue (Kaae et al., 1973).

Decoding chemical signals to the point where chemical structure can be related to biological function continues to be difficult. However, the first step in elucidating the biological activity (i.e., function) of chemical signals is to describe and compare the chemical composition among individuals within a single species. Those compounds that are different between sexes or among social groups, for example, could potentially be used in recognition. Although the results from these analyses are only suggestive, they facilitate a systematic approach to isolating hundreds of compounds which are generally a part of the scent secretions of carnivores (Decker et al, 1992). In a few mammals, for example Mesocricetus auratus (golden hamster) (Singer et al., 1976) and Sus scrofa (domestic pig) (Melrose et al., 1971), specific biological activities are due to a single compound or a small number of compounds. In many cases, however, the biological activity resides in chemically complex mixtures, containing a number of classes of compounds (Crump et al., 1984; Raymer et al., 1985; Belcher et al., 1986; Muller-Schwarze et al., 1986). These mixtures contain compounds of additive or redundant bioactivity, compounds which work in synergy, and compounds which inhibit the biological response (Albone, 1984; Novotny et al., 1985; Muller-Schwarze et al., 1986). Nevertheless, chemical analyses provide a basis for formulating specific hypotheses of scent marking functions which can be tested empirically.

The objectives of this study are to make intraspecific comparisons of chemicals present in anal sac secretions of various felid species, for which large samples are available (leopards, tigers, snow leopards), to determine whether the chemicals are potentially used in recognition. Comparison of chemical composition will examine the

effects of: sample size; temporal variability; location of anal sac; sex differences; reproductive status; dominance; and social versus solitary housing. Finally, of critical importance to phylogenetic studies, the species specific nature of felid semiochemicals is assessed.

Methods

Chapter 2 details the collection methods and chemical analyses used in this study. The number of compounds and percentage of major and minor components were determined in the glycolipid, neutral lipid, and phospholipid fractions for each species. All analyses and comparisons were made with the glycolipid, neutral lipid, and phospholipid fractions as outlined in the General Methods (Chapter 2).

Samples were collected from the right and left anal sac of leopards and tigers. This allowed comparison of the two sides to determine whether there were differences in chemical composition. Additionally, samples were collected from leopards, snow leopards, and tigers over a one year interval to determine whether there were temporal effects on the chemicals present in the anal sacs. Furthermore, three samples were collected at the same time from a single tiger to assess whether compounds were present in equal quantities for all samples. Sample sizes for the above comparisons do not lend themselves to statistical analyses, therefore, data analysis is restricted to qualitative statements and suggestions regarding possible differences.

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS). Mann-Whitney *U* tests were performed to determine whether

there were differences in chemical composition between pre-reproductive female and reproductive female snow leopards and lions, between reproductive male and reproductive female cheetahs, snow leopards, tigers, and lions, between dominant female and subordinate female lions and snow leopards and between dominant male and subordinate male lions.

A Mann-Whitney *U* Test was performed to determine whether there were differences in amounts of chemical compounds in the anal sac of snow leopard females housed alone versus those housed with males. A Kruskall-Wallis Analysis of Variance was performed to determine whether there were any significant differences among males that were housed alone, those housed with females and those housed with a mixed group of male and female lions. A Kruskall-Wallis Analysis of Variance was also used in lions to determine whether there were differences among females housed alone, those housed with males only, and those housed with males and females.

Results

The number of compounds present in all felid species range from 42-188 (Table 3-1). The compounds within a single species vary quantitatively, but not qualitatively (i.e., each individual within a single species has exactly the same compounds). For all species, 42%-98% of the compounds comprise minor components (<1.00 picomole), whereas only 2%-42% of the compounds are major components (>1.00 picomole) (Table 3-2).

Table 3-1.--Number of glycolipids, neutral lipids, and phospholipids present in anal sacs of each felid species.

Species	Glycolipids	Neutral Lipids	Phospholipids
Acinonyx jubatus	50	103	46
Felis bengalensis	59	78	64
Felis caracal	77	103	46
Felis concolor	72	129	97
Felis geoffroyi	60	80	40
Felis manul	64	109	121
Felis margarita	65	99	80
Felis pardalis	58	78	96
Felis rufus	91	130	---
Felis serval	60	80	65
Felis temminicki	60	109	42
Panthera leo	78	115	82
Panthera onca	92	122	121
Panthera pardus	188	124	121
Panthera tigris	61	134	161
Panthera uncia	67	147	148

Table 3-2.--Percent glycolipids (GL), neutral lipids (NL), and phospholipids (PL) represented by major and minor compounds in anal sacs of felid species.

Species	Minor Compounds			Major Compounds		
	GL	NL	PL	GL	NL	PL
Acinonyx jubatus	80	75	88	20	25	12
Felis bengalensis	83	83	45	17	17	35
Felis caracal	59	73	63	41	27	37
Felis concolor	58	71	69	42	29	31
Felis geoffroyi	75	74	70	25	26	30
Felis manul	87	80	83	13	20	17
Felis margarita	84	92	90	16	8	10
Felis pardalis	42	69	61	16	31	35
Felis rufus	90	84	---	10	16	---
Felis serval	88	80	57	12	20	43
Felis temminicki	98	94	90	2	6	10
Panthera leo	83	71	84	17	29	16
Panthera onca	80	79	79	20	21	21
Panthera pardus	83	80	88	17	20	32
Panthera tigris	98	90	98	2	10	2
Panthera uncia	80	90	71	20	10	29

Based on visual inspection of each compound within a species, there were no apparent differences between the right and left anal sacs for the glycolipid (Table A-1 - Appendix A), neutral lipid (Table A-2 - Appendix A), or phospholipid fractions (Table A-3 - Appendix A) in leopards and tigers. Similarly, from general inspection of the data, samples from the same individual at a one year interval revealed no apparent differences in relative amounts of compounds for the glycolipid (Table A-4 - Appendix A), neutral lipid (Table A-5 - Appendix A), or phospholipid fractions (Table A-6 - Appendix A). Finally, from qualitative inspection of the data, there were no apparent differences in the glycolipid (Table A-7 - Appendix A), neutral lipid (Table A-8 - Appendix A), or phospholipid fractions (Table A-9 - Appendix A) of samples collected at the same time from the same individual.

Pre-Reproductive vs. Reproductive Females

Sixty three compounds are significantly different between pre-reproductive female and reproductive female lions in the glycolipid fraction (Table 3-3). Forty seven compounds were significantly greater in the reproductive female whereas only 16 were significantly greater in the pre-reproductive female lions (Table A-10 - Appendix A). Thirty four compounds were significantly different between pre-reproductive and reproductive female snow leopards in the glycolipid fraction (Table 3-3). Only twelve compounds were significantly greater in the reproductive females, whereas 22 compounds were significantly greater in the pre-reproductive females (Table A-10 - Appendix A).

Table 3-3.--z scores and significance values of glycolipids present in anal sacs of pre-reproductive and reproductive *Panthera leo* and *P. uncia* females. Dashed lines represent the absence of a compound.

Compounds	*P. uncia*		*P. leo*	
	z-score	p value	z-score	p value
10 carbon compound B	3.0645	0.0022	---	---
10 carbon compound D	3.0645	0.0022	---	---
12 carbon compound Q	3.0645	0.0022	2.0000	0.0455
2,6-bis(1,1-dimethylethyl)-4-ethyl	---	---	2.0000	0.0455
12 carbon compound W	2.6389	0.0083	---	---
12 carbon compound X	3.0645	0.0022	2.0000	0.0455
12 carbon compound AB	---	---	2.0000	0.0455
13 carbon compound AC	---	---	2.0000	0.0455
13 carbon compound AH	3.0645	0.0022	---	---
13 carbon compound AM	---	---	2.0000	0.0455
13 carbon compound AP	3.0645	0.0022	---	---
Tetradecanoic acid	3.0645	0.0022	2.0000	0.0455
14 carbon compound AY	3.0645	0.0022	---	---
14 carbon compound BF	3.0645	0.0022	---	---
14 carbon compound BG	3.0645	0.0022	---	---
Pentadecanoic acid	3.0645	0.0022	---	---
15 carbon compound BQ	3.0645	0.0022	---	---
15 carbon compound BT	---	---	2.0000	0.0455
Hexadecanoic acid	3.0645	0.0022	2.0000	0.0455
16 carbon compound BV	---	---	2.0000	0.0455
16 carbon compound BY	3.0645	0.0022	---	---
16 carbon compound BZ	3.0645	0.0022	---	---
16 carbon compound CH	3.0645	0.0022	---	---
Heptadecanoic acid	3.0645	0.0022	---	---
17 carbon compound CI	3.0645	0.0022	---	---
17 carbon compound CP	2.6389	0.0083	---	---
X-Octadecenoic acid	3.0645	0.0022	---	---
18 carbon compound CW	---	---	2.0000	0.0455
18 carbon compound DA	---	---	2.0000	0.0455
X-methyl octadecanoic acid	3.0645	0.0022	---	---
18 carbon compound DC	3.0645	0.0022	2.0000	0.0455
18 carbon compound DF	---	---	2.0000	0.0455
19 carbon compound DG	3.0645	0.0022	---	---
19 carbon compound DM	---	---	2.0000	0.0455
19 carbon compound DP	3.0645	0.0022	---	---
19 carbon compound DS	---	---	2.0000	0.0455
Eicosanoic acid	3.0645	0.0022	2.0000	0.0455
20 carbon compound DX	---	---	2.0000	0.0455
20 carbon compound ED	3.0645	0.0022	---	---
20 carbon compound EH	---	---	2.0000	0.0455
20 carbon compound EK	3.0645	0.0022	---	---
21 carbon compound EQ	3.0645	0.0022	---	---
21 carbon compound EU	3.0645	0.0022	---	---
21 carbon compound FA	3.0645	0.0022	---	---
21 carbon compound FD	---	---	2.0000	0.0455
21 carbon compound FE	3.0645	0.0022	---	---
21 carbon compound FH	---	---	2.0000	0.0455

Table 3-3.–(continued)

Compound	*P. uncia*		*P. leo*	
	z-score	p value	z-score	p value
22 carbon compound FI	3.0645	0.0022	---------	---------
22 carbon compound FO	---------	---------	2.0000	0.0455
22 carbon compound FP	3.0645	0.0022	---------	---------
22 carbon compound FU	3.0645	0.0022	---------	---------
22 carbon compound GA	---------	---------	2.0000	0.0455
22 carbon compound GB	3.0645	0.0022	---------	---------
23 carbon compound GJ	---------	---------	2.0000	0.0455
23 carbon compound GL	---------	---------	2.0000	0.0455
23 carbon compound GM	3.0645	0.0022	---------	---------
23 carbon compound GO	3.0645	0.0022	---------	---------
Tetracosanoic acid	3.0645	0.0022	---------	---------
24 carbon compound HB	3.0645	0.0022	---------	---------
25 carbon compound HK	3.0645	0.0022	---------	---------
25 carbon compound HO	3.0645	0.0022	---------	---------
25 carbon compound HP	3.0645	0.0022	---------	---------
25 carbon compound HX	3.0645	0.0022	---------	---------
25 carbon compound IC	3.0645	0.0022	---------	---------
26 carbon compound ID	3.0645	0.0022	---------	---------
26 carbon compound IE	3.0645	0.0022	---------	---------
26 carbon compound II	3.0645	0.0022	---------	---------
26 carbon compound IJ	3.0645	0.0022	---------	---------
26 carbon compound IN	---------	---------	2.0000	0.0455
26 carbon compound IS	3.0645	0.0022	---------	---------
26 carbon compound IV	---------	---------	2.0000	0.0455
26 carbon compound IW	---------	---------	2.0000	0.0455
26 carbon compound IX	3.0645	0.0022	---------	---------
27 carbon compound JD	3.0645	0.0022	---------	---------
27 carbon sterol	2.4686	0.0136	---------	---------
27 carbon compound JI	3.0645	0.0022	---------	---------
27 carbon compound JP	3.0645	0.0022	---------	---------
27 carbon compound JW	3.0645	0.0022	---------	---------
27 carbon compound JX	3.0645	0.0022	---------	---------
28 carbon compound KI	---------	---------	2.0000	0.0455
28 carbon compound KK	3.0645	0.0022	---------	---------
28 carbon compound KM	3.0645	0.0022	---------	---------
29 carbon compound KZ	3.0645	0.0022	---------	---------
29 carbon compound LM	2.0000	0.0455	---------	---------
29 carbon compound LR	---------	---------	2.0000	0.0455
29 carbon compound LU	3.0645	0.0022	---------	---------
30 carbon compound LX	3.0645	0.0022	2.0000	0.0455
30 carbon compound MN	---------	---------	2.0000	0.0455
31 carbon compound MR	3.0645	0.0022	2.0000	0.0455

One hundred compounds were significantly different between the pre-reproductive and reproductive female lions in the neutral lipid fraction (Table 3-4). Eighty seven compounds were significantly greater in the reproductive females, whereas only 13 compounds were significantly greater in the pre-reproductive female lions (Table A-11 - Appendix A). Thirty six compounds were significantly different between pre-reproductive and reproductive female snow leopards in the neutral lipid fraction (Table 3-4). Eighteen compounds were significantly greater in the pre-reproductive females and 18 compounds were significantly greater in the reproductive females (Table A-11 - Appendix A).

Sixty three compounds were significantly different between pre-reproductive and reproductive female lions in the phospholipid fraction (Table 3-5). Forty five compounds were significantly greater in the reproductive females and 18 compounds were significantly greater in the pre-reproductive female lions (Table A-12 - Appendix A). Forty five compounds were significantly different between the pre-reproductive and reproductive female snow leopards in the phospholipid fraction (Table 3-5). Eleven compounds were significantly greater in the reproductive females, whereas 34 compounds were significantly greater in the pre-reproductive female snow leopards (Table A-12 - Appendix A).

Reproductive Males vs. Reproductive Females

Forty two compounds were significantly different between reproductive male and reproductive female cheetahs in the glycolipid fraction (Table 3-6). Sixteen compounds were significantly greater in the reproductive males and 26 compounds

Table 3-4.–z scores and significance values of neutral lipids present in anal sacs of pre-reproductive and reproductive *Panthera leo* and *P. uncia* females. Dashed lines represent the absence of a compound.

Compounds	*P. leo*		*P. uncia*	
	z-score	p value	z-score	p value
10 carbon compound C	--------	--------	2.0000	0.0455
11 carbon compound H	3.0645	0.0022	--------	--------
11 carbon compound N	--------	--------	2.0000	0.0455
11 carbon compound S	3.0645	0.0022	2.0000	0.0455
11 carbon compound V	--------	--------	2.0000	0.0455
12 carbon compound Z	3.0645	0.0022	2.0000	0.0455
12 carbon compound AG	3.0645	0.0022	--------	--------
12 carbon compound AL	3.0645	0.0022	--------	--------
12 carbon compound AM	3.0645	0.0022	--------	--------
12 carbon compound AP	3.0645	0.0022	--------	--------
13 carbon compound AY	3.0645	0.0022	--------	--------
13 carbon compound BA	3.0645	0.0022	--------	--------
X-branched Tridecanoic acid	3.0645	0.0022	--------	--------
13 carbon compound BF	3.0645	0.0022	--------	--------
13 carbon compound BJ	3.0645	0.0022	--------	--------
13 carbon compound BK	--------	--------	2.0000	0.0455
1,1'-(1,2)cyclobutanediyl)bis-, cis-Benzene	3.0645	0.0022	--------	--------
Tetradecanoic acid	3.0645	0.0022	--------	--------
14 carbon compound BR	3.0645	0.0022	--------	--------
14 carbon compound BX	3.0645	0.0022	2.0000	0.0455
14 carbon compound CC	3.0645	0.0022	--------	--------
14 carbon compound CE	--------	--------	2.0000	0.0455
14 carbon compound CF	3.0645	0.0022	--------	--------
15 carbon compound CT	3.0645	0.0022	--------	--------
15 carbon compound CV	3.0645	0.0022	--------	--------
15 carbon compound CW	3.0645	0.0022	--------	--------
15 carbon compound DB	3.0645	0.0022	2.0000	0.0455
Nonadecanoic acid	--------	--------	2.0000	0.0455
15 carbon compound DC	3.0645	0.0022	--------	--------
15 carbon compound DD	3.0645	0.0022	--------	--------
Hexadecanoic acid	3.0645	0.0022	--------	--------
16 carbon compound DL	3.0645	0.0022	--------	--------
16 carbon compound DN	--------	--------	2.0000	0.0455
16 carbon compound DT	--------	--------	2.0000	0.0455
16 carbon compound DV	3.0645	0.0022	--------	--------
16 carbon compound EA	3.0645	0.0022	2.0000	0.0455
17 carbon compound EH	--------	--------	2.0000	0.0455
17 carbon compound EJ	--------	--------	2.0000	0.0455
17 carbon compound EL	3.0645	0.0022	--------	--------
17 carbon compound EN	--------	--------	2.0000	0.0455
17 carbon compound ES	--------	--------	2.0000	0.0455
17 carbon compound ET	3.0645	0.0022	2.0000	0.0455
17 carbon compound EU	3.0645	0.0022	--------	--------
X-Octadecanoic acid	3.0645	0.0022	2.0000	0.0455
17 carbon compound EV	3.0645	0.0022	--------	--------
17 carbon compound EX	3.0645	0.0022	--------	--------

Table 3-4.–(continued)

Compounds	*P. leo*		*P. uncia*	
	z-score	p value	z-score	p value
18 carbon compound FC	3.0645	0.0022	--------	--------
18 carbon compound FG	3.0645	0.0022	--------	--------
18 carbon compound FH	3.0645	0.0022	--------	--------
18 carbon compound FK	3.0645	0.0022	--------	--------
18 carbon compound FN	3.0645	0.0022	--------	--------
18 carbon compound FT	3.0645	0.0022	--------	--------
18 carbon compound FY	3.0645	0.0022	2.0000	0.0455
18 carbon compound GA	3.0645	0.0022	--------	--------
19 carbon alcohol	3.0645	0.0022	--------	--------
19 carbon compound GJ	3.0645	0.0022	--------	--------
19 carbon compound GO	3.0645	0.0022	--------	--------
19 carbon compound GQ	3.0645	0.0022	--------	--------
19 carbon compound GR	3.0645	0.0022	--------	--------
19 carbon compound GT	3.0645	0.0022	--------	--------
19 carbon compound GY	3.0645	0.0022	--------	--------
Eicosanoic acid	3.0645	0.0022	2.0000	0.0455
20 carbon compound GZ	3.0645	0.0022	--------	--------
20 carbon compound HC	3.0645	0.0022	--------	--------
20 carbon compound HD	3.0645	0.0022	--------	--------
20 carbon compound HE	--------	--------	2.0000	0.0455
20 carbon compound HG	--------	--------	2.0000	0.0455
20 carbon compound HH	3.0645	0.0022	--------	--------
20 carbon compound HK	3.0645	0.0022	--------	--------
20 carbon compound HL	3.0645	0.0022	--------	--------
20 carbon compound HR	--------	--------	2.0000	0.0455
21 carbon compound HU	3.0645	0.0022	--------	--------
21 carbon compound IH	--------	--------	2.0000	0.0455
21 carbon compound IL	3.0645	0.0022	--------	--------
21 carbon compound IP	3.0451	0.0023	--------	--------
Docosanoic acid	3.0645	0.0022	--------	--------
22 carbon compound IW	3.0645	0.0022	--------	--------
22 carbon compound IX	--------	--------	2.0000	0.0455
22 carbon compound IY	3.0645	0.0022	--------	--------
22 carbon compound JF	3.0645	0.0022	--------	--------
22 carbon compound JG	3.0645	0.0022	--------	--------
22 carbon compound JH	3.0645	0.0022	--------	--------
22 carbon compound JM	--------	--------	2.0000	0.0455
22 carbon compound JN	3.0645	0.0022	--------	--------
23 carbon compound JP	3.0645	0.0022	--------	--------
23 carbon compound JS	3.0645	0.0022	--------	--------
23 carbon compound JU	3.0645	0.0022	--------	--------
23 carbon compound JV	3.0645	0.0022	--------	--------
23 carbon compound JX	--------	--------	2.0000	0.0455
23 carbon compound KD	3.0645	0.0022	--------	--------
23 carbon compound KG	3.0645	0.0022	--------	--------
3,7,11-Trimethyl (E,E)2,6,10-Dodecatrien-1-ol	3.0645	0.0022	--------	--------
24 carbon compound LB	3.0645	0.0022	2.0000	0.0455
24 carbon compound LC	3.0645	0.0022	--------	--------

Table 3-4.–(continued)

Compounds	*P. leo*		*P. uncia*	
	z-score	p value	z-score	p value
25 carbon compound LJ	3.0645	0.0022	--------	--------
25 carbon compound LM	3.0645	0.0022	--------	--------
25 carbon compound LO	3.0645	0.0022	--------	--------
25 carbon compound LR	3.0645	0.0022	--------	--------
25 carbon compound LT	3.0645	0.0022	--------	--------
25 carbon compound LV	3.0645	0.0022	--------	--------
25 carbon compound LY	3.0645	0.0022	--------	--------
25 carbon compound MC	3.0645	0.0022	--------	--------
25 carbon compound MH	3.0645	0.0022	--------	--------
26 carbon compound MK	3.0645	0.0022	--------	--------
26 carbon compound MY	--------	--------	2.0000	0.0455
26 carbon compound ND	3.0645	0.0022	2.0000	0.0455
27 carbon compound NF	3.0645	0.0022	--------	--------
27 carbon compound NG	3.0645	0.0022	--------	--------
27 carbon compound NH	3.0645	0.0022	--------	--------
27 carbon compound NP	3.0645	0.0022	--------	--------
27 carbon compound NV	3.0645	0.0022	--------	--------
27 carbon compound NX	3.0645	0.0022	--------	--------
27 carbon compound NY	--------	--------	2.0000	0.0455
28 carbon compound NZ	3.0645	0.0022	--------	--------
28 carbon compound OA	3.0645	0.0022	--------	--------
28 carbon compound OL	3.0645	0.0022	--------	--------
28 carbon compound OO	--------	--------	2.0000	0.0455
28 carbon compound OR	--------	--------	2.0000	0.0455
29 carbon compound PB	--------	--------	2.0000	0.0455
29 carbon compound PF	3.0645	0.0022	--------	--------
30 carbon compound PW	--------	--------	2.0000	0.0455
30 carbon compound PY	3.0645	0.0022	--------	--------
30 carbon compound PZ	3.0645	0.0022	--------	--------
30 carbon compound QD	3.0645	0.0022	--------	--------
30 carbon compound QG	3.0645	0.0022	--------	--------

Table 3-5.--z scores and significance values of phospholipids present in anal sacs of pre-reproductive and reproductive *Panthera leo* and *P. uncia* females. Dashed lines represent the absence of a compound.

Compounds	*P. leo*		*P. uncia*	
	z-score	p value	z-score	p value
12 carbon compound N	3.0645	0.0022	--------	--------
12 carbon compound Q	3.0645	0.0022	--------	--------
12 carbon compound S	--------	--------	2.0000	0.0455
12 carbon compound U	--------	--------	2.0000	0.0455
X-methyl pentadecanoic acid	3.0645	0.0022	--------	--------
13 carbon compound AP	3.0645	0.0022	2.0000	0.0455
13 carbon compound AR	3.0645	0.0022	--------	--------
13 carbon compound AS	3.0645	0.0022	--------	--------
13 carbon compound AX	3.0645	0.0022	--------	--------
Tetradecanoic acid	3.0645	0.0022	2.0000	0.0455
14 carbon compound AZ	3.0645	0.0022	--------	--------
14 carbon compound BE	3.0645	0.0022	--------	--------
14 carbon compound BF	3.0645	0.0022	--------	--------
14 carbon compound BG	--------	--------	2.0000	0.0455
14 carbon compound BJ	3.0645	0.0022	--------	--------
14 carbon compound BL	3.0645	0.0022	--------	--------
14 carbon compound BT	3.0645	0.0022	--------	--------
Pentadecanoic acid	3.0645	0.0022	--------	--------
15 carbon compound BU	3.0645	0.0022	--------	--------
15 carbon alcohol	3.0645	0.0022	--------	--------
15 carbon compound CA	3.0645	0.0022	--------	--------
15 carbon compound CC	3.0645	0.0022	2.0000	0.0455
15 carbon compound CE	3.0645	0.0022	--------	--------
15 carbon compound CG	3.0645	0.0022	--------	--------
15 carbon compound CI	3.0645	0.0022	--------	--------
15 carbon compound CL	3.0645	0.0022	2.0000	0.0455
15 carbon compound CO	3.0645	0.0022	--------	--------
Hexadecanoic acid	3.0645	0.0022	--------	--------
16 carbon compound CU	--------	--------	2.0000	0.0455
16 carbon compound CW	3.0645	0.0022	--------	--------
16 carbon compound DD	--------	--------	2.0000	0.0455
16 carbon compound DH	3.0645	0.0022	--------	--------
16 carbon compound DJ	--------	--------	2.0000	0.0455
17 carbon compound DM	3.0645	0.0022	2.0000	0.0455
17 carbon compound DN	--------	--------	2.0000	0.0455
17 carbon compound DO	3.0645	0.0022	--------	--------
17 carbon compound DQ	--------	--------	2.0000	0.0455
17 carbon compound DR	--------	--------	2.0000	0.0455
17 carbon compound DS	3.0645	0.0022	--------	--------
17 carbon compound DW	3.0645	0.0022	2.0000	0.0455
17 carbon compound DZ	3.0645	0.0022	2.0000	0.0455
(Z,Z)-9,12-Octadecanoic acid	3.0645	0.0022	--------	--------
17 carbon compound EC	3.0645	0.0022	--------	--------
17 carbon compound EF	--------	--------	2.0000	0.0455
Octadecanoic acid	3.0645	0.0022	--------	--------
18 carbon compound EO	--------	--------	2.0000	0.0455
18 carbon compound ER	--------	--------	2.0000	0.0455

Table 3-5.--(continued)

Compounds	*P. leo*		*P. uncia*	
	z-score	p value	z-score	p value
18 carbon compound EU	--------	--------	2.0000	0.0455
18 carbon compound EW	3.0645	0.0022	--------	--------
18 carbon compound EZ	--------	--------	2.0000	0.0455
19 carbon compound FC	3.0645	0.0022	--------	--------
19 carbon compound FF	3.0645	0.0022	--------	--------
19 carbon compound FL	--------	--------	2.0000	0.0455
19 carbon compound FP	3.0645	0.0022	--------	--------
19 carbon compound FS	3.0645	0.0022	--------	--------
19 carbon compound FT	--------	--------	2.0000	0.0455
19 carbon compound FV	3.0645	0.0022	--------	--------
19 carbon compound FW	--------	--------	2.0000	0.0455
19 carbon compound GA	3.0645	0.0022	2.0000	0.0455
20 carbon compound GC	3.0645	0.0022	--------	--------
20 carbon compound GH	3.0645	0.0022	--------	--------
20 carbon compound GN	--------	--------	2.0000	0.0455
21 carbon compound GZ	3.0645	0.0022	--------	--------
21 carbon compound HC	3.0645	0.0022	--------	--------
21 carbon compound HF	--------	--------	2.0000	0.0455
21 carbon compound HL	2.0430	0.0411	--------	--------
21 carbon compound HW	--------	--------	2.0000	0.0455
22 carbon compound HX	3.0645	0.0022	--------	--------
22 carbon compound IF	--------	--------	2.0000	0.0455
22 carbon compound IH	--------	--------	2.0000	0.0455
22 carbon compound IM	3.0645	0.0022	--------	--------
22 carbon compound IN	--------	--------	2.0000	0.0455
23 carbon compound IO	3.0645	0.0022	--------	--------
23 carbon compound IQ	3.0645	0.0022	--------	--------
23 carbon compound IY	3.0645	0.0022	--------	--------
23 carbon compound JE	--------	--------	2.0000	0.0455
23 carbon compound JF	3.0645	0.0022	--------	--------
24 carbon compound JH	3.0645	0.0022	--------	--------
24 carbon compound JJ	--------	--------	2.0000	0.0455
24 carbon compound JP	3.0645	0.0022	--------	--------
25 carbon compound JS	3.0645	0.0022	--------	--------
25 carbon compound KQ	3.0645	0.0022	--------	--------
26 carbon compound KZ	3.0645	0.0022	--------	--------
26 carbon sterol	--------	--------	2.0000	0.0455
27 carbon compound LP	3.0645	0.0022	--------	--------
27 carbon compound LT	3.0645	0.0022	--------	--------
27 carbon compound LZ	--------	--------	2.0000	0.0455
27 carbon compound MC	3.0645	0.0022	--------	--------
27 carbon compound MG	--------	--------	2.0000	0.0455
27 carbon compound MJ	--------	--------	2.0000	0.0455
28 carbon compound MM	--------	--------	2.0000	0.0455
28 carbon compound MO	--------	--------	2.0000	0.0455
28 carbon compound MS	--------	--------	2.0000	0.0455
28 carbon compound MX	--------	--------	2.0000	0.0455
28 carbon compound NC	--------	--------	2.0000	0.0455
28 carbon compound ND	--------	--------	2.0000	0.0455

Table 3-5.–(continued)

Compounds	*P. leo*		*P. uncia*	
	z-score	p value	z-score	p value
28 carbon compound MF	3.0645	0.0022	--------	--------
28 carbon compound NG	--------	--------	2.0000	0.0455
29 carbon compound NN	--------	--------	2.0000	0.0455
30 carbon compound OV	--------	--------	2.0000	0.0455

Table 3-6.--z scores and significance values of glycolipids present in anal sacs of reproductive female and reproductive male *Acinonyx jubatus* (cheetahs), *Panthera leo* (lions), *P. tigris* (tigers), and *P. uncia* (snow leopards). Dashed lines represent the absence of a compound.

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
X-oxo-Nonanoic acid	---------	-------	---------	-------	-2.1213	0.033	---------	-------
11 carbon compound I	---------	-------	---------	-------	---------	-------	-4.3916	0.001
11 carbon compound J	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
12 carbon compound Q	---------	-------	---------	-------	---------	-------	-4.3916	0.001
12 carbon compound X	---------	-------	---------	-------	---------	-------	-2.8301	0.001
12 carbon compound AB	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
13 carbon compound AC	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
13 carbon compound AM	---------	-------	-2.5584	0.010	---------	-------	-3.8060	0.001
Tetradecanoic acid	---------	-------	-2.5584	0.010	-2.1213	0.033	---------	-------
14 carbon compound AZ	---------	-------	---------	-------	-2.1213	0.033	---------	-------
Pentadecanoic acid	---------	-------	-2.5584	0.010	---------	-------	-4.3196	0.001
15 carbon compound BM	---------	-------	---------	-------	-2.1213	0.033	---------	-------
15 carbon compound BN	---------	-------	---------	-------	-2.1213	0.033	---------	-------
15 carbon compound BT	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.3196	0.001
Hexadecanoic acid	---------	-------	-2.5584	0.010	-2.1213	0.033	-2.0499	0.040
16 carbon compound BV	---------	-------	-2.5584	0.010	---------	-------	-4.3196	0.001
16 carbon compound BZ	---------	-------	-2.5584	0.010	---------	-------	-4.3196	0.001
16 carbon compound CA	---------	-------	---------	-------	-2.1213	0.033	---------	-------
16 carbon compound CG	---------	-------	-2.5584	0.010	---------	-------	-4.3196	0.001
Heptadecanoic acid	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.3196	0.001
17 carbon compound CI	---------	-------	---------	-------	-2.1213	0.033	---------	-------
X-Octadecanoic acid	-4.3152	0.001	---------	-------	---------	-------	---------	-------
17 carbon compound CR	-2.1576	0.031	---------	-------	---------	-------	---------	-------
Octadecanoic acid	---------	-------	-2.5584	0.010	-2.1213	0.033	-3.3669	0.001
18 carbon compound CW	---------	-------	-2.5584	0.010	---------	-------	-4.3196	0.001
18 carbon compound CX	---------	-------	---------	-------	-2.1213	0.033	---------	-------
18 carbon compound CY	---------	-------	-2.5584	0.010	-2.1213	0.033	---------	-------
18 carbon compound DC	---------	-------	-2.5584	0.010	---------	-------	---------	-------
18 carbon compound DF	---------	-------	-2.5584	0.010	---------	-------	---------	-------
19 carbon compound DG	---------	-------	-2.5584	0.010	-2.1213	0.033	---------	-------
2-hydroxy-octanoic acid	---------	-------	---------	-------	---------	-------	-4.3196	0.001
19 carbon compound DK	---------	-------	-2.5584	0.010	---------	-------	-4.3196	0.001
19 carbon compound DM	---------	-------	-2.5584	0.010	---------	-------	---------	-------
X-X-Eicosadienoic acid	---------	-------	-2.5584	0.010	---------	-------	---------	-------
19 carbon compound DS	---------	-------	---------	-------	---------	-------	-4.3196	0.001
Eicosanoic acid	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.3196	0.001
20 carbon compound DV	---------	-------	---------	-------	-2.1213	0.033	---------	-------
20 carbon compound DX	---------	-------	-2.5584	0.010	---------	-------	---------	-------
20 carbon compound EH	---------	-------	-2.5584	0.010	---------	-------	---------	-------
21 carbon compound EU	---------	-------	-2.5584	0.010	---------	-------	-4.3196	0.001
21 carbon compound EX	---------	-------	---------	-------	-2.1213	0.033	---------	-------
21 carbon compound EY	---------	-------	---------	-------	-2.1213	0.033	---------	-------
21 carbon compound EZ	---------	-------	---------	-------	---------	-------	-4.3916	0.001
21 carbon compound FB	---------	-------	-2.5584	0.010	---------	-------	---------	-------
21 carbon compound FD	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
21 carbon compound FH	---------	-------	---------	-------	-2.1213	0.033	---------	-------
22 carbon compound FI	---------	-------	---------	-------	-2.1213	0.033	-4.3916	0.001

Table 3-6.--(continued)

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
22 carbon compound FL	---------	-------	---------	-------	---------	-------	---------	-------
22 carbon compound FO	---------	-------	-2.5584	0.010	---------	-------	---------	-------
22 carbon compound FP	---------	-------	---------	-------	-2.1213	0.033	-4.3916	0.001
22 carbon compound FU	---------	-------	---------	-------	-2.1213	0.033	-4.3916	0.001
22 carbon compound FZ	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
22 carbon compound GA	---------	-------	-2.5584	0.010	---------	-------	-2.0982	0.035
23 carbon compound GE	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
23 carbon compound GH	---------	-------	---------	-------	-2.1213	0.033	---------	-------
23 carbon compound GJ	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
23 carbon compound GL	---------	-------	-2.5662	0.010	---------	-------	-3.9524	0.001
Tetracosanoic acid	---------	-------	-2.5662	0.010	-2.1213	0.033	-4.3916	0.001
24 carbon compound GU	---------	-------	---------	-------	-2.1213	0.033	---------	-------
24 carbon compound GX	---------	-------	---------	-------	-2.1213	0.033	---------	-------
24 carbon compound HJ	---------	-------	---------	-------	-2.1213	0.033	---------	-------
25 carbon compound HK	---------	-------	---------	-------	---------	-------	-4.3916	0.001
25 carbon compound HS	---------	-------	---------	-------	-2.1213	0.033	---------	-------
25 carbon compound HT	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
X-Hexacosanoic acid	---------	-------	-2.5584	0.010	---------	-------	-2.1470	0.031
25 carbon compound IB	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
26 carbon compound ID	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.3916	0.001
26 carbon compound IH	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.3916	0.001
26 carbon compound IJ	-2.0617	0.039			---------	-------	---------	-------
26 carbon compound IN	---------	-------	-2.5584	0.010	---------	-------	---------	-------
26 carbon compound IW	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
27 carbon compound JC	---------	-------	-1.9188	0.045	---------	-------	-4.3916	0.001
27 carbon compound JD	-4.3152	0.001	---------	-------	---------	-------	---------	-------
Cholesterol	---------	-------	---------	-------	-2.1213	0.033	---------	-------
27 carbon sterol	-2.1576	0.031	---------	-------	---------	-------	---------	-------
27 carbon sterol	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
27 carbon compound JG	---------	-------	---------	-------	-2.1213	0.033	---------	-------
27 carbon compound JH	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
27 carbon compound JI	-2.9247	0.003	---------	-------	---------	-------	---------	-------
27 carbon compound JL	---------	-------	---------	-------	-2.1213	0.033	---------	-------
27 carbon compound JO	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
27 carbon compound JX	-2.0137	0.044	---------	-------	---------	-------	---------	-------
Cholest-4-ene-3-one	---------	-------	---------	-------	-2.1213	0.033	---------	-------
28 carbon compound KI	---------	-------	-2.5584	0.010	---------	-------	-4.3916	0.001
28 carbon compound KS	---------	-------	---------	-------	-2.1213	0.033	---------	-------
28 carbon compound KT	---------	-------	-2.5584	0.010	---------	-------	-2.2446	0.024
28 carbon compound KU	---------	-------	-2.5584	0.010	---------	-------	---------	-------
28 carbon compound KY	---------	-------	-2.5584	0.010	---------	-------	---------	-------
29 carbon compound KZ	-2.2535	0.024	---------	-------	---------	-------	---------	-------
29 carbon compound LC	---------	-------	---------	-------	-2.1213	0.033	---------	-------
29 carbon compound LI	---------	-------	-2.5584	0.010	---------	-------	---------	-------
29 carbon compound LM	---------	-------	-2.5584	0.010	-2.1213	0.033	---------	-------
29 carbon compound LP	---------	-------	-2.5584	0.010	---------	-------	-2.5861	0.009
29 carbon compound LR	---------	-------	-2.5584	0.010	-2.1213	0.033	---------	-------
29 carbon compound LU	---------	-------	---------	-------	---------	-------	-4.3916	0.001
29 carbon compound LW	---------	-------	-2.5584	0.010	---------	-------	---------	-------

Table 3-6.--(continued)

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
30 carbon compound LX	---	---	-2.5584	0.010	-2.1213	0.033	-4.3916	0.001
30 carbon compound MF	---	---	-2.5584	0.010	---	---	---	---
30 carbon compound MH	---	---	---	---	-2.1213	0.033	---	---
30 carbon compound MN	---	---	-2.5584	0.010	---	---	-4.3916	0.001
30 carbon compound MR	---	---	-2.5584	0.010	---	---	-4.3916	0.001
31 carbon compound MV	---	---	---	---	-2.1213	0.033	---	---

were significantly greater in the reproductive females (Table A-13 - Appendix A). Fifty eight compounds were significantly different between reproductive male and reproductive female snow leopards in the glycolipid fraction (Table 3-6). Thirty one compounds were significantly greater in the reproductive males and 27 compounds were significantly greater in the reproductive females (Table A-13 - Appendix A). Fifty compounds were significantly different between reproductive male and reproductive female tigers in the glycolipid fraction (Table 3-6). Twenty seven compounds were significantly greater in the reproductive males and 23 compounds were significantly greater in the reproductive females (Table A-13 - Appendix A). Eight compounds were significantly different between reproductive male and reproductive female lions in the glycolipid fraction (Table 3-6). Four compounds were significantly greater in the reproductive males and four were significantly greater in the reproductive females (Table A-13 - Appendix A).

Fifty eight compounds were significantly different between reproductive male and reproductive female cheetahs in the neutral lipids (Table 3-7). Twenty one compounds were significantly greater in the reproductive males and 37 compounds were significantly greater in the reproductive females (Table A-14 - Appendix A). One hundred twenty three compounds were significantly different between reproductive male and reproductive female snow leopards in the neutral lipid fraction (Table 3-7). Eighty eight compounds were significantly greater in the reproductive males and 35 compounds were significantly greater in the reproductive females (Table A-14 - Appendix A). One hundred four compounds were significantly different between

Table 3-7.–z scores and significance values of neutral lipids present in anal sacs of reproductive female and reproductive male *Acinonyx jubatus* (cheetahs), *Panthera leo* (lions), *P. tigris* (tigers), and *P. uncia* (snow leopards). Dashed lines represent the absence of a compound.

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
10 carbon compound A	---------	-------	-2.5584	0.010	---------	-------	---------	-------
10 carbon compound C	---------	-------	-2.5584	0.010	---------	-------	---------	-------
10 carbon compound D	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
10 carbon compound G	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
11 carbon compound H	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
11 carbon compound J	---------	-------	-2.5584	0.010	---------	-------	---------	-------
11 carbon compound L	---------	-------	-2.5584	0.010	---------	-------	---------	-------
11 carbon compound N	---------	-------	-2.5584	0.010	---------	-------	---------	-------
11 carbon compound O	---------	-------	-2.5584	0.010	---------	-------	---------	-------
11 carbon compound S	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
11 carbon compound T	---------	-------	---------	-------	---------	-------	-4.4914	0.001
11 carbon compound V	---------	-------	-2.5584	0.010	---------	-------	---------	-------
11 carbon compound W	4.3152	0.001	---------	-------	---------	-------	---------	-------
11 carbon compound Y	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
12 carbon compound Z	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	---------	-------
12 carbon compound AB	---------	-------	---------	-------	---------	-------	-4.4914	0.001
12 carbon compound AG	4.3152	0.001	---------	-------	---------	-------	---------	-------
12 carbon compound AH	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
12 carbon compound AJ	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
12 carbon compound AM	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
12 carbon compound AO	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
12 carbon compound AP	4.3152	0.001	---------	-------	---------	-------	---------	-------
12 carbon compound AQ	---------	-------	-2.5584	0.010	---------	-------	---------	-------
12 carbon compound AS	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
12 carbon compound AV	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
13 carbon compound AX	---------	-------	-2.5584	0.010	-2.1213	0.033		
13 carbon compound AY	4.3152	0.001	---------	-------	-2.1213	0.033	---------	-------
13 carbon compound AZ	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	---------	-------
13 carbon compound BA	4.3152	0.001	---------	-------	---------	-------	---------	-------
x-branched Tridecanoic acid	4.3152	0.001	---------	-------	-2.1213	0.033	-4.4914	0.001
13 carbon compound BE	---------	-------	-2.5584	0.010	---------	-------	---------	-------
13 carbon compound BF	4.3152	0.001	---------	-------	---------	-------	---------	-------
13 carbon compound BG	---------	-------	---------	-------	-2.1213	0.033	---------	-------
13 carbon compound BH	---------	-------	-2.5584	0.010	---------	-------	---------	-------
13 carbon compound BJ	4.3152	0.001	---------	-------	-2.1213	0.033	---------	-------
13 carbon compound BK	---------	-------	-2.5584	0.010	---------	-------	-2.5106	0.012
13 carbon compound BO	---------	-------	---------	-------	-2.1213	0.033	---------	-------
1,1'-(1,2-Cyclobutanediyl) bis-, cis-Benzene	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	---------	-------
13 carbon compound BQ	---------	-------	---------	-------	-2.1213	0.033	-4.4914	0.001
Tetradecanoic acid	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	---------	-------
14 carbon compound BR	4.3152	0.001	---------	-------	---------	-------	---------	-------
14 carbon compound BS	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
14 carbon compound BW	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
14 carbon compound BX	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
14 carbon compound CC	4.3152	0.001	---------	-------	-2.1213	0.033	-2.2342	0.025

Table 3-7.--(continued)

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
14 carbon compound CE	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
14 carbon compound CF	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
14 carbon compound CG	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
14 carbon compound CH	---------	-------	---------	-------	-2.1213	0.033	---------	-------
15 carbon compound CT	4.3152	0.001	---------	-------	---------	-------	---------	-------
15 carbon compound CV	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
15 carbon compound CW	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
15 carbon compound CY	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
15 carbon compound DB	4.3152	0.001	---------	-------	-2.1213	0.033	-4.4914	0.001
Nonadecanoic acid	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
15 carbon compound DC	4.3152	0.001	---------	-------	---------	-------	---------	-------
15 carbon compound DD	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
15 carbon compound DF	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
Hexadecanoic acid	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-2.0499	0.040
16 carbon compound DL	3.8357	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
16 carbon compound DM	4.3152	0.001	---------	-------	-2.1213	0.033	-4.4914	0.001
16 carbon compound DN	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
16 carbon compound DQ	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
16 carbon compound DS	---------	-------	---------	-------	---------	-------	-4.4914	0.001
16 carbon compound DT	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
16 carbon compound DV	4.3152	0.001	---------	-------	---------	-------	---------	-------
16 carbon compound DZ	---------	-------	---------	-------	-2.1213	0.033	---------	-------
16 carbon compound EA	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
16 carbon compound EF	4.3152	0.001	---------	-------	---------	-------	---------	-------
16 carbon compound EH	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
17 carbon compound EJ	---------	-------	---------	-------	---------	-------	-4.4914	0.001
17 carbon compound EL	4.3152	0.001	---------	-------	---------	-------	---------	-------
17 carbon compound EN	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
17 carbon compound EP	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
17 carbon compound ER	---------	-------	---------	-------	-2.1213	0.033	---------	-------
17 carbon compound ES	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
17 carbon compound ET	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
17 carbon compound EU	4.3152	0.001	---------	-------	-2.1213	0.033	-4.4914	0.001
X-Octadecanoic acid	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
17 carbon compound EV	4.3152	0.001	-2.5584	0.010	---------	-------	---------	-------
17 carbon compound EX	4.3152	0.001	---------	-------	---------	-------	---------	-------
17 carbon compound EY	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
Octadecanoic acid	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
18 carbon compound FC	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
18 carbon compound FD	4.3152	0.001	-2.5584	0.010	---------	-------	---------	-------
18 carbon compound FG	4.3152	0.001	---------	-------	---------	-------	---------	-------
18 carbon compound FH	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
18 carbon compound FJ	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
18 carbon compound FK	4.3152	0.001	---------	-------	---------	-------	---------	-------
18 carbon compound FL	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
18 carbon compound FN	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
18 carbon compound FT	4.3152	0.001	---------	-------	---------	-------	---------	-------
18 carbon compound FX	---------	-------	---------	-------	---------	-------	-4.4914	0.001
18 carbon compound FY	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001

Table 3-7.--(continued)

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
18 carbon compound GA	4.3152	0.001	---------	-------	---------	-------	---------	-------
18 carbon compound GB	---------	-------	-2.5584	0.010	---------	-------	---------	-------
19 carbon compound GD	---------	-------	---------	-------	-2.1213	0.033	---------	-------
19 carbon alcohol	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
19 carbon compound GJ	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
19 carbon compound GO	4.3152	0.001	---------	-------	---------	-------	---------	-------
19 carbon compound GQ	4.3152	0.001	---------	-------	---------	-------	---------	-------
19 carbon compound GR	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
19 carbon compound GS	---------	-------	-2.5584	0.010	-2.1213	0.033	---------	-------
19 carbon compound GT	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
19 carbon compound GY	4.3152	0.001	---------	-------	---------	-------	---------	-------
Eicosanoic acid	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
20 carbon compound HC	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
20 carbon compound HD	4.3152	0.001	---------	-------	---------	-------	---------	-------
20 carbon compound HE	---------	-------	-2.5584	0.010	---------	-------	---------	-------
20 carbon compound HG	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
20 carbon compound HH	4.3152	0.001	---------	-------	---------	-------	---------	-------
20 carbon compound HI	---------	-------	---------	-------	---------	-------	-4.4914	0.001
20 carbon compound HK	4.3152	0.001	---------	-------	---------	-------	---------	-------
20 carbon compound HL	4.3152	0.001	---------	-------	---------	-------	---------	-------
20 carbon compound HM	---------	-------	---------	-------	---------	-------	-4.4914	0.001
20 carbon compound HR	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
21 carbon compound HU	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
21 carbon compound HZ	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
21 carbon compound IB	---------	-------	---------	-------	-2.1213	0.033	---------	-------
21 carbon compound ID	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
21 carbon compound IH	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
21 carbon compound IL	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
21 carbon compound IM	---------	-------	---------	-------	-2.1213	0.033	---------	-------
21 carbon compound IP	4.3152	0.001	---------	-------	-2.1213	0.033	-4.4914	0.001
Docosanoic acid	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
22 carbon compound IU	---------	-------	-2.5584	0.010	---------	-------	---------	-------
22 carbon compound IW	4.3152	0.001	---------	-------	---------	-------	---------	-------
22 carbon compound IX	---------	-------	-2.5584	0.010	---------	-------	-2.6488	0.008
22 carbon compound IY	2.7329	0.006	---------	-------	---------	-------	---------	-------
22 carbon compound JB	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
22 carbon compound JC	---------	-------	---------	-------	-2.1213	0.033	---------	-------
22 carbon compound JD	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
22 carbon compound JF	4.3152	0.001	---------	-------	---------	-------	---------	-------
22 carbon compound JG	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	---------	-------
22 carbon compound JH	4.3152	0.001	---------	-------	---------	-------	---------	-------
22 carbon compound JI	---------	-------	---------	-------	-2.1213	0.033	-4.4914	0.001
22 carbon compound JM	---------	-------	-2.5584	0.010	---------	-------	---------	-------
22 carbon compound JN	4.3152	0.001	---------	-------	---------	-------	---------	-------
22 carbon compound JO	---------	-------	-2.5584	0.010	---------	-------	---------	-------
23 carbon compound JP	4.3152	0.001	---------	-------	-2.1213	0.033	---------	-------
23 carbon compound JR	---------	-------	---------	-------	-2.1213	0.033	---------	-------
23 carbon compound JS	---------	-------	-2.5584	0.010	---------	-------	---------	-------
23 carbon compound JU	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001

Table 3-7.--(continued)

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
23 carbon compound JX	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
23 carbon compound JZ	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
23 carbon compound KC	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
23 carbon compound KD	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
23 carbon compound KG	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	---------	-------
23 carbon compound KI	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
3,7,11-trimethyl-(E,E) 2,6,10-Dodecatrien-1-ol	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	---------	-------
24 carbon compound KT	---------	-------	---------	-------	---------	-------	-4.4914	0.001
24 carbon compound LA	---------	-------	---------	-------	-2.1213	0.033	---------	-------
24 carbon compound LB	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
24 carbon compound LC	4.3152	0.001	---------	-------	---------	-------	---------	-------
24 carbon compound LD	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
24 carbon compound LI	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
25 carbon compound LJ	4.3152	0.001	---------	-------	---------	-------	---------	-------
25 carbon compound LK	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
25 carbon compound LM	4.3152	0.001	---------	-------	---------	-------	---------	-------
25 carbon compound LN	---------	-------	---------	-------	-2.1213	0.033	---------	-------
25 carbon compound LO	4.3152	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
25 carbon compound LR	4.3152	0.001	---------	-------	---------	-------	---------	-------
25 carbon compound LT	4.3152	0.001	---------	-------	---------	-------	---------	-------
25 carbon compound LU	---------	-------	-2.5584	0.010	---------	-------	---------	-------
25 carbon compound LV	4.3152	0.001	---------	-------	---------	-------	---------	-------
25 carbon compound LW	---------	-------	---------	-------	-2.1213	0.033	---------	-------
25 carbon compound LY	4.3152	0.001	-2.5584	0.010	---------	-------	---------	-------
25 carbon compound MC	4.3152	0.001	-2.5584	0.010	---------	-------	---------	-------
25 carbon compound MH	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
26 carbon compound MR	---------	-------	-2.5584	0.010	---------	-------	---------	-------
26 carbon compound MY	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
26 carbon compound NA	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
26 carbon compound ND	4.3152	0.001	---------	-------	---------	-------	-4.4914	0.001
Cholesterol	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
27 carbon compound NF	4.3152	0.001	---------	-------	---------	-------	---------	-------
27 carbon compound NG	4.3152	0.001	---------	-------	---------	-------	---------	-------
27 carbon compound NH	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
27 carbon compound NN	4.3152	0.001	---------	-------	---------	-------	-4.4914	0.001
27 carbon compound NO	---------	-------	---------	-------	---------	-------	---------	-------
27 carbon compound NP	4.3152	0.001	---------	-------	---------	-------	---------	-------
27 carbon compound NV	4.3152	0.001	---------	-------	---------	-------	---------	-------
27 carbon compound NW	---------	-------	-2.5584	0.010	---------	-------	---------	-------
27 carbon compound NX	4.3152	0.001	---------	-------	---------	-------	---------	-------
27 carbon compound NY	---------	-------	-2.5584	0.010	---------	-------	---------	-------
28 carbon compound NZ	4.3152	0.001	---------	-------	---------	-------	---------	-------
28 carbon compound OA	4.3152	0.001	-2.5584	0.010	---------	-------	---------	-------
28 carbon compound OC	---------	-------	-2.5584	0.010	---------	-------	---------	-------
28 carbon compound OE	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
28 carbon compound OL	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
28 carbon compound OO	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
28 carbon compound OR	---------	-------	-2.5584	0.010	---------	-------	---------	-------

Table 3-7.–(continued)

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
28 carbon compound OT	4.3152	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
28 carbon compound OW	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
29 carbon compound PB	---------	-------	-2.5584	0.010	---------	-------	---------	-------
29 carbon compound PE	---------	-------	---------	-------	---------	-------	-4.4914	0.001
29 carbon compound PI	---------	-------	-2.5584	0.010	---------	-------	---------	-------
29 carbon compound PK	---------	-------	-2.5584	0.010	---------	-------	---------	-------
29 carbon compound PL	4.3152	0.001	---------	-------	---------	-------	---------	-------
29 carbon compound PM	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
29 carbon compound PQ	---------	-------	-2.5584	0.010	---------	-------	---------	-------
30 carbon compound PW	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
30 carbon compound PY	4.3152	0.001	---------	-------	---------	-------	---------	-------
30 carbon compound QD	4.3152	0.001	---------	-------	---------	-------	---------	-------
30 carbon compound QG	4.3152	0.001	---------	-------	---------	-------	---------	-------
30 carbon compound QI	4.3152	0.001	---------	-------	---------	-------	---------	-------
31 carbon compound QL	4.3152	0.001	---------	-------	---------	-------	---------	-------

reproductive male and reproductive female tigers in the neutral lipid fraction (Table 3-7). Fifty five compounds were significantly greater in the reproductive males and 49 were significantly greater in the reproductive females (Table A-14 - Appendix A). One hundred compounds were significantly different between reproductive male and reproductive female lions in the neutral lipid fraction (Table 3-7). Thirty eight compounds were significantly greater in the reproductive males and 62 compounds were significantly greater in the reproductive females (Table A-14 - Appendix A).

Twenty eight compounds were significantly different between reproductive male and reproductive female cheetahs in the phospholipid fraction (Table 3-8). Seven compounds were significantly greater in the reproductive males and 21 compounds were significantly greater in the reproductive females (Table A-15 - Appendix A). One hundred twenty two compounds were significantly different between reproductive male and reproductive female snow leopards in the phospholipid fraction (Table 3-8). Thirty six compounds were significantly greater in the reproductive males and 86 compounds were significantly greater in the reproductive females (Table A-15 - Appendix A). One hundred twenty eight compounds were significantly different between reproductive male and reproductive female tigers in the phospholipid fraction (Table 3-8). Eighty nine compounds were significantly greater in the reproductive males and 39 compounds were significantly greater in the reproductive females (Table A-15 - Appendix A). Seventy two compounds were significantly different between reproductive male and reproductive female lions in the phospholipid fraction (Table 3-8). Forty three

Table 3-8.–z scores and significance values of phospholipids present in anal sacs of reproductive female and reproductive male *Acinonyx jubatus* (cheetahs), *Panthera leo* (lions), *P. tigris* (tigers), and *P. uncia* (snow leopards). Dashed lines represent the absence of a compound.

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
11 carbon compound E	---------	-------	-2.5584	0.010	---------	-------	---------	-------
11 carbon compound H	---------	-------	-2.5584	0.010	---------	-------	---------	-------
11 carbon compound J	---------	-------	---------	-------	---------	-------	-4.4914	0.001
11 carbon compound K	---------	-------	-2.1320	0.033	---------	-------	-4.4914	0.001
12 carbon compound P	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
12 carbon compound Q	-4.1662	0.001	---------	-------	---------	-------	---------	-------
12 carbon compound S	---------	-------	-2.5584	0.010	---------	-------	---------	-------
12 carbon compound X	---------	-------	-2.5584	0.010	---------	-------	---------	-------
13 carbon compound AG	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
13 carbon compound AH	---------	-------	-2.5584	0.010	---------	-------	---------	-------
13 carbon compound AK	-4.1662	0.001	---------	-------	---------	-------	---------	-------
13 carbon compound AN	---------	-------	-2.5584	0.010	---------	-------	---------	-------
X-methyl pentadecanoic acid	-4.1662	0.001	---------	-------	---------	-------	-4.4914	0.001
13 carbon compound AP	-4.1662	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
13 carbon compound AS	-4.1662	0.001	---------	-------	---------	-------	---------	-------
13 carbon compound AT	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
13 carbon compound AV	---------	-------	---------	-------	-2.1213	0.033	---------	-------
13 carbon compound AW	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
13 carbon compound AX	-4.1662	0.001	---------	-------	---------	-------	---------	-------
Tetradecanoic acid	-4.1662	0.001	-2.5584	0.010	-2.1213	0.033	---------	-------
14 carbon compound AZ	-4.1662	0.001	---------	-------	---------	-------	---------	-------
14 carbon compound BC	---------	-------	-2.5584	0.010	---------	-------	---------	-------
14 carbon compound BF	-4.1662	0.001	---------	-------	---------	-------	---------	-------
14 carbon compound BG	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
14 carbon compound BI	---------	-------	-2.5584	0.010	---------	-------	---------	-------
14 carbon compound BJ	-4.1662	0.001	---------	-------	---------	-------	---------	-------
14 carbon compound BL	-4.1662	0.001	---------	-------	-2.1213	0.033	---------	-------
14 carbon compound BN	---------	-------	-2.5584	0.010	---------	-------	---------	-------
14 carbon compound BO	-4.1662	0.001	---------	-------	-2.1213	0.033	---------	-------
14 carbon compound BQ	---------	-------	---------	-------	---------	-------	-4.4914	0.001
14 carbon compound BS	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
14 carbon compound BT	-4.1662	0.001	---------	-------	---------	-------	---------	-------
Pentadecanoic acid	-4.1662	0.001	---------	-------	---------	-------	---------	-------
15 carbon compound BU	-4.1662	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
15 carbon alcohol	-4.1662	0.001	---------	-------	---------	-------	---------	-------
15 carbon compound BW	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
15 carbon compound CA	-4.1662	0.001			---------	-------	-4.4914	0.001
15 carbon compound CC	-4.1662	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
15 carbon compound CD	---------	-------	---------	-------	---------	-------	-4.4914	0.001
15 carbon compound CF	---------	-------	---------	-------	---------	-------	-4.4914	0.001
15 carbon compound CG	-4.1662	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
(Z)-7-Hexadecanoic acid	---------	-------	---------	-------	---------	-------	-4.4914	0.001
15 carbon compound CI	-4.1662	0.001	-2.5584	0.010	---------	-------	---------	-------
15 carbon compound CJ	---------	-------	---------	-------	-2.1213	0.033	---------	-------
15 carbon compound CL	-4.1662	0.001	-2.5584	0.010	---------	-------	---------	-------
15 carbon compound CN								

Table 3-8.--(continued)

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
15 carbon compound CO	-4.1662	0.001	---------	-------	---------	-------	---------	-------
Hexadecanoic acid	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
16 carbon compound CS	---------	-------	---------	-------	---------	-------	-4.4914	0.001
16 carbon compound CW	-4.1662	0.001	---------	-------	---------	-------	---------	-------
16 carbon compound CX	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
16 carbon compound CZ	-4.1662	0.001	---------	-------	---------	-------	---------	-------
16 carbon compound DB	---------	-------	-2.5584	0.010	---------	-------	---------	-------
16 carbon compound DD	-4.1662	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
16 carbon compound DE	---------	-------	---------	-------	---------	-------	-4.4914	0.001
16 carbon compound DF	-4.1662	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
16 carbon compound DG	---------	-------	---------	-------	-2.1213	0.033	-4.4914	0.001
16 carbon compound DH	-4.1662	0.001	---------	-------	---------	-------	---------	-------
16 carbon compound DJ	---------	-------	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
17 carbon compound DM	-4.1662	0.001	-2.5584	0.010	---------	-------	---------	-------
17 carbon compound DN	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
17 carbon compound DO	-4.1662	0.001	---------	-------	-2.1213	0.033	---------	-------
17 carbon compound DQ	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
17 carbon compound DR	---------	-------	-2.5584	0.010	---------	-------	---------	-------
17 carbon compound DS	-4.1662	0.001	---------	-------	---------	-------	-4.4914	0.001
17 carbon compound DU	---------	-------	---------	-------	---------	-------	-4.4914	0.001
17 carbon compound DW	-4.1662	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
17 carbon compound DX	---------	-------	---------	-------	---------	-------	-4.4914	0.001
17 carbon compound DZ	-4.1662	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
(Z,Z)-9,12-Octadecadienoic acid	-4.1662	0.001	---------	-------	-2.1213	0.033	---------	-------
17 carbon compound EA	---------	-------	---------	-------	-2.1213	0.033	---------	-------
17 carbon compound EB	-4.1662	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
X-Octadecanoic acid	---------	-------	---------	-------	-2.1213	0.033	---------	-------
17 carbon compound EC	---------	-------	---------	-------	-2.1213	0.033	---------	-------
17 carbon compound ED	-2.3146	0.020	---------	-------	---------	-------	-4.4914	0.001
17 carbon compound EE	---------	-------	---------	-------	---------	-------	-4.4914	0.001
17 carbon compound EF	---------	-------	-2.5584	0.010	---------	-------	---------	-------
17 carbon compound EG	-4.1662	0.001	---------	-------	---------	-------	---------	-------
Octadecanoic acid	-4.1662	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
18 carbon compound EJ	---------	-------	---------	-------	---------	-------	-4.4914	0.001
18 carbon compound EM	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
18 carbon compound EO	---------	-------	-2.5584	0.010	---------	-------	---------	-------
18 carbon compound EP	-4.1662	0.001	---------	-------	---------	-------	---------	-------
18 carbon compound ER	---------	-------	---------	-------	---------	-------	-4.4914	0.001
18 carbon compound EU	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
18 carbon compound EW	-4.1662	0.001	---------	-------	---------	-------	-4.4914	0.001
18 carbon compound EY	---------	-------	---------	-------	---------	-------	-4.4914	0.001
18 carbon compound EZ	---------	-------	-2.5584	0.010	---------	-------	---------	-------
19 carbon compound FC	-4.1662	0.001	---------	-------	---------	-------	---------	-------
19 carbon compound FD	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
19 carbon compound FE	---------	-------	---------	-------	---------	-------	-4.4914	0.001
19 carbon compound FF	-4.1662	0.001	---------	-------	-2.1213	0.033	---------	-------
19 carbon compound FG	---------	-------	-2.5584	0.010	-2.1213	0.033	---------	-------
19 carbon compound FH	---------	-------	-2.5584	0.010	---------	-------	---------	-------

Table 3-8.–(continued)

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
19 carbon compound FJ	---------	-------	---------	-------	---------	-------	-4.4914	0.001
19 carbon compound FL	-4.1662	0.001	---------	-------	---------	-------	-4.4914	0.001
19 carbon compound FN	---------	-------	-2.5584	0.010	---------	-------	---------	-------
19 carbon compound FP	-4.1662	0.001	---------	-------	---------	-------	-4.4914	0.001
19 carbon compound FR	---------	-------	-2.5584	0.010	---------	-------	-3.4779	0.001
19 carbon compound FT	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
19 carbon compound FU	---------	-------	---------	-------	-2.1213	0.033	---------	-------
19 carbon compound FV	-4.1662	0.001	---------	-------	---------	-------	-4.4914	0.001
19 carbon compound FX	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
19 carbon compound GA	-4.1662	0.001	-2.5584	0.010	---------	-------	---------	-------
20 carbon compound GC	-4.1662	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
20 carbon compound GE	---------	-------	---------	-------	---------	-------	-4.4914	0.001
20 carbon compound GH	-4.1662	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
20 carbon compound GJ	---------	-------	-2.5584	0.010	---------	-------	-2.0960	0.036
20 carbon compound GL	-4.1662	0.001	---------	-------	---------	-------	-4.4914	0.001
20 carbon compound GM	---------	-------	-2.5584	0.010	---------	-------	---------	-------
20 carbon compound GO	---------	-------	---------	-------	---------	-------	-4.4914	0.001
20 carbon compound GP	---------	-------	-2.5584	0.010	---------	-------	---------	-------
20 carbon compound GT	---------	-------	-2.5584	0.010	---------	-------	---------	-------
20 carbon compound GW	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
20 carbon compound GX	-4.1662	0.001	---------	-------	---------	-------	---------	-------
20 carbon compound GY	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
21 carbon compound GZ	-4.1662	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
21 carbon compound HB	---------	-------	---------	-------	-2.1213	0.033	-4.4914	0.001
21 carbon compound HC	-4.1662	0.001	---------	-------	---------	-------	---------	-------
21 carbon compound HD	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
21 carbon compound HE	---------	-------	---------	-------	---------	-------	-4.4914	0.001
21 carbon compound HF	---------	-------	-2.5584	0.010	---------	-------	---------	-------
21 carbon compound HG	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
21 carbon compound HH	---------	-------	---------	-------	-2.1213	0.033	---------	-------
21 carbon compound HK	---------	-------	---------	-------	---------	-------	-4.4914	0.001
21 carbon compound HL	-4.1662	0.001	---------	-------	---------	-------	---------	-------
21 carbon compound HN	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
21 carbon compound HQ	---------	-------	---------	-------	---------	-------	-4.4914	0.001
21 carbon compound HT	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
21 carbon compound HV	-4.1662	0.001	---------	-------	---------	-------	---------	-------
21 carbon compound HW	---------	-------	-2.5584	0.010	---------	-------	---------	-------
22 carbon compound HX	-4.1662	0.001	-2.5584	0.010	-2.1213	0.033	-4.4914	0.001
22 carbon compound HZ	---------	-------	---------	-------	---------	-------	-4.4914	0.001
22 carbon compound IA	---------	-------	---------	-------	---------	-------	-4.4914	0.001
22 carbon compound IC	-4.1662	0.001	---------	-------	---------	-------	---------	-------
22 carbon compound ID	---------	-------	---------	-------	---------	-------	-4.4914	0.001
22 carbon compound IE	---------	-------	---------	-------	---------	-------	-4.4914	0.001
22 carbon compound IF	---------	-------	-2.5584	0.010	---------	-------	---------	-------
22 carbon compound IG	---------	-------	---------	-------	---------	-------	-4.4914	0.001
22 carbon compound II	---------	-------	---------	-------	---------	-------	-4.4914	0.001
22 carbon compound IJ	---------	-------	---------	-------	---------	-------	-4.4914	0.001
22 carbon compound IK	---------	-------	---------	-------	---------	-------	-4.4914	0.001
22 carbon compound IL	---------	-------	-2.5584	0.010	---------	-------	---------	-------

Table 3-8.--(continued)

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
22 carbon compound IM	-4.1662	0.001	---------	-------	---------	-------	---------	-------
23 carbon compound IO	-4.1662	0.001	---------	-------	---------	-------	-4.4914	0.001
23 carbon compound IP	---------	-------	---------	-------	---------	-------	-4.4914	0.001
23 carbon compound IQ	-4.1662	0.001	---------	-------	---------	-------	---------	-------
23 carbon compound IR	---------	-------	-2.5584	0.010	---------	-------	---------	-------
23 carbon compound IV	---------	-------	-2.5584	0.010	---------	-------	---------	-------
23 carbon compound IW	---------	-------	---------	-------	---------	-------	-4.4914	0.001
23 carbon compound IX	---------	-------	---------	-------	---------	-------	-4.4914	0.001
23 carbon compound IY	-4.1662	0.001	---------	-------	---------	-------	---------	-------
23 carbon compound JA	---------	-------	---------	-------	---------	-------	-4.4914	0.001
23 carbon compound JB	---------	-------	-2.5584	0.010	---------	-------	---------	-------
23 carbon compound JC	---------	-------	---------	-------	---------	-------	-4.4914	0.001
23 carbon compound JF	-4.1662	0.001	---------	-------	---------	-------	---------	-------
24 carbon compound JH	-4.1662	0.001	-2.5584	0.010	---------	-------	-4.4914	0.001
24 carbon compound JO	---------	-------	---------	-------	---------	-------	-4.4914	0.001
24 carbon compound JR	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
24 carbon compound JT	---------	-------	-2.5584	0.010	---------	-------	---------	-------
24 carbon compound JU	---------	-------	---------	-------	---------	-------	-4.4914	0.001
24 carbon compound JV	---------	-------	---------	-------	---------	-------	-4.4914	0.001
24 carbon compound JY	---------	-------	---------	-------	---------	-------	-4.4914	0.001
25 carbon compound KB	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
25 carbon compound KC	---------	-------	---------	-------	---------	-------	-4.4914	0.001
25 carbon compound KD	---------	-------	-2.5584	0.010	---------	-------	---------	-------
25 carbon compound KG	---------	-------	-2.5584	0.010	---------	-------	---------	-------
25 carbon compound KH	---------	-------	-2.5584	0.010	---------	-------	---------	-------
25 carbon compound KK	-4.1662	0.001	---------	-------	---------	-------	-4.4914	0.001
25 carbon compound KN	-4.1662	0.001	---------	-------	---------	-------	---------	-------
25 carbon compound KO	---------	-------	---------	-------	---------	-------	-4.4914	0.001
25 carbon compound KP	---------	-------	-2.5584	0.010	---------	-------	---------	-------
25 carbon compound KQ	-4.1662	0.001	---------	-------	---------	-------	---------	-------
25 carbon compound KS	---------	-------	-2.5584	0.010	---------	-------	---------	-------
25 carbon compound KT	---------	-------	---------	-------	---------	-------	-4.4914	0.001
25 carbon compound KU	---------	-------	-2.5584	0.010	---------	-------	---------	-------
26 carbon compound KV	---------	-------	---------	-------	---------	-------	-4.4914	0.001
26 carbon compound KX	---------	-------	-2.5584	0.010	---------	-------	---------	-------
26 carbon compound KZ	-4.1662	0.001	---------	-------	---------	-------	---------	-------
26 carbon compound LA	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
26 carbon compound LB	-4.1662	0.001	---------	-------	---------	-------	---------	-------
26 carbon compound LC	---------	-------	---------	-------	---------	-------	-4.4914	0.001
26 carbon compound LD	---------	-------	---------	-------	---------	-------	-4.4914	0.001
26 carbon compound LG	---------	-------	---------	-------	---------	-------	-4.4914	0.001
26 carbon compound LH	---------	-------	-2.5584	0.010	---------	-------	---------	-------
26 carbon compound LJ	---------	-------	---------	-------	---------	-------	-4.4914	0.001
26 carbon compound LL	---------	-------	---------	-------	---------	-------	-4.4914	0.001
26 carbon compound LM	---------	-------	---------	-------	---------	-------	-4.4914	0.001
26 carbon compound LN	---------	-------	-2.5584	0.010	---------	-------	---------	-------
27 carbon compound LP	-4.1662	0.001	---------	-------	---------	-------	---------	-------
27 carbon compound LQ	---------	-------	-2.5584	0.010	---------	-------	---------	-------
27 carbon compound LS	---------	-------	-2.5584	0.010	---------	-------	---------	-------

Table 3-8.--(continued)

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
27 carbon compound LT	-4.1662	0.001	---------	-------	---------	-------	-4.4914	0.001
27 carbon compound LV	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
27 carbon compound LX	---------	-------	-2.5584	0.010	---------	-------	---------	-------
27 carbon compound LY	---------	-------	---------	-------	---------	-------	-4.4914	0.001
27 carbon compound LZ	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
27 carbon compound MB	---------	-------	-2.5584	0.010	---------	-------	---------	-------
27 carbon compound MC	-4.1662	0.001	---------	-------	---------	-------	-4.4914	0.001
27 carbon compound MD	---------	-------	-2.5584	0.010	---------	-------	---------	-------
27 carbon compound MF	---------	-------	-2.5584	0.010	---------	-------	---------	-------
27 carbon compound MG	---------	-------	-2.5584	0.010	---------	-------	---------	-------
27 carbon compound MI	---------	-------	---------	-------	---------	-------	-4.4914	0.001
27 carbon compound MK	---------	-------	---------	-------	---------	-------	-4.4914	0.001
28 carbon compound ML	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
28 carbon compound MM	---------	-------	-2.5584	0.010	---------	-------	---------	-------
28 carbon compound MO	---------	-------	-2.5584	0.010	---------	-------	---------	-------
28 carbon compound MP	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
28 carbon compound MR	---------	-------	---------	-------	---------	-------	-4.4914	0.001
28 carbon compound MT	---------	-------	-2.5584	0.010	---------	-------	---------	-------
28 carbon compound MU	---------	-------	---------	-------	---------	-------	-4.4914	0.001
28 carbon compound MX	---------	-------	-2.5584	0.010	---------	-------	---------	-------
28 carbon compound NA	---------	-------	-2.5584	0.010	---------	-------	---------	-------
28 carbon compound NB	---------	-------	---------	-------	---------	-------	-4.4914	0.001
28 carbon compound NC	---------	-------	-2.5584	0.010	---------	-------	---------	-------
28 carbon compound ND	-4.1662	0.001	---------	-------	---------	-------	---------	-------
28 carbon compound NE	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
28 carbon compound NF	-4.1662	0.001	---------	-------	---------	-------	---------	-------
28 carbon compound NG	---------	-------	-2.5584	0.010	---------	-------	---------	-------
28 carbon compound NH	---------	-------	---------	-------	---------	-------	-4.4914	0.001
29 carbon compound NK	---------	-------	-2.5584	0.010	---------	-------	---------	-------
29 carbon compound NL	---------	-------	-2.5584	0.010	---------	-------	---------	-------
29 carbon compound NM	---------	-------	---------	-------	---------	-------	-4.4914	0.001
29 carbon compound NN	---------	-------	-2.5584	0.010	---------	-------	---------	-------
29 carbon compound NP	---------	-------	---------	-------	---------	-------	-4.4914	0.001
29 carbon compound NQ	---------	-------	-2.5584	0.010	---------	-------	---------	-------
29 carbon compound NR	---------	-------	---------	-------	---------	-------	-4.4914	0.001
29 carbon compound NT	---------	-------	---------	-------	---------	-------	-4.4914	0.001
29 carbon compound NV	---------	-------	-2.5584	0.010	---------	-------	-4.4914	0.001
29 carbon compound NZ	---------	-------	---------	-------	---------	-------	-4.4914	0.001
29 carbon compound OA	---------	-------	-2.5584	0.010	---------	-------	---------	-------
29 carbon compound OB	---------	-------	---------	-------	---------	-------	-4.4914	0.001
29 carbon compound OC	---------	-------	-2.5584	0.010	---------	-------	---------	-------
30 carbon compound OF	---------	-------	-2.5584	0.010	---------	-------	---------	-------
30 carbon compound OH	---------	-------	-2.5584	0.010	---------	-------	---------	-------
30 carbon compound OI	---------	-------	-2.5584	0.010	---------	-------	---------	-------
30 carbon compound OJ	---------	-------	-2.5662	0.010	---------	-------	---------	-------
30 carbon compound OL	---------	-------	---------	-------	---------	-------	-4.4914	0.001
30 carbon compound OM	---------	-------	-2.5584	0.010	---------	-------	---------	-------
30 carbon compound OR	---------	-------	-2.5584	0.010	---------	-------	---------	-------
30 carbon compound OS	---------	-------	-2.5584	0.010	---------	-------	---------	-------

Table 3-8.--(continued)

Compounds	*P. leo*		*P. uncia*		*A. jubatus*		*P. tigris*	
	z-score	p	z-score	p	z-score	p	z-score	p
30 carbon compound OT	---	---	---	---	---	---	-4.4914	0.001
30 carbon compound OV	---	---	-2.5584	0.010	---	---	---	---
31 carbon compound OX	---	---	-2.5584	0.010	---	---	---	---
31 carbon compound OZ	---	---	---	---	---	---	-4.4914	0.001

compounds were significantly greater in the reproductive males and 29 compounds were significantly greater in the reproductive females (Table A-15 - Appendix A).

Dominant vs. Subordinate

Seven compounds were significantly different between dominant and subordinate female snow leopards in the glycolipid fraction (Table 3-9). Five compounds were significantly greater in the dominant females and two were significantly greater in the subordinate females (Table A-16 - Appendix A). Five compounds were significantly different between dominant and subordinate female lions in the glycolipid fraction (Table 3-9). Two compounds were significantly greater in the dominant females and three were significantly greater in the subordinate females (Table A-16 - Appendix A).

Ten compounds were significantly different between dominant and subordinate female snow leopards in the neutral lipid fraction (Table 3-10). Five compounds were significantly greater in the dominant females and five were significantly greater in the subordinate females (Table A-17 - Appendix A). Two compounds were significantly different between the dominant and subordinate female lions in the neutral lipid fraction (Table 3-10). One compound was significantly greater in the dominant females and one was significantly greater in the subordinate females (Table A-17 - Appendix A).

Nine compounds were significantly different between dominant and subordinate female lions in the phospholipid fraction (Table 3-11). Seven compounds were significantly greater in the dominant females and two were significantly greater in the subordinate females (Table A-18 - Appendix A). No compounds were significantly

Table 3-9.–z scores and significance values of glycolipids present in anal sacs of dominant and subordinate *Panthera leo* (lions) and *P. uncia* (snow leopards) females. Dashed lines represent the absence of a compound.

Compounds	*Panthera uncia*		*Panthera leo*	
	z-score	p value	z-score	p-value
12 carbon compound R	-2.0000	0.0455	----------	----------
13 carbon compound AP	----------	----------	-2.0430	0.0411
Heptadecanoic acid	----------	----------	-2.0430	0.0411
17 carbon compound CR	----------	----------	-2.4686	0.0136
18 carbon compound CW	-2.0000	0.0455	----------	----------
20 carbon compound DX	-2.0000	0.0455	----------	----------
22 carbon compound FI	----------	----------	-2.8943	0.0038
22 carbon compound FU	-2.0000	0.0455	----------	----------
X-Hexacosanoic acid	-2.0000	0.0455	----------	----------
26 carbon compound ID	----------	----------	-2.3835	0.0171
26 carbon compound IH	-2.0000	0.0455	----------	----------
29 carbon compound LI	-2.0000	0.0455	----------	----------

Table 3-10.--z scores and significance values of neutral lipids present in anal sacs of dominant and subordinate *Panthera leo* (lions) and *P. uncia* (snow leopards) females. Dashed lines represent the absence of a compound.

Compounds	*Panthera leo*		*Panthera uncia*	
	z-score	p value	z-score	p value
12 carbon compound AS	-2.0000	0.0455	----------	----------
13 carbon compound BK	-2.0000	0.0455	----------	----------
Nonadecanoic acid	-2.0000	0.0455	----------	----------
18 carbon compound FC	-2.0000	0.0455	----------	----------
18 carbon compound FD	----------	----------	-2.2984	0.0215
19 carbon compound GT	-2.0000	0.0455	----------	----------
20 carbon compound HE	-2.0000	0.0455	----------	----------
21 carbon compound HU	----------	----------	-2.2133	0.0269
21 carbon compound HZ	-2.0000	0.0455	----------	----------
23 carbon compound JZ	-2.0000	0.0455	----------	----------
Cholesterol	-2.0000	0.0455	----------	----------
30 carbon compound PW	-2.0000	0.0455	----------	----------

Table 3-11.--z scores and significance values of phospholipids present in anal sacs of dominant and subordinate *Panthera leo* females.

Compounds	*Panthera leo*	
	z-score	p value
14 carbon compound BE	-2.5538	0.0107
14 carbon compound BJ	-2.2133	0.0269
14 carbon compound BT	-2.1281	0.0333
15 carbon compound CI	-2.2133	0.0269
15 carbon compound CO	-2.3835	0.0171
17 carbon compound DS	-2.2984	0.0215
24 carbon compound JH	-2.2133	0.0269
25 carbon compound KN	-2.1281	0.0333
27 carbon compound LT	-2.1281	0.0333

different between dominant and subordinate female snow leopards in the phospholipid fraction.

Four compounds were significantly different between dominant and subordinate male lions in the glycolipid fraction (Table 3-12). Two compounds were significantly greater in the dominant male and two were significantly greater in the subordinate males (Table A-19 - Appendix A). Seven compounds were significantly different between dominant and subordinate male lions in the phospholipid fraction (Table 3-12). Two compounds were significantly greater in the dominant male and five were significantly greater in the subordinate males (Table A-19 - Appendix A). No compounds were significantly different between dominant and subordinate male lions in the neutral lipid fraction.

Social Groups

No compounds were significantly different between male lions housed alone compared with males housed with females in all lipid fractions. Likewise, no compounds were significantly different between female lions housed alone and those housed with males in all lipid fractions. Similarly, no compounds were significantly different between female snow leopards housed alone compared with those housed with males in all lipid fractions. Tables summarizing statistical differences between pre-reproductive and reproductive females (Table 3-13), reproductive females and reproductive males (Table 3-14), dominant females and subordinate females (Table 3-15), and dominant males and subordinate males (Table 3-16) are presented.

Table 3-12.--z scores and significance values of glycolipids present in anal sacs of dominant and subordinate *Panthera leo* males.

Compounds	*Panthera leo*	
	z-score	p value
19 carbon compound DG	-2.7386	0.0062
26 carbon compound IJ	-2.0083	0.0446
26 carbon compound IS	-2.1909	0.0285
29 carbon compound KZ	-2.1909	0.0285

Table 3-13.--Glycolipid (GL), neutral lipid (NL), and phospholipid (PL) compounds present in anal sacs of snow leopards (*Panthera uncia*) and lions (*Panthera leo*) grouped by number of carbons. The total number of compounds and number of significant compounds are indicated for each species. Pre-Repro. F = Pre-Reproductive female; Repro. F = Reproductive female.

Number of Carbons	Pre-Repro. F vs. Repro. F											
	Panthera uncia						*Panthera leo*					
	Total Number			# Significant			Total Number			# Significant		
	GL	NL	PL	GL	NL	PL	GL	NL	PL	GL	NL	PL
10 carbon compounds	0	4	0	0	1	0	2	0	0	2	0	0
11 carbon compounds	1	9	4	0	3	0	1	3	0	0	2	0
12 carbon compounds	5	9	4	4	1	2	3	6	3	3	5	2
13 carbon compounds	2	11	6	2	1	1	2	7	7	2	6	5
14 carbon compounds	1	8	6	1	2	2	4	5	8	4	5	7
15 carbon compounds	2	7	8	2	2	2	1	6	10	1	6	10
16 carbon compounds	4	8	7	2	4	3	4	7	6	4	4	3
17 carbon compounds	1	9	10	0	5	7	4	6	10	3	6	7
18 carbon compounds	6	9	8	4	1	4	4	10	3	3	8	2
19 carbon compounds	5	6	10	2	0	4	4	7	7	2	7	6
20 carbon compounds	4	7	9	3	4	1	4	7	4	3	7	2
21 carbon compounds	4	7	9	2	1	2	3	5	4	3	4	3
22 carbon compounds	4	8	5	2	2	3	5	6	3	4	6	2
23 carbon compounds	3	9	4	2	1	1	2	7	4	2	7	4
24 carbon compounds	0	4	3	0	1	1	2	3	3	1	2	2
25 carbon compounds	2	7	8	0	0	0	5	9	1	5	9	1
26 carbon compounds	5	5	5	3	2	1	8	2	2	6	2	1
27 carbon compounds	4	5	11	0	1	3	8	7	4	6	6	3
28 carbon compounds	4	8	12	1	2	6	4	4	2	2	3	2
29 carbon compounds	5	7	7	1	1	1	3	2	0	3	1	0
30 carbon compounds	3	1	9	2	1	1	3	5	0	1	4	0
31 carbon compounds	1	0	1	1	0	0	1	1	0	1	0	0

Table 3-14.--Glycolipid (G), neutral lipid (N), and phospholipid (P) compounds present in anal sacs of *Acinonyx jubatus* (cheetahs), *Panthera uncia* (snow leopards), *P. tigris* (tigers), and *P. leo* (lions) grouped by number of carbons. The total number of compounds and number of significant compounds are indicated for each species.

Number of Carbons	Reproductive Females vs. Reproductive Males																							
	Acinonyx jubatus						*Panthera uncia*						*Panthera tigris*						*Panthera leo*					
	Total #			# Signif.			Total #			# Signif.			Total #			# Signif.			Total #			# Signif.		
	G	N	P	G	N	P	G	N	P	G	N	P	G	N	P	G	N	P	G	N	P	G	N	P
10 carbon compounds	3	0	0	1	0	0	0	4	0	0	4	0	0	4	0	0	2	0	2	0	0	0	0	0
11 carbon compounds	0	1	0	0	1	0	1	9	4	1	8	3	2	4	2	2	4	2	1	3	0	0	3	0
12 carbon compounds	2	5	0	0	3	0	5	9	4	1	8	3	4	8	1	3	7	1	3	6	3	0	4	1
13 carbon compounds	1	10	2	0	9	1	2	10	6	2	6	6	3	8	5	2	3	5	2	7	7	0	7	5
14 carbon compounds	2	5	3	2	3	3	1	8	6	1	7	6	1	8	6	0	7	3	4	5	8	0	5	7
15 carbon compounds	3	7	3	3	3	3	2	7	8	2	6	7	2	7	10	2	7	8	1	6	10	0	6	9
16 carbon compounds	2	5	4	2	5	4	4	8	7	4	7	6	4	9	10	4	9	8	4	7	6	0	7	5
17 carbon compounds	2	5	9	2	5	7	1	9	10	1	7	8	1	9	12	1	8	10	5	6	10	2	6	9
18 carbon compounds	4	1	1	3	1	1	6	9	8	5	9	5	3	10	9	2	8	7	3	10	3	0	7	3
19 carbon compounds	2	5	4	2	4	3	5	6	10	4	5	8	3	6	11	2	4	9	4	7	7	0	7	6
20 carbon compounds	2	2	2	2	2	2	3	7	9	3	5	8	2	7	10	1	6	8	3	7	4	0	6	4
21 carbon compounds	4	8	3	3	8	3	4	7	9	3	6	7	3	7	11	3	7	9	4	5	4	0	3	4
22 carbon compounds	3	3	1	3	3	1	4	8	5	3	7	3	5	8	9	5	4	9	5	6	3	0	6	3
23 carbon compounds	2	5	0	1	5	0	3	9	4	3	9	3	3	9	9	3	7	6	2	7	4	0	5	4
24 carbon compounds	4	3	1	4	3	0	1	4	6	1	3	3	1	4	9	1	4	6	3	3	1	0	1	1
25 carbon compounds	2	3	0	1	3	0	3	7	8	3	6	7	4	5	7	4	3	5	5	9	3	0	9	3
26 carbon compounds	2	1	0	2	0	0	5	5	5	4	2	4	5	4	9	3	3	8	8	2	2	1	1	2
27 carbon compounds	5	0	1	4	0	0	4	5	11	4	4	9	4	3	9	4	3	8	8	7	4	4	7	3
28 carbon compounds	1	0	0	1	0	0	4	8	12	4	8	10	4	6	10	2	5	7	4	4	2	0	4	2
29 carbon compounds	3	0	0	3	0	0	5	7	7	5	5	7	2	6	7	2	2	7	3	2	0	1	1	0
30 carbon compounds	2	0	0	2	0	0	3	1	9	3	1	8	2	2	4	2	1	2	3	5	0	0	4	0
31 carbon compounds	1	0	0	1	0	0	1	0	1	1	0	1	1	0	1	1	0	1	1	1	0	0	1	0

Table 3-15.--Glycolipid (G), neutral lipid (N), and phospholipid (P) compounds present in anal sacs of dominant and subordinate female *Panthera uncia* (snow leopards) and *P. leo* (lions) grouped by number of carbons. The total number of compounds and number of significant compounds are indicated for each species.

Number of Carbons	Dominant Females vs. Subordinate Females											
	Panthera uncia						*Panthera leo*					
	Total #			# Signif.			Total #			# Signif.		
	G	N	P	G	N	P	G	N	P	G	N	P
10 carbon compounds	0	4	---	0	0	---	2	0	0	0	0	0
11 carbon compounds	1	9	---	0	0	---	1	3	0	0	0	0
12 carbon compounds	5	9	---	1	1	---	3	6	3	0	0	0
13 carbon compounds	2	10	---	0	1	---	2	7	7	1	0	0
14 carbon compounds	1	8	---	0	0	---	4	5	8	0	0	3
15 carbon compounds	2	7	---	0	1	---	1	6	10	0	0	2
16 carbon compounds	4	8	---	0	0	---	4	7	6	0	0	0
17 carbon compounds	1	9	---	0	0	---	5	6	10	3	0	1
18 carbon compounds	6	9	---	1	1	---	3	10	3	0	1	0
19 carbon compounds	5	6	---	0	1	---	4	7	7	0	0	0
20 carbon compounds	3	7	---	1	1	---	3	7	4	0	0	0
21 carbon compounds	4	7	---	0	1	---	4	5	4	0	1	0
22 carbon compounds	4	8	---	1	0	---	5	6	3	4	0	0
23 carbon compounds	3	9	---	0	1	---	2	7	4	0	0	0
24 carbon compounds	1	4	---	0	0	---	3	3	2	0	0	1
25 carbon compounds	3	7	---	1	0	---	5	9	3	0	0	1
26 carbon compounds	5	5	---	1	0	---	8	2	2	1	0	0
27 carbon compounds	4	5	---	0	1	---	8	7	4	0	0	1
28 carbon compounds	4	8	---	0	0	---	4	4	2	0	0	0
29 carbon compounds	5	7	---	1	0	---	3	2	0	0	0	0
30 carbon compounds	3	1	---	0	1	---	3	5	0	0	0	0
31 carbon compounds	1	0	---	0	0	---	1	1	0	0	0	0

Table 3-16.--Glycolipid (G), neutral lipid (N), and phospholipid (P) compounds present in anal sacs of dominant and subordinate male *Panthera leo* (lions) grouped by number of carbons. The total number of compounds and number of significant compounds are indicated for each species.

Number of Carbons	Dominant Males vs. Subordinate Males					
	Panthera leo					
	Total #			# Signif.		
	G	N	P	G	N	P
10 carbon compounds	2	---	0	0	---	0
11 carbon compounds	1	---	0	0	---	0
12 carbon compounds	3	---	3	0	---	0
13 carbon compounds	2	---	7	0	---	0
14 carbon compounds	4	---	8	0	---	2
15 carbon compounds	1	---	10	0	---	2
16 carbon compounds	4	---	6	0	---	0
17 carbon compounds	5	---	10	0	---	0
18 carbon compounds	3	---	3	0	---	0
19 carbon compounds	4	---	7	1	---	0
20 carbon compounds	3	---	4	0	---	0
21 carbon compounds	4	---	4	0	---	1
22 carbon compounds	5	---	3	0	---	0
23 carbon compounds	2	---	4	0	---	0
24 carbon compounds	3	---	2	0	---	0
25 carbon compounds	5	---	3	0	---	1
26 carbon compounds	8	---	2	2	---	1
27 carbon compounds	8	---	4	0	---	0
28 carbon compounds	4	---	2	0	---	0
29 carbon compounds	3	---	0	1	---	0
30 carbon compounds	3	---	0	0	---	0
31 carbon compounds	1	---	0	0	---	0

Discussion

In agreement with work on other carnivores (Brinck et al., 1983; Kruuk et al., 1984; Davies et al., 1988; Buglass et al., 1990; Decker et al., 1992), this study reveals that individuals have the same chemical compounds within a single species, suggesting the species-specific nature of felid chemical signals. Such species specificity may actually reflect the presence of a subset, from the total mixture of compounds, which are collectively responsible for the uniqueness of the chemical message. However, the relative amount of compounds vary among individuals within each felid species. Results of this study suggest that this variation is important at the intraspecific level, communicating information such as sexual and reproductive status.

Previous studies emphasize the importance of major components (Raymer et al., 1985; Clapperton et al., 1988) while ignoring the likely informative minor components. Results of this study reveal a large quantity of minor components suggesting their importance to the overall scent. Indeed, for most species, over 70% of the compounds are minor components of less than 1 picomole. Felis caracal (caracal lynxes), F. concolor (pumas), and ocelots have slightly less minor components at 65%, 66%, and 57%, respectively. Preti et al. (1977) concluded that minor components of odorous secretions may be of critical importance to an animals' perception of odors. Species within a taxonomic group (i.e., family, subfamily) often share some of the same chemicals, as a result of common biosynthetic pathways (Roelofs and Brown, 1982). In closely related species, specificity is accomplished by the use of unique minor components or similar compounds in different ratios (Linn et al., 1988). Furthermore,

species may use a common major component with a unique set of minor components which provide the basis for discrimination among species. This study reveals a large mixture of chemical compounds present in the anal sac secretions of felid species. With few exceptions (Decker et al., 1992), prior studies on carnivore anal gland secretions reported a much smaller mixture of compounds (e.g., Kruuk et al., 1984). This may due to the fact that the authors report only the major components, largely ignoring the importance of the minor components which may actually be the compounds which carry the potential information.

Many species of mammals have a right and left anal gland and have voluntary control over expulsion (Asa et al., 1985a). Any differences in the volatile composition of the right and left anal sac could have different communicatory functions. Comparisons of right and left anal sacs of leopards, lions, and tigers reveal minuscule differences between the right and left sides. Raymer et al. (1985) and Albone and Perry (1975) reported slight differences between right and left anal sacs of Vulpes vulpes (red fox) and Canis lupus (gray wolf) respectively. However, as in the present study, they were not able to statistically evaluate these differences due to small sample sizes. Further studies must be carried out in which several samples are collected from the right and left anal sacs of the same individual, so that tests of significance can be performed.

Many studies emphasize the importance of individual recognition (e.g., Gorman et al., 1974). If chemicals are used for individual recognition, it is necessary for the scent profile of a single individual to remain stable over time. This study examines the

stability of the scent profile by analyzing individual leopards and tigers over a one year time interval. Results indicate that the chemical profile of these felid species is indeed stable over time.

There is a growing trend away from the idea that mammalian scent products have single, clearly defined functions. The same signal may have several meanings which varies in relation to the social context in which it appears and the past experience of the signal receiver (Johnson, 1973; Muller-Schwarze, 1977; Wilson, 1975). Furthermore, Decker et al. (in prep) demonstrate that the complex chemical mixture of carnivores may contain many subsets of chemicals, that may or may not overlap, which convey different messages to the receiving animal depending upon the animal's reproductive condition, dominance status, age, and a host of other possible factors (i.e., a pre-reproductive animal may not be able to recognize the signal of a reproductive animal). This study reveals that marked differences do indeed exist between pre-reproductive females and reproductive females. There is a consistent trend for reproductive female lions to have a larger number of compounds in significantly greater amounts in the glycolipid, neutral lipid and phospholipid fractions. This suggests that reproductive female lions potentially use these compounds to communicate their reproductive status. On the other hand, pre-reproductive female lions do not have as many compounds in greater quantities, suggesting that they do not have a threshold amount of chemicals that are necessary for communication of their reproductive status. The opposite trend holds true for reproductive female snow leopards. These reproductive females have fewer compounds that are represented in greater quantities

in comparison with the pre-reproductive female snow leopards for all lipid fractions. This suggests that pre-reproductive female snow leopards have compounds that communicate different information such as their pre-reproductive status. The fact that the trend for the quantities of compounds is not consistent across felid species suggests that species use the chemicals differently, further supporting the species-specific nature of the chemical signals. This result agrees with the observation of Bailey (1974) that the anal gland secretions of juvenile felids do not have the same chemical characteristics as adults, which is evidenced by its white to slightly yellowish color as opposed to the darker color in adult felids. Furthermore, subadult felids (cheetah - Eaton, 1970; bobcat - Bailey, 1974; serval - Geertsema, 1985) do not mark or show any behavioral associations of marking (Shorey, 1976).

This study also reveals differences in chemical composition between reproductive males and reproductive females for all felid species. Reproductive female cheetahs have more compounds that are in significantly greater quantities than the reproductive males. In contrast, reproductive male snow leopards, tigers, and lions have more compounds that are in significantly greater quantities than the reproductive females. The large number of compounds in greater quantities in the reproductive female cheetahs may communicate to conspecifics that the female is in estrous. On the other hand, the lack of compounds with greater quantities in reproductive male snow leopards, tigers, and lions may communicate to other males that they are not females because they do not contain the characteristic odor typical of reproductive females. These differences between reproductive males and females likely play a significant role

in specific mate recognition, where males and females communicate via a signal-response chain which informs each other that they are conspecifics ready to mate. Several behavioral studies demonstrate that species do indeed respond differently to the glandular secretions depending upon whether the secretion is from the same or opposite sex (Bowers and Alexander, 1967; Dagg and Windsor, 1971; Muller-Schwarze, 1977). Studies on felid scent marking indicate that females tend to be more attractive to males when they are in estrous (cheetahs - Schaller, 1967; Eaton, 1970; domestic cats - Verberne, 1976; lions - Eaton, 1978). Additionally, while solitary female lions patrol the boundaries of their territory, they collect olfactory information on the breeding status of adjacent females (Eaton, 1978). Female tigers double their rate of scent marking right before estrous (Smith et al., 1988). Similarly, males mark more frequently in the presence of an estrous female (Kitchener, 1991). Further detailed study of chemical composition and reproductive condition is necessary to test the trends observed here.

Several studies demonstrate that dominant individuals mark more frequently than subordinate individuals (Carr et al., 1970; Erlinge et al., 1982; Clapperton, 1989; Ryon and Brown, 1990), and that subordinate individuals mark less in the presence of dominant individuals then when alone (Shorey, 1976). A consequential function of this type of marking behavior is reduced overt aggression, whereby a dominant individual conveys to a subordinate individual that he is dominant, thus avoiding a potentially costly aggressive interaction. Kitchener (1991) suggests that the frequency of felid scent marking can be used to determine the dominance status. However, this study

does not strongly support the assertion of a different chemical profile for dominant individuals compared with subordinate individuals, as there are very few differences between dominant and subordinate female snow leopards and lions, and between dominant and subordinate male lions in all lipid fractions.

Many studies support the idea that social groups have a common odor which is shared among group members (e.g., Brown, 1979). Analyses within each felid species reveals no characteristic group odors. This finding is consistent with felids being primarily solitary, with the exception of lions, thus a common group odor most likely did not evolve in this group.

In summary, results of this study suggest that semiochemicals in felid species vary quantitatively and may be used for intraspecific communication regarding recognition of sexual status and reproductive status. The semiochemicals do not differ qualitatively, and therefore, are regarded as species-specific characters which can be used in phylogenetic studies.

Chapter 4

Phylogenetic Analysis of the Family Felidae

Introduction

Although the systematics of the Felidae is well studied, there is still considerable debate about relationships within this Family. Most disagreement concerns the number of genera and their relationships. The earliest classification of the Felidae (Severtzow, 1858) listed five genera and 27 subgenera. Pocock (1917) recognized three monophyletic groups, the Pantherinae (including Panthera leo - lion, P. tigris - tiger, P. pardus - leopard, P. uncia - snow leopard), and P. marmorata (marbled cat), the Acinonychinae (Acinonyx jubatus - cheetah), and the Felinae (which includes the remaining 14 genera). Early phylogenetic studies of felids were based on morphology, such as skin pattern and color (Pocock, 1917; Weigel, 1956), tongue morphology (Sonntag, 1923), structure of the anterior portion of the zygomatic arch (Lonnberg, 1926), and overall morphological structures (Haltenorth, 1936). Although morphological characters are important in the determination of evolutionary relationships, the morphology of felid species is markedly uniform, mainly differing in size (Ewer, 1973; Gittleman, 1985). Several later authors used chromosomal data (Roubin et al., 1973; Wurster-Hill and Gray, 1973, 1975; Benirschke et al., 1974; Wurster-Hill, 1974; Soderlund et al., 1980), dental features (Glass and Martin, 1978), and physiological data (Hemmer, 1976). Nevertheless, these types of characters are

mainly useful at the generic level. Thus, other non-morphological characters may be useful for diagnosing relationships in this group.

Four competing hypotheses currently exist concerning the relationships of the Felidae (Hemmer, 1978; Herrington, 1986; Collier and O'Brien, 1985; Salles, 1992). The following discussion summarizes the main differences between each phylogenetic tree and, in turn, illustrates the major relationships that are tested in this study. The resolution of Hemmer's (1978) phylogenetic tree based on morphological features is very poor. An unresolved polytomy occurs among several Felis species as well as cheetahs and all Panthera species (Fig. 4-1; node 1). Within the Panthera clade, P. onca (jaguar), P. pardus (leopard), and lions are presented as an unresolved trichotomy (Fig. 4-1; node 2), and snow leopards and tigers form an unresolved dichotomy (Fig. 4-1; node 3); Felis serval, (serval), F. rufus, (bobcat), F. pardina (spanish lynx), F. caracal (caracal lynx), F. canadensis (canadian lynx), and F. lynx (northern lynx) form a second unresolved polytomy (Fig. 4-1; node 4). Herrington's (1986) phylogenetic tree, based on morphological features, produces two major clades (Fig. 4-2; nodes 1 & 2). Within the first major clade (Fig. 4-2; node 1), the Panthera species are grouped as a monophyletic clade (Fig. 4-2, node 3). The lion is most closely related to the leopard (Fig. 4-2; node 4), the jaguar is a sister group to the leopard-lion clade (Fig. 4-2; node 5), the tiger is the sister group to the jaguar-leopard-lion clade (Fig. 4-2, node 6), and the snow leopard is the most primitive member of the Panthera clade (Fig. 4-2, node 7). Similar to Hemmer's (1978) tree, the bobcat and spanish lynx, canadian lynx, and northern lynx are grouped as a monophyletic clade (Fig. 4-2; node 8). The serval is

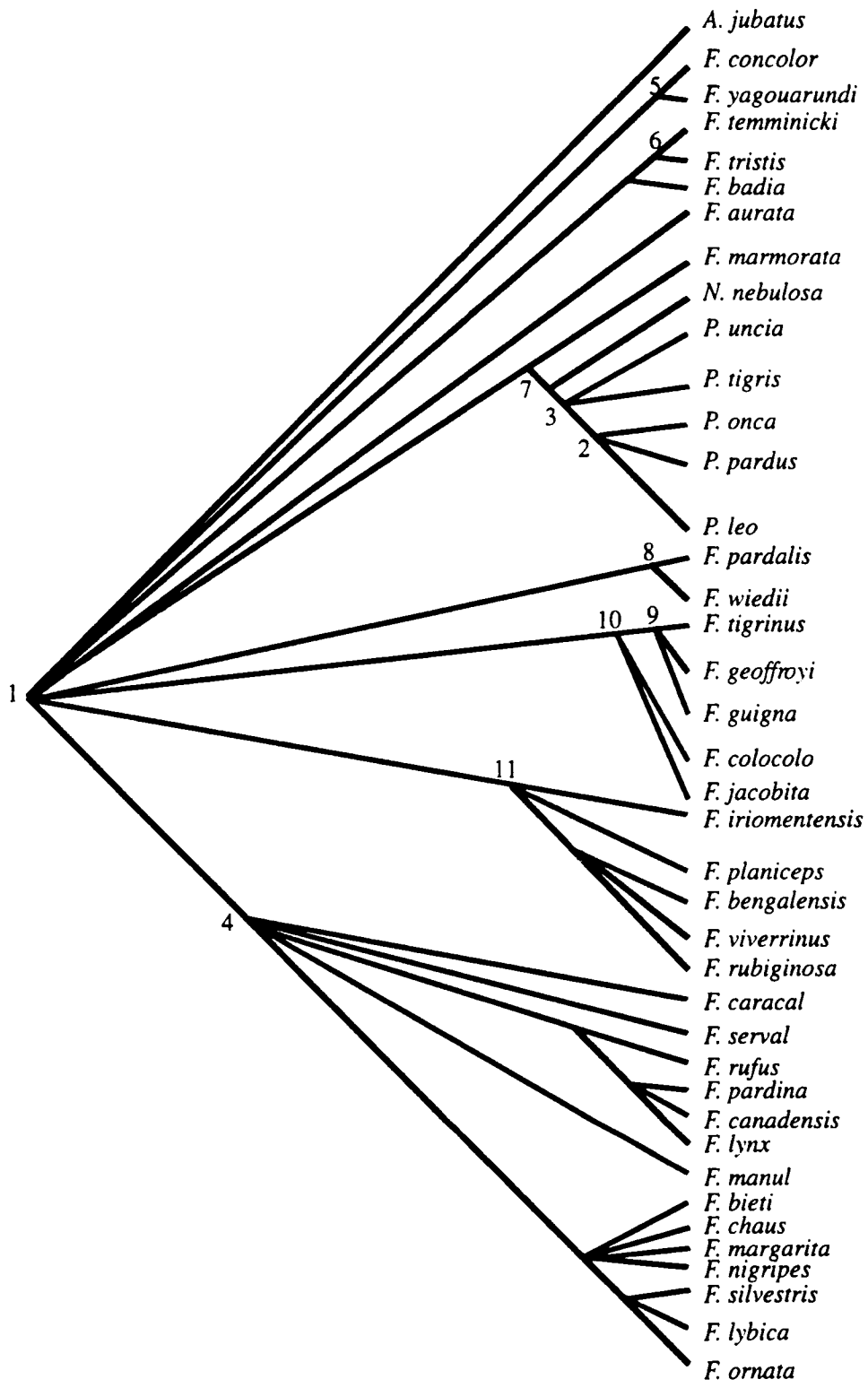


Figure 4-1.--Hemmer's (1978) phylogenetic tree based on morphological features. *A=jubatus; F=Felis; N=Neofelis; P=Panthera.*

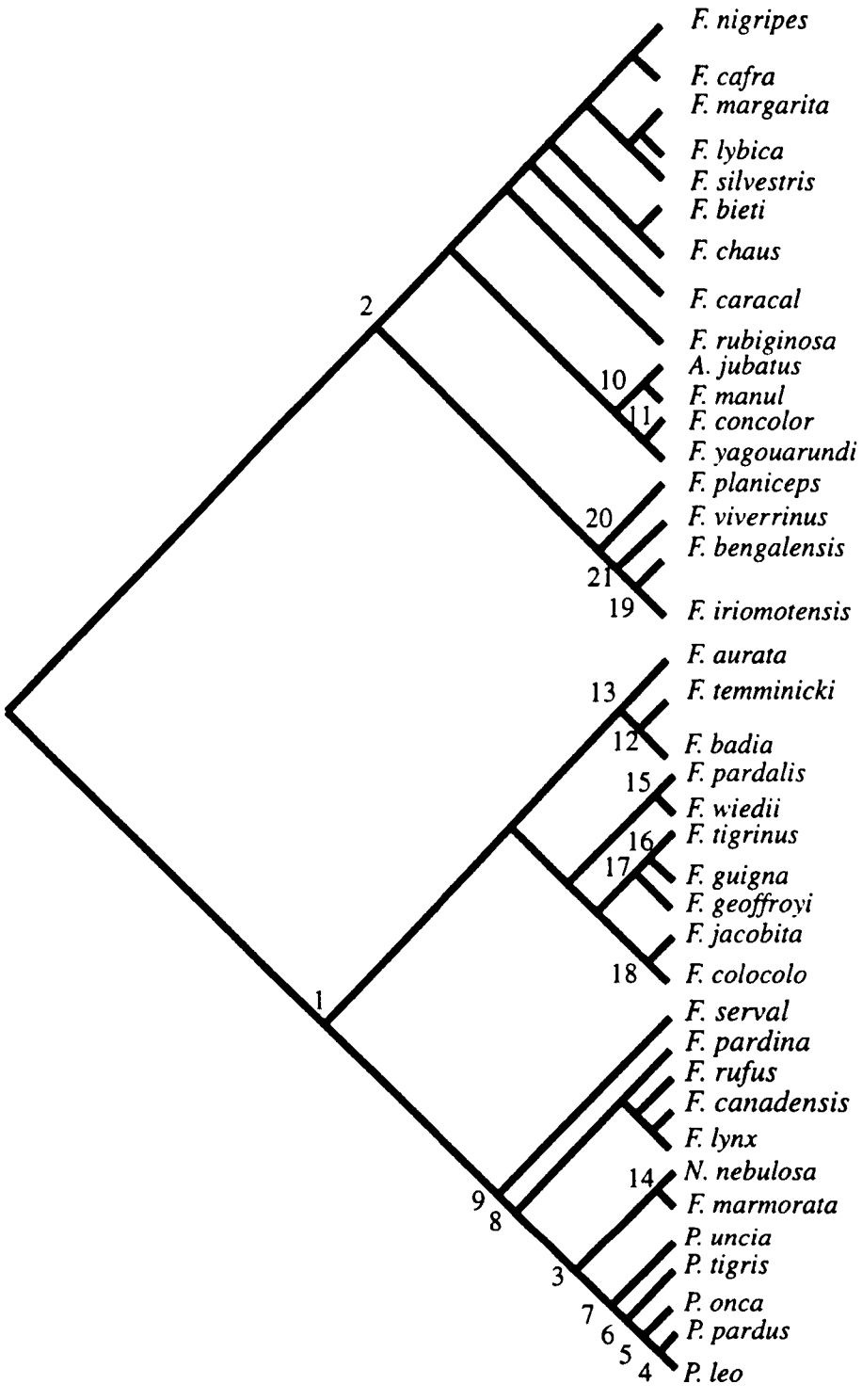


Figure 4-2.--Herrington's (1986) phylogenetic tree based on morphological features. A=*Acinonyx*; F=*Felis*; N=*Neofelis*; P=*Panthera*.

grouped as a sister taxon to the bobcat-spanish lynx-canadian lynx-northern lynx clade (Fig. 4-2; node 9). Within the second major clade (Fig. 4-2; node 2), the cheetah is grouped with F. manul (pallas' cat) (Fig. 4-2; node 10) and the puma is grouped with F. yagouarundi (jaguarundi) (Fig. 4-2; node 11). Collier and O'Brien's (1985) phylogenetic tree, based on albumin immunological distance, produces an unresolved trichotomy among the Panthera species (Fig. 4-3; node 1). The bobcat is grouped with the canadian lynx and northern lynx (Fig. 4-3; node 2), whereas the serval is grouped with the caracal lynx (Fig. 4-3; node 3). Salles' (1992) phylogenetic tree, based on morphological features, produces an unresolved trichotomy among the jaguar, lion, and leopard (Fig. 4-4; node 1). The tiger is a sister taxon to this unresolved trichotomy (Fig. 4-4; node 2). Neofelis nubulosa (clouded leopard) is grouped outside of the tiger-jaguar-lion-leopard clade (Fig. 4-4; node 3), with the snow leopard outside of this larger clade (Fig. 4-4; node 4). The cheetah is grouped as a sister taxon to the Panthera-Neofelis clade (Fig. 4-4; node 5). The bobcat and lynxes form a monophyletic clade (Fig. 4-4; node 6) with the serval as a distant relative (Fig. 4-4; node 7).

These aforementioned authors used morphology and molecular data to construct their phylogenetic trees. Chemical signals are used extensively in insect taxonomy (e.g., Buschinger, 1975) but relatively neglected, with a few exceptions (e.g., Vane-Wright et al., 1992), in rigorous phylogenetic analyses are chemical signals. Chemical signals are secreted from the scent sacs of mammals and used to communicate among individuals within a species. The purpose of this study is to apply

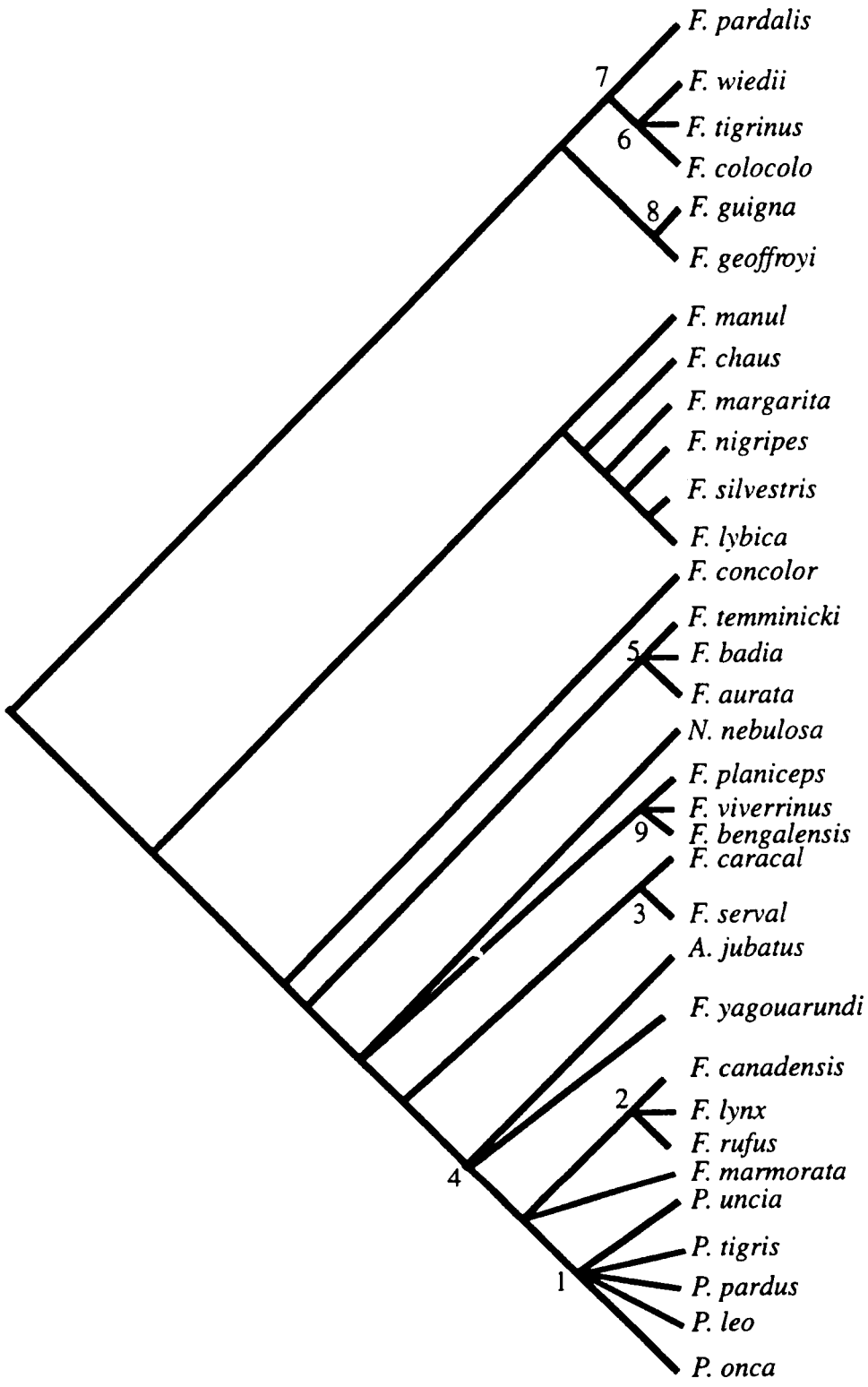


Figure 4-3.--Collier and O'Brien's (1985) phylogenetic tree based on albumin immunological distance. *A=Acinonyx; F=Felis; N=Neofelis; P=Panthera.*

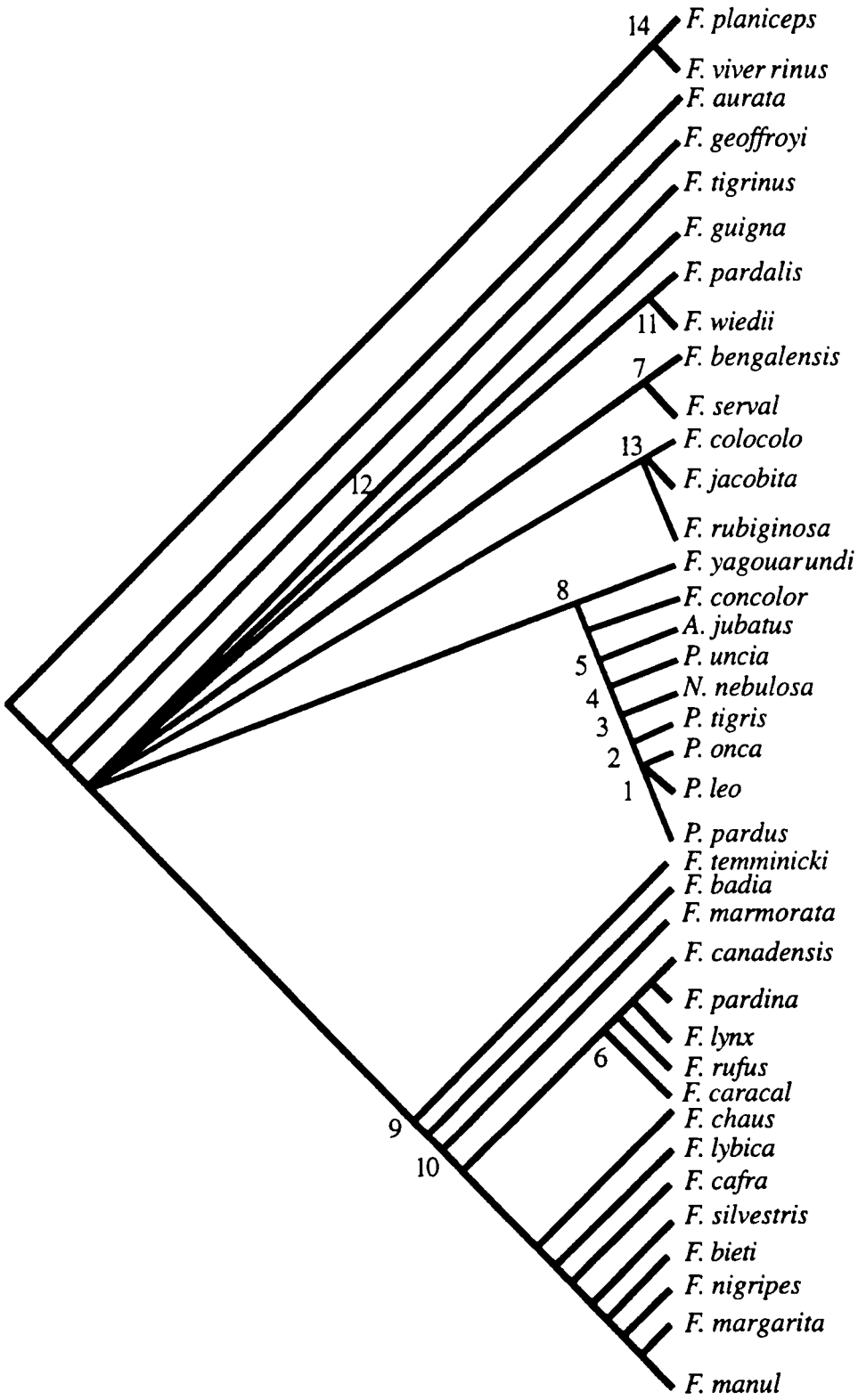


Figure 4-4.--Salles' (1992) phylogenetic tree based on morphological features. *A=Acinonyx; F=Felis; N=Neofelis; P=Panthera.*

phylogenetic analyses of chemical signals among species within the Family Felidae in order to test the above four competing hypotheses about phylogenetic relationships within this family. This study, therefore, examines phylogenetic relationships within the Felidae using an independent character set to evaluate currently existing phylogenies for this group and examines the extent to which chemical signals, specific mate recognition characters, are useful for systematic purposes.

Methods

Presently, as many as 16 different genera are recognized across the Felidae. Therefore, for ease of comparison among phylogenetic trees, the generic nomenclature is modified to correspond with the independent classification of Nowak and Paradiso (1983). The genera include Acinonyx, Felis, Neofelis, and Panthera.

A discussion of the collection methods and chemical analyses is presented in Chapter 2. Characters (chemical compounds) are treated as discrete variables. Extreme caution is used to ensure that those characters used in the phylogenetic analysis do not vary within a single species (i.e., a chemical is absent in one individual but present in another individual of the same species). Recent studies indicate that there are no qualitative differences among individuals within a single species, yet there are large quantitative differences among species (Decker et al., 1992; Chapter 3). Furthermore, this study agrees (Chapter 3) with prior studies (e.g., Decker et al., 1992) in that there is no qualitative variation in chemical compounds within a single species. Therefore, characters are coded as presence/absence features.

The family level relationships within the Superfamily Feloidea are controversial (Flynn et al., 1988; Wozencraft, 1989) making the use of one or more outgroups problematic (Maddison et al., 1986). Additionally, since there is no objective basis for determining the evolutionary direction of the chemical compounds, Lundberg Rooting is used *in lieu* of traditional outgroup rooting (Watrous and Wheeler, 1981). This method computes an unrooted phylogenetic tree for the ingroup taxa only, making no *a priori* assumptions about polarity. A hypothetical ancestor is then attached to the tree *a posteriori*. This *a posteriori* procedure does not change the tree length, and is used for output and interpretational purposes only (Swofford and Begle, 1993).

A phylogenetic analysis was performed using a computer algorithm - PAUP (Phylogenetic Analysis Using Parsimony, version 3.1.1; Swofford, 1995). Four chemical data sets were subject to analysis: (1) glycolipids (Table 4-1), (2) neutral lipids (Table 4-2), (3) phospholipids (Table 4-3), and (4) combined data set (includes glycolipids, neutral lipids, and phospholipids). Heuristic searching methods, which are statistically robust (Swofford and Begle, 1993), were used to derive the most parsimonious phylogenetic tree. Two strategies, stepwise addition and branch swapping, were used to obtain the most parsimonious phylogenetic tree. Stepwise addition works by connecting taxa to a tree one at a time until all taxa are used (Swofford and Begle, 1993). Initially, three taxa are randomly chosen to form a tree, then an additional taxon which is not part of the original group is selected to be added to the tree. All of the possible trees are generated using the four taxa. The most parsimonious tree is selected from among the trees generated and this continues until

Table 4-1.--Phylogenetic data matrix (glycolipids) used to generate phylogeny of Felidae (Fig. 5). 0 denotes the absence of a chemical and 1 denotes the presence of a chemical. A = *Acinonyx jubatus* (cheetah); B= *Felis bengalensis* (leopard cat); C = *F. caracal* (caracal lynx); D = *F. concolor* (puma); E = *F. geoffroyi* (Geoffroy's cat); F = *F. manul* (Pallas' cat); G = *F. margarita* (sand cat); H = *F. pardalis* (ocelot); I = *F. rufus* (bobcat); J = *F. serval* (serval); K = *F. temminicki* (Temminick's Golden cat); L = *Panthera leo* (lion); M = *P. onca* (jaguar); N = *P. pardus* (leopard); O = *P. tigris* (tiger); P = *P. uncia* (snow leopard).

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10 carbon compound A	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
10 carbon compound B	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0
X-Oxo-Nonanoic acid	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
10 carbon compound C	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
10 carbon compound D	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0
11 carbon compound E	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
11 carbon compound F	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
11 carbon compound G	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
11 carbon compound H	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
11 carbon compound I	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0
11 carbon compound J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
11 carbon compound K	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
11 carbon compound L	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
11 carbon compound M	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
11 carbon compound N	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
11 carbon compound O	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
11 carbon compound P	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Dodecanoic acid	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
Nonadecanoic acid	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
12 carbon compound Q	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
12 carbon compound R	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
12 carbon compound S	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0
12 carbon compound T	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
12 carbon compound U	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
2,6-bis(1,1-dimethylethyl)-4-ethyl Phenol	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
12 carbon compound V	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
12 carbon compound W	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
12 carbon compound X	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
12 carbon compound Y	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
12 carbon compound Z	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
12 carbon compound AA	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
12 carbon compound AB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Tridecanoic acid	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
13 carbon compound AC	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
13 carbon compound AD	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
13 carbon compound AE	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
13 carbon compound AF	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
13 carbon compound AG	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
13 carbon compound AH	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
13 carbon compound AI	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
13 carbon compound AJ	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
13 carbon compound AK	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
13 carbon compound AL	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
13 carbon compound AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1

Table 4-1.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
13 carbon compound AN	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
13 carbon compound AO	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
13 carbon compound AP	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
13 carbon compound AQ	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
13 carbon compound AR	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Tetradecanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14 carbon compound AS	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
14 carbon compound AT	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
14 carbon compound AU	0	1	0	0	1	1	1	1	0	1	0	0	0	0	0	0
14 carbon compound AV	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
14 carbon compound AW	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
14 carbon compound AX	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
14 carbon compound AY	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0
14 carbon alcohol	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
14 carbon compound AZ	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
14 carbon compound BA	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
14 carbon compound BB	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
14 carbon compound BC	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
14 carbon compound BD	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
14 carbon compound BE	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
14 carbon compound BF	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
14 carbon compound BG	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
Pentadecanoic acid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
15 carbon compound BH	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
15 carbon compound BI	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0
X-Hydroxy-Tetradecanoic acid	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0
15 carbon compound BJ	0	1	0	0	1	1	1	1	0	1	0	0	0	0	0	0
15 carbon compound BK	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
15 carbon compound BL	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
15 carbon compound BM	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 carbon compound BN	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 carbon compound BO	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
15 carbon alcohol	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
15 carbon compound BP	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
15 carbon compound BQ	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
X-Hexadecenoic acid	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
15 carbon compound BR	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
X-Hexadecanoic acid	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
15 carbon compound BS	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
15 carbon compound BT	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
15 carbon compound BU	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Hexadecanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16 carbon compound BV	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
16 carbon compound BW	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
16 carbon compound BX	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
16 carbon compound BY	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
16 carbon compound BZ	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
16 carbon compound CA	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
16 carbon compound CB	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
16 carbon alcohol	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4-1.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
16 carbon compound CC	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
16 carbon compound CD	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
14-methyl Hexadecanoic acid	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
X-Hydroxy Hexadecanoic acid	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
16 carbon compound CE	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
16 carbon compound CF	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
16 carbon compound CG	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
16 carbon compound CH	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
Heptadecanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17 carbon compound CI	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 carbon compound CJ	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
17 carbon compound CK	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
17 carbon alcohol	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
17 carbon compound CL	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
17 carbon compound CM	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
17 carbon compound CN	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
17 carbon compound CO	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
17 carbon compound CP	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
X,X-Octadecadienoic acid	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
9,12-Octadecanoic acid	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
X-Octadecanoic acid	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
X-Octadecenoic acid	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
X-Octadecenoic acid	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
17 carbon compound CQ	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
X-Octadecanoic acid	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
17 carbon compound CR	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
17 carbon compound CS	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Octadecanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
18 carbon compound CT	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
18 carbon compound CU	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
18 carbon compound CV	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
18 carbon compound CW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
18 carbon compound CX	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18 carbon compound CY	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
18 carbon compound CZ	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
18 carbon compound DA	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
X-methyl Octadecanoic acid	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
18 carbon compound DB	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
18 carbon compound DC	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
18 carbon compound DD	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
18 carbon compound DE	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
18 carbon compound DF	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
19 carbon compound DG	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19 carbon compound DH	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
X,X,X,X-Eicosatetraenoic acid	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
2-Hydroxy-Octanoic acid	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
19 carbon compound DI	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
19 carbon compound DJ	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
19 carbon compound DK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
19 carbon compound DL	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0

Table 4-1.–(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
19 carbon compound DM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
19 carbon compound DN	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
X,X-Eicosadienoic acid	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
X-Eicosanoic acid	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
19 carbon compound DO	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
X-Eicosanoic acid	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
19 carbon compound DP	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
19 carbon compound DQ	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
19 carbon compound DR	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1
19 carbon compound DS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 carbon compound DT	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
19 carbon compound DU	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1
Eicosanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
20 carbon compound DV	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 carbon compound DW	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1
20 carbon compound DX	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
20 carbon compound DY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 carbon compound DZ	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
20 carbon compound EA	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
20 carbon compound EB	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 carbon compound EC	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0
20 carbon compound ED	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
20 carbon compound EE	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
20 carbon compound EF	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
20 carbon compound EG	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
20 carbon compound EH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 carbon compound EI	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
20 carbon compound EJ	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0
20 carbon compound EK	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
20 carbon compound EL	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
20 carbon compound EM	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
20 carbon compound EN	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
20 carbon compound EO	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
21 carbon compound EP	0	0	1	0	0	0	0	0	1	0	1	0	1	1	0	0
21 carbon compound EQ	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
21 carbon compound ER	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound ES	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
21 carbon compound ET	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
Docosanoic acid	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
21 carbon compound EU	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
21 carbon compound EV	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
21 carbon compound EW	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound EX	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
21 carbon compound EY	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
21 carbon compound EZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound FA	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
21 carbon compound FB	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
X-Docosenoic acid	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0
21 carbon compound FC	0	0	0	0	0	1	1	0	0	0	0	0	1	0	1	1
21 carbon compound FD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4-1.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
X-Docosenoic acid	0	1	0	0	1	1	1	1	0	1	0	0	0	1	0	0
21 carbon compound FE	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
21 carbon compound FF	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound FG	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1
21 carbon compound FH	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Docosanoic acid	1	0	1	0	0	0	0	0	1	0	1	0	1	1	1	0
22 carbon compound FI	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
22 carbon compound FJ	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
22 carbon compound FK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 carbon compound FL	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
22 carbon compound FM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
22 carbon compound FN	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	0
22 carbon compound FO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 carbon compound FP	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
22 carbon compound FQ	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
22 carbon compound FR	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
22 carbon compound FS	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1
22 carbon compound FT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 carbon compound FU	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
22 carbon compound FV	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
22 carbon compound FW	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
22 carbon compound FX	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1
22 carbon compound FY	0	1	0	0	1	1	1	1	0	1	0	0	1	0	1	1
22 carbon compound FZ	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
22 carbon compound GA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 carbon compound GB	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
22 carbon compound GC	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	1
23 carbon compound GD	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
23 carbon compound GE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23 carbon compound GF	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
23 carbon compound GG	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
X-Eicosene	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
23 carbon compound GH	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
23 carbon compound GI	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
23 carbon compound GJ	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
23 carbon compound GK	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
23 carbon compound GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23 carbon compound GM	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
23 carbon compound GN	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
23 carbon compound GO	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
X-Tetracosenoic acid	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
X-Tetracosenoic acid	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
23 carbon compound GP	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
23 carbon compound GQ	0	1	0	0	1	0	0	1	0	1	0	0	1	1	1	1
23 carbon compound GR	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0
Tetracosanoic acid	1	1	1	1	1	0	1	1	1	1	1	1	0	0	0	0
24 carbon compound GS	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
24 carbon compound GT	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
24 carbon compound GU	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24 carbon compound GV	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0

Table 4-1.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
24 carbon compound GW	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
24 carbon compound GX	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
24 carbon compound GY	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
24 carbon compound GZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24 carbon compound HA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24 carbon compound HB	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
24 carbon compound HC	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
24 carbon compound HD	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
24 carbon compound HE	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
24 carbon compound HF	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
24 carbon compound HG	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
24 carbon compound HH	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0
24 carbon compound HI	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
24 carbon compound HJ	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25 carbon compound HK	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
25 carbon compound HL	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0
25 carbon compound HM	0	1	0	0	1	1	1	1	0	1	0	0	1	1	0	0
25 carbon compound HN	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
25 carbon compound HO	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
25 carbon compound HP	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
25 carbon compound HQ	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
25 carbon compound HR	0	0	1	0	0	0	0	0	1	0	0	0	1	0	1	1
25 carbon compound HS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25 carbon compound HT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X-Hexacosanoic acid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25 carbon compound HU	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0
25 carbon compound HV	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
X-Tetracosenoic acid	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
25 carbon compound HW	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
25 carbon compound HX	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
25 carbon compound HY	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
25 carbon compound HZ	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
25 carbon compound IA	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	1
25 carbon compound IB	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
25 carbon compound IC	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
26 carbon compound ID	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
26 carbon compound IE	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
26 carbon compound IF	0	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0
26 carbon compound IG	0	1	0	0	1	0	0	1	0	1	0	0	0	1	0	0
26 carbon compound IH	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 carbon compound II	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
26 carbon compound IJ	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
26 carbon compound IK	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1
26 carbon compound IL	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0
26 carbon compound IM	0	0	0	0	1	1	1	1	0	0	0	0	0	1	0	0
26 carbon compound IN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 carbon compound IO	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
26 carbon compound IP	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
26 carbon compound IQ	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
26 carbon compound IR	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0

Table 4-1.–(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
26 carbon compound IS	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
26 carbon compound IT	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
26 carbon compound IU	0	0	1	0	0	0	0	0	1	0	1	0	0	1	0	0
26 carbon compound IV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 carbon compound IW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 carbon compound IX	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
26 carbon compound IY	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
26 carbon compound IZ	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	1
26 carbon compound JA	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0
26 carbon compound JB	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
27 carbon compound JC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27 carbon compound JD	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
27 carbon sterol	0	1	0	0	1	1	1	1	0	1	0	0	1	1	1	1
Cholesterol	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27 carbon sterol	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
27 carbon sterol	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
27 carbon compound JE	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1
27 carbon compound JF	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0
27 carbon compound JG	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27 carbon compound JH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27 carbon compound JI	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
27 carbon compound JJ	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
27 carbon compound JK	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
27 carbon compound JL	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
27 carbon compound JM	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0
27 carbon compound JN	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
27 carbon compound JO	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
27 carbon compound JP	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
27 carbon compound JQ	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
27 carbon compound JR	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
27 carbon compound JS	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
27 carbon compound JT	0	0	0	0	1	1	1	1	0	0	0	0	1	1	0	0
27 carbon compound JU	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27 carbon compound JV	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0
27 carbon compound JW	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
27 carbon compound JX	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
28 carbon compound JY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28 carbon compound JZ	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
28 carbon compound KA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28 carbon compound KB	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
28 carbon compound KC	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Cholest-4-ene-3-one	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28 carbon compound KD	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
28 carbon compound KE	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
28 carbon compound KF	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	1
28 carbon compound KG	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
28 carbon compound KH	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
28 carbon compound KI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28 carbon compound KJ	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
28 carbon compound KK	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

Table 4-1.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
28 carbon compound KL	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
28 carbon compound KM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
28 carbon compound KN	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
28 carbon compound KO	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
28 carbon compound KP	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
28 carbon compound KQ	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1
28 carbon compound KR	0	0	0	0	0	1	1	0	0	0	0	0	1	1	1	1
28 carbon compound KS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28 carbon compound KT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28 carbon compound KU	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
28 carbon compound KV	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
28 carbon compound KW	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0
28 carbon compound KX	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
28 carbon compound KY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29 carbon compound KZ	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
29 carbon compound LA	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
29 carbon compound LB	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
29 carbon compound LC	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29 carbon compound LD	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
29 carbon compound LE	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
29 carbon compound LF	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1
29 carbon compound LG	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
29 carbon compound LH	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
29 carbon compound LI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29 carbon compound LJ	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
29 carbon compound LK	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
29 carbon compound LL	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
29 carbon compound LM	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
29 carbon compound LN	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0
29 carbon compound LO	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	1
29 carbon compound LP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29 carbon compound LQ	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
29 carbon compound LR	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0
29 carbon compound LS	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
29 carbon compound LT	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1
29 carbon compound LU	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
29 carbon compound LV	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
29 carbon compound LW	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
30 carbon compound LX	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
30 carbon compound LY	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
30 carbon compound LZ	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
30 carbon compound MA	0	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0
30 carbon compound MB	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
30 carbon compound MC	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
30 carbon compound MD	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
30 carbon compound ME	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
30 carbon compound MF	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
30 carbon compound MG	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
30 carbon compound MH	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30 carbon compound MI	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Table 4-1.–(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
30 carbon compound MJ	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
30 carbon compound MK	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1
30 carbon compound ML	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
30 carbon compound MM	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
30 carbon compound MN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30 carbon compound MO	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1
31 carbon compound MP	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
31 carbon compound MQ	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
31 carbon compound MR	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
31 carbon compound MS	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
31 carbon compound MT	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0
31 carbon compound MU	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
31 carbon compound MV	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4-2.--Phylogenetic data matrix (neutral lipids) used to generate phylogeny of Felidae (Fig. 6). 0 denotes the absence of a chemical and 1 denotes the presence of a chemical. A = *Acinonyx jubatus* (cheetah); B = *Felis bengalensis* (leopard cat); C = *F. caracal* (caracal lynx); D = *F. concolor* (puma); E = *F. geoffroyi* (Geoffroy's cat); F = *F. manul* (Pallas' cat); G = *F. margarita* (sand cat); H = *F. pardalis* (ocelot); I = *F. rufus* (bobcat); J = *F. serval* (serval); K = *F. temminicki* (Temminick's Golden cat); L = *Panthera leo* (lion); M = *P. onca* (jaguar); N = *P. pardus* (leopard); O = *P. tigris* (tiger); P = *P. uncia* (snow leopard).

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10 carbon compound A	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
10 carbon compound B	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
10 carbon compound C	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
10 carbon compound D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
10 carbon compound E	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
10 carbon compound F	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
10 carbon compound G	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
11 carbon compound H	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
11 carbon compound I	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0
11 carbon compound J	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1
11 carbon compound K	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
11 carbon compound L	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
11 carbon compound M	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
11 carbon compound N	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
11 carbon compound O	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
11 carbon compound P	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
11 carbon compound Q	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
11 carbon compound R	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
11 carbon compound S	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
11 carbon compound T	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
11 carbon compound U	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
11 carbon compound V	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1
11 carbon compound W	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0
11 carbon compound X	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
11 carbon compound Y	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1
12 carbon compound Z	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12 carbon compound AA	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
12 carbon compound AB	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1
12 carbon compound AC	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
12 carbon compound AD	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
12 carbon compound AE	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0
12 carbon compound AF	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
12 carbon compound AG	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
12 carbon compound AH	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
12 carbon compound AI	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
12 carbon compound AJ	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
12 carbon compound AK	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
12 carbon compound AL	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
12 carbon compound AM	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12 carbon compound AN	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
12 carbon compound AO	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
12 carbon compound AP	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
12 carbon compound AQ	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1

Table 4-2.–(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
12 carbon compound AR	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
12 carbon compound AS	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
12 carbon compound AT	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
12 carbon compound AU	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
12 carbon compound AV	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
12 carbon compound AW	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
13 carbon compound AX	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
13 carbon compound AY	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
13 carbon compound AZ	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13 carbon compound BA	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
13 carbon compound BB	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 carbon compound BC	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
13 carbon compound BD	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
X-branched Tridecanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
X,X-diphenyl-cyclobutane	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
13 carbon compound BE	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
13 carbon compound BF	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
13 carbon compound BG	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 carbon compound BH	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
13 carbon compound BI	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
13 carbon compound BJ	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
13 carbon compound BK	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
13 carbon compound BL	0	0	1	0	1	0	0	1	1	0	1	0	0	0	0	0
13 carbon compound BM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
13 carbon compound BN	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
13 carbon compound BO	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1
1,1'-(1,2-cyclobutanediyl) bis-cis-Benzene	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13 carbon compound BP	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
13 carbon compound BQ	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
Tetradecanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14 carbon compound BR	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
14 carbon compound BS	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
14 carbon compound BT	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
14 carbon compound BU	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
14 carbon compound BV	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
Methyl 9-methyltetradecanoate	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
14 carbon compound BW	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
14 carbon compound BX	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14 carbon compound BY	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
X-hydroxy Tetradecanoic acid	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
14 carbon compound BZ	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
14 carbon compound CA	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
14 carbon compound CB	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
14 carbon compound CC	1	0	0	1	0	1	1	0	0	0	0	1	1	1	1	1
14 carbon compound CD	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
14 carbon compound CE	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
14 carbon compound CF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14 carbon compound CG	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
14 carbon compound CH	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Table 4-2.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
14 carbon compound CI	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
14 carbon compound CJ	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
14 carbon compound CK	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
14 carbon compound CL	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
15 carbon compound CM	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
15 carbon compound CN	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0
15 carbon compound CO	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 carbon compound CP	0	1	1	0	1	0	0	0	1	1	1	0	0	0	0	0
15 carbon compound CQ	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
15 carbon compound CR	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
15 carbon compound CS	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
15 carbon compound CT	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
15 carbon compound CU	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
15 carbon compound CV	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
15 carbon compound CW	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
15 carbon compound CX	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0
15 carbon compound CY	1	0	0	1	0	1	1	0	0	0	0	0	0	0	1	1
15 carbon compound CZ	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
15 carbon compound DA	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0
15 carbon compound DB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Nonadecanoic acid	1	0	0	1	0	1	1	0	0	0	0	0	0	0	1	1
15 carbon compound DC	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
15 carbon compound DD	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
15 carbon compound DE	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
15 carbon compound DF	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
15 carbon compound DG	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
15 carbon compound DH	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
15 carbon compound DI	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
15 carbon compound DJ	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Hexadecanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16 carbon compound DK	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0
16 carbon compound DL	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
16 carbon compound DM	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16 carbon compound DN	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
16 carbon compound DO	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
16 carbon compound DP	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
16 carbon compound DQ	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
16 carbon compound DR	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
16 carbon compound DS	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
16 carbon compound DT	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1
16 carbon compound DU	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
16 carbon compound DV	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
16 carbon compound DW	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0
16 carbon compound DX	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
16 carbon compound DY	0	1	1	0	1	0	1	1	1	1	1	0	0	0	0	0
16 carbon compound DZ	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 carbon compound EA	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16 carbon compound EB	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
16 carbon compound EC	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
16 carbon compound ED	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0

Table 4-2.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
16 carbon compound EE	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
16 carbon compound EF	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
16 carbon compound EG	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
16 carbon compound EH	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
17 carbon compound EI	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0
17 carbon compound EJ	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	1
17 carbon compound EK	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
17 carbon compound EL	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
2-Hydroxy-Hexadecanoic acid	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
X-Octadecanoic acid	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
17 carbon compound EM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
17 carbon compound EN	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
17 carbon compound EO	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
17 carbon compound EP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
17 carbon compound EQ	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
17 carbon compound ER	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 carbon compound ES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
X-Octadecanoic acid	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0
17 carbon compound ET	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
9,12-Octadecanoic acid	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0
17 carbon compound EU	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
X-Octadecanoic acid	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0
X-Octadecanoic acid	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
17 carbon compound EV	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
17 carbon compound EW	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
17 carbon compound EX	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
17 carbon compound EY	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
17 carbon compound EZ	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
17 carbon compound FA	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
17 carbon compound FB	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Octadecanoic acid	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
18 carbon compound FC	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
18 carbon compound FD	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
18 carbon compound FE	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
18 carbon compound FF	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
18 carbon compound FG	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
18 carbon compound FH	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
18 carbon compound FI	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
18 carbon compound FJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
18 carbon compound FK	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
18 carbon compound FL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
18 carbon compound FM	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
18 carbon compound FN	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
18 carbon compound FO	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
18 carbon compound FP	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
18 carbon compound FQ	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
18 carbon compound FR	0	1	1	0	1	0	0	1	1	1	1	0	0	0	0	0
18 carbon compound FS	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
18 carbon compound FT	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
18 carbon compound FU	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0

Table 4-2.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
18 carbon compound FV	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
18 carbon compound FW	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
18 carbon compound FX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
18 carbon compound FY	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
18 carbon compound FZ	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
18 carbon compound GA	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
18 carbon compound GB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
19 carbon compound GC	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
19 carbon compound GD	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 carbon compound GE	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
19 carbon alcohol	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19 carbon compound GF	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
19 carbon compound GG	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
19 carbon compound GH	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
19 carbon compound GI	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
19 carbon compound GJ	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
19 carbon compound GK	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
19 carbon compound GL	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
19 carbon compound GM	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
19 carbon compound GN	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
19 carbon compound GO	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
19 carbon compound GP	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
19 carbon compound GQ	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
19 carbon compound GR	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
19 carbon compound GS	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
19 carbon compound GT	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
19 carbon compound GU	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
19 carbon compound GV	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
19 carbon compound GW	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
19 carbon compound GX	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
19 carbon compound GY	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
Eicosanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20 carbon compound GZ	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
20 carbon compound HA	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
20 carbon compound HB	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
20 carbon compound HC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20 carbon compound HD	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
20 carbon compound HE	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
20 carbon compound HF	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
20 carbon compound HG	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
20 carbon compound HH	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
20 carbon compound HI	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
20 carbon compound HJ	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
20 carbon compound HK	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
20 carbon compound HL	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
20 carbon compound HM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
20 carbon compound HN	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
20 carbon compound HO	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
20 carbon compound HP	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
20 carbon compound HQ	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0

Table 4-2.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
20 carbon compound HR	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
20 carbon compound HS	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
20 carbon compound HT	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
21 carbon compound HU	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
21 carbon compound HV	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
21 carbon compound HW	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
21 carbon compound HX	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
21 carbon compound HY	0	1	0	0	1	1	1	1	0	1	0	0	0	0	0	0
X-Tetracosenoic acid	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
21 carbon compound HZ	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
21 carbon compound IA	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
21 carbon compound IB	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound IC	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound ID	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
21 carbon compound IE	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound IF	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
21 carbon compound IG	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
21 carbon compound IH	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
21 carbon compound II	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
21 carbon compound IJ	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound IK	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
21 carbon compound IL	1	0	0	1	1	1	1	1	0	0	0	1	1	1	1	1
21 carbon compound IM	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound IN		1	0	0	1	1	1	1	0	1	0	0	0	0	0	0
21 carbon compound IO	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
21 carbon compound IP	1	0	0	1	1	1	1	1	0	0	0	1	1	1	1	1
21 carbon compound IQ	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
21 carbon compound IR	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0
Docosanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
22 carbon compound IS	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
22 carbon compound IT	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
22 carbon compound IU	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
22 carbon compound IV	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
22 carbon compound IW	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
22 carbon compound IX	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
22 carbon compound IY	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
22 carbon compound IZ	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
22 carbon compound JA	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
22 carbon compound JB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
22 carbon compound JC	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 carbon compound JD	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
22 carbon compound JE	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
22 carbon compound JF	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
22 carbon compound JG	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
22 carbon compound JH	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
22 carbon compound JI	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
22 carbon compound JJ	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
22 carbon compound JK	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
22 carbon compound JL	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
22 carbon compound JM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1

Table 4-2.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
22 carbon compound JN	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
22 carbon compound JO	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
23 carbon compound JP	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
23 carbon compound JQ	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
23 carbon compound JR	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
23 carbon compound JS	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	1
23 carbon compound JT	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
23 carbon compound JU	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
23 carbon compound JV	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
23 carbon compound JW	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
23 carbon compound JX	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
23 carbon compound JY	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
23 carbon compound JZ	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
23 carbon compound KA	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
23 carbon compound KB	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
23 carbon compound KC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
23 carbon compound KD	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
23 carbon compound KE	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
23 carbon compound KF	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
23 carbon compound KG	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
23 carbon compound KH	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
23 carbon compound KI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
23 carbon compound KJ	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
23 carbon compound KK	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
3,7,11-trimethyl-(E,E)-2,6,10-Dodecatrien-1-ol	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24 carbon compound KL	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
24 carbon compound KM	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
24 carbon compound KN	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
24 carbon compound KO	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
24 carbon compound KP	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
24 carbon compound KQ	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
24 carbon compound KR	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
24 carbon compound KS	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
24 carbon compound KT	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
24 carbon compound KU	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
24 carbon compound KV	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
24 carbon compound KW	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0
24 carbon compound KX	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
24 carbon compound KY	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
24 carbon compound KZ	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
24 carbon compound LA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24 carbon compound LB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24 carbon compound LC	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
24 carbon compound LD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
24 carbon compound LE	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
24 carbon compound LF	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
24 carbon compound LG	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
24 carbon compound LH	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
24 carbon compound LI	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1

Table 4-2.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
25 carbon compound LJ	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
25 carbon compound LK	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
25 carbon compound LL	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
25 carbon compound LM	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
25 carbon compound LN	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25 carbon compound LO	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
25 carbon compound LP	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
25 carbon compound LQ	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
25 carbon compound LR	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
25 carbon compound LS	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
25 carbon compound LT	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
25 carbon compound LU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
25 carbon compound LV	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
25 carbon compound LW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25 carbon compound LX	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
25 carbon compound LY	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
25 carbon compound LZ	0	1	1	0	1	0	0	1	1	1	1	0	0	0	0	0
25 carbon compound MA	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
25 carbon compound MB	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
25 carbon compound MC	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
25 carbon compound MD	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
25 carbon compound ME	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
25 carbon compound MF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
25 carbon compound MG	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
25 carbon compound MH	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
25 carbon compound MI	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
26 carbon compound MJ	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
26 carbon compound MK	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
26 carbon compound ML	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
26 carbon compound MM	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
26 carbon compound MN	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
26 carbon compound MO	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
26 carbon compound MP	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
26 carbon compound MQ	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
26 carbon compound MR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
26 carbon compound MS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 carbon compound MT	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
26 carbon compound MU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
26 carbon compound MV	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
26 carbon compound MW	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
26 carbon compound MX	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
26 carbon compound MY	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
26 carbon compound MZ	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
26 carbon compound NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
26 carbon compound NB	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
26 carbon compound NC	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 carbon compound ND	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
26 carbon compound NE	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Cholesterol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
27 carbon compound NF	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0

Table 4-2.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
27 carbon compound NG	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
27 carbon compound NH	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
27 carbon sterol	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
27 carbon compound NI	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
27 carbon compound NJ	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
27 carbon compound NK	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
27 carbon compound NL	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
27 carbon compound NM	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
27 carbon compound NN	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
27 carbon compound NO	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
27 carbon compound NP	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0
27 carbon compound NQ	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
27 carbon compound NR	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
27 carbon compound NS	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
27 carbon compound NT	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
27 carbon compound NU	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0
27 carbon compound NV	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
27 carbon compound NW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
27 carbon compound NX	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
27 carbon compound NY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
28 carbon compound NZ	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
28 carbon compound OA	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
28 carbon compound OB	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
28 carbon compound OC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
28 carbon compound OD	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
28 carbon compound OE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
28 carbon compound OF	0	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0
28 carbon compound OG	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
28 carbon compound OH	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
28 carbon compound OI	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
28 carbon compound OJ	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
28 carbon compound OK	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
28 carbon compound OL	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
28 carbon compound OM	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
28 carbon compound ON	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
28 carbon compound OO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
28 carbon compound OP	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
28 carbon compound OQ	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
28 carbon compound OR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
28 carbon compound OS	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
28 carbon compound OT	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
28 carbon compound OU	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
28 carbon compound OV	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
28 carbon compound OW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
28 carbon compound OX	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
29 carbon compound OY	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
29 carbon compound OZ	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
29 carbon compound PA	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
29 carbon compound PB	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
29 carbon compound PC	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0

Table 4-2.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
29 carbon compound PD	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
29 carbon compound PE	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
29 carbon compound PF	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
29 carbon compound PG	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
29 carbon compound PH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29 carbon compound PI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
29 carbon compound PJ	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
29 carbon compound PK	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
29 carbon compound PL	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
29 carbon compound PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
29 carbon compound PN	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
29 carbon compound PO	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
29 carbon compound PP	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
29 carbon compound PQ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
29 carbon compound PR	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
29 carbon compound PS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
29 carbon compound PT	0	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0
30 carbon compound PU	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
30 carbon compound PV	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30 carbon compound PW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
30 carbon compound PX	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
30 carbon compound PY	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
30 carbon compound PZ	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
30 carbon compound QA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
30 carbon compound QB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
30 carbon compound QC	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
30 carbon compound QD	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
30 carbon compound QE	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
30 carbon compound QF	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
30 carbon compound QG	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
30 carbon compound QH	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
30 carbon compound QI	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
31 carbon compound QJ	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
31 carbon compound QK	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
31 carbon compound QL	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
31 carbon compound QM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

Table 4-3.--Phylogenetic data matrix (phospholipids) used to generate phylogeny of Felidae (Fig. 7). 0 denotes the absence of a chemical and 1 denotes the presence of a chemical. A = *Acinonyx jubatus* (cheetah); B = *Felis bengalensis* (leopard cat); C = *F. caracal* (caracal lynx); D = *F. concolor* (puma); E = *F. geoffroyi* (Geoffroy's cat); F = *F. manul* (Pallas' cat); G = *F. margarita* (sand cat); H = *F. pardalis* (ocelot); I = *F. serval* (serval); J = *F. temminicki* (Temminick's Golden cat); K = *Panthera leo* (lion); L = *P. onca* (jaguar); M = *P. pardus* (leopard); N = *P. tigris* (tiger); O = *P. uncia* (snow leopard).

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
11 carbon compound A	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
11 carbon compound B	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
11 carbon compound C	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
11 carbon compound D	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
11 carbon compound E	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
11 carbon compound F	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
11 carbon compound G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
11 carbon compound H	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
11 carbon compound I	0	0	0	1	0	0	0	0	0	0	1	1	1	1	1
11 carbon compound J	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
11 carbon compound K	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
11 carbon compound L	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
11 carbon compound M	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
12 carbon compound N	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
12 carbon compound O	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
12 carbon compound P	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
12 carbon compound Q	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
12 carbon compound R	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 carbon compound S	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
12 carbon compound T	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
12 carbon compound U	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
12 carbon compound V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 carbon compound W	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0
12 carbon compound X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
12 carbon compound Y	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
12 carbon compound Z	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
12 carbon compound AA	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
12 carbon compound AB	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
12 carbon compound AC	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
12 carbon compound AD	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
12 carbon compound AE	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
12 carbon compound AF	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
13 carbon compound AG	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0
13 carbon compound AH	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
13 carbon compound AI	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
13 carbon compound AJ	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
13 carbon compound AK	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
13 carbon compound AL	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
13 carbon compound AM	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
13 carbon compound AN	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
13 carbon compound AO	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

Table 4-3.–(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
X-methyl pentadecanoic acid	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
13 carbon compound AP	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
13 carbon compound AQ	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
13 carbon compound AR	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
13 carbon compound AS	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
13 carbon compound AT	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
13 carbon compound AU	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
13 carbon compound AV	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 carbon compound AW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
13 carbon compound AX	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
13 carbon compound AY	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Tetradecanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14 carbon compound AZ	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
14 carbon compound BA	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
14 carbon compound BB	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
14 carbon compound BC	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
14 carbon compound BD	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
14 carbon compound BE	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
14 carbon compound BF	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
14 carbon compound BG	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
14 carbon compound BH	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
14 carbon compound BI	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
14 carbon compound BJ	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
14 carbon compound BK	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
14 carbon compound BL	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
14 carbon compound BM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
14 carbon compound BN	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
14 carbon compound BO	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
14 carbon compound BP	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
14 carbon compound BQ	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
14 carbon compound BR	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
14 carbon compound BS	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
14 carbon compound BT	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Pentadecanoic acid	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0
15 carbon compound BU	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
15 carbon compound BV	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0
15 carbon alcohol	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
15 carbon compound BW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 carbon compound BX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
15 carbon compound BY	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
15 carbon compound BZ	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0
15 carbon compound CA	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
15 carbon compound CB	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
15 carbon compound CC	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
15 carbon compound CD	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
15 carbon compound CE	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0
15 carbon compound CF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
15 carbon compound CG	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

Table 4-3.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
15 carbon compound CH	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
(Z)-7-Hexadecenoic acid	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
15 carbon compound CI	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
15 carbon compound CJ	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
15 carbon compound CK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
15 carbon compound CL	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
15 carbon compound CM	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
15 carbon compound CN	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
15 carbon compound CO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
15 carbon compound CP	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0
X-methyl pentadcanoic acid	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Hexadecanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16 carbon compound CQ	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
16 carbon compound CR	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
16 carbon compound CS	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
16 carbon compound CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
16 carbon compound CU	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
16 carbon compound CV	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
16 carbon compound CW	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
16 carbon compound CX	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
16 carbon compound CY	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
16 carbon compound CZ	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
16 carbon compound DA	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
16 carbon compound DB	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
16 carbon compound DC	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
16 carbon compound DD	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
16 carbon compound DE	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
16 carbon compound DF	0	1	0	0	1	1	1	1	1	1	0	0	0	0	0
16 carbon compound DG	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
16 carbon compound DH	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
16 carbon compound DI	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
16 carbon compound DJ	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
16 carbon compound DK	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
16 carbon compound DL	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
17 carbon compound DM	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0
17 carbon compound DN	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
17 carbon compound DO	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
17 carbon compound DP	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
17 carbon compound DQ	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
17 carbon compound DR	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
17 carbon compound DS	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
17 carbon compound DT	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
17 carbon compound DU	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
17 carbon compound DV	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
17 carbon compound DW	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1
17 carbon compound DX	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 carbon compound DY	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
17 carbon compound DZ	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0

Table 4-3.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
(Z,Z)-9,12-Octadecadienoic acid	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
17 carbon compound EA	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
17 carbon compound EB	0	1	1	0	1	0	0	1	1	1	0	0	0	0	0
X-Octadecanoic acid	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
17 carbon compound EC	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
17 carbon compound ED	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
17 carbon compound EE	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
17 carbon compound EF	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
17 carbon compound EG	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
17 carbon compound EH	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
Octadecanoic acid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
18 carbon compound EI	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
18 carbon compound EJ	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
18 carbon compound EK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
18 carbon compound EL	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
18 carbon compound EM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
18 carbon compound EN	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
18 carbon compound EO	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
18 carbon compound EP	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
18 carbon compound EQ	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
18 carbon compound ER	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
18 carbon compound ES	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
18 carbon compound ET	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
18 carbon compound EU	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0
18 carbon compound EV	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
18 carbon compound EW	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
18 carbon compound EX	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
18 carbon compound EY	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
18 carbon compound EZ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
18 carbon compound FA	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0
18 carbon compound FB	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
19 carbon compound FC	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
19 carbon compound FD	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0
19 carbon compound FE	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
19 carbon compound FF	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
19 carbon compound FG	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
19 carbon compound FH	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
19 carbon compound FI	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
19 carbon compound FJ	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
19 carbon compound FK	1	0	0	1	0	0	0	0	0	0	1	1	1	1	1
19 carbon compound FL	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
19 carbon compound FM	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
19 carbon compound FN	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
19 carbon compound FO	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
19 carbon compound FP	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0
19 carbon compound FQ	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
19 carbon compound FR	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0

Table 4-3.–(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
19 carbon compound FS	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
19 carbon compound FT	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
19 carbon compound FU	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
19 carbon compound FV	0	1	0	0	1	1	1	1	1	1	0	0	0	0	0
19 carbon compound FW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
19 carbon compound FX	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
19 carbon compound FY	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
19 carbon compound FZ	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
19 carbon compound GA	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
19 carbon compound GB	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
20 carbon compound GC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20 carbon compound GD	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
20 carbon compound GE	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
20 carbon compound GF	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
20 carbon compound GG	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 carbon compound GH	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
20 carbon compound GI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
20 carbon compound GJ	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
20 carbon compound GK	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
20 carbon compound GL	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
20 carbon compound GM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
20 carbon compound GN	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
20 carbon compound GO	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
20 carbon compound GP	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
20 carbon compound GQ	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0
20 carbon compound GR	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
20 carbon compound GS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 carbon compound GT	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
20 carbon compound GU	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
20 carbon compound GV	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
20 carbon compound GW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
20 carbon compound GX	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 carbon compound GY	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
21 carbon compound GZ	0	1	1	0	1	0	0	1	1	1	0	0	0	0	0
21 carbon compound HA	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
21 carbon compound HB	1	0	0	0	0	0	0	0	0	0	0	1	0	1	1
21 carbon compound HC	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
21 carbon compound HD	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
21 carbon compound HE	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound HF	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
21 carbon compound HG	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
21 carbon compound HH	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
21 carbon compound HI	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
21 carbon compound HJ	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
21 carbon compound HK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
21 carbon compound HL	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
21 carbon compound HM	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
21 carbon compound HN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 4-3.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
21 carbon compound HO	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
21 carbon compound HP	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
21 carbon compound HQ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound HR	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
21 carbon compound HS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
21 carbon compound HT	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound HU	0	1	0	0	1	1	1	1	1	1	0	0	0	0	0
21 carbon compound HV	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 carbon compound HW	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0
22 carbon compound HX	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
22 carbon compound HY	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
22 carbon compound HZ	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
22 carbon compound IA	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
22 carbon compound IB	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
22 carbon compound IC	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
22 carbon compound ID	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
22 carbon compound IE	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
22 carbon compound IF	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
22 carbon compound IG	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
22 carbon compound IH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
22 carbon compound II	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
22 carbon compound IJ	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
22 carbon compound IK	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
22 carbon compound IL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
22 carbon compound IM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
22 carbon compound IN	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
23 carbon compound IO	0	1	0	0	1	1	1	1	1	1	0	0	0	0	0
23 carbon compound IP	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
23 carbon compound IQ	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
23 carbon compound IR	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0
23 carbon compound IS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
23 carbon compound IT	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
23 carbon compound IU	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
23 carbon compound IV	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
23 carbon compound IW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
23 carbon compound IX	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
23 carbon compound IY	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
23 carbon compound IZ	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1
23 carbon compound JA	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
23 carbon compound JB	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
23 carbon compound JC	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
23 carbon compound JD	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
23 carbon compound JE	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
23 carbon compound JF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
23 carbon compound JG	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
23 carbon compound JH	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
24 carbon compound JI	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24 carbon compound JJ	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0

Table 4-3.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
24 carbon compound JK	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
24 carbon compound JL	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
24 carbon compound JM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
24 carbon compound JN	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
24 carbon compound JO	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
24 carbon compound JP	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
24 carbon compound JQ	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
24 carbon compound JR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
24 carbon compound JS	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0
24 carbon compound JT	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
24 carbon compound JU	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
24 carbon compound JV	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
24 carbon compound JW	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
24 carbon compound JX	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
24 carbon compound JY	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
24 carbon compound JZ	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
25 carbon compound KA	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
25 carbon compound KB	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
25 carbon compound KC	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0
25 carbon compound KD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
25 carbon compound KE	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
25 carbon compound KF	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25 carbon compound KG	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
25 carbon compound KH	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
25 carbon compound KI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
25 carbon compound KJ	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
25 carbon compound KK	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
25 carbon compound KL	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
25 carbon compound KM	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
25 carbon compound KN	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
25 carbon compound KO	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
25 carbon compound KP	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
25 carbon compound KQ	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
25 carbon compound KR	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
25 carbon compound KS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25 carbon compound KT	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
25 carbon compound KU	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0
25 carbon compound KV	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
26 carbon compound KW	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
26 carbon compound KX	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 carbon compound KY	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
26 carbon compound KZ	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
26 carbon compound LA	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
26 carbon compound LB	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
26 carbon compound LC	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
26 carbon compound LD	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
26 carbon compound LE	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
26 carbon compound LF	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0

Table 4-3.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
26 carbon compound LG	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
26 carbon compound LH	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
26 carbon compound LI	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
26 carbon compound LJ	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
26 carbon compound LK	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
26 carbon compound LL	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
26 carbon sterol	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
26 carbon compound LM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
26 carbon compound LN	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
26 carbon compound LO	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
26 carbon compound LP	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1
Cholesterol	1	0	0	1	0	0	0	0	0	0	1	1	1	1	1
27 carbon compound LQ	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0
27 carbon compound LR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
27 carbon compound LS	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
27 carbon compound LT	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
27 carbon compound LU	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
27 carbon compound LV	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
27 carbon compound LW	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
27 carbon compound LX	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
27 carbon compound LY	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
27 carbon compound LZ	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
27 carbon compound MA	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
27 carbon compound MB	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
27 carbon compound MC	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
27 carbon compound MD	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
27 carbon compound ME	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1
27 carbon compound MF	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
27 carbon compound MG	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
27 carbon compound MH	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1
27 carbon compound MI	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0
27 carbon compound MJ	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
27 carbon compound MK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
27 carbon compound ML	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
28 carbon compound MM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
28 carbon compound MN	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
28 carbon compound MO	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
28 carbon compound MP	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
28 carbon compound MQ	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
28 carbon compound MR	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
28 carbon compound MS	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
28 carbon compound MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
28 carbon compound MU	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
28 carbon compound MV	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0
28 carbon compound MW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28 carbon compound MX	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
28 carbon compound MY	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1
28 carbon compound MZ	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0

Table 4-3.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
28 carbon compound NA	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
28 carbon compound NB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
28 carbon compound NC	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
28 carbon compound ND	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
28 carbon compound NE	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
28 carbon compound NF	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0
28 carbon compound NG	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
28 carbon compound NH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
28 carbon compound NI	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
28 carbon compound NJ	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
29 carbon compound NK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29 carbon compound NL	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
29 carbon compound NM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
29 carbon compound NN	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
29 carbon compound NO	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
29 carbon compound NP	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
29 carbon compound NQ	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
29 carbon compound NR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
29 carbon compound NS	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
29 carbon compound NT	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
29 carbon compound NU	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
29 carbon compound NV	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
29 carbon compound NW	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
29 carbon compound NX	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
29 carbon compound NY	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
29 carbon compound NZ	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
29 carbon compound OA	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
29 carbon compound OB	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
29 carbon compound OC	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
29 carbon compound OD	1	0	0	0	0	0	0	0	0	0	0	1	0	1	1
30 carbon compound OE	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
30 carbon compound OF	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
30 carbon compound OG	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
30 carbon compound OH	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
30 carbon compound OI	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
30 carbon compound OJ	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
30 carbon compound OK	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
30 carbon compound OL	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
30 carbon compound OM	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
30 carbon compound ON	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
30 carbon compound OO	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
30 carbon compound OP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
30 carbon compound OQ	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
30 carbon compound OR	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
30 carbon compound OS	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
30 carbon compound OT	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
30 carbon compound OU	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
30 carbon compound OV	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0

Table 4-3.--(continued)

Compounds	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
30 carbon compound OW	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
31 carbon compound OX	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
31 carbon compound OY	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
31 carbon compound OZ	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
31 carbon compound PA	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
31 carbon compound PB	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
31 carbon compound PC	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
31 carbon compound PD	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0

all of the taxa are placed on the tree. The branch swapping strategy is useful to improve an initial estimate of the stepwise addition procedure (Swofford and Begle, 1993). As the name implies, this method iteratively swaps branches of the tree until a more optimal tree is derived.

The tree length, consistency index (CI), homoplasy index (HI), retention index (r), rescaled consistency index, and a patristic distance matrix was obtained for each tree generated. The tree length represents the sum of the number of times each character changes throughout the entire tree and is dependent upon the number of characters. The CI ranges from 0 to 1 and is calculated by taking the ratio of the minimum amount of changes that the tree might show divided by the amount of change it actually shows (Kluge and Farris, 1969). It is a convenient statistic to compare phylogenetic trees derived from the same data set. However, it cannot be used to compare phylogenetic trees that are based on different data sets (Wiley et al., 1991). The HI is equal to 1 - CI and measures the amount of homoplastic characters that are present in the data set which are due to convergent or parallel evolution. The r is calculated as the maximum amount of changes a tree could possibly have minus the amount of change a tree actually has divided by the maximum amount of change a tree could show minus the minimum amount of change a tree could possibly show (Farris, 1986). r is equal to zero when a character fits a tree as poorly as possible (Swofford and Begle, 1993). Farris (1986) uses the retention index and consistency index to compute a rescaled consistency index which he defines as the product of r and c. The rescaled consistency index provides a more conservative estimate of the number of

changes in a phylogenetic tree. The patristic distance matrix measures the phylogenetic distance between taxa.

The phylogenetic tree from this study wes compared to the four proposed phylogenetic trees using the Matrix Correlation Coefficient (LaPointe and Legendre, 1992). This method requires calculation of patristic (similarity due to relatedness) distance matrices for the topology of all of the independent trees. In order to calculate the patristic distance matrices for the four independent phylogenetic trees (Hemmer, 1978; Herrington, 1986; Collier and O'Brien, 1985; Salles, 1992), four user-defined topologies, which correspond to each of the four independent phylogenies (Figs. 4-1 through 4-4), were inputed into PAUP. For comparison, only those taxa represented in this study were placed on the topologies of the four independent phylogenies. Pairwise comparisons were made between the patristic distance matrix derived from the tree produced from this study using the combined (includes glycolipids, neutral lipids, and phospholipids) data matrix (Tables 4-1, 4-2, & 4-3) and each of the four independent trees (Figs. 4-1 through 4-4). Because the trees generated from the glycolipid, neutral lipid, and phospholipid data were virtually identical to the topology of the tree produced from the combined data set, comparisons were not made with each individual lipid class. A Matrix Correlation Coefficient was used to determine whether the tree produced from this study was significantly correlated with the four independent phylogenies, or whether they were correlated by chance. This analysis produced correlation matrices for each pairwise comparison with the significance of each patristic distance indicated (Tables 4-4, 4-5, 4-6, & 4-7). In order to determine whether the

Table 4-4.--Matrix of correlation coefficients of Patristic Distance Matrices from this study (using combined data set) and Hemmer (1978). jub=*Acinonyx jubatus*; ben=*Felis bengalensis*; car=*F. caracal*; con=*F. concolor*; geo=*F. geoffroyi*; man=*F. manul*; mar=*F. margarita*; parda=*F. pardalis*; ruf=*F. rufus*; ser=*F. serval*; tem=*F. temminicki*; leo=*Panthera leo*; onc=*P. onca*; pardu=*P. pardus*; tig=*P. tigris*; unc=*P. uncia*.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1jub	---	0.156	0.153	0.677	0.086	-0.058	0.348	0.278	0.250	0.124	0.346	0.047	-0.056	-0.018	0.095	0.075
2ben		---	0.590	-0.220	0.845	0.728	0.875	0.933	0.782	0.942	0.833	-0.157	-0.413	-0.178	0.114	0.059
3car			---	-0.175	-0.261	-0.406	-0.119	-0.161	-0.192	-0.294	-0.173	-0.229	-0.094	-0.276	0.524	0.527
4con				---	-0.261	-0.406	-0.119	-0.161	-0.192	-0.294	-0.173	-0.229	-0.094	-0.276	0.524	0.527
5geo					---	0.859	0.962	0.960	0.804	0.867	0.865	-0.228	-0.494	-0.246	0.110	0.053
6man						---	0.993	0.820	0.733	0.787	0.795	-0.227	-0.483	-0.243	0.112	0.059
7mar							---	0.979	0.862	0.930	0.953	-0.246	-0.538	-0.265	0.125	0.062
8parda								---	0.896	0.973	0.962	-0.220	-0.522	-0.245	0.091	0.028
9ruf									---	0.950	0.949	-0.265	-0.559	-0.281	0.066	0.007
10ser										---	0.938	-0.262	-0.582	-0.291	0.039	-0.025
11tem											---	-0.143	-0.474	-0.183	-0.027	-0.038
12leo												---	0.917	1.000	-0.638	-0.614
13onc													---	0.911	-0.412	-0.375
14pardu														---	-0.664	-0.638
15tig															---	1.000
16unc																---

Table 4-5.--Matrix of correlation coefficients of Patristic Distance Matrices from this study (using combined data set) and Herrington (1986). jub=*Acinonyx jubatus*; ben=*Felis bengalensis*; car=*F. caracal*; con=*F. concolor*; geo=*F. geoffroyi*; man=*F. manul*; mar=*F. margarita*; parda=*F. pardalis*; ruf=*F. rufus*; ser=*F. serval*; tem=*F. temminicki*; leo=*Panthera leo*; onc=*P. onca*; pardu=*P. pardus*; tig=*P. tigris*; unc=*P. uncia.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1jub	---	0.156	0.153	0.668	0.048	-0.013	0.362	0.299	0.331	0.287	0.260	0.091	0.183	0.022	0.131	0.354
2ben		---	0.592	-0.195	0.844	0.711	0.869	0.851	0.754	0.890	0.826	0.774	0.147	0.015	-0.086	0.787
3car			---	-0.142	0.482	0.389	0.580	0.562	0.938	0.784	0.736	-0.067	0.143	0.020	-0.076	0.703
4con				---	-0.312	-0.350	-0.083	-0.106	-0.105	-0.162	-0.182	-0.298	-0.163	-0.238	0.572	0.129
5geo					---	0.863	0.947	0.920	0.758	0.776	0.858	-0.143	0.096	-0.027	-0.124	0.763
6man						---	0.999	0.629	0.714	0.731	0.780	-0.162	0.079	-0.035	-0.109	0.716
7mar							---	0.852	0.859	0.904	0.951	-0.126	0.156	0.007	-0.091	0.915
8parda								---	0.768	0.812	0.879	-0.064	0.175	0.037	-0.057	0.817
9ruf									---	0.981	0.987	-0.111	0.166	0.013	-0.097	0.919
10ser										---	0.991	-0.047	0.211	0.031	-0.174	0.966
11tem											---	-0.049	0.212	0.031	-0.174	0.974
12leo												---	0.998	0.049	-0.674	-0.443
13onc													---	-0.169	-0.439	-0.052
14pardu														---	-0.384	-0.086
15tig															---	1.000
16unc																---

Table 4-6.--Matrix of correlation coefficients of Patristic Distance Matrices from this study (using combined data set) and Collier and O'Brien (1985). jub=*Acinonyx jubatus*; ben=*Felis bengalensis*; car=*F. caracal*; con=*F. concolor*; geo=*F. geoffroyi*; man=*F. manul*; mar=*F. margarita*; parda=*F. pardalis*; ruf=*F. rufus*; ser=*F. serval*; tem=*F. temminicki*; leo=*Panthera leo*; onc=*P. onca*; pardu=*P. pardus*; tig=*P. tigris*; unc=*P. uncia.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1jub	---	0.156	0.158	0.671	0.057	-0.024	-0.079	0.277	0.306	0.239	0.225	0.038	0.025	0.018	-0.035	-0.023
2ben		---	0.592	-0.208	0.845	0.721	0.709	0.856	0.767	0.916	0.847	-0.311	-0.153	-0.345	-0.689	-0.640
3car			---	-0.148	0.486	0.395	0.380	0.559	0.937	0.779	0.759	-0.279	-0.137	-0.312	-0.623	-0.572
4con				---	-0.306	-0.373	-0.399	-0.124	-0.136	-0.177	-0.214	-0.151	-0.291	-0.126	0.252	0.061
5geo					---	0.866	0.860	0.943	0.787	0.813	0.856	-0.390	-0.232	-0.437	-0.788	-0.751
6man						---	1.000	0.672	0.730	0.753	0.797	-0.405	-0.252	-0.454	-0.781	-0.758
7mar							---	0.660	0.717	0.729	0.773	-0.427	-0.281	-0.483	-0.806	-0.786
8parda								---	0.7959	0.840	0.868	-0.316	-0.151	-0.347	-0.698	-0.649
9ruf									---	0.968	0.995	-0.399	-0.214	-0.443	-0.857	-0.807
10ser										---	0.995	-0.376	-0.192	-0.431	-0.907	-0.834
11tem											---	-0.376	-0.191	-0.434	-0.924	-0.846
12leo												---	0.950	0.996	0.570	0.829
13onc													---	0.919	0.373	0.729
14pardu														---	0.643	0.898
15tig															---	1.000
16unc																---

Table 4-7.--Matrix of correlation coefficients of Patristic Distance Matrices from this study (using combined data set) and Salles (1992). jub=*Acinonyx jubatus*; ben=*Felis bengalensis*; car=*F. caracal*; con=*F. concolor*; geo=*F. geoffroyi*; man=*F. manul*; mar=*F. margarita*; parda=*F. pardalis*; ruf=*F. rufus*; ser=*F. serval*; tem=*F. temminicki*; leo=*Panthera leo*; onc=*P. onca*; pardu=*P. pardus*; tig=*P. tigris*; unc=*P. uncia*.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1jub	---	0.156	0.156	0.506	-0.235	-0.292	-0.335	-0.088	-0.020	0.325	-0.271	-0.192	-0.272	-0.255	-0.186	-0.211
2ben		---	0.592	-0.235	0.822	0.730	0.718	0.896	0.631	0.911	0.783	-0.076	-0.317	-0.094	0.123	0.715
3car			---	-0.183	0.486	0.418	0.403	0.665	0.908	0.574	0.628	-0.100	-0.318	-0.117	0.066	0.577
4con				---	-0.315	-0.385	-0.415	-0.313	-0.444	-0.051	-0.436	-0.080	0.088	-0.118	0.373	-0.132
5geo					---	0.877	0.871	0.945	0.659	0.518	0.874	0.037	-0.179	0.023	0.233	0.800
6man						---	1.000	0.786	0.620	0.536	0.805	-0.020	-0.235	-0.031	0.200	0.733
7mar							---	0.771	0.610	0.517	0.786	-0.039	-0.255	-0.051	0.179	0.713
8parda								---	0.818	0.674	0.965	0.117	-0.120	0.097	0.268	0.889
9ruf									---	0.545	0.845	0.073	-0.132	0.060	0.247	0.771
10ser										---	0.612	-0.130	-0.363	-0.152	0.013	0.548
11tem											---	0.196	-0.045	0.169	0.276	0.906
12leo												---	0.935	1.000	-0.257	-0.097
13onc													---	0.931	-0.035	-0.059
14pardu														---	-0.278	-0.125
15tig															---	1.000
16unc																---

overall topology of the tree produced from this study (based on the combined data set) was significantly correlated with each of the four independent phylogenetic trees (Figs. 4-1 through 4-4), it was necessary to average the correlations over each matrix. However, correlation coefficients cannot be averaged because they are not additive, i.e., the value of the correlation coefficient is not a linear function of the magnitude of the relation between the variables (Statistica, 1994). In order to obtain a linear relationship, the coefficient of determination (the square of the correlation coefficient) was calculated for each matrix (Table 4-8, 4-9, 4-10, & 4-11). The coefficient of determination is linearly dependent and therefore can be averaged (Statistica, 1994). The coefficient of determination is then averaged across each matrix. The average correlation coefficient for each pair of phylogenetic trees is compared to the table of critical values provided by LaPointe and Legendre (1992) to determine whether each pair of trees is significantly correlated with each other.

Results

Analyses of glycolipids, neutral lipids, phospholipids, and a combined data set produced only one most parsimonious phylogenetic tree in each of the four cases, regardless of whether branch swapping options or stepwise addition searching strategies were used. Slightly different trees were produced for each of the four sets of data.

The glycolipids produced a tree with a length of 476, a consistency index of 0.834, a homoplasy index of 0.166, a retention index of 0.838 and a rescaled

Table 4-8.–Matrix of coefficients of determination produced from the correlation matrix in Table 4-4 (Hemmer, 1978). jub=*Acinonyx jubatus*; ben=*Felis bengalensis*; car=*F. caracal*; con=*F. concolor*; geo=*F. geoffroyi*; man=*F. manul*; mar=*F. margarita*; parda=*F. pardalis*; ruf=*F. rufus*; ser=*F. serval*; tem=*F. temminicki*; leo=*Panthera leo*; onc=*P. onca*; pardu=*P. pardus*; tig=*P. tigris*; unc=*P. uncia.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1jub	—	0.024	0.023	0.459	0.007	0.003	0.121	0.077	0.062	0.015	0.119	0.002	0.003	0.001	0.009	0.005
2ben		—	0.349	0.048	0.714	0.530	0.766	0.871	0.612	0.887	0.694	0.024	0.170	0.031	0.013	0.003
3car			—	0.030	0.239	0.156	0.309	0.402	0.888	0.580	0.434	0.036	0.177	0.045	0.000	0.001
4con				—	0.068	0.165	0.014	0.025	0.036	0.086	0.030	0.052	0.008	0.076	0.274	0.278
5geo					—	0.738	0.925	0.923	0.647	0.753	0.748	0.052	0.244	0.060	0.012	0.002
6man						—	0.986	0.672	0.538	0.620	0.632	0.051	0.233	0.059	0.012	0.003
7mar							—	0.960	0.744	0.866	0.908	0.060	0.289	0.070	0.015	0.003
8parda								—	0.804	0.946	0.926	0.048	0.273	0.060	0.008	0.000
9ruf									—	0.903	0.901	0.070	0.313	0.083	0.004	0.001
10ser										—	0.880	0.068	0.338	0.085	0.001	0.001
11tem											—	0.020	0.225	0.033	0.000	0.001
12leo												—	0.841	1.000	0.407	0.377
13onc													—	0.829	0.170	0.140
14pardu														—	0.441	0.408
15tig															—	1.000
16unc																—

Table 4-9.--Matrix of coefficients of determination produced from the correlation matrix in Table 4-5 (Herrington, 1986). jub=*Acinonyx jubatus*; ben=*Felis bengalensis*; car=*F. caracal*; con=*F. concolor*; geo=*F. geoffroyi*; man=*F. manul*; mar=*F. margarita*; parda=*F. pardalis*; ruf=*F. rufus*; ser=*F. serval*; tem=*F. temminicki*; leo=*Panthera leo*; onc=*P. onca*; pardu=*P. pardus*; tig=*P. tigris*; unc=*P. uncia*.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1jub	---	0.024	0.023	0.446	0.002	0.001	0.131	0.089	0.109	0.082	0.067	0.008	0.033	0.001	0.017	0.125
2ben		---	0.350	0.038	0.713	0.506	0.756	0.725	0.568	0.792	0.682	0.007	0.021	0.001	0.007	0.620
3car			---	0.020	0.232	0.151	0.337	0.316	0.879	0.614	0.542	0.004	0.020	0.001	0.005	0.495
4con				---	0.097	0.122	0.007	0.011	0.011	0.026	0.033	0.089	0.026	0.056	0.327	0.016
5geo					---	0.746	0.898	0.847	0.574	0.603	0.737	0.020	0.009	0.001	0.015	0.582
6man						---	0.998	0.396	0.510	0.534	0.608	0.026	0.006	0.001	0.012	0.513
7mar							---	0.727	0.739	0.817	0.904	0.015	0.024	0.001	0.008	0.837
8parda								---	0.590	0.660	0.773	0.004	0.030	0.001	0.003	0.668
9ruf									---	0.962	0.974	0.012	0.027	0.001	0.009	0.844
10ser										---	0.983	0.002	0.044	0.001	0.030	0.934
11tem											---	0.002	0.044	0.001	0.030	0.948
12leo												---	0.997	0.002	0.455	0.196
13onc													---	0.028	0.193	0.002
14pardu														---	0.147	0.007
15tig															---	1.000
16unc																---

Table 4-10.–Matrix of coefficients of determination produced from the correlation matrix in Table 4-6 (Collier & O'Brien, 1985). jub=*Acinonyx jubatus*; ben=*Felis bengalensis*; car=*F. caracal*; con=*F. concolor*; geo=*F. geoffroyi*; man=*F. manul*; mar=*F. margarita*; parda=*F. pardalis*; ruf=*F. rufus*; ser=*F. serval*; tem=*F. temminicki*; leo=*Panthera leo*; onc=*P. onca*; pardu=*P. pardus*; tig=*P. tigris*; unc=*P. uncia.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1jub	---	0.024	0.024	0.451	0.003	0.001	0.006	0.076	0.094	0.057	0.050	0.001	0.000	0.001	0.001	0.001
2ben		---	0.351	0.043	0.715	0.520	0.503	0.734	0.589	0.840	0.718	0.097	0.023	0.119	0.474	0.409
3car			---	0.021	0.237	0.156	0.144	0.312	0.878	0.607	0.576	0.078	0.018	0.097	0.389	0.335
4con				---	0.094	0.139	0.159	0.015	0.018	0.031	0.046	0.022	0.085	0.015	0.063	0.003
5geo					---	0.751	0.739	0.889	0.619	0.661	0.733	0.152	0.053	0.191	0.621	0.564
6man						---	1.000	0.451	0.533	0.567	0.635	0.164	0.063	0.206	0.610	0.575
7mar							---	0.436	0.514	0.531	0.598	0.182	0.079	0.233	0.651	0.618
8parda								---	0.633	0.706	0.754	0.099	0.022	0.120	0.487	0.421
9ruf									---	0.938	0.991	0.159	0.046	0.196	0.734	0.652
10ser										---	0.991	0.141	0.037	0.186	0.824	0.696
11tem											---	0.141	0.036	0.188	0.854	0.717
12leo												---	0.902	0.993	0.325	0.687
13onc													---	0.844	0.139	0.531
14pardu														---	0.413	0.808
15tig															---	1.000
16unc																---

Table 4-11.--Matrix of coefficients of determination produced from the correlation matrix in Table 4-7 (Salles, 1992). jub=*Acinonyx jubatus*; ben=*Felis bengalensis*; car=*F. caracal*; con=*F. concolor*; geo=*F. geoffroyi*; man=*F. manul*; mar=*F. margarita;* parda=*F. pardalis*; ruf=*F. rufus*; ser=*F. serval*; tem=*F. temminicki*; leo=*Panthera leo*; onc=*P. onca*; pardus=*P. pardus*; tig=*P. tigris*; unc=*P. uncia.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1jub	---	0.024	0.024	0.256	0.055	0.085	0.112	0.007	0.000	0.105	0.073	0.036	0.074	0.065	0.034	0.044
2ben		---	0.351	0.055	0.676	0.533	0.515	0.802	0.399	0.831	0.614	0.005	0.100	0.008	0.015	0.512
3car			---	0.033	0.236	0.175	0.162	0.442	0.824	0.329	0.395	0.010	0.101	0.013	0.004	0.333
4con				---	0.099	0.148	0.172	0.098	0.197	0.002	0.190	0.006	0.007	0.014	0.139	0.017
5geo					---	0.769	0.759	0.893	0.434	0.268	0.764	0.001	0.032	0.000	0.054	0.641
6man						---	1.000	0.617	0.384	0.287	0.649	0.000	0.055	0.000	0.040	0.537
7mar							---	0.594	0.372	0.267	0.618	0.001	0.065	0.002	0.032	0.509
8parda								---	0.670	0.455	0.931	0.013	0.014	0.009	0.072	0.790
9ruf									---	0.297	0.714	0.005	0.017	0.003	0.061	0.595
10ser										---	0.375	0.017	0.132	0.023	0.000	0.301
11tem											---	0.038	0.002	0.028	0.076	0.821
12leo												---	0.875	1.000	0.066	0.009
13onc													---	0.868	0.001	0.003
14pardu														---	0.077	0.015
15tig															---	1.000
16unc																---

consistency index of 0.699. The phylogenetic tree produced two major clades (Fig. 4-5). The cheetah branched off first (node 1). The other two clades comprised the Felis species and Panthera species, respectively. Within the Felis clade, F. concolor (puma) branched as a sister group to the remaining Felis species (node 20). Felis bengalensis (leopard cat) and the serval formed a monophyletic group (node 5), while F. geoffroyi (geoffroyis cat), F. pardalis (ocelot), pallas' cat, and F. margarita (sand cat) formed another monophyletic group (node 8). These two groups formed a larger monophyletic clade (node 4). The caracal lynx, bobcat, and F. temminicki (Temminick' golden cat) formed another monophyletic clade as a sister group to the taxa in node 4 (node 15). Within the Panthera clade (node 21), the lion, leopard, and jaguar formed a monophyletic group (node 22) and the tiger and snow leopard formed a sister group to the lion-leopard-jaguar clade (node 27).

The neutral lipids produced a tree with a length of 572, a consistency index of 0.788, a homoplasy index of 0.212, a retention index of 0.844 and a rescaled consistency index of 0.665. The phylogenetic tree produced two major clades (Fig. 4-6). Similar to the tree based on glycolipids, the cheetah branched off first (node 1). One monophyletic clade consisted of all of the Panthera species (node 19). The other monophyletic clade consisted of all of the Felis species (node 2) with the exception of the puma which branched with the Panthera clade. Within the Felis clade, the species which comprised the three monophyletic clades were the same as for the glycolipids (leopard cat-serval at node 4; caracal lynx-bobcat-Temminick's Golden cat at node 7; and Geoffroy's cat-ocelot-pallas' cat-sand cat at node 12). However, the position of

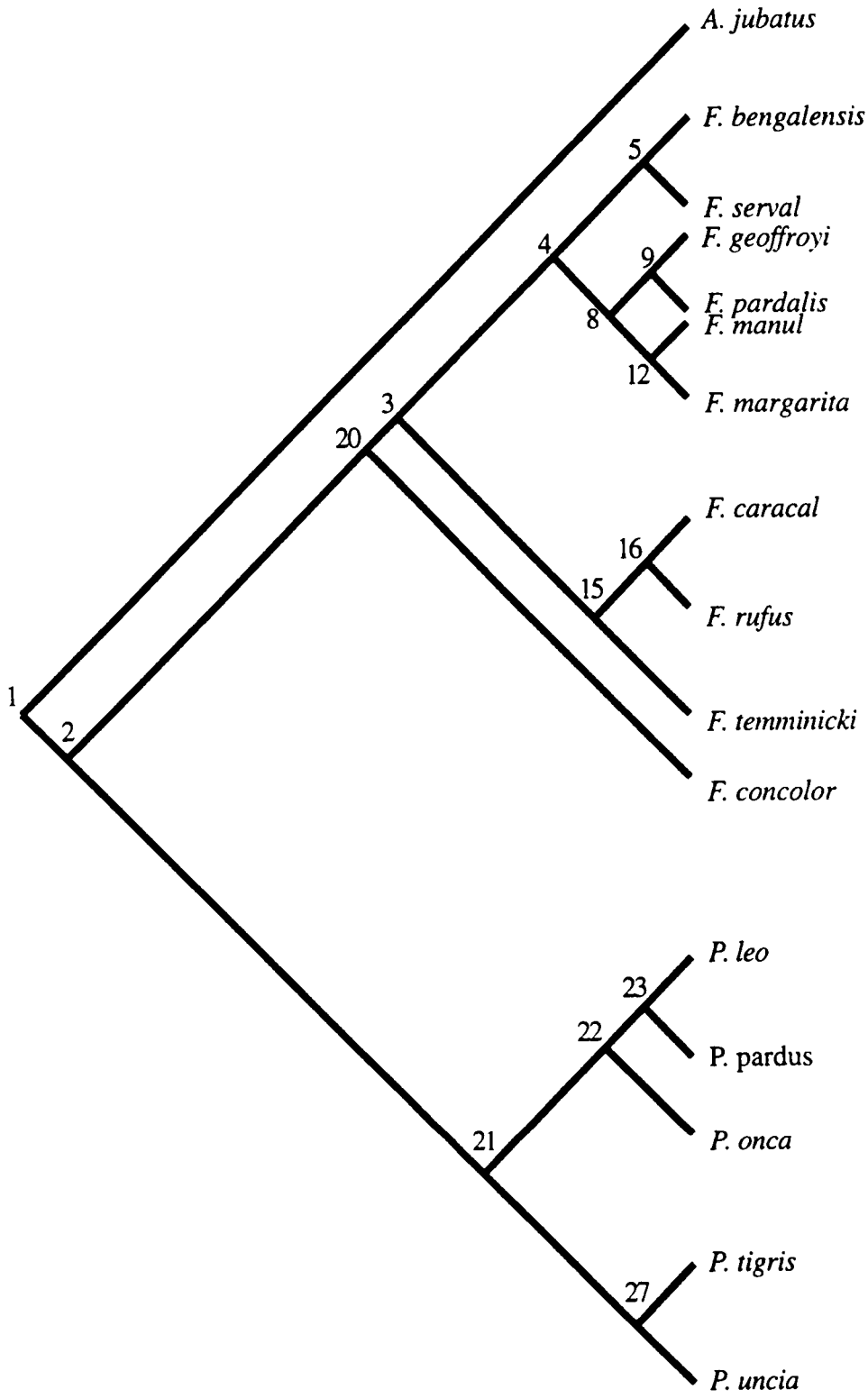


Figure 4-5.--Phylogenetic tree of Family Felidae based on glycolipid compounds present in anal sacs. A=Acinonyx; F = *Felis*; P = *Panthera*.

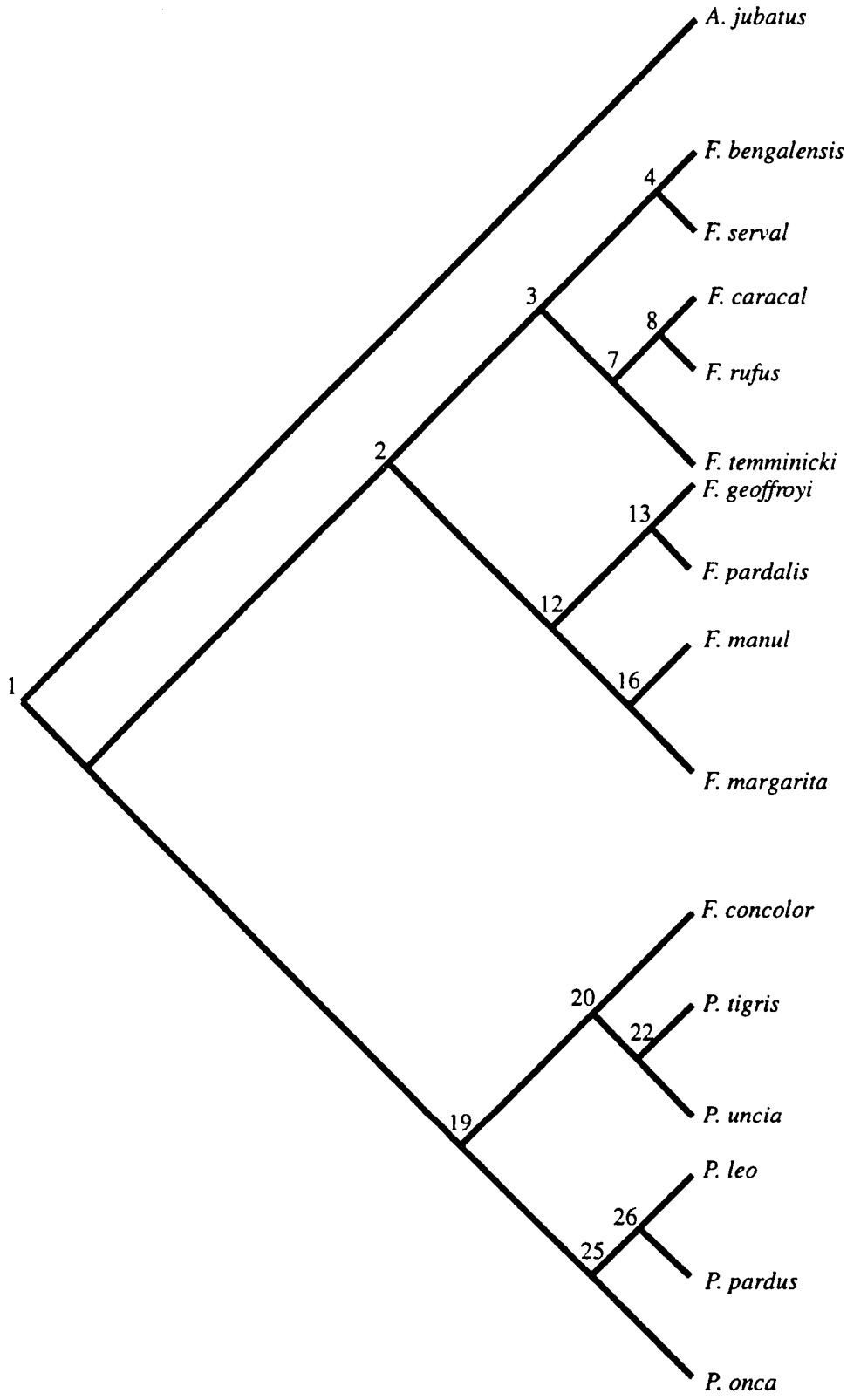


Figure 4-6.--Phylogenetic tree of Family Felidae based on neutral lipid compounds present in anal sacs. *A=Acinonyx; F=Felis; P=Panthera.*

the Geoffroy's cat-ocelot-pallas' cat-sand cat clade (node 12) switched places with the caracal lynx-bobcat-Temminick's Golden cat clade (node 7), making the caracal lynx-bobcat-Temminick's Golden cat clade a sister group to the leopard cat-serval (node 3) clade. Within the Panthera clade (node 19), the lion, leopard, and jaguar remained a monophyletic group (node 25). The tiger, snow leopard, and puma formed the second monophyletic clade (node 20) within the Panthera clade.

The phospholipids produced a tree with a length of 531, a consistency index of 0.797, a homoplasy index of 0.203, a retention index of 0.808 and a rescaled consistency index of 0.644. The phylogenetic tree produced two major clades (Fig. 4-7). Similar to the trees produced by the glycolipids and neutral lipids, the cheetah formed the first branch (node 1). The puma formed the next branch outside of the Felis clade (node 2). The two major clades consisted of Felis species and Panthera species, respectively. The relationships among the species within the Felis clade were similar to that shown for the glycolipids and neutral lipids. However, the Geoffroy's cat-ocelot-pallas' cat-sand cat clade split into two clades (Geoffroy's cat-ocelot at node 9 and pallas' cat-sand cat at node 12) which formed sister groups to each other. Within the Panthera clade, two monophyletic groups were formed. One clade consisted of the lion-leopard clade (node 24) and the other consisted of the jaguar-tiger-snow leopard group (node 19).

The combined data set (includes all glycolipids, neutral lipids, and phospholipids) produced a tree with a length of 1623, a consistency index of 0.783, a homoplasy index of 0.217, a retention index of 0.807 and a rescaled consistency index

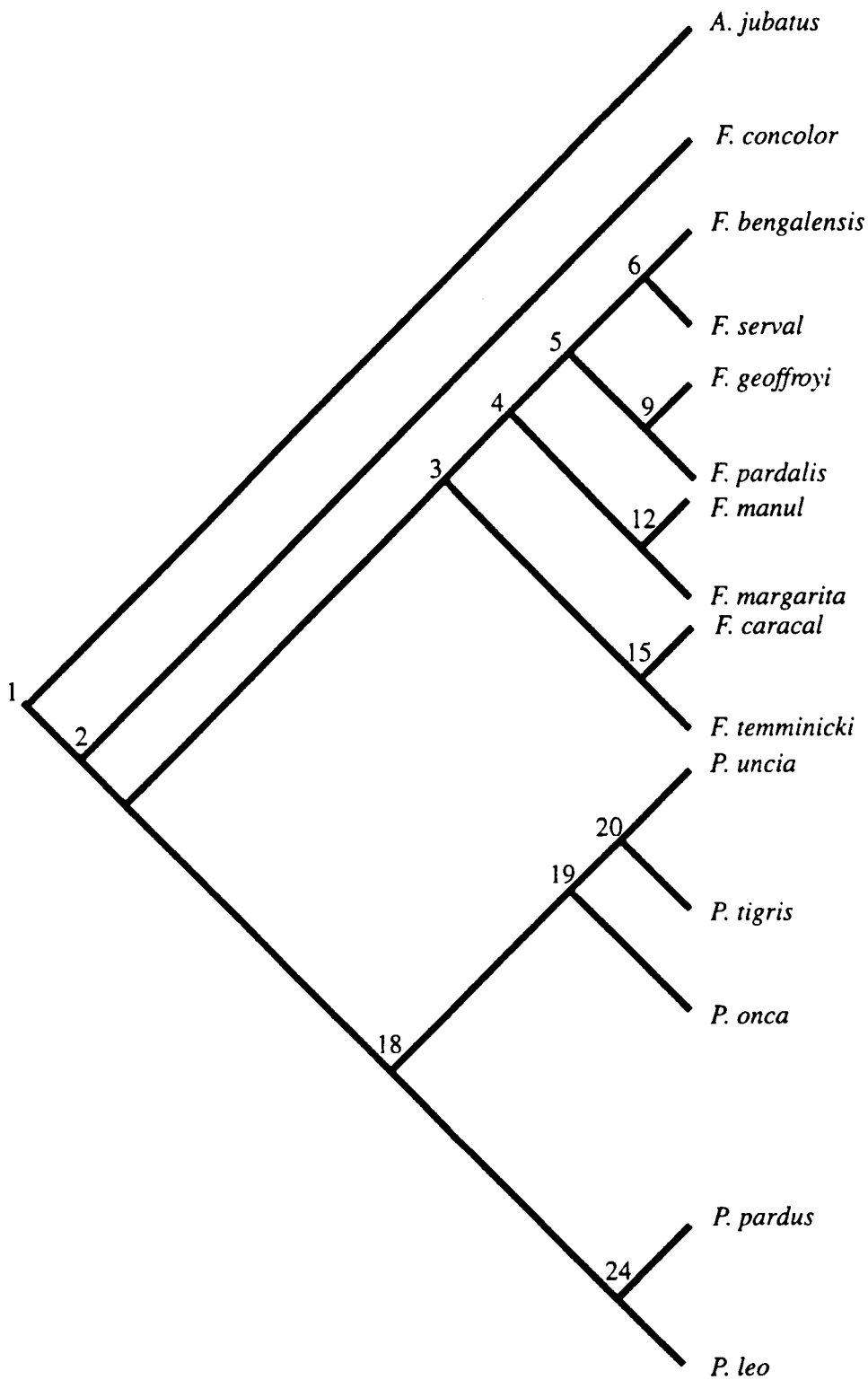


Figure 4-7.--Phylogenetic tree of Family Felidae based on phospholipid compounds present in anal sacs. *A=Acinonyx; F=Felis; P=Panthera.*

of 0.632. In concordance with the other three phylogenetic trees, the cheetah was the first branch off the tree (Fig. 4-8; node 1). Likewise, there were two major clades, the Felis clade (node 2) and the Panthera clade (node 19). The arrangement of taxa within both clades were exactly the same as for the tree produced with the glycolipids with the exception of the placement of the puma, which formed a monophyletic clade with the tiger-snow leopard clade (node 25).

Results of correlation of the patristic distance matrices revealed that the phylogenetic tree (of the combined data set) in this study was significantly correlated with the tree by Collier and O'Brien (1985) at the 0.05 level of significance (r=0.6711). The remaining three trees were not significantly correlated with the tree generated from this study (Hemmer - r=0.3044; Herrington - r=0.2978; Salles - r=0.2635).

Discussion

The cheetah is considered to be an early divergence from the main stem of felid evolution (Kral and Zima, 1980; Neff, 1983). Although several authors (Hemmer, 1978; Herrington, 1986; Collier and O'Brien, 1985; Salles, 1992) do not agree with this assertion, this study is in complete agreement as all four trees place the cheetah as the first branch. The resolution of Hemmer's (1978) tree is such that he is not able to resolve several branches including the placement of the cheetah (Fig. 4-1). Other authors place the cheetah as the sister taxon to the lynxes and Panthera group (node 4; Fig. 4-3), to Pallas' cat (node 10; Fig. 2), or to the Panthera group (node 5; Fig. 4-4). The trees based on morphological and molecular traits did not place the cheetah as the

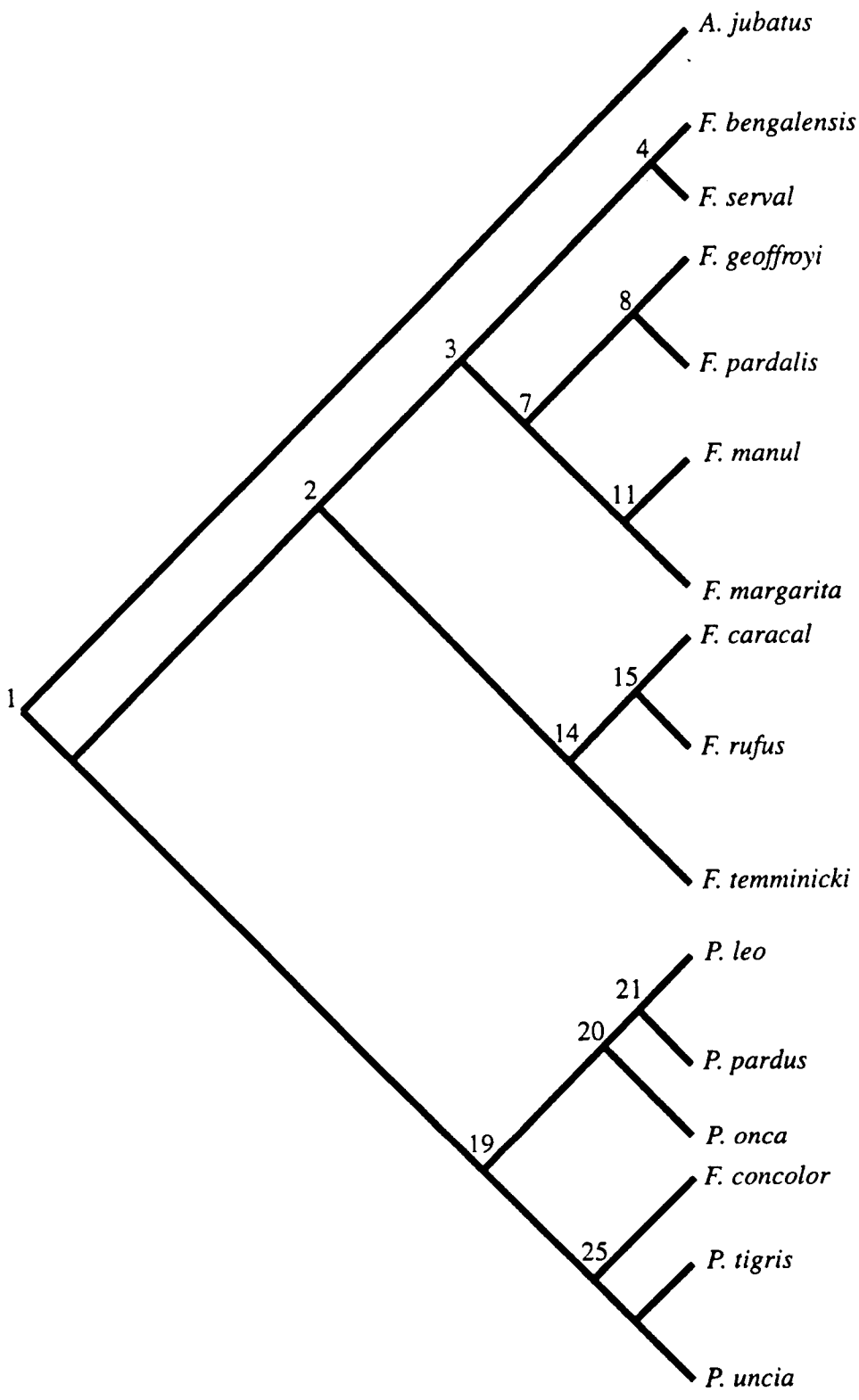


Figure 4-8.--Phylogenetic tree of Family Felidae based on glycolipid, neutral lipid, and phospholipid compounds present in anal sacs. *A=Acinonyx; F=Felis; P=Panthera.*

most primitive branch. Therefore, the relationship of the cheetah with other felid species warrants further investigation. Perhaps the most efficient method for examining this question further, would be to combine the most informative characters (those characters that did not show homoplasy or reversals) from the phylogenies based on molecular, morphological, and chemical data into one analysis.

It is generally agreed upon that the puma jaguarundi are sister taxa (Fig. 4-1 node 5, Fig. 2 - node 11 & Fig. 4-4 - node 8). However, Collier and O'Brien (1985) place them as distant relatives (Fig. 4-3). Although this study cannot evaluate the potential sister relationship between the puma and jaguarundi, the puma is the only taxon whose position does not remain stable among the trees. In the tree based on glycolipids, the puma branches as a sister group to the remaining Felis species (Fig. 4-5; node 20). The puma groups outside of all felid species, except for the cheetah in the tree based on phospholipids (Fig. 4-7; node 2). The tree based on neutral lipids (Fig. 4-6; node 20) and the combined data set (Fig. 4-8; node 25) places the puma as a sister group to the tiger and snow leopard. Temminick's golden cat and F. tristis are recognized as sister taxa by Hemmer (1978) (Fig. 4-1; node 6). However, many authors recognize these taxa as conspecific (Ewer, 1973; Herrington, 1986; Nowak and Paradiso, 1983; Collier and O'Brien, 1985; Salles, 1992;), and place F. badia (bay cat) and Temminick's Golden cat (including F. tristis) as sister taxa (Fig. 2; node 12; and Fig. 4-4; node 9) with F. aurata (African golden cat) as the basal taxa of the Temmick's Golden cat-bay cat group (Fig. 4-2; node 13). On the other hand, Collier and O'Brien's (1985) tree produced an unresolved trichotomy among Teminick's golden cat), bay cat

and African golden cat (Fig. 4-3; node 5). All of the phylogenetic trees in this study are in agreement in placing Temminick's golden cat as a sister group to the bobcat-caracal lynx clade.

Hemmer (1978) and Herrington (1986) placed F. marmorata (marbled cat) and the clouded leopard as basal taxa to the Panthera group (Fig. 4-1; node 7; & Fig. 4-2; node 14). Salles (1992) also placed the clouded leopard as a sister taxon to the Panthera group. However, he placed the marbled cat as a distant relative (Fig. 4-4; node 10). Collier and O'Brien (1985) were not able to resolve the position of these taxa relative to the Panthera group. Collier and O'Brien (1985) were also unable to resolve the relationships among the Panthera species, simply producing an unresolved polytomy (Fig. 4-3; node 1). Both Hemmer (1978) and Salles (1992) were not able to resolve the relationships among the leopard, lion, and jaguar (Fig. 4-1; node 2; & Fig. 4-4; node 1), producing an unresolved trichotomy. Salles (1992) concluded that the tiger is the most closely related sister taxon to the leopard-lion-jaguar trichotomy, and that the snow leopard was the most primitive branch of the Panthera clade. Hemmer (1978) was not able to resolve the relationship of the snow leopard and tiger. Herrington's (1986) tree completely resolved the relationships of the Panthera species, placing the leopard and lion as a monophyletic clade. The jaguar, tiger, and snow leopard were sequentially placed as sister taxa to the leopard-lion clade. All of the trees in this study produced the same relationships among Panthera taxa as that of Herrington (1986). However, the tree based on neutral lipids (Fig. 4-6; node 20) and

the combined data set (Fig. 4-8; node 25) placed the puma as a sister group to the tiger and snow leopard as well.

The ocelot and F. weidii (margay) were recognized as sister taxa by all authors (Fig. 4-1; node 8; Fig. 4-2; node 15; Fig. 4-4; node 11) except Collier and O'Brien (1985) who produced an unresolved trichotomy among the margay, F. tigrinus (fishing cat), and F. colocolo (pampas cat) (Fig. 4-3; node 6) and placed the ocelot outside of that group (Fig. 4-3; node 7). Hemmer (1978) and Salles (1992) recognized an unresolved trichotomy among the fishing cat, F. guigna (kodkod), and Geoffroy's cat (Fig. 4-1; node 9; Fig. 4-4; node 12). While Herrington (1986) placed the fishing cat and kodkod as sister taxa (Fig. 4-2; node 16) and Geoffroy's cat as the basal taxa to this group (Fig. 4-2; node 17). Collier and O'Brien (1985) placed Geoffroy's cat and the kodkod as sister taxa (Fig. 4-3; node 8) and the fishing cat as a distant relative. Hemmer (1978) and Herrington (1986) recognized the pampas cat and F. jacobita (mountain cat) as sister taxa outside of the Geoffroy's cat-fishing cat-kodkod group (Fig. 4-1; node 10; Fig. 4-2; node 18), while Salles (1992) recognized an unresolved trichotomy among the pampas cat, mountain cat, and F. rubiginosa (rusty spotty cat) (Fig. 4-4; node 13). In this study, the ocelot and Geoffroy's cat were placed as sister taxa in all phylogenetic trees.

Hemmer (1978) produced an unresolved polytomy among F. iriomotensis (iriomote cat), F. planiceps (flat headed cat), the leopard cat, fishing cat, and rusty spotted cat (Fig. 4-1; node 11). There were also unresolved branches among these species (except for the iriomote cat and rusty spotted cat which were excluded from

their study) in Collier and O'Brien's (1985) tree (Fig. 4-3; node 9). Herrington (1986) placed the iriomote cat and leopard cat as sister taxa (Fig. 4-2; node 19), then the fishing cat and flat headed cat branched, respectively (Fig. 4-2; nodes 20 & 21). Salles (1992) recognized the flat headed cat and fishing cat as sister taxa (Fig. 4-4; node 14) and grouped the remaining taxa as distant relatives. The serval was placed outside of the lynx group in all of the trees (Fig. 4-1; node 4; Fig. 4-2; node 9; Fig. 4-3; node - 3) except for Salles' (1992) in which it was recognized as a distant relative of the lynxes. The leopard cat and serval consistently grouped as sister taxa in all trees generated in this study regardless of the data set used. Likewise, the caracal lynx and bobcat consistently grouped as sister taxa. The position of the caracal lynx-bobcat clade and the leopard cat-serval clade vared as far as overall placement on the tree was concerned, but their sister relationship remained stable within each monophyletic clade.

In all four trees, F. bieti (Chinese Desert cat), F. chaus (jungle cat), the sand cat, F. nigripes (black-footed cat), F. silvestris (European wild cat), F. lybica (African wild cat), and F. ornata (Indian Desert cat) were recognized (Figs. 4-1, 4-2, 4-3, 4-4) as a monophyletic clade. However, the relationships among species within this group were either uncompletely resolved (Hemmer, 1978), or the arrangement of species was controversial (Collier and O'Brien, 1985; Herrington, 1986; Salles, 1992). The trees from this study consistently placed the sand cat and pallas' cat as sister taxa, regardless of the data set used.

For the most part, phylogenetic relationships among felid species based on chemical signals were consistent with those proposed by other authors based on

morphological and genetic data. Differences in the topologies between the phylogenetic trees based on chemical data and those based on morphological and molecular data could be the result of differences in types of characters used, as well as differences in the phylogenetic methodologies and rooting methods used. Several branches in the trees produced by Hemmer (1978), Collier and O'Brien (1985), Herrington (1986), and Salles (1992) were either partially or completely unresolved. The chemical data used in this study produced phylogenetic trees that were completely resolved for all major groups. The arrangement of taxa in all four trees in this study were in general agreement with only a few branches shifting positions. The main disagreement among these four trees was the placement of the puma. The position of the puma remains dubious as other authors either cannot resolve its affinity with other taxa (Hemmer, 1978), or place it in a questionable position such as with the Panthera clade (Salles, 1992), with the cheetah (Herrington, 1983), or as a primitive group to most of the Felis species (Collier and O'Brien, 1985). This study illustrates the potential for chemical signals to aid in understanding the evolution of the Family Felidae. Furthermore, this study demonstrates the conservative nature of chemical signals, possibly not as malleable to environmental conditions as traditionally regarded.

Chapter 5

Ecological, Morphological, and Life History Correlates of Relative Volatility Across the Family Felidae (Order Carnivora)

Introduction

Numerous studies focus on the functional significance of scent marking in mammals (for reviews see Ralls, 1971; Eisenberg and Kleiman, 1972; Johnson, 1973; MacDonald, 1985). Olfactory communication is a unique form of communication in that it is somewhat stable over time and can persist in the absence of the signaling animal. However, the length of time that a scent mark conveys information varies and such variability is thought to relate to the scent marks functional significance. For example, some scent marks are important for short term signaling in which case the scent is highly volatile (Gorman et al., 1984). Additionally, alarm signals are highly volatile to ensure that they do not remain in the environment at detectable levels for too long after their function is served (Wilson, 1970). Most sex and recognition signals also act at close range and are expected to have higher volatility so they can be detected easily and quickly (Alberts, 1992). Further, sexual signals presumably act to attract potential mates to each other directly rather than simply to draw them into the general vicinity as might less volatile scent marks (Johnson, 1973). Other olfactory cues seem to function in long term signaling (e.g., territory ownership) where the scent needs to persist long enough to broadcast in the absence of the signaler (Davies et al., 1988; Alberts, 1992).

The volatility of scent marks in relation to their functional significance is obviously important. In general, higher molecular weight results in lower volatility (Alberts, 1992). Therefore, relative volatility can be estimated from the molecular weight of the compounds. When the functional significance of a character is unknown, as with relative volatility, the comparative method is often useful for detecting general patterns and generating new hypotheses (Harvey and Mace, 1982; Gittleman, 1989). Thus, in the present study, relative volatility is compared with ecological, morphological, and life history parameters to assess possible relationships across the Felidae, a group which is particularly amenable to comparative analysis due to considerable trait variability.

Home range designation is a common function of felid scent marking (Eaton, 1970; Muckenhirn and Eisenberg, 1973; Singh, 1973; York, 1973; Bailey, 1974; Geertsema, 1985; Caro, 1994). The area of an individual's home range should effect the frequency with which it is marked. For example, it might take longer for an animal who is marking a large area to get back to the area to re-mark it. Therefore, felids with larger home ranges should have scent marks with less volatile chemicals compared with species that have smaller home ranges. This hypothesis is tested by assessing the relationship of home range size with relative volatility.

Similarly, it is advantageous to the signaler to reach the maximum number of desired receiver's at minimum energetic cost. Therefore, for species at higher population densities, the compounds should be more volatile because the chemicals are directly emitted at close range. Individuals of these species, in higher population

densities, most likely communicate more rapidly due to the greater number of conspecifics in the area. Whereas species at lower densities may require a scent mark to remain longer (low volatility) so that the chances of other conspecifics receiving the scent are greater. Evidence to support this hypothesis shows that felids mark frequently on heavily traveled trails in high population densities (Wemmer and Scow, 1977). I examine this idea by assessing the relationship between volatility and population density.

There is mounting evidence for the importance of communication between a mother and her offspring. Several studies demonstrate the ease with which offspring are able to recognize their mother (Beer, 1970; Rosenblum and Alpert, 1977; Porter et al., 1978, 1981; Porter and Wyrick, 1979; Evans, 1980; Rowley, 1980; Trillmich, 1981; McArthur, 1982). If litter size is large it seems more likely that a mother would need to communicate more rapidly with her offspring, thus maintaining highly volatile scent. Similarly, if litter size is smaller, the need for rapid communication may be less and scent is less volatile. This hypothesis is tested by assessing the relationship between litter size and relative volatility.

Regardless of the function of these chemical compounds, their production may incur a cost. For example, passage of compounds from the gut into hemolymph and to the site of sequestration may require special carrier molecules (Duffey, 1980; Wilkinson, 1986; Wink, 1988). The construction of specialized glands or organs for storage may also be costly (Duffey, 1980; Scudder et al., 1986). Furthermore, enzymes are needed to catalyze the reactions to produce the compounds (Bowers, 1992). These

costs may result in evolutionary effects because the resources that might otherwise be used for growth would be used for production of these compounds (Bowers, 1992). Additionally, sequestering food resources would entail moving the compounds out of the gut and storing them elsewhere, and metabolically converting the original compounds into other compounds (Bernays et al., 1977; Duffey et al., 1978; Brattsten, 1979; Seiber et al., 1980; Gardner and Stermitz, 1988). Determination of a cost to sequestration of chemical compounds is typically revealed by a correlation of chemicals with morphological and reproductive fitness measures such as body weight, growth rate, or inter-birth interval (Brower and Glazier, 1975; Cohen, 1985). Body weight and head and body length are used as measures of size and correlated with relative volatility to determine whether the production of semiochemicals in felids incurs a cost in the form of reduced size.

Although suggestions are made concerning functional relationships between volatility and various phenotypic traits, no study has systematically examined these in relation to ecological, life history, and morphological correlates. Therefore, in addition to the hypotheses developed above, investigative relationships are also examined between relative volatility and inter-birth interval, olfactory bulb size, orbit area, and habitat type.

Methods

Anal sac secretions were collected from 16 felid species (see Table 5-1 for species listing). The methods used to collect the samples as well as the methods for

Table 5-1.--Percentage relative volatility of glycolipid (GL), neutral lipid (NL) and polar lipid fragment (PL) compounds present in anal sac secretions of felid species.

	High Volatility			Medium Volatility			Low Volatility		
	GL	NL	PL	GL	NL	PL	GL	NL	PL
Acinonyx jubatus	32	51	62	38	39	35	30	10	3
Felis bengalensis	29	42	38	32	37	41	39	21	22
Felis caracal	51	40	46	26	28	50	23	32	4
Felis concolor	39	49	44	42	36	42	19	15	13
Felis geoffroyi	35	49	33	33	34	48	32	21	20
Felis manul	31	46	39	36	34	36	33	20	26
Felis margarita	31	39	40	35	38	33	34	22	28
Felis pardalis	36	42	33	34	35	44	29	23	23
Felis rufus	47	40	----	31	25	----	22	35	----
Felis serval	28	46	43	35	39	31	37	15	26
Felis temminicki	60	40	55	23	30	33	17	29	12
Panthera leo	32	30	51	31	41	35	37	29	13
Panthera onca	57	34	26	36	41	30	8	25	44
Panthera pardus	37	31	30	40	38	44	23	31	26
Panthera tigris	33	39	28	36	39	39	31	22	33
Panthera uncia	31	40	30	34	35	33	34	25	37

chemical analyses are detailed in Chapter 2. Percent relative volatility was calculated for each chemical compound by dividing the list of compounds into three equal parts, then assigning high volatility to those compounds that eluted first, low volatility to those that eluted last, and medium volatility to those that eluted between the high and low volatile compounds. The number of compounds in each of the three categories were then counted and the percentages of compounds within each category were calculated (Table 5-1). All analyses were performed with each of the three lipid fractions (neutral lipids, glycolipids, and polar lipid fragments derived from the phospholipid fraction) separately and then with all three lipid fractions combined. Information for felid life history, morphology, and ecology were taken from published sources (Table 5-2). Means for these variables were calculated and used for subsequent data analyses.

Variables

Body weight: Average body weight of adult male and adult female (Source: This Study & Gittleman, 1986).

Habitat Type: General type of habitat in which species occur (Source: Gittleman, 1986).

Head & Body Length: Length, in mm, of head and body length excluding tail length (SOURCE: Gittleman, 1986).

Home Range Size: Average range of adult males and adult females measured in kilometers (Source: Eaton, 1973; Muckenhirn and Eisenberg, 1973; Provost et al., 1973; Singh, 1973; Bailey, 1974; Seidensticker, 1976; Berg, 1979; Hanby and Bygott, 1979; Karpowitz and Flinders, 1979; Kitchings and Story, 1979; Miller and Speake, 1979; Vogt, 1979; Fendley and Buie, 1986; Hopkins et al., 1986; Mondolfi and Hoogestein, 1986; Emmons, 1988).

Table 5-2.--Ecological, morphological, and life history traits by species. PD=Population Density (# of individuals per sq. km.); HRS=Home Range Size (sq. km.); BW=Body Weight (Kg); OBS=Olfactory Bulb Size; BL=Head & Body Length; LS=Litter Size; IBI=Inter-Birth Interval; OA=Orbit Area.

	PD	HRS	BW	OBS	BL	LS	IBI	OA
Acinonyx jubatus	0.120	67.49	36.5	2.013	1619.71	3.8	18	4.17
Felis bengalensis	------	9.00	5.5	------	720.54	2.5	12	2.14
Felis caracal	------	------	11.59	2.087	742.48	3.0	12	------
Felis concolor	0.023	48.62	51.8	5.427	1176.15	2.5	19	4.03
Felis geoffroyi	------	1.80	2.2	------	------	2.0	12	------
Felis manul	------	------	------	0.655	555.57	------	------	------
Felis margarita	------	------	------	0.544	------	------	------	2.57
Felis pardalis	0.800	2.78	11.88	2.714	915.99	2.5	------	------
Felis rufus	1.946	30.69	6.2	1.751	651.97	3.2	12	------
Felis serval	0.416	1.50	11.7	2.443	772.78	2.4	6	------
Felis temminicki	------	------	------	------	796.32	------	------	------
Panthera leo	0.053	240.0	159.3	7.146	2591.52	2.6	25	5.25
Panthera onca	0.060	31.50	86.2	4.385	1352.89	2.5	------	3.89
Panthera pardus	0.992	23.59	52.4	3.821	1152.86	2.6	24	3.89
Panthera tigris	0.025	71.38	132	11.93	2230.54	2.5	32	5.50
Panthera uncia	0.008	138.0	32.28	2.591	1053.63	2.8	------	------

Inter-Birth Interval: Number of months between successive births (Source: Gittleman, 1986).

Litter Size: Average number of offspring at birth (Source: Gittleman, 1986).

Olfactory Bulb Size: Volume estimated from length, height, and width using the following equation: *Volume = 1/4 x 3.14 x a x b x c* (Source: Gittleman, 1991).

Orbital Area: Average area of eye size (Source: Radinsky, 1981).

Population Density: Average number of individuals per sq. km. (Source: Provost et al., 1973; Bertram, 1978; Eaton, 1978; Berg, 1979; Lembeck and Gould, 1979; Geertsema, 1985; Seidensticker, 1987; Caro, 1994).

Data Analyses

All data were logarithmically transformed prior to statistical analyses (Harvey, 1982). Because chemical signals were shown to be related to phylogeny (Chapter 4), it was necessary to test for statistical independence in the comparative data (Felsenstein, 1985). Therefore, correlations, using a Moran's I statistic, was performed on each variable to test for phylogenetic pattern (for details of the method see Gittleman and Kot, 1990). The patristic distance matrix from Collier and O'Brien's (1985) molecular phylogeny was used in this analysis because it represents an independent phylogeny and is statistically most similar to the phylogeny produced with chemical data (Chapter 4). For those characters that showed a statistical correlation with phylogeny, spatial autocorrelation was used to remove the effects of phylogeny (Gittleman and Kot, 1990) and residuals were then used for further data analyses only when there was a significant correlation. Ecological (e.g., home range size, population density) and life history traits are typically correlated with body size (Gittleman and Harvey, 1982;

Gittleman, 1985). Therefore, allometric relationships were assessed in the present analysis and, when significant correlations were observed, body size effects were removed by using the residual values for subsequent data analyses.

Correlation coefficients were used to assess relationships between ecological, morphological, and life history variables with high, medium, and low volatility. Differences in relative volatility across habitat types were assessed by pairwise comparisons using t-tests. There were a lot of correlations performed here because of the many hypotheses and many variables included in this study. Although spurious correlations may result in one out of twenty times, this study is preliminary and, therefore, it's general aim is to set forth additional hypotheses to be tested.

Results

Even though there was a significant inverse correlation between high and low volatility for the neutral lipids ($r=-0.7166$; $p=0.001$), glycolipids ($r=-0.8564$; $p=0.00002$) and polar lipid fragments ($r=-0.8007$; $p=0.0003$), all analyses were performed using high, medium, and low volatility because there was still considerable variation among the three measures (Figs. 5-1, 5-2 & 5-3).

The high volatile glycolipid and neutral lipids and the medium volatile glycolipids were significantly correlated with phylogeny (Fig. 5-4). Olfactory bulb size, head and body length, and inter-birth interval were also correlated with phylogeny (Fig. 5-5). Inter-birth interval ($r=0.774$; $p=0.008$), home range size ($r=0.817$; $p=0.002$),

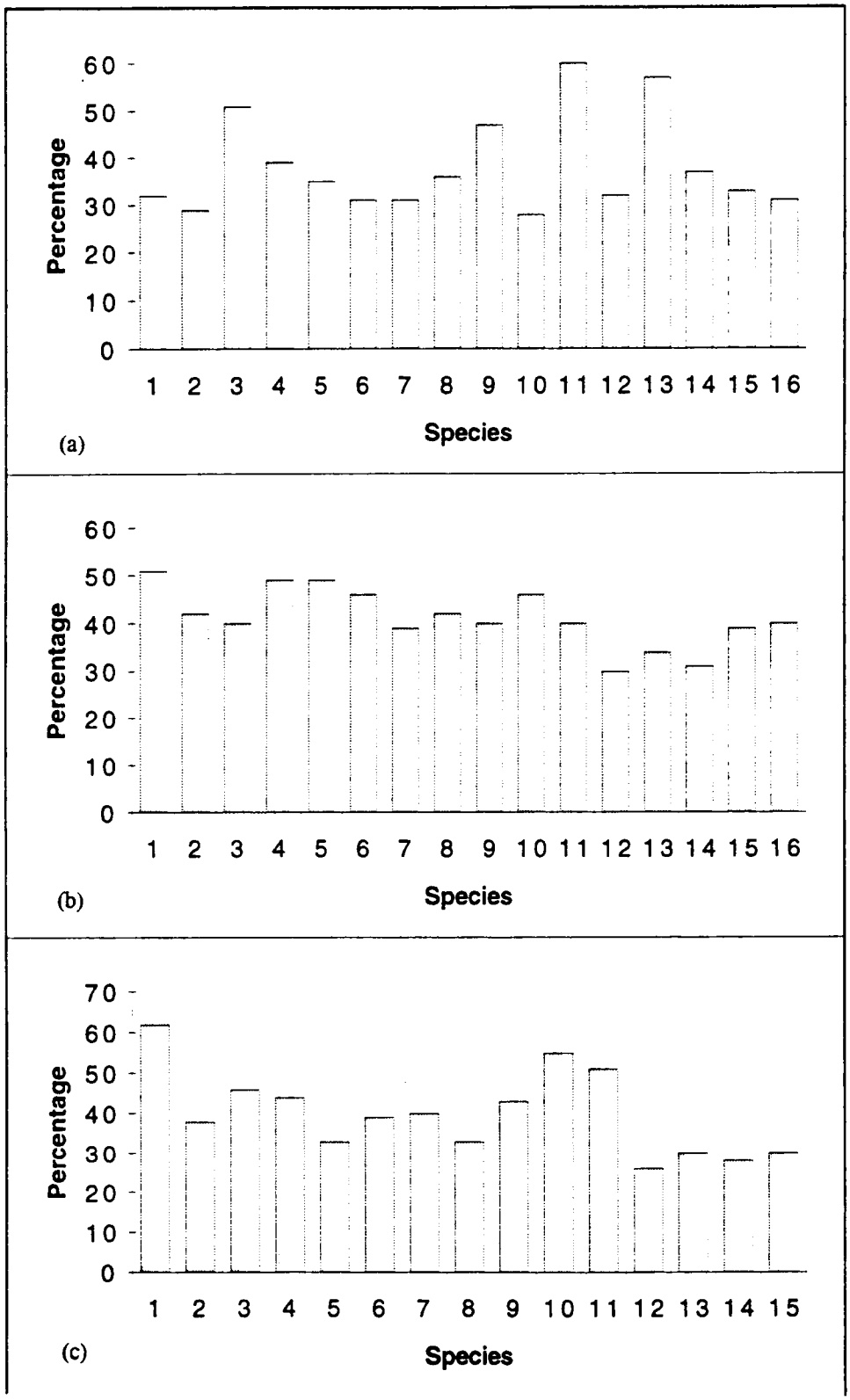


Figure 5-1.--Percent high volatility of (a) Glycolipids; (b) Neutral Lipids; (c) Phospholipids in anal gland secretions across felid species. 1=*Acinonyx jubatus*; 2=*Felis bengalensis*; 3=*F. caracal*; 4=*F. concolor*; 5=*F. geoffroyi*; 6=*F. manul*; 7=*F. margarita*; 8=*F. pardalis*; 9=*F. rufus*; 10=*F. serval*; 11=*F. temminicki*; 12=*Panthera leo*; 13=*P. onca*; 14=*P. pardus*; 15=*P. tigris*; 16=*P. uncia*. Note: *F. rufus* is missing in phospholipid fraction.

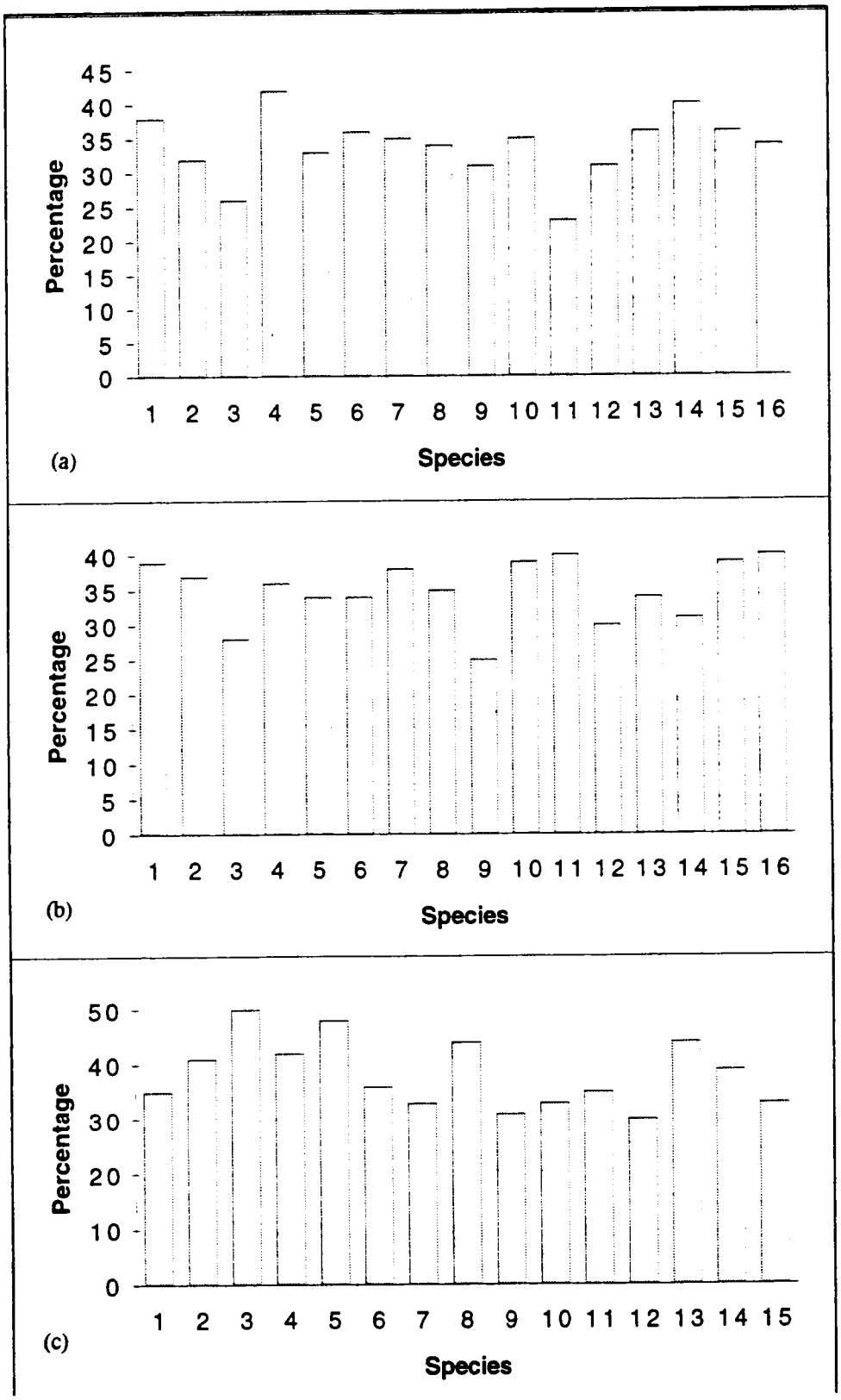


Figure 5-2.--Percent medium volatility of (a) Glycolipids; (b) Neutral Lipids; (c) Phospholipids in anal gland secretions across felid species. 1=*Acinonyx jubatus*; 2=*Felis bengalensis*; 3=*F. caracal*; 4=*F. concolor*; 5=*F. geoffroyi*; 6=*F. manul*; 7=*F. margarita*; 8=*F. pardalis*; 9=*F. rufus*; 10=*F. serval*; 11=*F. temminicki*; 12=*Panthera leo*; 13=*P. onca*; 14=*P. pardus*; 15=*P. tigris*; 16=*P. uncia*. Note: *F. rufus* is missing in phospholipid fraction.

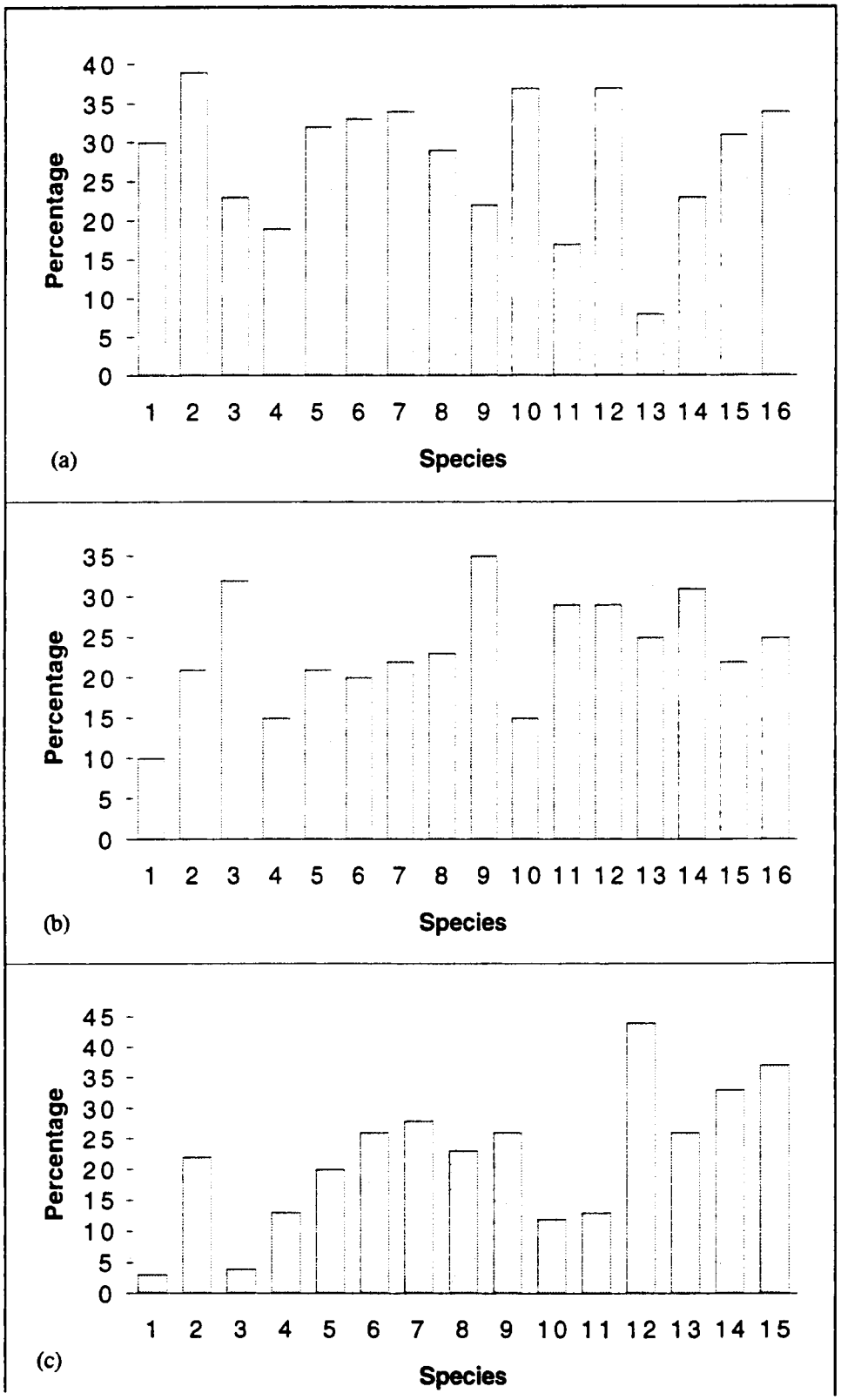


Figure 5-3.--Percent low volatility of (a) Glycolipids; (b) Neutral Lipids; (c) Phospholipids in anal gland secretions across felid species. 1=*Acinonyx jubatus*; 2=*Felis bengalensis*; 3=*F. caracal*; 4=*F. concolor*; 5=*F. geoffroyi*; 6=*F. manul*; 7=*F. margarita*; 8=*F. pardalis*; 9=*F. rufus*; 10=*F. serval*; 11=*F. temminicki*; 12=*Panthera leo*; 13=*P. onca*; 14=*P. pardus*; 15=*P. tigris*; 16=*P. uncia*. Note: *F. rufus* is missing in phospholipid fraction.

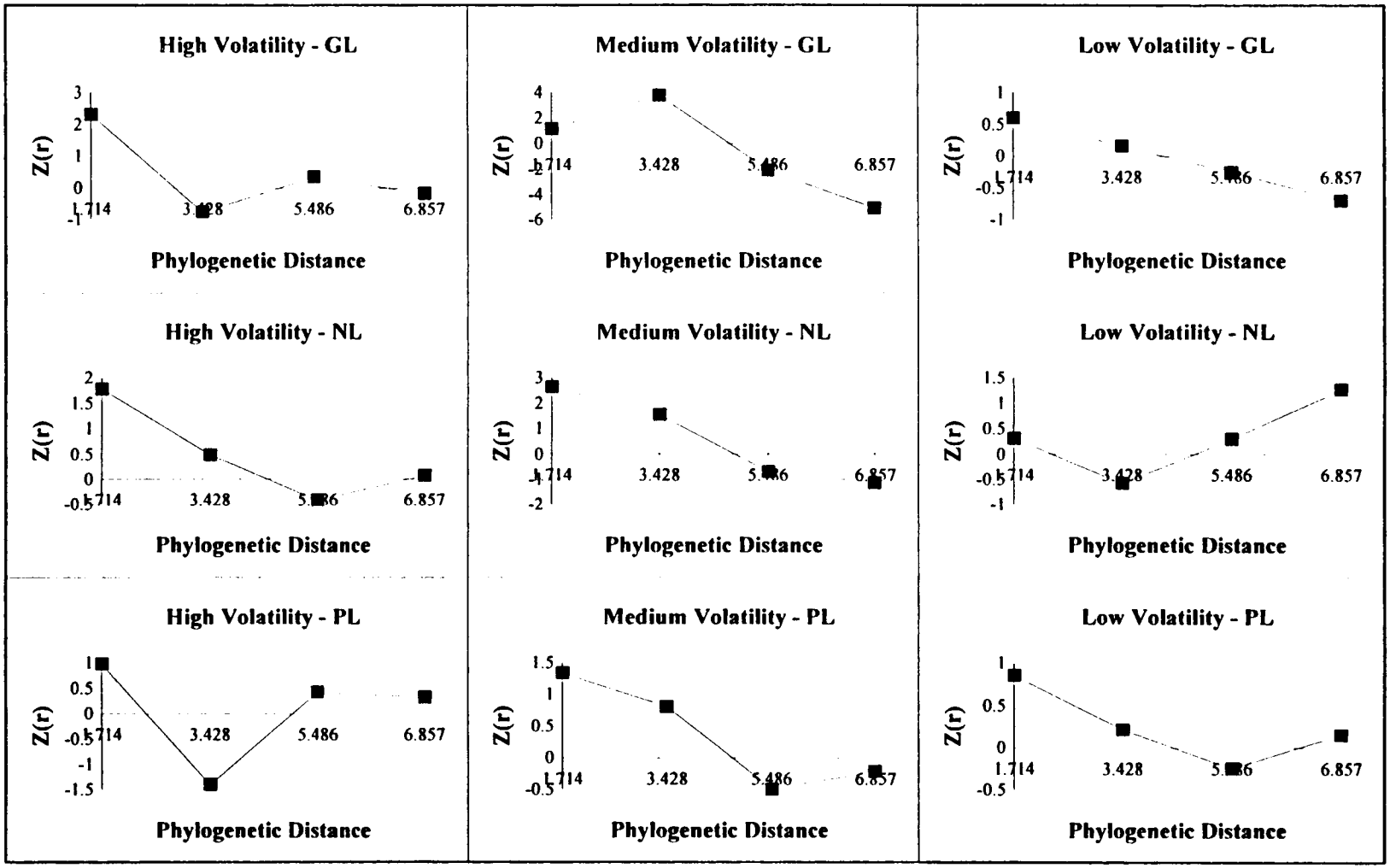


Figure 5-4.--Correlograms of high, medium, and low volatilities for glycolipids (GL), neutral lipids (NL), and phospholipids (PL). A Z(r) of greater than 1.96 represents a significant correlation.

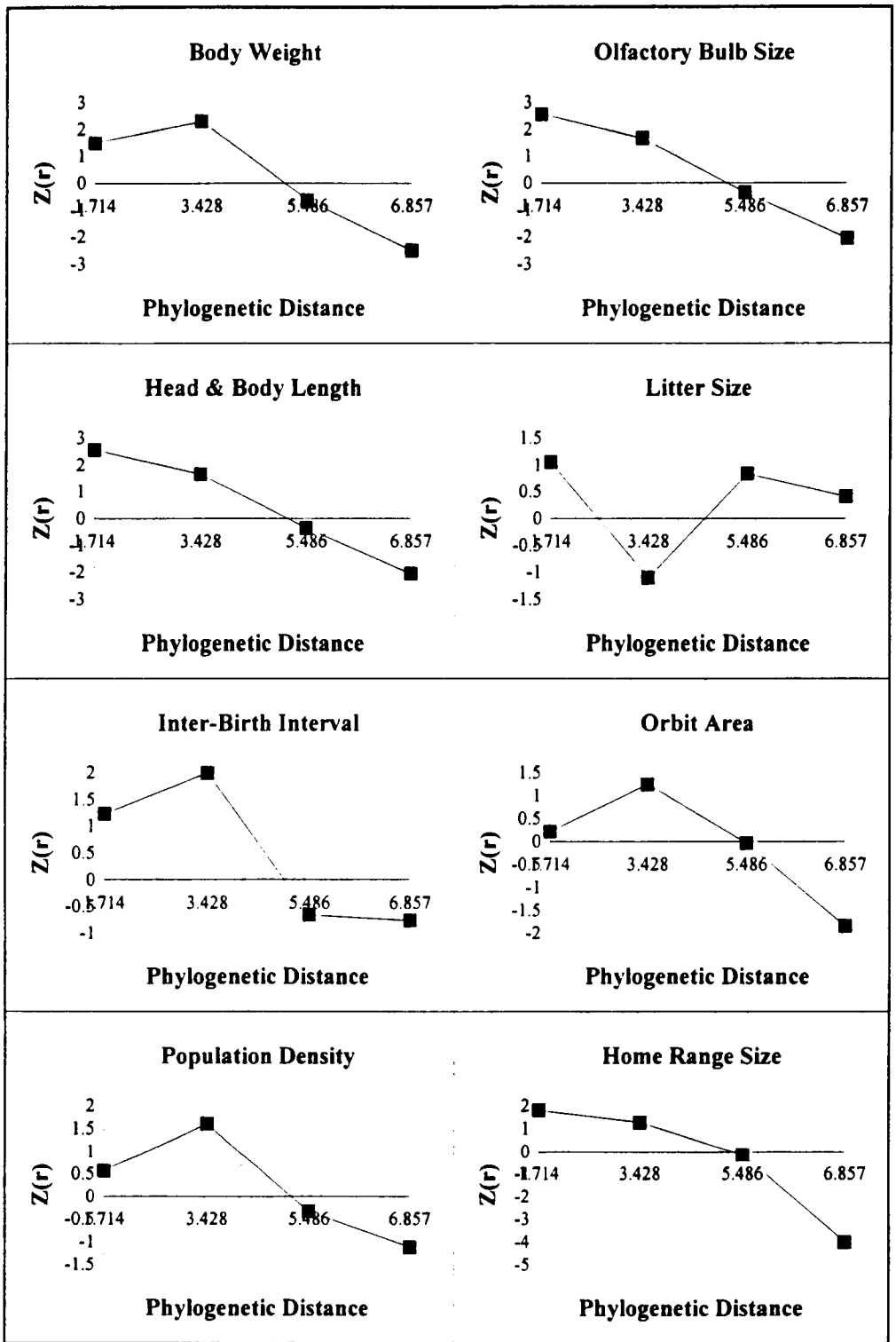


Figure 5-5.--Correlograms of morphological, ecological, and life history variables. A Z(r) of greater than 1.96 represents a significant correlation.

olfactory bulb size (r=0.855; p=0.0008), and orbital area (r=0.962; p=0.0001) were significantly correlated with body size.

Body weight (r=0.5839; p=0.0361) and head and body length (r=0.6029; p=0.0291) were significantly correlated with medium volatility for the polar lipid fragment (Table 5-3). Litter size was significantly correlated with low volatility for both the polar lipid fragment (r=0.6868; p=0.0136) and for the combined data (r=0.6671; p=0.0178). The volatility of open grassland species was significantly greater than that for forest dwelling species for the polar lipid fragment (high volatility t=5.376; p=0.033; low volatility t=-5.333; p=0.033) (Table 5-4). No significant correlations were found for all other variables (Tables 5-3 & 5-4).

Discussion

Ecological Correlates

There were no significant correlations between home range size and volatility for any of the lipid fractions. An animal with a large home range size cannot possibly defend the entire area and, therefore, probably does not produce potentially costly low volatile compounds in relation to home range movements. Furthermore, animals with larger home ranges are unlikely to encounter other animals by chance. Additionally, male home range size shifts in response to several factors such as waterways (Antilocapra americana - pronghorn - Clemente et al., 1995), food resources (Vulpes vulpes - red fox - Lovari et al., 1994), and female home range size (Taxidea taxus - badger - Minta, 1993; Martes martes - pine marten - Katnik et al., 1994; Apodemus

Table 5-3.--Correlation values for ecological, morphological, and life history variable with high, medium, and low volatility. Values in bold represent significant correlations. GL=glycolipids; NL=neutral lipids; PL=phospholipids; ALL=combined data set.

	High Volatility			
Variables	**GL**	**NL**	**PL**	**ALL**
Body Weight	0.046	-0.536	-0.040	-0.471
Head & Body Length	-0.060	-0.133	-0.274	-0.040
Home Range Size	-0.273	0.092	0.251	0.040
Inter-Birth Interval	0.249	-0.153	-0.438	0.640
Litter Size	0.154	0.064	0.562	-0.188
Olfactory Bulb Size	-0.049	-0.011	-0.325	0.330
Orbit Area	-0.701	0.582	0.601	0.249
Population Density	0.059	-0.072	-0.107	0.233

	Medium Volatility			
Variables	**GL**	**NL**	**PL**	**ALL**
Body Weight	-0.205	0.405	**0.583**	0.127
Head & Body Length	-0.211	0.457	**0.602**	0.434
Home Range Size	0.097	-0.197	-0.251	-0.113
Inter-Birth Interval	-0.247	0.083	-0.106	0.519
Litter Size	0.471	-0.094	-0.293	-0.206
Olfactory Bulb Size	-0.297	-0.040	-0.124	0.235
Orbit Area	0.409	0.231	-0.144	0.330
Population Density	-0.263	-0.319	-0.603	0.066

	Low Volatility			
Variables	**GL**	**NL**	**PL**	**ALL**
Body Weight	-0.276	-0.019	0.064	-0.022
Head & Body Length	-0.190	-0.330	0.020	-0.159
Home Range Size	0.295	-0.039	-0.329	-0.120
Inter-Birth Interval	-0.203	-0.323	0.055	0.100
Litter Size	-0.039	-0.129	**-0.686**	**-0.667**
Olfactory Bulb Size	0.143	0.220	0.378	0.446
Orbit Area	0.629	-0.683	**-0.728**	-0.489
Population Density	0.146	0.375	0.104	0.248

Table 5-4.--Results of pairwise comparisons of relative volatility of chemicals present in anal sac secretions with habitat in felid species. The first number of each pair represents the t-value. The number in parentheses is the p value. Values in bold represent significant differences.

	High Volatility		
Habitat	**Glycolipids**	**Neutral lipids**	**Polar Frag.**
Open Grassland vs. Forest	-0.196 (0.862)	0.247 (0.827)	**5.376 (0.0329)**
Open Grassland vs. Woodland	0.788 (0.513)	0.377 (0.741)	**17.000 (0.037)**
Forest vs. Woodland	-0.032 (0.976)	-0.209 (0.853)	-0.333 (0.795)

	Medium Volatility		
Habitat	**Glycolipids**	**Neutral lipids**	**Polar Frag.**
Open Grassland vs. Forest	0.548 (0.638)	-0.610 (0.603)	0.433 (0.706)
Open Grassland vs. Woodland	-3.927 (0.059)	0.0001 (1.000)	-0.076 (0.951)
Forest vs. Woodland	-0.976 (0.431)	1.710 (0.229)	-1.000 (0.500)

	Low Volatility		
Habitat	**Glycolipids**	**Neutral lipids**	**Polar Frag.**
Open Grassland vs. Forest	0.152 (0.892)	-0.763 (0.525)	**-5.333 (0.033)**
Open Grassland vs. Woodland	2.205 (0.158)	-3.779 (0.063)	-2.666 (0.228)
Forest vs. Woodland	1.801 (0.213)	0.313 (0.783)	0.500 (0.704)

sylvaticus - Old World wood mouse - Tew and MacDonald, 1994). Therefore, it may be more effective and less costly to increase marking intensity (Richardson, 1993) rather than varying the volatility of the scent mark. Although home range size is not directly related to volatility of the scent marks, there is no doubt that olfactory mechanisms are important to communicate information such as identity, sexual status, and reproductive condition (Chapter 3). Therefore, other strategies are most likely in place to deter costly aggressive encounters between conspecifics. Evidence for this suggestion shows that clashes between lions (Bertram, 1978) and cheetahs (Caro, 1994) are very rare at home range boundaries. Furthermore, there is ample evidence which suggests that felids mark their home range boundaries and that conspecifics use this information to mutually avoid each other (leopards - Schaller, 1972; bobcats - Bailey, 1974; cheetahs - Guggisberg, 1975; sand cats - Leyhausen, 1979; Spanish lynx - Robinson and Delibes, 1988).

The present study shows that scent secretions of species living in open grasslands are more highly volatile than those of forest living species. The type of habitat and, in turn, the substrate that is marked, may have a great effect on the volatility of the scent mark. For example, the surface area, porosity, and chemical charge of a substrate affects the rate of signal release from scent marks (Alberts, 1992). Therefore, by varying the substrate to which secretions are applied, a signaler can adjust the dissipation rate of a scent mark at little additional energetic cost. For instance, Ursus arctos (grizzly bears) selectively scent mark amabilis fir trees, which produce abundant sap that may serve to retard odor evaporation (Lloyd, 1978).

Therefore, the substrate in forests probably aids the scent from dissipating rapidly and allows it to remain in place longer. On the other hand, the available substrate for depositing scent in open grasslands is such that the scent mark dissipates rapidly; thus it would be disadvantageous for an open grassland species to deposit a compound of low volatility because heavier compounds are more costly to produce (Alberts, 1992).

Although no significant correlations exist between population density and relative volatility for any of the lipid fractions, olfactory cues still may be important in regulation of prey density. For example, Saguinus oedipus (cotton-top tamarins) have an innate ability to recognize and avoid the scents of predators (Buchanan-Smith et al., 1993). Furthermore, the population density of Peromyscus maniculatus (deer mice) decreases in response to mustelid semiochemicals (Zimmerling and Sullivan, 1994). Thus, the volatility of predator semiochemicals may vary with prey population density.

Life History Correlates

Although no significant correlations exist between relative volatility and inter-birth interval, the phospholipid fraction reveals a strong positive correlation (0.640) between medium volatility and inter-birth interval, suggesting that this life history trait is not related to the volatility of the compounds. This further suggests that species who reproduce more frequently do not rely upon the volatility of the compounds, but may instead produce the compound more frequently to communicate its reproductive status.

Litter size was significantly correlated with low volatility for the phospholipid fraction, suggesting the importance of olfactory communication between an offspring

and its mother. A species with a larger litter size produces scent that is more volatile, and therefore, disperses faster to ensure that all offspring receive the message. Support for this finding shows that female bobcats tend to mark more intensely when they have a litter of kittens (Bailey, 1974). While most studies focus on auditory cues as being important for mother-offspring recognition (e.g., Beer, 1970; Evans, 1980; McArthur, 1982; Hanggi, 1992; Smolker et al., 1993), fewer studies recognize the importance of other cues (i.e., pelage pigmentation - Ruiz-Miranda, 1993; olfactory cues - McCracken and Gustin, 1991; Beauchamp et al., 1994; Bordi et al., 1994; Porter et al., 1994). In fact, olfactory cues seem to be very important in this respect. For example, Beauchamp et al. (1994) demonstrated that olfactory cues used in recognition between mothers and offspring are innate, developed and expressed *in utero*. Results of this study not only suggest the importance of olfactory cues in mother-offspring recognition, but also that the average litter size for a species varies with the relative volatility of the scent.

Morphological Correlates

Head and body length is significantly correlated with medium volatility for the neutral lipid fraction; similarly, a suggestive but non-significant correlation ($r=0.584$) is observed between body weight and medium volatility for the neutral lipid fraction. These results suggest that there is little cost associated with producing these chemical compounds and that preexisting glands and enzymes are most likely used.

Other studies on the determination of a cost of chemical compounds present mixed results. Some conclude a cost as indicated by lower weight or lower growth rate (Cohen, 1985; Rowell-Rahier and Pasteels, 1986; Bjorkman and Larsson, 1991; Bowers and Collinge, 1992) while others reveal no apparent cost (Erickson, 1973; Seiber et al., 1980; Cohen, 1985; Rowell-Rahier and Pasteels, 1986; Bowers, 1988;). In fact, Bjorkman and Larsson (1991) indicate that certain insects change their feeding behavior in response to a need to sequester other compounds. Additionally, several studies show that insects with a chemically-based anti-predator defense are better protected against natural enemies when feeding on tissue rich in the sequestered chemical (Brower and Moffitt, 1974; Campbell and Duffey, 1979; Smiley et al., 1985).

Regarding more specific morphological traits, the relationship between olfactory bulb size and relative volatility has previously not been investigated. Results of this study suggest that there is a trend, although not significant, toward species with large olfactory bulbs possessing low volatile compounds and those with small olfactory bulbs having highly volatile compounds. The relationship of scents to the olfactory bulb is obviously important, as evidenced by the decrease of social behavior in Microtus ochrogaster (prairie voles) following an olfactory bulbectomy (Kirkpatrick et al., 1994). Furthermore, Li et al. (1994) electrically stimulated the pathways to the olfactory bulbs that are responsible for receiving sensory input from pheromones which block pregnancy in female mice. This stimulation induces pregnancy block which is similar to that induced naturally by pheromones. However, the importance of specific aspects of the olfactory bulb, such as weight or details of the microanatomy (e.g.,

glomeruli - Ressler et al., 1994; Vassar et al., 1994) in relation to scent is unclear. Perhaps the distribution of the glomeruli within the olfactory bulb could shed light on the importance of its overall size in relation to scents. For example, the spatial distribution and number of glomeruli may dictate, in part, the size of the olfactory bulbs. Further studies, with larger sample sizes and perhaps for species with more variation in olfactory bulb size are needed to determine whether volatility is indeed related to olfactory bulb size.

Orbit area, which is an estimator of reliance on vision (Radinsky, 1981), is significantly correlated with low volatility for the phospholipid fraction. This suggests that species with smaller orbital areas rely less on visual communication and perhaps more on chemical communication. This hypothesis is further supported by the fact that species with smaller orbital areas have less volatile chemicals which remain for a longer period of time. On the other hand, species with a large orbit area probably rely more on visual communication and the chemicals are highly volatile and remain only for short term communication.

Overview

There are few significant correlations between the ecological, morphological, and life history variables with volatility. However, since there is ample evidence that suggests that animals communicate with conspecifics through olfaction, other mechanisms are most likely used to control the dissipation rate of the chemicals in the scent marks. One strategy for increasing the life of a signal is through the use of carrier

compounds to retard evaporation of volatile compounds. Sebum slows evaporation and increases persistence of otherwise volatile signals (Regnier and Goodwin, 1977). For example, despite the high volatility of the carboxylic acids present in the anal glands of the Indian mongooses, the secretion retains its activity for up to 14 days, probably owing to lipids in sebum that act as carriers for more volatile components (Gorman et al., 1974). Furthermore, some shrew species can discharge volatile compounds either directly from their postauricular sweat glands or else in conjunction with sebum from separate side glands, which allows them to control how quickly their signal dissipates (Dryden and Conaway, 1967). Other long chain chemical constituents, such as squalene, may act to increase the persistence of volatile components in scent marks (Russell, 1985).

Results of this study suggest that relative volatility, although an important factor in controlling the amount of compounds present at a certain time, should not solely be used to determine the relationship between chemical structure and function. Future studies should examine the relative contributions of carrier compounds and proteins which can effect the persistence of the signal as well as the substrate on which the scent is deposited.

Chapter 6

Summary and Conclusions

This study demonstrates the usefulness of chemical signals as characters in phylogenetic studies of the Felidae. The chemicals from the anal sacs of felid species reveal consistent relationships among felid species, and resolve relationships that are unclear using morphological and molecular traits. For example, Acinonyx jubatus (cheetah) branches as the most primitve taxa to the Felidae, a position that is not resolved in phylogenies based on morphological and molecular data sets. Further, the chemical data also clarify unresolved relationships among the Panthera species. However, regardless of the types of characters used, the position of Felis concolor (puma) remains ambiguous. The chemicals used in this study are species-specific and used in specific mate recognition. However, other traits likely play a very important role in the specific mate recognition system. Perhaps a combination of behavioral, morphological, molecular, and chemical characters are needed to resolve the more difficult relationships such as with F. concolor (puma).

This study also demonstrates the importance of chemical signals in intraspecific communication. For individuals within a single species, the chemicals vary quantitatively and are important for communicating individual, reproductive, sexual, and dominance status to conspecifics. For example, males most likely use some sort of cues to determine whether a female is in reproductive condition. This study demonstrates that chemical cues are at least partially used to communicate this information to males. Further, dominant and subordinate information is transferred between individuals. There is ample behavioral

data which suggest that dominant individuals scent mark more frequently than subordinate individuals and that dominant males usually gain access to reproductive females over subordinate males. The chemical data from this study suggests that dominant individuals have different amounts of compounds. However, because of small sample sizes, this trend is not strong.

The relative volatility of chemical compounds in a scent mark is clearly important. For example, litter size is greater in felid species that produce scent marks with more compounds of lower volatility, and lower in those species with compounds of high volatility. Furthermore, there is a trend for felid species with large olfactory bulbs to possess low volatile compounds and those with small olfactory bulbs to have highly volatile compounds. However, other factors that control the rate of signal release are obviously important and should be considered when attempting to study the functional significance of the chemicals present in scent marks.

This study can be improved by increasing sample sizes, particularly for the study on intraspecific variation. Many of the small cats are not included in this study due to their rareness and lack of representation in zoos. The chemical data most likely would have been useful to resolve major relationships among the small cats. For example, the relationships among the lynxes are ambiguous using morphological and molecular data sets. Similarly, the relationships of Felis sylvestris (European wild cat) and F. lybica (African wildcat) with many of the other small cats (e.g., F. bieti - Chinese desert cat; F. chaus - jungle cat; F. margarita - sand cat; F. nigripes - black-footed cat) is unclear. Finally, because the chemicals present in felid anal sacs are represented in such small

quantities, identification of some of the compounds are hopeless. However, information concerning diagnostic ions, molecular weights, and retention indices are given in the Appendix. This information can perhaps be used in conjunction with future studies of felid anal sac secretions to elucidate chemical structure.

Chemical communication is an exciting field of research which has been well studied in some groups (e.g., insects), but relatively neglected in mammals, with the exception of the Order Rodentia. Few studies have focused on chemical communication in large mammals such as in the Order Carnivora. This is not surprising considering the fact that olfactory communication is more difficult to study in this group due to their largely nocturnal and secretive nature. Several functions of scent marking have been proposed, of which many are anecdotal or interpreted with preconceived notions of function in mind (Johnson, 1973). Chemical analyses of scent secretions can provide more detailed information on function by identifying the potentially active compounds from amongst the hundreds of chemicals commonly found in the mixture.

Besides containing behaviorally active compounds, glandular secretions probably contain behaviorally inactive metabolites and fixatives which are involved in the control of the release and stability of chemical communicants (Regnier and Goodwin, 1977). Fractionation of these potentially active compounds could provide a means for assessing the scent marks specific function by assessing an animals reaction toward a bioassay. For instance, Smith et al. (1985) demonstrated that tamarin monkeys could distinguish sex based on a subset of compounds. By characterizing chemical compounds which make up an anal gland secretion, progress can be made toward determining whether specific classes

of compounds are responsible for a certain set of functional attributes. Odors are very difficult to characterize. However, compounds with functional groups are generally considered odoriferous (Raymer et al., 1985). The quality of an odor is usually based on molecular configuration rather than chemical properties (Macleod, 1980). Therefore, chemical analysis of scent secretions allows one to determine the configuration of the potentially active compounds which, in turn, may allow prediction of function. For example, acids are commonly seen in anal gland secretions (Albone and Eglington, 1974; Doty and Dunbar, 1974; Gorman et al., 1974; Albone and Perry, 1975; Preti et al., 1976; Sokolov et al., 1980; Goodrich et al., 1981; Decker et al., 1992), which may suggest that anal glands are involved in a specific set of communicatory cues.

In summary, future studies need to emphasize chemical analysis of scent secretions. These analyses can separate the potential information carrying compounds from those that are behaviorally inactive. After chemical analyses are complete, behavioral studies need to be done using bioassays that contain subsets of the chemicals to more effectively assess the biological function. This field remains a difficult one in that mammalian behavior is very complex, and the context in which an animal perceives a scent mark could have a dramatic effect on it's reaction, and consequently, on the postulated function of the odor. Nevertheless, olfaction is a very important mode of communication for most carnivores (MacDonald, 1985) and studies desperately need to be done.

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APPENDIX A

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Table A-1.--Relative amount (picomoles) of glycolipids in right and left anal sacs of *Panthera pardus* (leopard) and *P. tigris* (tiger). Dashed lines represent the absence of a compound.

Compounds	*Panthera pardus*		*Panthera tigris*		*Panthera tigris*	
	R. Sac	L. Sac	L. Sac	R. Sac	L. Sac	R. Sac
X-oxo-Nonanoic acid	0.24079	0.24014	----------	----------	----------	----------
10 carbon compound D	0.05181	0.05151	----------	----------	----------	----------
11 carbon compound F	0.32730	0.32731	----------	----------	----------	----------
11 carbon compound G	0.14396	0.14397	----------	----------	----------	----------
11 carbon compound H	0.05069	0.05061	----------	----------	----------	----------
11 carbon compound I	----------	----------	0.45790	0.45798	0.4793	0.47954
11 carbon compound J	0.01589	0.01553	0.27859	0.27849	0.27785	0.27782
11 carbon compound K	0.04466	0.04416	----------	----------	----------	----------
11 carbon compound N	0.01222	0.01276	----------	----------	----------	----------
Dodecanoic acid	0.01533	0.01570	----------	----------	----------	----------
Nonanedioic acid	0.02980	0.02965	----------	----------	----------	----------
12 carbon compound Q	----------	----------	0.17498	0.17487	0.18979	0.18924
12 carbon compound S	0.02844	0.02830	----------	----------	----------	----------
12 carbon compound T	1.12872	1.12875	----------	----------	----------	----------
12 carbon compound U	0.03118	0.03127	----------	----------	----------	----------
2,6-bis(1,1-dimethylethyl)-4-ethyl Phenol	0.03979	0.03991	----------	----------	----------	----------
12 carbon compound W	----------	----------	0.01749	0.01798	0.01372	0.01399
12 carbon compound X	----------	----------	0.02734	0.02774	0.02847	0.02838
12 carbon compound Y	0.26622	0.26635	----------	----------	----------	----------
12 carbon compound AA	0.03502	0.03581	----------	----------	----------	----------
12 carbon compound AB	----------	----------	0.00397	0.00382	0.00348	0.00398
Tridecanoic acid	0.37148	0.37151	----------	----------	----------	----------
13 carbon compound AC	0.25034	0.25029	0.17849	0.17842	0.19748	0.19787
13 carbon compound AF	0.08564	0.08536	----------	----------	----------	----------
13 carbon compound AI	0.09835	0.09813	----------	----------	----------	----------
13 carbon compound AL	0.10246	0.10258	----------	----------	----------	----------
13 carbon compound AM	----------	----------	0.01739	0.01798	0.01972	0.01948
13 carbon compound AN	0.02460	0.02946	0.05759	0.05798	0.02403	0.02489
13 carbon compound AP	0.01865	0.01895	----------	----------	----------	----------
Tetradecanoic acid	1.47660	1.47002	0.07984	0.07947	0.06816	0.06895
14 carbon compound AW	0.04548	0.04232	----------	----------	----------	----------
14 carbon alcohol	0.01855	0.01873	----------	----------	----------	----------
14 carbon compound BA	5.21293	5.21264	----------	----------	----------	----------
14 carbon compound BC	0.32442	0.32467	----------	----------	----------	----------
14 carbon compound BD	0.28264	0.28292	----------	----------	----------	----------
14 carbon compound BE	0.02286	0.02247	----------	----------	----------	----------
Pentadecanoic acid	0.41720	0.02259	0.18498	0.18497	0.10897	0.10859
15 carbon compound BI	0.05773	0.05761	----------	----------	----------	----------
X-Hydroxy-Tetradecanoic acid	0.03951	0.03994	----------	----------	----------	----------
15 carbon compound BK	0.97067	0.97027	----------	----------	----------	----------
15 carbon compound BM	0.16289	0.16244	----------	----------	----------	----------
15 carbon compound BO	0.49633	0.49611	----------	----------	----------	----------
15 carbon alcohol	0.53713	0.53750	----------	----------	----------	----------
15 carbon compound BQ	0.79724	0.79766	----------	----------	----------	----------
15 carbon compound BR	0.15833	0.15819	----------	----------	----------	----------

Table A-1.--(continued)

Compounds	Panthera pardus		Panthera tigris		Panthera tigris	
	R. Sac	L. Sac	L. Sac	R. Sac	L. Sac	R. Sac
15 carbon compound BS	8.17168	8.17107	----------	----------	----------	----------
15 carbon compound BT	----------	----------	0.01838	0.01894	0.01942	0.01949
Hexadecanoic acid	0.53088	0.53096	0.00859	0.00897	0.00894	0.00890
16 carbon compound BV	----------	----------	0.00573	0.00589	0.00593	0.00582
16 carbon compound BW	16.47686	16.47659	----------	----------	----------	----------
16 carbon compound BY	3.46563	3.46592	----------	----------	----------	----------
16 carbon compound BZ	----------	----------	0.00578	0.00589	0.00483	0.00495
16 carbon compound CA	0.14438	0.14416	----------	----------	----------	----------
16 carbon compound CB	6.23096	6.23011	----------	----------	----------	----------
16 carbon alcohol	0.07607	0.07601	----------	----------	----------	----------
16 carbon compound CC	0.17429	0.17453	----------	----------	----------	----------
14-methyl Hexadecanoic acid	0.37335	0.37386	----------	----------	----------	----------
X-hydroxy-Hexadecanoic acid	0.17754	0.17766	----------	----------	----------	----------
16 carbon compound CF	0.08764	0.08762	----------	----------	----------	----------
16 carbon compound CG	----------	----------	0.00579	0.00584	0.00472	0.00402
Heptadecanoic acid	5.25435	5.25436	0.04798	0.04798	0.03856	0.03857
17 carbon compound CI	1.20836	1.20889	----------	----------	----------	----------
17 carbon compound CJ	0.07508	0.07517	----------	----------	----------	----------
17 carbon compound CL	0.20726	0.20732	----------	----------	----------	----------
17 carbon compound CM	0.47357	0.47335	----------	----------	----------	----------
17 carbon compound CN	0.71017	0.71094	----------	----------	----------	----------
9,12-Octadecanoic acid	0.05464	0.05486	----------	----------	----------	----------
X-Octadecanoic acid	0.61518	0.61500	----------	----------	----------	----------
X-Octadecanoic acid	0.51397	0.51336	----------	----------	----------	----------
17 carbon compound CQ	0.24617	0.24662	----------	----------	----------	----------
X-Octadecanoic acid	0.28989	0.28998	----------	----------	----------	----------
Octadecanoic acid	1.41641	1.41699	0.05798	0.05798	0.03489	0.03479
18 carbon compound CT	0.10688	0.10648	----------	----------	----------	----------
18 carbon compound CW	0.24641	0.24671	0.01748	0.01776	0.01847	0.01849
18 carbon compound CX	0.11066	0.11070	----------	----------	----------	----------
18 carbon compound CZ	0.04146	0.04123	----------	----------	----------	----------
X-methyl Octadecanoic acid	0.07703	0.07753	----------	----------	----------	----------
18 carbon compound DB	0.34872	0.34859	----------	----------	----------	----------
18 carbon compound DC	0.16283	0.16286	0.04732	0.04759	0.03487	0.03493
18 carbon compound DD	0.24152	0.24168	----------	----------	----------	----------
18 carbon compound DE	0.03478	0.03404	----------	----------	----------	----------
19 carbon compound DG	----------	----------	0.01835	0.01849	0.01974	0.01949
19 carbon compound DH	0.22501	0.22579	----------	----------	----------	----------
X,X,X,X-Eicosatetraenoic acid	0.21277	0.21206	----------	----------	----------	----------
2-Hydroxy-Octanoic acid	0.14022	0.14068	0.01733	0.01798	0.01747	0.01748
19 carbon compound DI	0.02620	0.02659	----------	----------	----------	----------
19 carbon compound DJ	0.03582	0.03510	----------	----------	----------	----------
19 carbon compound DK	----------	----------	0.03749	0.03798	0.04235	0.04294
19 carbon compound DL	0.10388	0.10329	----------	----------	----------	----------
19 carbon compound DN	0.06648	0.06644	----------	----------	----------	----------
X,X-Eicosadienoic acid	----------	----------	0.01742	0.01759	0.01849	0.01890
X-Eicosanoic acid	0.88228	0.88206	----------	----------	----------	----------

Table A-1.--(continued)

Compounds	Panthera pardus		Panthera tigris		Panthera tigris	
	R. Sac	L. Sac	L. Sac	R. Sac	L. Sac	R. Sac
X-Eicosanoic acid	0.02662	0.02679	----------	----------	----------	----------
19 carbon compound DR	0.04665	0.04632	----------	----------	----------	----------
19 carbon compound DS	----------	----------	0.15004	0.15086	0.19042	0.19049
19 carbon compound DT	0.19771	0.19710	----------	----------	----------	----------
Eicosanoic acid	0.05236	0.05274	0.01278	0.01289	0.01944	0.01949
20 carbon compound DW	0.24819	0.24852	----------	----------	----------	----------
20 carbon compound DX	0.05373	0.05316	----------	----------	----------	----------
20 carbon compound DZ	0.01473	0.01489	----------	----------	----------	----------
20 carbon compound EA	0.49602	0.49691	----------	----------	----------	----------
20 carbon compound ED	0.02534	0.02533	----------	----------	----------	----------
20 carbon compound EF	0.12635	0.12659	----------	----------	----------	----------
20 carbon compound EH	----------	----------	0.05783	0.05798	0.04534	0.04588
20 carbon compound EI	0.05327	0.05329	----------	----------	----------	----------
20 carbon compound EJ	0.04798	0.04722	----------	----------	----------	----------
20 carbon compound EL	0.03334	0.03330	----------	----------	----------	----------
20 carbon compound EO	0.06431	0.06483	----------	----------	----------	----------
21 carbon compound EP	0.02012	0.02002	----------	----------	----------	----------
21 carbon compound ES	0.03208	0.03252	----------	----------	----------	----------
Docosanoic acid	0.02241	0.02240	----------	----------	----------	----------
21 carbon compound EU	0.02458	0.02443	0.67598	0.67585	0.69037	0.69058
21 carbon compound EV	0.09865	0.09826	----------	----------	----------	----------
21 carbon compound EW	0.67906	0.67983	----------	----------	----------	----------
21 carbon compound EY	0.12721	0.12721	----------	----------	----------	----------
21 carbon compound EZ	----------	----------	0.01747	0.01748	0.01948	0.01948
21 carbon compound FA	0.10057	0.10026	----------	----------	----------	----------
21 carbon compound FB	0.09660	0.09645	----------	----------	----------	----------
21 carbon compound FC	30.40893	30.40804	----------	----------	----------	----------
21 carbon compound FD	----------	----------	0.00574	0.00583	0.00449	0.00498
21 carbon compound FE	0.05626	0.05603	----------	----------	----------	----------
21 carbon compound FF	0.11408	0.11496	----------	----------	----------	----------
21 carbon compound FH	0.24680	0.24678	----------	----------	----------	----------
Docasanoic acid	0.47610	0.47664	----------	----------	----------	----------
22 carbon compound FI	0.28994	0.28991	0.00489	0.00479	0.00475	0.00475
22 carbon compound FK	0.05145	0.05183	----------	----------	----------	----------
22 carbon compound FM	0.03586	0.03507	----------	----------	----------	----------
22 carbon compound FN	0.07445	0.07476	----------	----------	----------	----------
22 carbon compound FP	----------	----------	0.04789	0.04798	0.04583	0.04578
22 carbon compound FQ	0.06457	0.06479	----------	----------	----------	----------
22 carbon compound FR	0.09770	0.09755	----------	----------	----------	----------
22 carbon compound FU	0.07689	0.07601	0.17489	0.17485	0.18482	0.18476
22 carbon compound FY	0.01966	0.01998	----------	----------	----------	----------
22 carbon compound FZ	----------	----------	0.06043	0.06068	0.03478	0.03484
22 carbon compound GA	----------	----------	0.03150	0.03185	0.03475	0.03489
22 carbon compound GC	0.06382	0.06325	----------	----------	----------	----------
23 carbon compound GD	0.08486	0.08498	----------	----------	----------	----------
23 carbon compound GE	0.09100	0.09158	0.27849	0.27876	0.27498	0.27498
23 carbon compound GF	0.06749	0.06741	----------	----------	----------	----------

Table A-1.--(continued)

Compounds	Panthera pardus		Panthera tigris		Panthera tigris	
	R. Sac	L. Sac	L. Sac	R. Sac	L. Sac	R. Sac
X-Eicosene	0.09815	0.09826	----------	----------	----------	----------
23 carbon compound GI	0.03797	0.03755	----------	----------	----------	----------
23 carbon compound GJ	0.12639	0.12601	0.27572	0.27579	0.27498	0.27498
23 carbon compound GK	0.15821	0.15874	----------	----------	----------	----------
23 carbon compound GL	----------	----------	0.18598	0.18579	0.18747	0.18798
23 carbon compound GM	0.07269	0.07285	----------	----------	----------	----------
23 carbon compound GN	0.12987	0.12930	----------	----------	----------	----------
X-Tetracosenoic acid	0.03206	0.03275	----------	----------	----------	----------
23 carbon compound GP	0.03559	0.03562	----------	----------	----------	----------
Tetracosanoic acid	0.12149	0.12198	0.01749	0.01798	0.01904	0.01949
24 carbon compound GS	0.06868	0.06850	0.17482	0.17487	0.18758	0.18749
24 carbon compound GU	0.03875	0.03865	----------	----------	----------	----------
24 carbon compound GY	0.50043	0.50036	----------	----------	----------	----------
24 carbon compound HA	0.11275	0.11287	----------	----------	----------	----------
24 carbon compound HB	0.41254	0.41275	----------	----------	----------	----------
24 carbon compound HD	0.07132	0.07184	----------	----------	----------	----------
24 carbon compound HF	0.13756	0.13734	----------	----------	----------	----------
24 carbon compound HH	0.07846	0.07845	----------	----------	----------	----------
24 carbon compound HI	0.01374	0.01374	----------	----------	----------	----------
25 carbon compound HL	0.03195	0.03143	----------	----------	----------	----------
25 carbon compound HM	0.08163	0.08185	----------	----------	----------	----------
25 carbon compound HN	0.01474	0.01463	----------	----------	----------	----------
25 carbon compound HP	0.87743	0.87732	----------	----------	----------	----------
25 carbon compound HQ	0.02856	0.02887	----------	----------	----------	----------
25 carbon compound HR	0.02374	0.02374	----------	----------	----------	----------
25 carbon compound HT	----------	----------	0.03746	0.03798	0.03325	0.03375
X-Hexacosanoic acid	0.00743	0.00764	0.05648	0.05683	0.07188	0.07174
25 carbon compound HU	0.02475	0.02473	----------	----------	----------	----------
25 carbon compound HW	0.04037	0.04037	----------	----------	----------	----------
25 carbon compound IA	0.17736	0.17743	----------	----------	----------	----------
25 carbon compound IB	----------	----------	0.05723	0.05798	0.04857	0.04846
26 carbon compound ID	0.12546	0.12546	0.18947	0.18976	0.11950	0.11975
26 carbon compound IH	----------	----------	0.37492	0.37498	0.39859	0.39849
26 carbon compound II	0.01275	0.01274	----------	----------	----------	----------
26 carbon compound IK	0.02176	0.02174	----------	----------	----------	----------
26 carbon compound IN	----------	----------	0.037498	0.037739	0.034938	0.03476
26 carbon compound IP	0.08473	0.08475	----------	----------	----------	----------
26 carbon compound IV	----------	----------	0.05297	0.05276	0.04757	0.04790
26 carbon compound IW	----------	----------	6.07498	6.07475	6.87739	6.87747
26 carbon compound IX	0.12857	0.12857	----------	----------	----------	----------
26 carbon compound JA	0.00965	0.00968	----------	----------	----------	----------
27 carbon compound JC	----------	----------	0.28583	0.28573	0.29759	0.29759
27 carbon sterol	----------	----------	0.08979	0.08957	0.08498	0.08478
27 carbon compound JE	0.01275	0.01275	----------	----------	----------	----------
27 carbon compound JG	0.37785	0.37726	----------	----------	----------	----------
27 carbon compound JH	----------	----------	0.00476	0.00472	0.00348	0.00304
27 carbon compound JJ	0.01857	0.01857	----------	----------	----------	----------

Table A-1.--(continued)

Compounds	Panthera pardus		Panthera tigris		Panthera tigris	
	R. Sac	L. Sac	L. Sac	R. Sac	L. Sac	R. Sac
27 carbon compound JN	0.03385	0.03375	----------	----------	----------	----------
27 carbon compound JO	----------	----------	0.00859	0.00894	0.00893	0.00859
27 carbon compound JP	0.06975	0.06977	----------	----------	----------	----------
27 carbon compound JS	0.11047	0.11079	----------	----------	----------	----------
27 carbon compound JV	0.01079	0.01089	----------	----------	----------	----------
28 carbon compound JY	0.01267	0.01267	----------	----------	----------	----------
28 carbon compound KA	0.03688	0.03664	----------	----------	----------	----------
28 carbon compound KC	0.05366	0.05345	----------	----------	----------	----------
28 carbon compound KF	0.02886	0.02886	----------	----------	----------	----------
28 carbon compound KH	0.05264	0.05276	----------	----------	----------	----------
28 carbon compound KI	----------	----------	0.17348	0.17398	0.19076	0.19089
28 carbon compound KK	0.01375	0.01378	----------	----------	----------	----------
28 carbon compound KR	0.02468	0.02479	----------	----------	----------	----------
28 carbon compound KT	0.02957	0.02974	0.04013	0.04058	0.03849	0.03858
28 carbon compound KU	----------	----------	0.07724	0.07774	0.05798	0.05798
28 carbon compound KV	0.01179	0.01189	----------	----------	----------	----------
28 carbon compound KY	0.40968	0.40976	0.03337	0.03356	0.02384	0.02039
29 carbon compound LC	0.05279	0.05275	----------	----------	----------	----------
29 carbon compound LD	0.05476	0.05476	----------	----------	----------	----------
29 carbon compound LE	0.00679	0.00676	----------	----------	----------	----------
29 carbon compound LF	0.04186	0.04178	----------	----------	----------	----------
29 carbon compound LH	8.65978	8.65976	----------	----------	----------	----------
29 carbon compound LJ	0.01976	0.10973	----------	----------	----------	----------
29 carbon compound LO	0.05575	0.05578	----------	----------	----------	----------
29 carbon compound LP	----------	----------	0.04893	0.04858	0.04757	0.04759
29 carbon compound LS	0.01987	0.01979	----------	----------	----------	----------
29 carbon compound LU	0.11684	0.11689	0.22332	0.22388	0.29583	0.29576
30 carbon compound LX	0.07479	0.07473	0.18590	0.18578	0.19075	0.19085
30 carbon compound MB	0.02589	0.02578	----------	----------	----------	----------
30 carbon compound ME	0.00979	0.00997	----------	----------	----------	----------
30 carbon compound MG	0.00672	0.00683	----------	----------	----------	----------
30 carbon compound MH	0.01578	0.01583	----------	----------	----------	----------
30 carbon compound MK	0.01886	0.01898	----------	----------	----------	----------
30 carbon compound ML	0.02484	0.02489	----------	----------	----------	----------
30 carbon compound MN	0.01876	0.01889	0.09978	0.09996	0.08739	0.08789
31 carbon compound MR	----------	----------	0.27498	0.27487	0.27598	0.27575
31 carbon compound MT	0.00976	0.00990	----------	----------	----------	----------

Table A-2.--Relative amount (picomoles) of neutral lipids in right and left anal sacs of *Panthera pardus* (leopard) and *P. tigris* (tiger). Dashed lines represent the absence of a compound.

Compounds	*Panthera pardus*		*Panthera tigris*		*Panthera tigris*	
	L. Sac	R. Sac	L. Sac	R. Sac	L. Sac	R. Sac
10 carbon compound B	----------	----------	0.08557	0.08518	0.03862	0.03822
10 carbon compound C	----------	----------	0.05757	0.05730	0.03580	0.03551
10 carbon compound D	----------	----------	0.16379	0.16322	0.10956	0.10900
10 carbon compound G	----------	----------	0.00159	0.00138	0.00884	0.00882
11 carbon compound H	----------	----------	0.00142	0.00176	0.00665	0.00647
11 carbon compound J	0.09173	0.09106	----------	----------	----------	----------
11 carbon compound S	0.04878	0.04824	0.00353	0.00391	0.00932	0.00941
11 carbon compound T	----------	----------	0.03500	0.03508	0.06167	0.06128
11 carbon compound V	1.00101	1.00129	----------	----------	----------	----------
11 carbon compound Y	----------	----------	0.00307	0.00307	0.00312	0.00320
12 carbon compound Z	0.02532	0.02531	0.08976	0.08993	0.07685	0.07666
12 carbon compound AA	0.02525	1.02590	----------	----------	----------	----------
12 carbon compound AB	----------	----------	0.16407	0.16469	0.14314	0.14310
12 carbon compound AF	0.00227	0.00220	----------	----------	----------	----------
12 carbon compound AH	----------	----------	0.06298	0.06295	0.09323	0.09382
12 carbon compound AJ	----------	----------	0.00840	0.00828	0.00992	0.00962
12 carbon compound AK	0.08702	0.08727	----------	----------	----------	----------
12 carbon compound AM	0.00637	0.00624	0.00338	0.00341	0.00299	0.00237
12 carbon compound AO	----------	----------	0.00897	0.00865	0.00932	0.00926
12 carbon compound AR	0.05378	0.05352	----------	----------	----------	----------
12 carbon compound AS	----------	----------	0.06011	0.06080	0.08513	0.08532
12 carbon compound AV	----------	----------	0.08772	0.08737	0.07918	0.07919
13 carbon compound AY	0.10117	0.10172	----------	----------	----------	----------
13 carbon compound AZ	0.12369	0.12362	0.06804	0.06857	0.09369	0.09303
13 carbon compound BA	0.04655	0.04619	----------	----------	----------	----------
X-branched Tridecanoic acid	0.02055	0.02008	0.05819	0.05811	0.06815	0.06852
13 carbon compound BF	0.03497	0.03408	----------	----------	----------	----------
13 carbon compound BH	----------	----------	0.03333	0.03308	0.07299	0.07213
13 carbon compound BJ	0.18704	0.18762	----------	----------	----------	----------
13 carbon compound BK	----------	----------	0.00594	0.00594	0.00726	0.00749
13 carbon compound BM	----------	----------	0.01136	0.01172	0.06396	0.06360
13 carbon compound BO	0.17304	0.17371	0.10975	0.10949	0.12022	0.12025
1,1'-(1,2-cyclobutanediyl)bis-, cis-Benzene	0.06790	0.06769	0.05427	0.05473	0.08071	0.08027
13 carbon compound BQ	----------	----------	0.01952	0.01967	0.03677	0.03623
Tetradecanoic acid	0.49484	0.49437	0.05197	0.05199	0.07944	0.07989
14 carbon compound BR	0.01911	0.01900	----------	----------	----------	----------
14 carbon compound BS	----------	----------	0.03764	0.03704	0.05865	0.05870
14 carbon compound BW	----------	----------	0.01980	0.01939	0.04360	0.04373
14 carbon compound BX	0.00235	0.00241	1.48144	1.48193	1.79869	1.79849
14 carbon compound CB	0.25925	0.25933	----------	----------	----------	----------
14 carbon compound CC	0.08042	0.08006	0.02948	0.02928	0.03807	0.03871
14 carbon compound CE	----------	----------	0.04295	0.04231	0.03452	0.03426
14 carbon compound CF	0.02981	0.02984	0.00713	0.00717	0.00823	0.00854
14 carbon compound CG	----------	----------	0.00619	0.00695	0.00458	0.00483
15 carbon compound CU	0.02184	0.02127	----------	----------	----------	----------

Table A-2.--(continued)

Compounds	*Panthera pardus*		*Panthera tigris*		*Panthera tigris*	
	L. Sac	R. Sac	L. Sac	R. Sac	L. Sac	R. Sac
15 carbon compound CV	0.07357	0.07349	0.05703	0.05799	0.09304	0.09368
15 carbon compound CW	1.85472	1.85480	0.07323	0.07367	0.08135	0.08199
15 carbon compound CY	----------	----------	0.09605	0.09664	0.06729	0.06776
15 carbon compound DB	0.05108	0.05173	0.03034	0.03046	0.09347	0.09333
Nonadecanoic acid	----------	----------	0.22172	0.22110	0.21710	0.21711
15 carbon compound DC	2.52122	2.52183	----------	----------	----------	----------
15 carbon compound DD	0.01333	0.01300	0.59563	0.59520	0.58708	0.58717
15 carbon compound DF	----------	----------	0.54730	0.54748	0.56255	0.56211
Hexadecanoic acid	0.00108	0.00123	0.03311	0.03370	0.01666	0.01611
16 carbon compound DL	0.06502	0.06573	0.64625	0.64641	0.64821	0.64810
16 carbon compound DM	0.04304	0.04396	1.05795	1.05722	1.13908	1.13943
16 carbon compound DN	----------	----------	0.01499	0.01438	0.01988	0.01900
16 carbon compound DQ	0.00643	0.00668	0.05203	0.05232	0.02468	0.02420
16 carbon compound DS	----------	----------	0.13982	0.13903	0.13995	0.13957
16 carbon compound DT	0.02230	0.02210	0.00505	0.00595	0.00977	0.00922
16 carbon compound DV	0.51714	0.51788	----------	----------	----------	----------
16 carbon compound EA	0.57153	0.57106	0.01786	0.01792	0.06299	0.07620
16 carbon compound EF	0.03041	0.03011	----------	----------	----------	----------
16 carbon compound EH	----------	----------	0.35849	0.35889	0.38488	0.38441
17 carbon compound EJ	----------	----------	0.34862	0.34844	0.37628	0.37635
17 carbon compound EL	0.01794	0.01739	----------	----------	----------	----------
17 carbon compound EN	----------	----------	0.62486	0.62405	0.69085	0.69086
17 carbon compound EP	----------	----------	0.36418	0.36450	0.38445	0.38425
17 carbon compound ES	----------	----------	1.28279	1.28200	1.09875	1.09873
17 carbon compound ET	0.02743	0.02772	0.11747	0.11761	0.12430	0.12432
17 carbon compound EU	0.48818	0.48829	0.08357	0.08369	0.03215	0.03211
X-Octadecanoic acid	0.19671	0.19625	0.07740	0.07785	0.09191	0.09174
17 carbon compound EV	0.16276	0.16233	0.05863	0.05852	0.08927	0.04038
17 carbon compound EX	0.02485	0.02438	----------	----------	----------	----------
17 carbon compound EY	----------	----------	9.11864	9.11856	9.16665	9.16609
Octadecanoic acid	0.01539	0.01502	0.00326	0.00320	0.00928	0.00932
18 carbon compound FC	5.73141	5.73190	0.37351	0.37360	0.30980	0.30956
18 carbon compound FD	1.03468	1.03459	0.05969	0.05902	0.03312	0.03368
18 carbon compound FG	9.26253	9.26250	----------	----------	----------	----------
18 carbon compound FH	1.27325	1.27320	0.09602	0.09675	0.05183	0.05162
18 carbon compound FJ	----------	----------	0.08207	0.08275	0.07880	0.07884
18 carbon compound FK	6.40769	6.40730	----------	----------	----------	----------
18 carbon compound FL	----------	----------	0.04392	0.04347	0.06648	0.06660
18 carbon compound FN	0.16723	0.16777	0.16575	0.16587	0.12137	0.12163
18 carbon compound FO	3.51936	3.51940	----------	----------	----------	----------
18 carbon compound FT	0.54404	0.54400	----------	----------	----------	----------
18 carbon compound FX	----------	----------	0.38557	0.38562	0.36607	0.36689
18 carbon compound FY	0.00468	0.00453	0.03031	0.03037	0.02104	0.02162
18 carbon compound GA	0.05277	0.05243	----------	----------	----------	----------
18 carbon compound GB	----------	----------	0.01397	0.01389	0.04175	0.04172
19 carbon alcohol	0.18344	0.18398	0.18940	0.18958	0.15466	0.15419
19 carbon compound GJ	0.15442	0.15479	0.95356	0.95739	0.97871	0.97854

Table A-2.–(continued)

Compounds	*Panthera pardus*		*Panthera tigris*		*Panthera tigris*	
	L. Sac	R. Sac	L. Sac	R. Sac	L. Sac	R. Sac
19 carbon compound GO	0.81158	0.81198	----------	----------	----------	----------
19 carbon compound GP	----------	----------	1.13653	1.13693	1.03826	1.03861
19 carbon compound GQ	0.23308	0.23373	----------	----------	----------	----------
19 carbon compound GR	0.44838	0.44845	0.45170	0.45197	0.42672	0.42637
19 carbon compound GS	----------	----------	0.04186	0.04127	0.01712	0.01759
19 carbon compound GT	3.31604	3.31667	0.20619	0.20670	0.20361	0.20370
19 carbon compound GY	0.05578	0.05563	----------	----------	----------	----------
Eicosanoic acid	4.17391	4.17370	1.12603	1.12672	1.20686	1.20672
20 carbon compound GZ	0.87024	0.87015	----------	----------	----------	----------
20 carbon compound HC	0.04172	0.04168	0.94629	0.94678	0.95915	0.95949
20 carbon compound HD	0.16618	0.16631	----------	----------	----------	----------
20 carbon compound HE	----------	----------	0.04787	0.04798	0.02878	0.02812
20 carbon compound HG	----------	----------	6.36915	6.36949	6.01615	6.01676
20 carbon compound HI	----------	----------	0.11125	0.11175	0.18657	0.18617
20 carbon compound HK	0.48622	0.48605	----------	----------	----------	----------
20 carbon compound HM	----------	----------	5.11514	5.11578	5.06155	5.06119
20 carbon compound HP	0.06226	0.06223	----------	----------	----------	----------
20 carbon compound HR	----------	----------	1.10230	1.10284	1.16948	1.16921
21 carbon compound HU	0.08312	0.08318	1.07935	1.07948	1.22046	1.22023
21 carbon compound HZ	----------	----------	0.14735	0.14798	0.14883	0.14860
21 carbon compound IA	0.34934	0.34957	----------	----------	----------	----------
21 carbon compound ID	----------	----------	8.28390	8.82378	8.07057	8.07057
21 carbon compound IH	----------	----------	1.48239	1.48298	1.45720	1.45757
21 carbon compound IL	0.17157	0.17129	13.38238	13.38291	13.02369	13.02383
21 carbon compound IP	0.36930	0.36916	1.38723	1.38759	1.07681	1.07679
Docosanoic acid	0.08344	0.08365	0.18390	0.18378	0.17521	0.17535
22 carbon compound IT	0.04549	0.04571	----------	----------	----------	----------
22 carbon compound IU	----------	----------	0.01238	0.01289	0.02409	0.02462
22 carbon compound IW	0.27498	0.27419	----------	----------	----------	----------
22 carbon compound IX	----------	----------	0.09857	0.09851	0.06152	0.06148
22 carbon compound IY	0.00578	0.00581	----------	----------	----------	----------
22 carbon compound JB	----------	----------	0.28398	0.28375	0.24408	0.24488
22 carbon compound JD	----------	----------	3.58985	3.58976	3.01457	3.01414
22 carbon compound JF	0.03798	0.03728	----------	----------	----------	----------
22 carbon compound JG	0.10849	0.10814	0.02849	0.02896	0.04129	0.04193
22 carbon compound JH	0.74527	0.74527	----------	----------	----------	----------
22 carbon compound JI	----------	----------	0.08590	0.08572	0.02247	0.02232
22 carbon compound JM	----------	----------	0.02379	0.02398	0.07652	0.07682
22 carbon compound JN	0.08865	0.08846	----------	----------	----------	----------
22 carbon compound JO	----------	----------	0.02849	0.02866	0.02923	0.02905
23 carbon compound JP	0.01798	0.01779	----------	----------	----------	----------
23 carbon compound JS	0.02749	0.02768	0.07982	0.07984	0.05608	0.05666
23 carbon compound JX	0.01848	0.01865	0.00239	0.00275	0.00215	0.00249
23 carbon compound JZ	----------	----------	0.03890	0.03895	0.07118	0.07175
23 carbon compound KC	----------	----------	0.02384	0.02378	0.04992	0.04956
23 carbon compound KD	0.07987	0.07979	0.28490	0.28475	0.26804	0.26816
23 carbon compound KG	0.03239	0.03274	0.68239	0.68269	0.68645	0.68606

TableA-2.--(continued)

Compounds	*Panthera pardus*		*Panthera tigris*		*Panthera tigris*	
	L. Sac	R. Sac	L. Sac	R. Sac	L. Sac	R. Sac
23 carbon compound KI	----------	----------	0.04890	0.04845	0.07765	0.07746
3,7,11-trimethyl(E,E)-2,6,10-Dodecatrien-1-ol	0.05735	0.05778	0.05789	0.05729	0.05705	0.05794
24 carbon compound KT	----------	----------	0.52390	0.52387	0.51371	0.51337
24 carbon compound LB	0.53859	0.53885	0.28312	0.28390	0.29354	0.29390
24 carbon compound LC	0.18979	0.18948	----------	----------	----------	----------
24 carbon compound LD	----------	----------	9.28423	9.28476	9.22641	9.22638
24 carbon compound LH	0.24982	0.24975	----------	----------	----------	----------
24 carbon compound LI	----------	----------	0.02384	0.02389	0.01253	0.01268
25 carbon compound LJ	0.38459	0.38476	----------	----------	----------	----------
25 carbon compound LK	----------	----------	4.21823	4.21890	4.14989	4.14914
25 carbon compound LL	0.05793	0.05798	----------	----------	----------	----------
25 carbon compound LM	0.17844	0.17875	----------	----------	----------	----------
25 carbon compound LO	0.03785	0.03786	1.47234	1.47289	1.15948	1.15905
25 carbon compound LQ	0.18492	0.18475	----------	----------	----------	----------
25 carbon compound LR	0.01798	0.01774	----------	----------	----------	----------
25 carbon compound LT	0.03782	0.03798	----------	----------	----------	----------
25 carbon compound LV	0.03798	0.03784	----------	----------	----------	----------
25 carbon compound LY	0.00585	0.00573	0.18498	0.18474	0.14250	0.14222
25 carbon compound MC	0.01874	0.01885	0.18349	0.18390	0.12532	0.12571
25 carbon compound MD	0.00790	0.00790	----------	----------	----------	----------
25 carbon compound MH	0.04798	0.04798	0.75903	0.75957	0.71433	0.71483
26 carbon compound MK	0.17598	0.17587	----------	----------	----------	----------
26 carbon compound MO	0.18928	0.18975	----------	----------	----------	----------
26 carbon compound MQ	0.28492	0.28474	----------	----------	----------	----------
26 carbon compound MU	----------	----------	0.28498	0.28479	0.21190	0.21194
26 carbon compound MY	----------	----------	0.18590	0.18572	0.13850	0.13874
26 carbon compound NA	----------	----------	0.01890	0.01849	0.01834	0.01894
26 carbon compound ND	0.28498	0.28478	0.38598	0.38572	0.32805	0.32815
Cholesterol	----------	----------	0.74598	0.74576	0.70859	0.70895
27 carbon compound NF	0.00674	0.00679	----------	----------	----------	----------
27 carbon compound NG	0.37592	0.37585	----------	----------	----------	----------
27 carbon compound NH	0.27983	0.27979	0.99057	0.99045	0.95766	0.95748
27 carbon compound NN	0.03849	0.03887	----------	----------	----------	----------
27 carbon compound NO	----------	----------	0.37855	0.37847	0.30643	0.30633
27 carbon compound NP	0.02759	0.02798	----------	----------	----------	----------
27 carbon compound NR	0.04748	0.04786	----------	----------	----------	----------
27 carbon compound NV	0.02842	0.02084	----------	----------	----------	----------
27 carbon compound NX	0.05734	0.05794	----------	----------	----------	----------
28 carbon compound NZ	0.38983	0.38974	----------	----------	----------	----------
28 carbon compound OA	0.06738	0.06797	0.00374	0.00384	0.00717	0.00721
28 carbon compound OE	----------	----------	0.02385	0.02389	0.01214	0.01271
28 carbon compound OL	0.07482	0.07475	0.02389	0.02389	0.01239	0.01292
28 carbon compound OO	----------	----------	0.00374	0.00385	0.00341	0.00310
28 carbon compound OT	0.05487	0.05475	0.08498	0.08487	0.03917	0.03955
28 carbon compound OW	----------	----------	0.00759	0.00745	0.00559	0.00554
29 carbon compound PB	----------	----------	0.02384	0.02389	0.01733	0.01725

Table A-2.--(continued)

Compounds	*Panthera pardus*		*Panthera tigris*		*Panthera tigris*	
	L. Sac	R. Sac	L. Sac	R. Sac	L. Sac	R. Sac
29 carbon compound PE	----------	----------	0.79865	0.79895	0.74216	0.74294
29 carbon compound PF	0.02748	0.02798	----------	----------	----------	----------
29 carbon compound PI	----------	----------	0.02849	0.02884	0.03361	0.03380
29 carbon compound PK	----------	----------	0.01284	0.01289	0.02960	0.02903
29 carbon compound PL	0.09987	0.09976	----------	----------	----------	----------
29 carbon compound PM	----------	----------	0.01284	0.01289	0.08478	0.08438
29 carbon compound PQ	----------	----------	0.01248	0.01286	0.08557	0.08535
30 carbon compound PW	----------	----------	0.28498	0.28478	0.24578	0.24590
30 carbon compound PY	0.18492	0.18479	----------	----------	----------	----------
30 carbon compound PZ	0.07785	0.07798	----------	----------	----------	----------
30 carbon compound QB	----------	----------	0.03749	0.03749	0.07822	0.07882
30 carbon compound QD	0.03759	0.03798	----------	----------	----------	----------
30 carbon compound QG	0.03749	0.03798	----------	----------	----------	----------
30 carbon compound QI	0.37598	0.37587	----------	----------	----------	----------
31 carbon compound QL	18.75984	18.75997	----------	----------	----------	----------

Table A-3.--Relative amount (picomoles) of phospholipids in right and left anal sacs of *Panthera pardus* (leopard) and *P. tigris* (tiger). Dashed lines represent the absence of a compound.

Compounds	*Panthera pardus*		*Panthera tigris*		*Panthera tigris*	
	R. Sac	L. Sac	R. Sac	L. Sac	R. Sac	L. Sac
11 carbon compound J	----------	----------	0.29958	0.29959	0.24983	0.24924
11 carbon compound K	0.38355	0.38398	0.02369	0.02352	0.04398	0.04378
12 carbon compound P	----------	----------	0.08890	0.08873	0.02948	0.02910
12 carbon compound U	0.10827	0.10807	----------	----------	----------	----------
12 carbon compound X	0.09248	0.09218	----------	----------	----------	----------
13 carbon compound AG	0.10145	0.10115	0.07067	0.07079	0.08490	0.08458
X-methyl pentadecanoic acid	0.09188	0.09134	0.00180	0.00176	0.00349	0.00327
13 carbon compound AP	0.05852	0.05823	0.38940	0.38997	0.38437	0.38477
13 carbon compound AR	0.05636	0.05633	----------	----------	----------	----------
13 carbon compound AT	----------	----------	0.40892	0.40893	0.43949	0.43976
13 carbon compound AW	0.20102	0.20146	0.03746	0.03799	0.04892	0.04877
Tetradecanoic acid	0.14567	0.14525	0.10938	0.10955	0.14394	0.14380
14 carbon compound BC	0.07233	0.07299	0.04953	0.04999	0.04834	0.04854
14 carbon compound BG	0.05811	0.05857	0.03614	0.03698	0.08409	0.08452
14 carbon compound BL	0.16909	0.16982	----------	----------	----------	----------
14 carbon compound BN	----------	----------	0.02910	0.02935	0.02349	0.02359
14 carbon compound BO	0.04151	0.04110	----------	----------	----------	----------
14 carbon compound BQ	----------	----------	0.92192	0.92110	0.92489	0.92403
14 carbon compound BS	0.17445	0.17422	0.00804	0.00863	0.00438	0.00497
15 carbon compound BU	0.15623	0.15650	0.00178	0.00132	0.00324	0.12031
15 carbon alcohol	0.28161	0.28158	----------	----------	----------	----------
15 carbon compound BW	----------	----------	0.00431	0.00434	0.00494	0.00442
15 carbon compound CA	----------	----------	0.04276	0.04243	0.04394	0.04303
15 carbon compound CC	0.10608	0.10676	0.06960	0.06947	0.09432	0.09493
15 carbon compound CD	----------	----------	0.37223	0.37298	0.39038	0.39006
15 carbon compound CF	----------	----------	0.07700	0.07728	0.04928	0.04994
15 carbon compound CG	----------	----------	0.00993	0.00974	0.00194	0.00145
15 carbon compound CH	0.74538	0.74539	----------	----------	----------	----------
(Z)-7-Hexadecanoic acid	----------	----------	0.03449	0.03483	0.03949	0.03963
15 carbon compound CI	0.03991	0.03959	----------	----------	----------	----------
15 carbon compound CJ	----------	----------	0.04359	0.04373	0.02594	0.02574
15 carbon compound CM	0.11639	0.11633	----------	----------	----------	----------
15 carbon compound CN	----------	----------	0.09060	0.09037	0.02499	0.02477
15 carbon compound CO	0.43446	0.43413	----------	----------	----------	----------
Hexadecanoic acid	0.05615	0.05683	0.00159	0.00147	0.00585	0.00537
16 carbon compound CS	0.07532	0.07561	0.00342	0.00339	0.00394	0.00322
16 carbon compound CX	0.10645	0.10610	0.00752	0.00739	0.00428	0.00422
16 carbon compound CZ	----------	----------	0.37626	0.37638	0.32394	0.32381
16 carbon compound DA	7.99994	7.99931	----------	----------	----------	----------
16 carbon compound DD	0.18459	0.18405	0.48853	0.48837	0.42598	0.42562
16 carbon compound DE	----------	----------	0.12884	0.12848	0.14909	0.14972
16 carbon compound DF	0.15323	0.15306	0.01537	0.01585	0.02848	0.02889
16 carbon compound DG	0.35561	0.35511	0.16552	0.16503	0.12349	0.12381
16 carbon compound DH	0.13319	0.13327	1.03478	1.03449	1.24938	1.24962
16 carbon compound DJ	----------	----------	0.10395	0.10384	0.19389	0.19327
17 carbon compound DM	0.04582	0.04553	0.03758	0.03794	0.08328	0.08341

Table A-3.–(continued)

Compounds	Panthera pardus		Panthera tigris		Panthera tigris	
	R. Sac	L. Sac	R. Sac	L. Sac	R. Sac	L. Sac
17 carbon compound DN	----------	----------	0.02373	0.02332	0.09287	0.09295
17 carbon compound DO	0.03648	0.03674	----------	----------	----------	----------
17 carbon compound DQ	----------	----------	0.05734	0.05737	0.08240	0.08268
17 carbon compound DS	----------	----------	0.43475	0.43493	0.48934	0.48963
17 carbon compound DU	0.04504	0.04561	0.00376	0.00392	0.00839	0.00896
17 carbon compound DW	0.16325	0.16389	0.20375	0.20339	0.23498	0.23441
17 carbon compound DX	----------	----------	0.03758	0.03734	0.04293	0.04270
17 carbon compound DZ	0.47681	0.47692	0.07349	0.07349	0.03493	0.03427
17 carbon compound EB	0.04433	0.04483	0.07598	0.07584	0.04328	0.04360
17 carbon compound EC	----------	----------	0.47349	0.47388	0.49840	0.49860
17 carbon compound ED	0.04982	0.04999	0.30277	0.30239	0.32478	0.32413
17 carbon compound EE	0.48200	0.48275	0.31939	0.31992	0.39484	0.39460
Octadecanoic acid	1.22368	1.22322	0.10920	0.10923	0.19284	0.19227
18 carbon compound EI	0.57183	0.57129	----------	----------	----------	----------
18 carbon compound EJ	0.03588	0.03556	0.14141	0.14129	0.14394	0.14396
18 carbon compound EM	----------	----------	0.51401	0.51483	0.59485	0.59412
18 carbon compound EO	0.67547	0.67587	----------	----------	----------	----------
18 carbon compound EP	----------	----------	0.10216	0.10221	0.18349	0.18312
18 carbon compound ER	----------	----------	0.00419	0.00484	0.00298	0.00276
18 carbon compound EU	6.43948	6.43975	0.15826	0.15883	0.12834	0.12873
18 carbon compound EV	0.31439	0.31441	----------	----------	----------	----------
18 carbon compound EW	----------	----------	0.27654	0.27639	0.23480	0.23412
18 carbon compound EX	11.60960	11.60901	----------	----------	----------	----------
18 carbon compound EY	----------	----------	0.08261	0.08239	0.04281	0.04222
18 carbon compound EZ	2.18158	2.18129	----------	----------	----------	----------
18 carbon compound FA	----------	----------	0.03662	0.03649	0.01498	0.01488
19 carbon compound FD	----------	----------	0.09575	0.09547	0.04982	0.04904
19 carbon compound FE	----------	----------	0.00361	0.00308	0.00898	0.00824
19 carbon compound FF	0.30632	0.30686	----------	----------	----------	----------
19 carbon compound FJ	0.12689	0.12626	0.38425	0.38438	0.33984	0.33951
19 carbon compound FL	0.14486	0.14416	0.40170	0.40139	0.47384	0.47310
19 carbon compound FM	----------	----------	0.02555	0.02594	0.03123	0.03127
19 carbon compound FP	12.40203	12.40221	0.13515	0.13539	0.12390	0.12374
19 carbon compound FR	0.05082	0.05076	0.03821	0.03898	0.03928	0.03964
19 carbon compound FT	0.03936	0.03979	0.03863	0.03892	0.09238	0.09258
19 carbon compound FV	----------	----------	0.08209	0.08282	0.03498	0.03426
19 carbon compound FW	0.25398	0.25313	----------	----------	----------	----------
19 carbon compound FX	0.15348	0.15395	0.90301	0.90342	0.90285	0.90257
19 carbon compound FY	----------	----------	0.00403	0.00498	0.00138	0.00131
19 carbon compound FZ	0.30879	0.30891	----------	----------	----------	----------
20 carbon compound GC	0.39472	0.39482	0.00460	0.00498	0.00492	0.00404
20 carbon compound GE	0.21366	0.21364	0.00933	0.00989	0.00298	0.00287
20 carbon compound GH	0.04732	0.04734	0.07224	0.07289	0.02392	0.02354
20 carbon compound GJ	0.12790	0.12756	0.01558	0.01547	0.03984	0.03905
20 carbon compound GL	----------	----------	0.38932	0.38980	0.34983	0.34946
20 carbon compound GN	----------	----------	0.03385	0.03394	0.03928	0.03988
20 carbon compound GO	24.44456	24.44427	----------	----------	----------	----------

Table A-3.--(continued)

Compounds	Panthera pardus		Panthera tigris		Panthera tigris	
	R. Sac	L. Sac	R. Sac	L. Sac	R. Sac	L. Sac
20 carbon compound GP	----------	----------	0.00937	0.00923	0.00293	0.00204
20 carbon compound GQ	----------	----------	0.03952	0.03938	0.08238	0.08250
20 carbon compound GT	1.55149	1.55116	----------	----------	----------	----------
20 carbon compound GW	0.09734	0.09746	----------	----------	----------	----------
20 carbon compound GX	----------	----------	0.07920	0.07937	0.03921	0.03913
20 carbon compound GY	0.30510	0.30518	0.03641	0.03628	0.03978	0.03998
21 carbon compound GZ	0.24615	0.24693	0.00211	0.00290	0.00294	0.00203
21 carbon compound HB	0.08182	0.08163	0.00235	0.00209	0.00329	0.00317
21 carbon compound HC	0.76582	0.76578	----------	----------	----------	----------
21 carbon compound HD	----------	----------	0.00285	0.00275	0.00295	0.00237
21 carbon compound HE	----------	----------	0.31573	0.31592	0.32398	0.32341
21 carbon compound HF	0.39984	0.39913	----------	----------	----------	----------
21 carbon compound HG	----------	----------	0.43607	0.43639	0.43283	0.43207
21 carbon compound HH	0.51587	0.51531	----------	----------	----------	----------
21 carbon compound HJ	0.16060	0.16085	----------	----------	----------	----------
21 carbon compound HK	----------	----------	0.13351	0.13349	0.19848	0.19862
21 carbon compound HL	----------	----------	0.08966	0.08929	0.08074	0.08099
21 carbon compound HM	0.73448	0.73479	----------	----------	----------	----------
21 carbon compound HN	----------	----------	0.17023	0.17039	0.13828	0.13850
21 carbon compound HO	0.43264	0.43279	----------	----------	----------	----------
21 carbon compound HP	0.76994	0.76975	----------	----------	----------	----------
21 carbon compound HQ	----------	----------	1.01964	1.01909	1.28319	1.28322
21 carbon compound HR	----------	----------	0.12415	0.12429	0.10382	0.10350
21 carbon compound HS	0.19107	0.19175	----------	----------	----------	----------
21 carbon compound HT	----------	----------	0.09243	0.09294	0.03928	0.03927
21 carbon compound HW	4.76361	4.76375	----------	----------	----------	----------
22 carbon compound HX	0.04948	0.04976	0.09030	0.09039	0.04389	0.04313
22 carbon compound HY	0.03674	0.03665	----------	----------	----------	----------
22 carbon compound HZ	----------	----------	0.02732	0.02788	0.02839	0.02814
22 carbon compound IA	0.13374	0.13375	0.45382	0.45392	0.43928	0.43911
22 carbon compound ID	----------	----------	0.00999	0.00938	0.00283	0.00260
22 carbon compound IE	----------	----------	0.21771	0.21748	0.23784	0.23794
22 carbon compound IG	0.28362	0.28374	0.05733	0.05739	0.04395	0.04372
22 carbon compound II	----------	----------	0.05593	0.05523	0.03489	0.03450
22 carbon compound IJ	----------	----------	0.05031	0.05048	0.02847	0.02818
22 carbon compound IK	----------	----------	0.42623	0.42693	0.43274	0.43226
23 carbon compound IO	0.03923	0.03975	0.35226	0.35239	0.39284	0.39283
23 carbon compound IP	----------	----------	0.31677	0.31678	0.32934	0.32916
23 carbon compound IR	0.11064	0.11085	0.14255	0.14278	0.12398	0.12371
23 carbon compound IT	0.07214	0.07276	0.16617	0.16624	0.12398	0.12378
23 carbon compound IW	0.17287	0.17274	0.57367	0.57348	0.53247	0.53265
23 carbon compound IX	----------	----------	0.16224	0.16298	0.13484	0.13415
23 carbon compound JA	----------	----------	0.00399	0.00373	0.00293	0.00200
23 carbon compound JB	0.02274	0.02278	----------	----------	----------	----------
23 carbon compound JC	1.11685	1.11684	0.15245	0.15237	0.13878	0.13814
23 carbon compound JE	----------	----------	0.21647	0.21608	0.24278	0.24240
23 carbon compound JF	0.20798	0.20798	----------	----------	----------	----------

Table A-3.--(continued)

Compounds	Panthera pardus		Panthera tigris		Panthera tigris	
	R. Sac	L. Sac	R. Sac	L. Sac	R. Sac	L. Sac
24 carbon compound JH	0.07845	0.07879	0.06041	0.06035	0.09338	0.09368
24 carbon compound JI	----------	----------	0.07345	0.07349	0.01249	0.01216
24 carbon compound JJ	0.04698	0.04674	----------	----------	----------	----------
24 carbon compound JK	0.22765	0.22764	----------	----------	----------	----------
24 carbon compound JO	----------	----------	0.06361	0.06392	0.02849	0.02855
24 carbon compound JP	0.20687	0.20687	----------	----------	----------	----------
24 carbon compound JR	0.01858	0.01886	0.00670	0.00649	0.00894	0.00832
24 carbon compound JS	0.06998	0.06947	----------	----------	----------	----------
24 carbon compound JT	----------	----------	0.36916	0.36948	0.32939	0.32932
24 carbon compound JU	----------	----------	0.46361	0.46392	0.49384	0.49377
24 carbon compound JV	0.23175	0.23181	0.03671	0.03648	0.03943	0.03989
24 carbon compound JW	----------	----------	0.17761	0.17747	0.19349	0.19325
24 carbon compound JY	0.22084	0.22085	0.02963	0.02987	0.01392	0.01326
25 carbon compound KB	0.09698	0.09675	0.09417	0.09429	0.02484	0.02460
25 carbon compound KC	----------	----------	0.03500	0.03538	0.03166	0.03167
25 carbon compound KE	----------	----------	0.91320	0.91392	0.93140	0.93196
25 carbon compound KK	----------	----------	0.00539	0.00598	0.00374	0.00319
25 carbon compound KM	----------	----------	0.00529	0.00539	0.00124	0.00130
25 carbon compound KO	0.06174	0.06175	0.00250	0.00287	0.00416	0.00410
25 carbon compound KS	2.72574	2.72579	----------	----------	----------	----------
25 carbon compound KT	----------	----------	0.04547	0.04598	0.08342	0.19453
25 carbon compound KU	0.13076	0.13076	----------	----------	----------	----------
26 carbon compound KV	----------	----------	0.02711	0.02794	0.01398	0.01367
26 carbon compound KW	0.06775	0.06765	----------	----------	----------	----------
26 carbon compound LA	----------	----------	0.37023	0.37049	0.31767	0.31746
26 carbon compound LC	0.03375	0.03398	0.08496	0.08447	0.06042	0.06028
26 carbon compound LD	----------	----------	0.00987	0.00939	0.00968	0.00955
26 carbon compound LG	----------	----------	0.01835	0.01839	0.07520	0.07529
26 carbon compound LI	----------	----------	0.03001	0.03071	0.05251	0.05215
26 carbon compound LJ	0.62975	0.62978	0.01298	0.01232	0.07651	0.07618
26 carbon compound LL	----------	----------	0.00798	0.00742	0.00585	0.00541
26 carbon compound LM	----------	----------	0.00666	0.00684	0.00865	0.00877
27 carbon compound LP	0.03473	0.03474	----------	----------	----------	----------
27 carbon compound LQ	0.01784	0.01749	0.00654	0.00639	0.00752	0.00736
27 carbon compound LS	0.21279	0.21279	----------	----------	----------	----------
27 carbon compound LT	----------	----------	0.39350	0.39323	0.39921	0.39928
27 carbon compound LU	0.06698	0.06687	----------	----------	----------	----------
27 carbon compound LV	----------	----------	0.48157	0.48149	0.47863	0.47888
27 carbon compound LX	0.15084	0.15037	----------	----------	----------	----------
27 carbon compound LY	0.09975	0.09978	0.19350	0.19328	0.14776	0.14732
27 carbon compound LZ	1.52975	1.52975	0.04004	0.04028	0.02823	0.02862
27 carbon compound MC	0.19876	0.19898	0.18520	0.18594	0.19393	0.19348
27 carbon compound ME	----------	----------	1.03244	1.03249	1.23588	1.23575
27 carbon compound MI	----------	----------	0.12372	0.12387	0.14960	0.14929
27 carbon compound MK	----------	----------	0.05498	0.05428	0.09340	0.09392
28 carbon compound ML	----------	----------	0.05458	0.05449	0.03404	0.03431
28 carbon compound MM	0.02785	0.02849	----------	----------	----------	----------

Table A-3.--(continued)

Compounds	Panthera pardus		Panthera tigris		Panthera tigris	
	R. Sac	L. Sac	R. Sac	L. Sac	R. Sac	L. Sac
28 carbon compound MN	----------	----------	0.04504	0.04549	0.03113	0.03142
28 carbon compound MP	----------	----------	0.48227	0.48223	0.46573	0.46508
28 carbon compound MQ	0.03479	0.03489	----------	----------	----------	----------
28 carbon compound MR	----------	----------	0.00650	0.00649	0.00588	0.00538
28 carbon compound MS	0.09685	0.09679	----------	----------	----------	----------
28 carbon compound MT	0.09076	0.09084	----------	----------	----------	----------
28 carbon compound MU	----------	----------	0.21302	0.21392	0.21767	0.21712
28 carbon compound MZ	----------	----------	0.01174	0.01149	0.06042	0.06007
28 carbon compound NA	0.54985	0.54978	----------	----------	----------	----------
28 carbon compound NB	----------	----------	0.04458	0.04438	0.02322	0.02383
28 carbon compound NC	0.16375	0.16375	----------	----------	----------	----------
28 carbon compound ND	----------	----------	0.02583	0.02599	0.06781	0.06786
28 carbon compound NE	1.44289	1.44275	0.48216	0.48282	0.42617	0.42610
28 carbon compound NH	----------	----------	0.30466	0.30439	0.37340	0.37343
29 carbon compound NM	----------	----------	0.34635	0.34649	0.30949	0.30925
29 carbon compound NO	0.08479	0.08476	----------	----------	----------	----------
29 carbon compound NP	----------	----------	0.18752	0.18798	0.19763	0.19733
29 carbon compound NR	0.48975	0.48974	0.14461	0.14434	0.12296	0.12200
29 carbon compound NT	----------	----------	0.51605	0.51634	0.56754	0.56753
29 carbon compound NU	0.18473	0.18475	----------	----------	----------	----------
29 carbon compound NV	----------	----------	0.15016	0.15093	0.12612	0.12618
29 carbon compound NZ	0.19086	0.19086	0.00255	0.00243	0.00963	0.00947
29 carbon compound OB	----------	----------	0.15548	0.15543	0.17071	0.17071
30 carbon compound OD	----------	----------	0.24141	0.24198	0.21558	0.21555
30 carbon compound OI	----------	----------	0.06311	0.06398	0.05858	0.05886
30 carbon compound OK	0.05798	0.05747	----------	----------	----------	----------
30 carbon compound OL	----------	----------	0.05884	0.05884	0.02322	0.02395
30 carbon compound ON	0.03778	0.03776	----------	----------	----------	----------
30 carbon compound OS	0.08678	0.08674	----------	----------	----------	----------
30 carbon compound OT	----------	----------	0.03679	0.03693	0.06754	0.06701
31 carbon compound OZ	----------	----------	0.00106	0.00194	0.00232	0.00278

Table A-4.--Relative amount (picomoles) of glycolipids present in anal sacs of *Panthera pardus* (leopard), *P. uncia* (snow leopard) and *P. tigris* (tiger). Samples for each species were collected over a one year interval. Dashed lines represent the absence of a compound.

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
X-oxo-Nonanoic acid	0.24014	0.24051	----------	----------	----------	----------
10 carbon compound D	0.05151	0.05118	----------	----------	----------	----------
11 carbon compound F	0.32731	0.32774	----------	----------	----------	----------
11 carbon compound G	0.14397	0.14392	----------	----------	----------	----------
11 carbon compound H	0.05061	0.05086	----------	----------	----------	----------
11 carbon compound I	----------	----------	----------	----------	0.01851	0.01832
11 carbon compound J	0.01553	0.01516	0.29826	0.29890	0.09427	0.09823
11 carbon compound K	0.04416	0.04421	----------	----------	----------	----------
11 carbon compound N	0.01276	0.01209	----------	----------	----------	----------
Dodecanoic acid	0.01570	0.01520	----------	----------	----------	----------
Nonadecanoic acid	0.02965	0.02929	----------	----------	----------	----------
12 carbon compound Q	----------	----------	0.01969	0.01959	0.06145	0.02898
12 carbon compound R	----------	----------	0.02890	0.02811	----------	----------
12 carbon compound S	0.02830	0.02844	----------	----------	----------	----------
12 carbon compound T	1.12875	1.12881	----------	----------	----------	----------
12 carbon compound U	0.03127	0.03133	----------	----------	----------	----------
2,6-bis(1,1-dimethylethyl)-4-ethyl-Phenol	----------	----------	0.03609	0.03684	----------	----------
12 carbon compound V	0.03991	0.03954	----------	----------	----------	----------
12 carbon compound W	----------	----------	----------	----------	0.03738	0.02839
12 carbon compound X	----------	----------	0.06050	0.06016	0.07915	0.01238
12 carbon compound Y	0.26635	0.26690	----------	----------	----------	----------
12 carbon compound AA	0.03581	0.03569	----------	----------	----------	----------
12 carbon compound AB	----------	----------	0.14474	0.14461	0.01551	0.01837
Tridecanoic acid	0.37151	0.37148	----------	----------	----------	----------
13 carbon compound AC	0.25029	0.25069	0.39170	0.39161	0.02027	0.01283
13 carbon compound AF	0.08536	0.08513	----------	----------	----------	----------
13 carbon compound AI	0.09813	0.09814	----------	----------	----------	----------
13 carbon compound AL	0.10258	0.10251	----------	----------	----------	----------
13 carbon compound AM	----------	----------	0.39956	0.39921	0.00775	0.00284
13 carbon compound AN	0.02946	0.03440	----------	----------	0.04116	0.02384
13 carbon compound AP	0.01895	0.01828	----------	----------	----------	----------
Tetradecanoic acid	1.47002	1.47569	0.63142	0.63171	0.08326	0.01283
14 carbon compound AW	0.04232	0.04341	----------	----------	----------	----------
14 carbon compound AY	0.01873	0.01831	----------	----------	----------	----------
14 carbon compound BA	5.21264	5.21249	----------	----------	----------	----------
14 carbon compound BC	0.32467	0.32437	----------	----------	----------	----------
14 carbon compound BD	0.28292	0.28240	----------	----------	----------	----------
14 carbon compound BE	0.02247	0.02231	----------	----------	----------	----------
Pentadecanoic acid	0.02259	0.03105	0.09406	0.09458	0.04654	0.01283
15 carbon compound BI	0.05761	0.05728	----------	----------	----------	----------
X-Hydroxy-Tetradecanoic acid	0.03994	0.03900	----------	----------	----------	----------
15 carbon compound BK	0.97027	0.97089	----------	----------	----------	----------
15 carbon compound BM	0.16244	0.16213	----------	----------	----------	----------
15 carbon compound BO	0.49611	0.49636	----------	----------	----------	----------

Table A-4.–(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
15 carbon alcohol	0.53750	0.53755	----------	----------	----------	----------
15 carbon compound BQ	0.79766	0.79734	----------	----------	----------	----------
15 carbon compound BR	0.15819	0.15895	----------	----------	----------	----------
15 carbon compound BS	8.17107	8.17138	----------	----------	----------	----------
15 carbon compound BT	----------	----------	0.06466	0.06423	0.00708	0.00218
Hexadecanoic acid	0.53096	0.53007	0.15133	0.15187	0.03391	0.01285
16 carbon compound BV	----------	----------	0.39040	0.39074	0.06083	0.03848
16 carbon compound BW	16.47659	16.47696	----------	----------	----------	----------
16 carbon compound BY	3.46592	3.46502	----------	----------	----------	----------
16 carbon compound BZ	----------	----------	0.17494	0.17443	0.08519	0.01284
16 carbon compound CA	0.14416	0.14436	----------	----------	----------	----------
16 carbon compound CB	6.23011	6.23088	----------	----------	----------	----------
16 carbon alcohol	0.07601	0.07684	----------	----------	----------	----------
16 carbon compound CC	0.17453	0.17485	----------	----------	----------	----------
14-methyl Hexadecanoic acid	0.37386	0.37323	----------	----------	----------	----------
X-hydroxy Hexadecanoic acid	0.17766	0.17744	----------	----------	----------	----------
16 carbon compound CF	0.08762	0.08757	----------	----------	----------	----------
16 carbon compound CG	----------	----------	0.16169	0.16141	0.12459	0.18391
Heptadecanoic acid	5.25436	5.25425	0.04633	0.04672	1.03365	1.82349
17 carbon compound CI	1.20889	1.20885	----------	----------	----------	----------
17 carbon compound CJ	0.07517	0.07572	----------	----------	----------	----------
17 carbon compound CL	0.20732	0.20706	----------	----------	----------	----------
17 carbon compound CM	0.47335	0.47301	----------	----------	----------	----------
17 carbon compound CN	0.71094	0.71082	----------	----------	----------	----------
X,X-Octadecadienoic acid	0.05486	0.05443	----------	----------	----------	----------
X-Octadecenoic acid	0.61500	0.61587	----------	----------	----------	----------
X-Octadecenoic acid	0.51336	0.51317	----------	----------	----------	----------
17 carbon compound CQ	0.24662	0.24769	----------	----------	----------	----------
X-Octadecanoic acid	0.28998	0.28977	----------	----------	----------	----------
Octadecanoic acid	1.41699	1.41603	0.96201	0.96238	0.04472	0.01844
18 carbon compound CT	0.10648	0.10612	----------	----------	----------	----------
18 carbon compound CW	0.24671	0.24612	0.04569	0.04571	0.00144	0.00128
18 carbon compound CX	0.11070	0.11075	----------	----------	----------	----------
18 carbon compound CY	----------	----------	0.03207	0.03228	----------	----------
18 carbon compound CZ	0.04123	0.04144	----------	----------	----------	----------
18 carbon compound DA	----------	----------	0.36827	0.36834	----------	----------
X-methyl Octadecanoic acid	0.07753	0.07757	----------	----------	----------	----------
18 carbon compound DB	0.34859	0.34877	----------	----------	----------	----------
18 carbon compound DC	0.16286	0.16265	0.05763	0.05709	0.03797	0.01283
18 carbon compound DD	0.24168	0.24117	----------	----------	----------	----------
18 carbon compound DE	0.03404	0.03476	----------	----------	----------	----------
18 carbon compound DF	----------	----------	0.09049	0.09029	----------	----------
19 carbon compound DG	----------	----------	0.19026	0.19098	0.02729	0.01829
19 carbon compound DH	0.22579	0.22551	----------	----------	----------	----------
X,X,X,X-Eicosatetraenoic acid	0.21206	0.21264	----------	----------	----------	----------
2-Hydroxy-Octanoic acid	0.14068	0.14083	----------	----------	0.10090	0.18812
19 carbon compound DI	0.02659	0.02602	----------	----------	----------	----------

Table A-4.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
19 carbon compound DJ	0.035107	0.03542	----------	----------	----------	----------
19 carbon compound DK	----------	----------	0.109989	0.109147	0.552635	0.581294
19 carbon compound DL	0.103291	0.103087	----------	----------	----------	----------
19 carbon compound DM	----------	----------	0.02538	0.02556	----------	----------
19 carbon compound DN	0.066443	0.066244	----------	----------	----------	----------
X,X-Eicosadienoic acid	----------	----------	0.170166	0.170341	0.011096	0.018375
X-Eicosanoic acid	0.882068	0.882656	----------	----------	----------	----------
X-Eicosanoic acid	0.02679	0.026111	----------	----------	----------	----------
19 carbon compound DR	0.046326	0.046893	----------	----------	----------	----------
19 carbon compound DS	----------	----------	0.021216	0.021974	0.005026	0.001278
19 carbon compound DU	0.197104	0.197247	----------	----------	----------	----------
Eicosanoic acid	0.052742	0.052669	0.011041	0.011416	0.166956	0.138892
20 carbon compound DW	0.248524	0.248302	----------	----------	----------	----------
20 carbon compound DX	0.053161	0.053585	0.426249	0.426831	----------	----------
20 carbon compound DZ	0.014894	0.01409	----------	----------	----------	----------
20 carbon compound EA	0.496919	0.49666	----------	----------	----------	----------
20 carbon compound ED	0.025339	0.025516	----------	----------	----------	----------
20 carbon compound EF	0.126599	0.126618	----------	----------	----------	----------
20 carbon compound EH	----------	----------	0.103547	0.103983	0.018126	0.083183
20 carbon compound EI	0.05329	0.053408	----------	----------	----------	----------
20 carbon compound EJ	0.047229	0.04773	----------	----------	----------	----------
20 carbon compound EL	0.033302	0.03336	----------	----------	----------	----------
20 carbon compound EO	0.064831	0.064407	----------	----------	----------	----------
21 carbon compound EP	0.02002	0.020942	----------	----------	----------	----------
21 carbon compound ES	0.032528	0.032501	----------	----------	----------	----------
Docosanoic acid	0.022406	0.022465	----------	----------	----------	----------
21 carbon compound EU	0.024437	0.024615	0.642976	0.64235	0.813216	0.813901
21 carbon compound EV	0.098262	0.098264	----------	----------	----------	----------
21 carbon compound EW	0.679838	0.679053	----------	----------	----------	----------
21 carbon compound EY	0.127212	0.127701	----------	----------	----------	----------
21 carbon compound EZ	----------	----------	----------	----------	0.31993	0.38192
21 carbon compound FA	0.100261	0.100605	----------	----------	----------	----------
21 carbon compound FB	0.096457	0.096197	0.259701	0.259848	----------	----------
21 carbon compound FC	30.40804	30.40889	----------	----------	----------	----------
21 carbon compound FD	----------	----------	0.343519	0.343845	0.052471	0.012388
21 carbon compound FE	0.05603	0.056001	----------	----------	----------	----------
21 carbon compound FF	0.114961	0.114646	----------	----------	----------	----------
21 carbon compound FH	0.246783	0.246155	0.138704	0.138476	----------	----------
Docosanoic acid	0.476641	0.476436	----------	----------	----------	----------
22 carbon compound FI	0.289918	0.289746	----------	----------	13.07522	13.83912
22 carbon compound FK	0.051839	0.051116	----------	----------	----------	----------
22 carbon compound FM	0.035075	0.035042	----------	----------	----------	----------
22 carbon compound FN	0.07476	0.074274	----------	----------	----------	----------
22 carbon compound FO	----------	----------	0.088667	0.088835	----------	----------
22 carbon compound FP	----------	----------	----------	----------	0.253787	0.29303
22 carbon compound FQ	0.064799	0.064996	----------	----------	----------	----------
22 carbon compound FR	0.097553	0.09775	----------	----------	----------	----------

Table A-4.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
22 carbon compound FS	0.07601	0.07620	0.02020	0.02083	0.01249	0.01823
22 carbon compound FY	0.01998	0.01989	----------	----------	----------	----------
22 carbon compound FZ	----------	----------	0.38374	0.38398	0.19426	0.19849
22 carbon compound GA	----------	----------	1.24977	1.24983	0.01755	0.01939
22 carbon compound GC	0.06325	0.06356	----------	----------	----------	----------
23 carbon compound GD	0.08498	0.08408	----------	----------	----------	----------
23 carbon compound GE	0.09158	0.09195	0.08935	0.08983	0.02000	0.04923
23 carbon compound GF	0.06741	0.06798	----------	----------	----------	----------
X-Eicosene	0.09826	0.09873	----------	----------	----------	----------
23 carbon compound GI	0.03755	0.03794	----------	----------	----------	----------
23 carbon compound GJ	0.12601	0.12688	0.51350	0.51398	0.15968	0.18287
23 carbon compound GK	0.15874	0.15853	----------	----------	----------	----------
23 carbon compound GL	----------	----------	7.08084	7.08084	0.05058	0.01283
23 carbon compound GM	0.07285	0.07266	----------	----------	----------	----------
23 carbon compound GN	0.12930	0.12900	----------	----------	----------	----------
X-Tetracosenoic acid	0.03275	0.03265	----------	----------	----------	----------
23 carbon compound GP	0.03562	0.03500	----------	----------	----------	----------
Tetracosanoic acid	0.12198	0.12186	1.02476	1.02446	0.18902	0.12788
24 carbon compound GS	0.06850	0.06863	----------	----------	0.27334	0.23892
24 carbon compound GY	0.50036	0.50051	----------	----------	----------	----------
24 carbon compound HA	0.11287	0.11221	----------	----------	----------	----------
24 carbon compound HB	0.41275	0.41299	----------	----------	----------	----------
24 carbon compound HD	0.07184	0.07165	----------	----------	----------	----------
24 carbon compound HF	0.13734	0.13756	----------	----------	----------	----------
24 carbon compound HH	0.07845	0.07857	----------	----------	----------	----------
24 carbon compound HI	0.01374	0.01324	----------	----------	----------	----------
25 carbon compound HL	0.03143	0.03140	----------	----------	----------	----------
25 carbon compound HM	0.08185	0.08132	----------	----------	----------	----------
25 carbon compound HN	0.01463	0.01496	----------	----------	----------	----------
25 carbon compound HO	0.87732	0.87762	----------	----------	----------	----------
25 carbon compound HQ	0.02887	0.02843	----------	----------	----------	----------
25 carbon compound HR	0.02374	0.02316	----------	----------	----------	----------
25 carbon compound HT	----------	----------	9.54706	9.54798	0.43384	0.41228
X-Hexacosanoic acid	0.00764	0.00774	3.09489	3.09498	0.01076	0.01283
25 carbon compound HU	0.02473	0.02402	----------	----------	----------	----------
X-Tetracosenoic acid	0.04037	0.04083	----------	----------	----------	----------
25 carbon compound IA	0.17743	0.17779	----------	----------	----------	----------
25 carbon compound IB	----------	----------	0.23186	0.23183	4.21900	4.12838
26 carbon compound ID	0.12546	0.12582	0.39138	0.39198	0.03660	0.03821
26 carbon compound IH	----------	----------	0.26173	0.26159	0.03520	0.01238
26 carbon compound II	0.01274	0.01234	----------	----------	----------	----------
26 carbon compound IK	0.02174	0.02102	----------	----------	----------	----------
26 carbon compound IN	----------	----------	7.39388	7.39398	0.07113	0.01283
26 carbon compound IP	0.08475	0.08434	----------	----------	----------	----------
26 carbon compound IV	----------	----------	0.08544	0.08513	0.05228	0.01283
26 carbon compound IW	----------	----------	0.09167	0.09157	3.39403	3.89123
26 carbon compound IX	0.12857	0.12848	----------	----------	----------	----------

Table A-4.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
26 carbon compound JA	0.00968	0.00922	----------	----------	----------	----------
27 carbon compound JC	----------	----------	0.29178	0.29119	0.36180	0.31289
27 carbon sterol	----------	----------	0.06502	0.06567	12.04290	12.84875
27 carbon compound JE	0.01275	0.01226	----------	----------	----------	----------
27 carbon compound JF	0.37726	0.37751	----------	----------	----------	----------
27 carbon compound JH	----------	----------	0.25420	0.25426	0.41905	0.41278
27 carbon compound JJ	0.01857	0.01818	----------	----------	----------	----------
27 carbon compound JN	0.03375	0.03376	----------	----------	----------	----------
27 carbon compound JO	----------	----------	0.39789	0.39755	0.02442	0.01283
27 carbon compound JP	0.06977	0.06947	----------	----------	----------	----------
27 carbon compound JS	0.11079	0.11027	----------	----------	----------	----------
27 carbon compound JV	0.01089	0.01047	----------	----------	----------	----------
28 carbon compound JY	0.01267	0.01296	----------	----------	----------	----------
28 carbon compound KA	0.03664	0.03649	----------	----------	----------	----------
28 carbon compound KC	0.05345	0.05367	----------	----------	----------	----------
28 carbon compound KF	0.02886	0.02829	----------	----------	----------	----------
28 carbon compound KH	0.05276	0.05226	----------	----------	----------	----------
28 carbon compound KI	----------	----------	0.06870	0.06802	0.02631	0.01283
28 carbon compound KK	0.01378	0.01346	----------	----------	----------	----------
28 carbon compound KR	0.02479	0.02453	----------	----------	----------	----------
28 carbon compound KT	0.02974	0.02944	0.17349	0.17375	10.21050	10.38482
28 carbon compound KU	----------	----------	10.06292	10.06282	0.01237	0.01838
28 carbon compound KV	0.01189	0.01159	----------	----------	----------	----------
28 carbon compound KY	0.40976	0.40913	0.20383	0.20362	0.03059	0.01283
29 carbon compound LC	0.05275	0.05248	----------	----------	----------	----------
29 carbon compound LD	0.05476	0.05438	----------	----------	----------	----------
29 carbon compound LE	0.00676	0.00602	----------	----------	----------	----------
29 carbon compound LF	0.04178	0.04102	----------	----------	----------	----------
29 carbon compound LH	8.65976	8.65952	----------	----------	----------	----------
29 carbon compound LI	----------	----------	0.24945	0.24985	----------	----------
29 carbon compound LJ	0.10973	0.01961	----------	----------	----------	----------
29 carbon compound LM	----------	----------	0.17943	0.17945	----------	----------
29 carbon compound LO	0.05578	0.05579	----------	----------	----------	----------
29 carbon compound LP	----------	----------	0.16205	0.16298	0.01115	0.01284
29 carbon compound LR	----------	----------	0.13204	0.13272	----------	----------
29 carbon compound LS	0.01979	0.01917	----------	----------	----------	----------
29 carbon compound LU	0.11689	0.11624	----------	----------	0.13119	0.13891
29 carbon compound LW	----------	----------	0.58055	0.58093	----------	----------
30 carbon compound LX	0.07473	0.07475	1.19692	1.19637	0.02709	0.01283
30 carbon compound MB	0.02578	0.02591	----------	----------	----------	----------
30 carbon compound ME	0.00997	0.00930	----------	----------	----------	----------
30 carbon compound MF	----------	----------	0.38128	0.38141	----------	----------
30 carbon compound MG	0.00683	0.00675	----------	----------	----------	----------
30 carbon compound MH	0.01583	0.01571	----------	----------	----------	----------
30 carbon compound MK	0.01898	0.01834	----------	----------	----------	----------
30 carbon compound ML	0.02489	0.02415	----------	----------	----------	----------
30 carbon compound MN	0.01889	0.01822	0.67624	0.67607	0.37729	0.31288

Table A-4.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	**Sample 2**	**Sample 1**	**Sample 2**	**Sample 1**	**Sample 2**
31 carbon compound MR	----------	----------	0.53269	0.53250	0.01974	0.01283
31 carbon compound MT	0.00990	0.00910	----------	----------	----------	----------

Table A-5.--Relative amount (picomoles) of neutral lipids present in anal sacs of *Panthera pardus* (leopard), *P. uncia* (snow leopard) and *P. tigris* (tiger). Samples for each species were collected over a one year interval. Dashed lines represent the absence of a compound.

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
10 carbon compound A	----------	----------	0.36319	0.36287	0.03212	0.016787
10 carbon compound C	----------	----------	0.00581	0.00458	0.09950	0.018212
10 carbon compound D	----------	----------	0.04571	0.05281	0.01719	0.039591
10 carbon compound G	----------	----------	0.02997	0.03088	0.02264	0.013422
11 carbon compound H	----------	----------	0.07274	0.01037	0.02719	0.014411
11 carbon compound J	0.09106	0.09175	0.34315	0.30954	----------	----------
11 carbon compound L	----------	----------	0.04984	0.07557	----------	----------
11 carbon compound N	----------	----------	0.00574	0.00459	----------	----------
11 carbon compound O	----------	----------	0.07440	0.05448	----------	----------
11 carbon compound S	0.04824	0.04858	0.05799	0.03264	0.03964	0.037454
11 carbon compound T	----------	----------	0.10767	0.14607	0.90428	0.905186
11 carbon compound V	1.00129	1.00157	0.03053	0.05209	----------	----------
11 carbon compound Y	----------	----------	0.00341	0.00358	0.01859	0.047866
12 carbon compound Z	0.02531	0.02584	0.52072	0.52310	0.06941	0.079223
12 carbon compound AA	1.02590	1.02558	----------	----------	----------	----------
12 carbon compound AB	----------	----------	0.06507	0.04578	0.01637	0.042719
12 carbon compound AF	0.00220	0.00257	----------	----------	----------	----------
12 carbon compound AH	----------	----------	0.17471	0.13707	1.01242	1.009621
12 carbon compound AJ	----------	----------	0.05628	0.02351	0.06645	0.060575
12 carbon compound AK	0.08727	0.08757	----------	----------	----------	----------
12 carbon compound AM	0.00624	0.00657	0.09569	0.06365	0.20458	0.201767
12 carbon compound AO	----------	----------	0.13419	0.14034	0.03255	0.039552
12 carbon compound AQ	----------	----------	0.07547	0.02603	----------	----------
12 carbon compound AR	0.05352	0.05347	----------	----------	----------	----------
12 carbon compound AS	----------	----------	0.84433	0.85130	0.80549	0.827279
12 carbon compound AV	----------	----------	0.00827	0.00255	0.10152	0.103167
13 carbon compound AX	----------	----------	0.06140	0.03395	----------	----------
13 carbon compound AY	0.10172	0.10175	----------	----------	----------	----------
13 carbon compound AZ	0.12362	0.12347	0.04732	0.07055	0.01750	0.073284
13 carbon compound BA	0.04619	0.04675	----------	----------	----------	----------
X-branched Tridecanoic acid	0.02008	0.02076	0.00116	0.00134	10.08008	10.49038
13 carbon compound BE	----------	----------	0.09935	0.03984	----------	----------
13 carbon compound BF	0.03408	0.03475	----------	----------	----------	----------
13 carbon compound BH	----------	----------	0.09134	0.08038	0.01476	0.068993
13 carbon compound BJ	0.18762	0.18757	----------	----------	----------	----------
13 carbon compound BK	----------	----------	0.13929	0.17114	0.00929	0.00137
13 carbon compound BM	----------	----------	0.12942	0.10520	0.04759	0.031612
13 carbon compound BO	0.17371	0.17389	0.03863	0.03751	0.12146	0.159585
1,1'-(1,2-cyclobutanediyl)bis-, cis-Benzene	0.06769	0.06748	0.21559	0.23147	0.04747	0.04363
13 carbon compound BQ	----------	----------	0.03453	0.04300	0.12894	0.107689
Tetradecanoic acid	0.49437	0.49485	0.00719	0.00493	0.03134	0.02233
14 carbon compound BR	0.01900	0.01957	----------	----------	----------	----------
14 carbon compound BS	----------	----------	0.01202	0.01155	0.23850	0.238602
14 carbon compound BW	----------	----------	0.00192	0.00453	8.58027	8.277774

Table A-5.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
14 carbon compound BX	0.00241	0.00258	0.22174	0.27708	0.10374	0.18013
14 carbon compound CB	0.25933	0.25975	----------	----------	----------	----------
14 carbon compound CC	0.08006	0.08085	0.03786	0.03080	0.07652	0.05649
14 carbon compound CE	----------	----------	0.00865	0.00145	3.03675	3.28399
14 carbon compound CF	0.02984	0.02957	0.06776	0.04712	0.42303	0.42947
14 carbon compound CG	----------	----------	0.00130	0.00224	15.00586	15.82893
15 carbon compound CU	0.02127	0.02174	----------	----------	----------	----------
15 carbon compound CV	0.07349	0.07375	0.04818	0.02720	0.41596	0.40330
15 carbon compound CW	1.85480	1.85457	0.05074	0.09591	0.24704	0.26037
15 carbon compound CY	----------	----------	0.23500	0.23707	8.23839	8.04707
15 carbon compound DB	0.05173	0.05157	0.12681	0.15994	0.00724	0.00667
Nonadecanoic acid	----------	----------	0.17675	0.12912	0.08590	0.03341
15 carbon compound DC	2.52183	2.52158	----------	----------	----------	----------
15 carbon compound DD	0.01300	0.01385	0.01014	0.08522	0.03125	0.08789
15 carbon compound DF	----------	----------	0.07253	0.07225	0.09650	0.02149
Hexadecanoic acid	0.00123	0.00176	0.06652	0.07606	0.06123	0.05535
16 carbon compound DL	0.06573	0.06557	0.08825	0.06033	0.45637	0.40647
16 carbon compound DM	0.04396	0.04375	0.09880	0.07281	0.04594	0.08199
16 carbon compound DN	----------	----------	0.85741	0.83803	3.01530	3.06964
16 carbon compound DQ	0.00668	0.00676	0.23849	0.21506	0.32018	0.38770
16 carbon compound DS	----------	----------	----------	----------	1.09446	1.61826
16 carbon compound DT	0.02210	0.02257	0.18392	0.12066	0.05182	0.03215
16 carbon compound DV	0.51788	0.51757	----------	----------	----------	----------
16 carbon compound EA	0.57106	0.57175	1.13892	1.22322	0.20529	0.27238
16 carbon compound EF	0.03011	0.03075	----------	----------	----------	----------
16 carbon compound EH	----------	----------	0.00239	0.00657	1.00495	1.04054
17 carbon compound EJ	----------	----------	0.09391	0.01397	0.21117	0.26520
17 carbon compound EL	0.01739	0.01757	----------	----------	----------	----------
17 carbon compound EN	----------	----------	0.12982	0.12477	1.00806	1.69415
17 carbon compound EP	----------	----------	0.08319	0.02948	0.15723	0.15667
17 carbon compound ES	----------	----------	0.01839	0.01525	0.01199	0.06433
17 carbon compound ET	0.02772	0.02775	0.08193	0.05525	0.04158	0.04472
17 carbon compound EU	0.48829	0.48875	0.32833	0.31008	3.08197	2.08860
X-Octadecenoic acid	0.19625	0.19658	4.18391	4.01255	0.00180	0.00757
17 carbon compound EV	0.16233	0.16276	0.28234	0.28102	0.04563	0.06263
17 carbon compound EX	0.02438	0.02475	----------	----------	----------	----------
17 carbon compound EY	----------	----------	4.02489	4.03130	0.03161	0.07316
Octadecanoic acid	0.01502	0.01557	0.08193	0.05942	0.08921	0.04273
18 carbon compound FC	5.73190	5.73145	0.62488	0.64636	0.09868	0.07801
18 carbon compound FD	1.03459	1.03448	0.27483	0.29483	0.01644	0.06616
18 carbon compound FG	9.26250	9.26248	----------	----------	----------	----------
18 carbon compound FH	1.27320	1.27345	0.02384	0.04741	0.48925	0.41254
18 carbon compound FJ	----------	----------	0.12384	0.17569	0.13773	0.14699
18 carbon compound FK	6.40730	6.40723	----------	----------	----------	----------
18 carbon compound FL	----------	----------	10.02385	10.13561	0.14328	0.10927
18 carbon compound FN	0.16777	0.16738	0.68198	0.63667	1.07964	1.90676
18 carbon compound FO	3.51940	3.51947	----------	----------	----------	----------

Table A-5.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
18 carbon compound FT	0.54400	0.54445	----------	----------	----------	----------
18 carbon compound FX	----------	----------	----------	----------	0.90829	0.91042
18 carbon compound FY	0.00453	0.00428	0.38493	0.37867	0.60762	0.62712
18 carbon compound GA	0.05243	0.05232	----------	----------	----------	----------
18 carbon compound GB	----------	----------	0.28198	0.21129	0.03382	0.09422
19 carbon alcohol	0.18398	0.18323	0.03984	0.05560	0.09056	0.06845
19 carbon compound GJ	0.15479	0.15423	0.01294	0.06729	0.03086	0.06849
19 carbon compound GO	0.81198	0.81158	----------	----------	----------	----------
19 carbon compound GP	----------	----------	0.08213	0.07385	1.88350	1.00673
19 carbon compound GQ	0.23373	0.23332	----------	----------	----------	----------
19 carbon compound GR	0.44845	0.44823	0.08392	0.06737	0.05424	0.09099
19 carbon compound GS	----------	----------	0.04928	0.06498	0.09176	0.04521
19 carbon compound GT	3.31667	3.31675	0.02349	0.04537	0.14557	0.18805
19 carbon compound GY	0.05563	0.05566	----------	----------	----------	----------
Eicosanoic acid	4.17370	4.17358	0.28374	0.25782	0.10343	0.14383
20 carbon compound GZ	0.87015	0.87058	----------	----------	----------	----------
20 carbon compound HC	0.04168	0.04168	0.08321	0.01896	0.06572	0.01310
20 carbon compound HD	0.16631	0.16628	----------	----------	----------	----------
20 carbon compound HE	----------	----------	0.03898	0.08430	0.08652	0.02578
20 carbon compound HG	----------	----------	0.12384	0.12422	0.12913	0.10668
20 carbon compound HI	----------	----------	0.04987	0.08621	0.06709	0.02079
20 carbon compound HK	0.48605	0.48614	----------	----------	----------	----------
20 carbon compound HM	----------	----------	0.03294	0.03684	0.02608	0.08608
20 carbon compound HP	0.06223	0.06223	----------	----------	----------	----------
20 carbon compound HR	----------	----------	0.23824	0.25535	0.23267	0.21303
21 carbon compound HU	0.08318	0.08358	0.03827	0.09108	0.20553	0.29160
21 carbon compound HZ	----------	----------	0.18327	0.15628	2.00257	2.15167
21 carbon compound IA	0.34957	0.34934	----------	----------	----------	----------
21 carbon compound ID	----------	----------	0.12983	0.14929	1.02014	1.13892
21 carbon compound IH	----------	----------	0.58329	0.59701	0.10854	0.15325
21 carbon compound IL	0.17129	0.17138	0.12384	0.16541	0.05329	0.04163
21 carbon compound IP	0.36916	0.36923	1.02849	1.53362	3.00447	3.05772
Docosanoic acid	0.08365	0.08334	0.02832	0.05317	0.00261	0.00225
22 carbon compound IT	0.04571	0.04528	----------	----------	----------	----------
22 carbon compound IU	----------	----------	0.38274	0.32768	0.07668	0.06886
22 carbon compound IW	0.27419	0.27423	----------	----------	----------	----------
22 carbon compound IX	----------	----------	0.28988	0.23121	0.01742	0.08314
22 carbon compound IY	0.00581	0.00518	----------	----------	----------	----------
22 carbon compound JB	----------	----------	0.28392	0.23513	0.08259	0.02019
22 carbon compound JD	----------	----------	0.38319	0.31129	0.02665	0.04070
22 carbon compound JF	0.03728	0.03734	----------	----------	----------	----------
22 carbon compound JG	0.10814	0.10823	0.72832	0.72643	0.07273	0.04592
22 carbon compound JH	0.74527	0.74524	----------	----------	----------	----------
22 carbon compound JI	----------	----------	0.19839	0.18818	0.23987	0.21773
22 carbon compound JM	----------	----------	3.02893	3.11308	0.05501	0.06057
22 carbon compound JN	0.08846	0.08823	----------	----------	----------	----------
22 carbon compound JO	----------	----------	0.13827	0.13727	0.05251	0.07973

Table A-5.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
23 carbon compound JP	0.01779	0.01759	----------	----------	----------	----------
23 carbon compound JS	0.02768	0.02728	0.12842	0.10383	0.01903	0.04055
23 carbon compound JU	0.01865	0.01819	0.02348	0.02110	0.08651	0.04430
23 carbon compound JX	----------	----------	0.02835	0.09594	2.38894	2.14652
23 carbon compound JZ	----------	----------	0.03294	0.01918	0.28250	0.21943
23 carbon compound KC	----------	----------	0.20034	0.24554	0.91875	0.90875
23 carbon compound KD	0.07979	0.07923	0.20438	0.28306	0.61562	0.62395
23 carbon compound KG	0.03274	0.03212	0.53279	0.52098	0.05990	0.04295
23 carbon compound KI	----------	----------	0.28389	0.26127	1.04967	1.01599
3,7,11-trimethyl-(E,E)-2,6,10-Dodecatrien-1-ol	0.05778	0.05723	1.08234	1.21774	0.06132	0.02153
24 carbon compound KT	----------	----------	2.24832	2.12217	0.01125	0.08782
24 carbon compound LB	0.53885	0.53819	1.13456	1.01799	0.05070	0.04790
24 carbon compound LC	0.18948	0.18914	----------	----------	----------	----------
24 carbon compound LD	----------	----------	0.59012	0.57547	0.00674	0.00126
24 carbon compound LH	0.24975	0.24935	----------	----------	----------	----------
24 carbon compound LI	----------	----------	0.05346	0.04776	7.01623	7.00728
25 carbon compound LJ	0.38476	0.38419	----------	----------	----------	----------
25 carbon compound LK	----------	----------	0.18232	0.10648	0.83344	0.83167
25 carbon compound LL	0.05798	0.05724	----------	----------	----------	----------
25 carbon compound LM	0.17875	0.17818	----------	----------	----------	----------
25 carbon compound LO	0.03786	0.03724	0.02438	0.01116	0.20610	0.24584
25 carbon compound LQ	0.18475	0.18423	----------	----------	----------	----------
25 carbon compound LR	0.01774	0.01723	----------	----------	----------	----------
25 carbon compound LT	0.03798	0.03714	----------	----------	----------	----------
25 carbon compound LU	----------	----------	0.02347	0.01662	----------	----------
25 carbon compound LV	0.03784	0.03732	----------	----------	----------	----------
25 carbon compound LY	0.00573	0.00523	0.00235	0.00608	0.12961	0.12550
25 carbon compound MC	0.01885	0.01828	0.31209	0.31149	0.10939	0.10538
25 carbon compound MD	0.00790	0.00737	----------	----------	----------	----------
25 carbon compound MF	----------	----------	0.02489	0.04515	----------	----------
25 carbon compound MH	0.04798	0.04728	4.13128	4.02174	0.30482	0.32066
26 carbon compound MK	0.17587	0.17524	----------	----------	----------	----------
26 carbon compound MO	0.18975	0.18923	----------	----------	----------	----------
26 carbon compound MQ	0.28474	0.28429	----------	----------	----------	----------
26 carbon compound MR	----------	----------	0.02178	0.03579	----------	----------
26 carbon compound MU	----------	----------	0.12047	0.10804	0.24493	0.20559
26 carbon compound MY	----------	----------	1.22904	1.16942	0.06184	0.04988
26 carbon compound NA	----------	----------	0.19234	0.10460	0.21733	0.22329
26 carbon compound ND	0.28478	0.28425	0.01018	0.03223	0.01733	0.08639
Cholesterol	----------	----------	0.04923	0.06161	0.04005	0.08076
27 carbon compound NF	0.00679	0.00623	----------	----------	----------	----------
27 carbon compound NG	0.37585	0.37525	----------	----------	----------	----------
27 carbon compound NH	0.27979	0.27923	0.24903	0.26490	0.01045	0.08868
27 carbon compound NN	0.03887	0.03828	----------	----------	----------	----------
27 carbon compound NO	----------	----------	1.09347	1.24025	0.02043	0.06676
27 carbon compound NP	0.02798	0.02738	----------	----------	----------	----------

Table A-5.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
27 carbon compound NR	0.04786	0.04734	----------	----------	----------	----------
27 carbon compound NV	0.02084	0.02035	----------	----------	----------	----------
27 carbon compound NW	----------	-	0.01390	0.05673	----------	----------
27 carbon compound NX	0.05794	0.05735	----------	----------	----------	----------
27 carbon compound NY	----------	----------	0.28475	0.25390	----------	----------
28 carbon compound NZ	0.38974	0.38923	----------	----------	----------	----------
28 carbon compound OA	0.06797	0.06785	0.04783	0.05184	0.00700	0.00180
28 carbon compound OC	----------	----------	0.52904	0.53965	----------	----------
28 carbon compound OE	----------	----------	0.23423	0.22259	0.50753	0.58215
28 carbon compound OL	0.07475	0.07437	1.02437	1.24528	0.10377	0.16658
28 carbon compound OO	----------	----------	2.02989	2.02029	0.09673	0.02415
28 carbon compound OR	----------	----------	0.83108	0.83752	----------	----------
28 carbon compound OT	0.05475	0.05427	0.23249	0.28933	0.50726	0.51714
28 carbon compound OW	----------	----------	0.59458	0.51164	0.07233	0.03119
29 carbon compound PB	----------	----------	0.13409	0.17215	0.06851	0.02276
29 carbon compound PE	----------	----------	0.02044	0.07982	0.03399	0.02594
29 carbon compound PF	0.02798	0.02776	----------	----------	----------	----------
29 carbon compound PI	----------	----------	0.93439	0.95211	0.06825	0.07336
29 carbon compound PK	----------	----------	0.12349	0.15462	0.03796	0.02771
29 carbon compound PL	0.09976	0.09984	----------	----------	----------	----------
29 carbon compound PM	----------	----------	0.04732	0.05483	0.21116	0.20931
29 carbon compound PQ	----------	----------	0.02094	0.03113	0.04939	0.01548
29 carbon compound PS	----------	----------	0.01038	0.05876	----------	----------
30 carbon compound PW	----------	----------	0.02398	0.02857	1.01317	1.02482
30 carbon compound PY	0.18479	0.18445	----------	----------	----------	----------
30 carbon compound PZ	0.07798	0.07712	----------	----------	----------	----------
30 carbon compound QB	----------	----------	----------	----------	0.02286	0.02384
30 carbon compound QD	0.03798	0.03723	----------	----------	----------	----------
30 carbon compound QG	0.03798	0.03737	----------	----------	----------	----------
30 carbon compound QI	0.37587	0.37528	----------	----------	----------	----------
31 carbon compound QL	18.75997	18.75924	----------	----------	----------	----------

Table A-6.--Relative amount (picomoles) of phospholipids present in anal sacs of *Panthera pardus* (leopard), *P. uncia* (snow leopard) and *P. tigris* (tiger). Samples for each species were collected over a one year interval. Dashed lines represent the absence of a compound.

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
11 carbon compound E	----------	----------	0.02798	0.02735	----------	----------
11 carbon compound G	----------	----------	0.08478	0.08424	----------	----------
11 carbon compound H	----------	----------	0.26298	0.26275	----------	----------
11 carbon compound J	----------	----------	----------	----------	0.05598	0.05582
11 carbon compound K	0.38398	0.38345	0.07847	0.07874	0.13256	0.13238
12 carbon compound P	----------	----------	0.27198	0.27139	1.90996	1.90948
12 carbon compound S	----------	----------	0.17498	0.17486	----------	----------
12 carbon compound U	0.10807	0.10853	0.03798	0.03782	----------	----------
12 carbon compound X	0.09218	0.09299	0.58985	0.58905	----------	----------
13 carbon compound AG	0.10115	0.10146	0.21895	0.21883	0.17717	0.17760
13 carbon compound AH	----------	----------	1.04296	1.04283	----------	----------
13 carbon compound AN	----------	----------	0.08576	0.08537	----------	----------
X-methyl Pentadecanoic acid	0.09134	0.09169	----------	----------	3.03021	3.03014
13 carbon compound AP	0.05823	0.05800	0.01858	0.01847	1.85920	1.85907
13 carbon compound AR	0.05633	0.05653	----------	----------	----------	----------
13 carbon compound AT	----------	----------	0.24798	0.24786	0.00539	0.00570
13 carbon compound AW	0.20146	0.20107	0.14798	0.14790	0.12771	0.12722
Tetradecanoic acid	0.14525	0.14553	0.05376	0.05323	0.17279	0.17234
14 carbon compound BB	0.07299	0.07238	----------	----------	----------	----------
14 carbon compound BC	----------	----------	2.18885	2.18867	0.07421	0.07414
14 carbon compound BG	0.05857	0.05853	2.13989	2.13987	0.10385	0.10352
14 carbon compound BI	----------	----------	0.00759	0.00794	----------	----------
14 carbon compound BL	0.16982	0.16999	----------	----------	----------	----------
14 carbon compound BN	----------	----------	0.13995	0.13985	----------	----------
14 carbon compound BO	0.04110	0.04153	----------	----------	2.06969	2.06956
14 carbon compound BQ	----------	----------	----------	----------	0.10689	0.10635
14 carbon compound BS	0.17422	0.17415	0.28975	0.28985	0.02868	0.02877
15 carbon compound BU	0.15650	0.15692	0.07848	0.07884	0.27837	0.27892
15 carbon alcohol	0.28158	0.21892	----------	----------	----------	----------
15 carbon compound BW	----------	----------	0.27875	0.27848	0.06969	0.06966
15 carbon compound CA	----------	----------	----------	----------	0.10046	0.10067
15 carbon compound CC	0.10676	0.10653	0.05285	0.05249	0.28913	0.28942
15 carbon compound CD	----------	----------	----------	----------	0.08069	0.08097
15 carbon compound CE	----------	----------	0.08573	0.08542	----------	----------
15 carbon compound CF	----------	----------	----------	----------	0.20458	0.20499
15 carbon compound CG	0.74539	0.74584	0.79858	0.79874	1.02853	1.02851
(Z)-7-Hexadecenoic acid	----------	----------	----------	----------	0.91494	0.91409
15 carbon compound CI	0.03959	0.03946	0.21773	0.21784	----------	----------
15 carbon compound CJ	----------	----------	----------	----------	0.01505	0.01562
15 carbon compound CL	----------	----------	0.11976	0.11959	----------	----------
15 carbon compound CM	0.11633	0.11699	----------	----------	----------	----------
15 carbon compound CN	----------	----------	0.02798	0.02734	0.06350	0.06306
15 carbon compound CO	0.43413	0.43438	----------	----------	----------	----------
Hexadecanoic acid	0.05683	0.05692	0.24579	0.24583	0.01922	0.01944
16 carbon compound CS	0.07561	0.07576	----------	----------	0.23034	0.23077

Table A-6.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
16 carbon compound CU	----------	----------	0.08579	0.08585	----------	----------
16 carbon compound CX	0.10610	0.10615	0.17985	0.17978	0.05953	0.05989
16 carbon compound DA	7.99931	7.99932	----------	----------	0.21230	0.21233
16 carbon compound DB	----------	----------	0.07588	0.07575	----------	----------
16 carbon compound DD	0.18405	0.18430	0.27598	0.27598	0.14841	0.14889
16 carbon compound DE	----------	----------	1.00483	1.00498	0.08480	0.08429
16 carbon compound DF	0.15306	0.15369	0.07857	0.07874	0.57659	0.57692
16 carbon compound DG	0.35511	0.35553	----------	----------	0.21215	0.21246
16 carbon compound DH	0.13327	0.13315	----------	----------	1.92478	1.92429
16 carbon compound DJ	----------	----------	----------	----------	0.03972	0.03974
17 carbon compound DM	0.04553	0.04584	0.00579	0.00576	0.02570	0.02586
17 carbon compound DN	----------	----------	0.05798	0.05734	0.26698	0.26616
17 carbon compound DO	0.03674	0.03653	----------	----------	----------	----------
17 carbon compound DQ	----------	----------	0.00188	0.00188	0.17096	0.17002
17 carbon compound DR	----------	----------	0.00199	0.00153	----------	----------
17 carbon compound DS	----------	----------	----------	----------	0.08281	0.08231
17 carbon compound DU	0.04561	0.04507	0.14798	0.14798	2.23748	2.23784
17 carbon compound DW	0.16389	0.16323	0.18487	0.18437	2.18084	2.18013
17 carbon compound DX	----------	----------	----------	----------	0.00539	0.00576
17 carbon compound DZ	0.47692	0.47699	0.07490	0.07448	0.14351	0.14351
17 carbon compound EB	0.04483	0.04461	0.25798	0.25790	0.25238	0.25272
17 carbon compound EC	----------	----------	0.17579	0.17588	0.09695	0.09656
17 carbon compound ED	0.04999	0.04984	----------	----------	0.21623	0.21606
17 carbon compound EE	0.48275	0.48238	----------	----------	0.01435	0.01404
17 carbon compound EF	----------	----------	0.29989	0.29982	----------	----------
Octadecanoic acid	1.22322	1.22314	1.05858	1.05884	0.04667	0.04611
18 carbon compound EI	0.57129	0.57138	----------	----------	----------	----------
18 carbon compound EJ	0.03556	0.03530	----------	----------	0.73463	0.73419
18 carbon compound EK	----------	----------	0.07698	0.07698	----------	----------
18 carbon compound EM	----------	----------	0.87598	0.87572	0.28015	0.28035
18 carbon compound EO	0.67587	0.67553	0.15798	0.15787	----------	----------
18 carbon compound EP	----------	----------	----------	----------	0.17835	0.17851
18 carbon compound ER	----------	----------	0.04583	0.04578	0.08069	0.08010
18 carbon compound EU	6.43975	6.43948	0.27588	0.27548	0.20162	0.20189
18 carbon compound EV	0.31441	0.31461	----------	----------	----------	----------
18 carbon compound EW	----------	----------	0.01798	0.01789	0.04787	0.04703
18 carbon compound EX	11.60901	11.60937	----------	----------	----------	----------
18 carbon compound EY	----------	----------	----------	----------	0.10957	0.10965
18 carbon compound EZ	2.18129	2.18167	0.12749	0.12737	----------	----------
18 carbon compound FA	----------	----------	----------	----------	0.01254	0.01295
19 carbon compound FD	----------	----------	0.12798	0.12785	0.24548	0.24512
19 carbon compound FE	----------	----------	----------	----------	1.07644	1.07628
19 carbon compound FF	0.30686	0.30684	----------	----------	----------	----------
19 carbon compound FG	----------	----------	0.19475	0.19494	----------	----------
19 carbon compound FH	----------	----------	0.20898	0.20837	----------	----------
19 carbon compound FJ	0.12626	0.12653	----------	----------	0.01270	0.01298
19 carbon compound FL	0.14416	0.14484	0.01798	0.01742	0.08685	0.08689

Table A-6.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
19 carbon compound FM	----------	----------	----------	----------	0.01077	0.01026
19 carbon compound FN	----------	----------	0.20779	0.20779	----------	----------
19 carbon compound FP	12.40221	12.40221	----------	----------	0.00822	0.00827
19 carbon compound FR	0.05076	0.05038	0.21798	0.21748	0.00379	0.00334
19 carbon compound FT	0.03979	0.03938	0.08397	0.08359	0.15312	0.15316
19 carbon compound FV	----------	----------	----------	----------	0.14011	0.14031
19 carbon compound FW	0.25313	0.25322	0.08487	0.08486	----------	----------
19 carbon compound FX	0.15395	0.15330	0.27598	0.27585	0.08223	0.08257
19 carbon compound FY	----------	----------	----------	----------	0.27084	0.27070
19 carbon compound FZ	0.30891	0.30869	----------	----------	----------	----------
19 carbon compound GA	----------	----------	0.13749	0.13759	----------	----------
20 carbon compound GC	0.39482	0.39438	0.16596	0.16547	0.19419	0.19449
20 carbon compound GE	0.21364	0.21307	----------	----------	0.26887	0.26840
20 carbon compound GH	0.04734	0.04700	0.13798	0.13758	1.02833	1.02830
20 carbon compound GJ	0.12756	0.12761	1.01758	1.01759	0.05478	0.05402
20 carbon compound GL	----------	----------	----------	----------	0.87412	0.87472
20 carbon compound GM	----------	----------	2.03798	2.03798	----------	----------
20 carbon compound GN	----------	----------	0.04798	0.04772	0.01399	0.01333
20 carbon compound GO	24.44427	24.44435	----------	----------	0.20590	0.20562
20 carbon compound GP	----------	----------	0.14785	0.14749	----------	----------
20 carbon compound GQ	----------	----------	----------	----------	0.09366	0.09388
20 carbon compound GT	----------	----------	0.63798	0.63789	----------	----------
20 carbon compound GU	1.55116	1.55183	----------	----------	----------	----------
20 carbon compound GW	0.09746	0.09792	0.18575	0.18559	0.29994	0.29978
20 carbon compound GY	0.30518	0.30584	1.02389	1.02337	0.17656	0.17656
21 carbon compound GZ	0.24693	0.24676	0.13483	0.13438	0.13184	0.13196
21 carbon compound HB	0.08163	0.08153	----------	----------	0.13783	0.13701
21 carbon compound HC	0.76578	0.76514	----------	----------	----------	----------
21 carbon compound HD	----------	----------	0.21979	0.21949	0.20990	0.20996
21 carbon compound HE	----------	----------	----------	----------	0.05409	0.05455
21 carbon compound HF	0.39913	0.39976	0.07875	0.07859	----------	----------
21 carbon compound HG	----------	----------	0.13289	0.13249	0.21212	0.21289
21 carbon compound HH	0.51531	0.51568	----------	----------	----------	----------
21 carbon compound HJ	0.16085	0.16038	----------	----------	----------	----------
21 carbon compound HK	----------	----------	0.15789	0.15759	0.26608	0.26682
21 carbon compound HL	----------	----------	----------	----------	0.02663	0.02626
21 carbon compound HM	0.73479	0.73453	----------	----------	----------	----------
21 carbon compound HN	0.43279	0.43230	0.29876	0.29898	0.09369	0.09355
21 carbon compound HP	0.76975	0.76953	----------	----------	----------	----------
21 carbon compound HQ	----------	----------	0.04859	0.04848	0.21370	0.21397
21 carbon compound HR	----------	----------	----------	----------	0.12045	0.12083
21 carbon compound HS	0.19175	0.19199	----------	----------	----------	----------
21 carbon compound HT	----------	----------	0.20798	0.20748	0.13667	0.13649
21 carbon compound HW	4.76375	4.76311	0.03798	0.03779	----------	----------
22 carbon compound HX	0.04976	0.04900	0.21859	0.21849	0.13867	0.13802
22 carbon compound HY	0.03665	0.03653	----------	----------	----------	----------
22 carbon compound HZ	----------	----------	----------	----------	1.12045	1.12089

Table A-6.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
22 carbon compound IA	0.13375	0.13338	----------	----------	2.24477	2.24433
22 carbon compound ID	----------	----------	----------	----------	0.09034	0.09030
22 carbon compound IE	----------	----------	----------	----------	0.16871	0.16880
22 carbon compound IF	----------	----------	0.18996	0.18979	----------	----------
22 carbon compound IG	0.28374	0.28376	----------	----------	0.60331	0.60313
22 carbon compound IH	----------	----------	0.03857	0.03884	----------	----------
22 carbon compound II	----------	----------	----------	----------	0.13349	0.13330
22 carbon compound IJ	----------	----------	----------	----------	1.01996	1.01989
22 carbon compound IK	----------	----------	----------	----------	0.12123	0.12136
22 carbon compound IL	----------	----------	1.85991	1.85959	----------	----------
22 carbon compound IN	----------	----------	0.07579	0.07598	----------	----------
23 carbon compound IO	0.03975	0.03923	----------	----------	0.20964	0.20901
23 carbon compound IP	----------	----------	----------	----------	0.01420	0.01442
23 carbon compound IR	0.11085	0.11092	1.12798	1.12757	----------	----------
23 carbon compound IS	----------	----------	----------	----------	0.16331	0.16383
23 carbon compound IT	0.07276	0.07269	----------	----------	0.10757	0.10788
23 carbon compound IV	----------	----------	0.91749	0.91739	----------	----------
23 carbon compound IW	0.17274	0.17276	----------	----------	0.25571	0.25565
23 carbon compound IX	----------	----------	----------	----------	0.01204	0.01223
23 carbon compound JA	----------	----------	----------	----------	0.29033	0.29028
23 carbon compound JB	0.02278	0.02284	0.14990	0.14949	----------	----------
23 carbon compound JC	1.11684	1.11614	----------	----------	----------	----------
23 carbon compound JD	----------	----------	----------	----------	0.04590	0.04592
23 carbon compound JE	----------	----------	0.02798	0.02749	0.23403	0.23497
23 carbon compound JF	0.20798	0.20746	----------	----------	----------	----------
24 carbon compound JH	0.07879	0.07838	0.28586	0.28549	0.10517	0.10557
24 carbon compound JI	----------	----------	----------	----------	0.05482	0.05440
24 carbon compound JJ	0.04674	0.04676	0.14779	0.14797	----------	----------
24 carbon compound JK	0.22764	0.22761	----------	----------	----------	----------
24 carbon compound JO	----------	----------	----------	----------	1.25284	1.25243
24 carbon compound JP	0.20687	0.20646	----------	----------	----------	----------
24 carbon compound JR	0.01886	0.01838	0.21798	0.21798	0.01254	0.01222
24 carbon compound JS	0.06947	0.06969	----------	----------	1.17154	1.17103
24 carbon compound JT	----------	----------	0.94758	0.94778	----------	----------
24 carbon compound JU	----------	----------	----------	----------	0.94628	0.94630
24 carbon compound JV	0.23181	0.23146	----------	----------	0.15666	0.15694
24 carbon compound JW	----------	----------	----------	----------	0.06496	0.06479
24 carbon compound JY	0.22085	0.22015	0.10383	0.10382	0.28690	0.28629
25 carbon compound KB	0.09675	0.09699	0.02859	0.02824	0.18223	0.18222
25 carbon compound KC	----------	----------	----------	----------	0.26374	0.26371
25 carbon compound KD	----------	----------	0.28979	0.28937	----------	----------
25 carbon compound KE	----------	----------	----------	----------	0.96331	0.96371
25 carbon compound KG	----------	----------	1.18479	1.18449	----------	----------
25 carbon compound KH	----------	----------	0.98756	0.98749	----------	----------
25 carbon compound KK	----------	----------	0.12006	0.12047	0.17476	0.17468
25 carbon compound KM	----------	----------	----------	----------	0.08347	0.08383
25 carbon compound KO	0.06175	0.06176	----------	----------	0.21250	0.21236

Table A-6.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
25 carbon compound KP	----------	----------	5.15836	5.15889	----------	----------
25 carbon compound KS	2.72579	2.72505	6.24169	6.24123	----------	----------
25 carbon compound KT	----------	----------	----------	----------	2.01250	2.01272
25 carbon compound KU	0.13076	0.13030	0.82525	0.82559	----------	----------
26 carbon compound KV	----------	----------	----------	----------	0.90478	0.90490
26 carbon compound KW	0.06765	0.06738	----------	----------	----------	----------
26 carbon compound KX	----------	----------	1.35475	1.35479	----------	----------
26 carbon compound LA	----------	----------	1.10100	1.10187	0.19486	0.19467
26 carbon compound LC	0.03398	0.03376	----------	----------	5.03428	5.03476
26 carbon compound LD	----------	----------	----------	----------	6.20822	6.20844
26 carbon compound LG	----------	----------	----------	----------	0.81725	0.81760
26 carbon compound LH	----------	----------	0.82267	0.82278	----------	----------
26 carbon compound LI	----------	----------	----------	----------	1.24351	1.24344
26 carbon compound LJ	0.62978	0.62930	----------	----------	1.98239	1.98278
26 carbon compound LL	----------	----------	1.02156	1.02137	0.80199	0.80175
26 carbon compound LM	----------	----------	----------	----------	1.03522	1.03525
26 carbon compound LN	----------	----------	0.23029	0.23072	----------	----------
Cholesterol	----------	----------	0.09839	0.09885	----------	----------
27 carbon compound LP	0.03474	0.03446	----------	----------	----------	----------
27 carbon compound LQ	0.01749	0.01776	0.13434	0.13407	0.23287	0.23216
27 carbon compound LS	0.21279	0.21246	1.06109	1.06174	----------	----------
27 carbon compound LT	----------	----------	----------	----------	0.01270	0.01274
27 carbon compound LU	0.06687	0.06653	----------	----------	----------	----------
27 carbon compound LV	----------	----------	0.13587	0.13548	0.14225	0.14244
27 carbon compound LX	0.15037	0.15084	3.10809	3.10875	----------	----------
27 carbon compound LY	----------	----------	----------	----------	1.94823	1.94826
27 carbon compound LZ	0.09978	0.09946	1.04779	1.04775	0.17607	0.17688
27 carbon compound MB	----------	----------	0.26580	0.26583	----------	----------
27 carbon compound MC	1.52975	1.52991	----------	----------	3.52596	3.52553
27 carbon compound MD	----------	----------	0.04947	0.04948	----------	----------
27 carbon compound ME	0.19898	0.19884	----------	----------	1.86102	1.86111
27 carbon compound MF	----------	----------	0.28757	0.28785	----------	----------
27 carbon compound MG	----------	----------	0.13555	0.13528	----------	----------
27 carbon compound MI	----------	----------	----------	----------	0.00252	0.00227
27 carbon compound MJ	----------	----------	0.02357	0.02354	----------	----------
27 carbon compound MK	----------	----------	----------	----------	0.14438	0.14416
28 carbon compound ML	----------	----------	1.07555	1.07548	0.16482	0.16463
28 carbon compound MM	0.02849	0.03000	0.03842	0.03879	----------	----------
28 carbon compound MN	----------	----------	----------	----------	0.04250	0.04223
28 carbon compound MO	----------	----------	1.01853	1.01874	----------	----------
28 carbon compound MP	----------	----------	0.93745	0.93799	0.16011	0.16024
28 carbon compound MQ	0.03489	0.03461	----------	----------	----------	----------
28 carbon compound MR	----------	----------	----------	----------	2.06709	2.06743
28 carbon compound MS	0.09679	0.09699	0.14225	0.14279	----------	----------
28 carbon compound MT	0.09084	0.09038	0.01333	0.01399	----------	----------
28 carbon compound MU	----------	----------	----------	----------	0.15443	0.15478
28 carbon compound MX	----------	----------	0.25085	0.25076	----------	----------

Table A-6.--(continued)

Compounds	*Panthera pardus*		*Panthera uncia*		*Panthera tigris*	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
28 carbon compound MZ	----------	----------	----------	----------	0.08138	0.08181
28 carbon compound NA	0.54978	0.54930	0.11621	0.11689	----------	----------
28 carbon compound NB	----------	----------	----------	----------	0.28511	0.28586
28 carbon compound NC	----------	----------	0.21517	0.21584	----------	----------
28 carbon compound ND	0.16375	0.16307	----------	----------	0.02022	0.02085
28 carbon compound NE	1.44275	1.44260	0.90699	0.90608	0.12231	0.12265
28 carbon compound NG	----------	----------	0.12923	0.12983	----------	----------
28 carbon compound NH	----------	----------	----------	----------	0.20890	0.20872
28 carbon compound NI	----------	----------	0.02624	0.02679	----------	----------
29 carbon compound NK	----------	----------	0.23393	0.23339	----------	----------
29 carbon compound NL	----------	----------	1.04750	1.04789	----------	----------
29 carbon compound NM	----------	----------	----------	----------	0.09563	0.09519
29 carbon compound NN	----------	----------	0.93876	0.93898	----------	----------
29 carbon compound NO	0.08476	0.08476	----------	----------	----------	----------
29 carbon compound NP	----------	----------	----------	----------	0.25109	0.25144
29 carbon compound NQ	----------	----------	0.13255	0.13276	----------	----------
29 carbon compound NR	0.48974	0.48968	----------	----------	1.07973	1.07902
29 carbon compound NT	----------	----------	----------	----------	0.92354	0.92313
29 carbon compound NU	0.18475	0.18499	----------	----------	----------	----------
29 carbon compound NV	----------	----------	5.06924	5.06990	0.08895	0.08849
29 carbon compound NZ	0.19086	0.19007	----------	----------	0.08555	0.08502
29 carbon compound OA	----------	----------	6.20747	6.20798	----------	----------
29 carbon compound OB	----------	----------	----------	----------	0.02803	0.02819
29 carbon compound OC	----------	----------	0.80980	0.80975	----------	----------
30 carbon compound OD	----------	----------	----------	----------	0.29466	0.29428
30 carbon compound OF	----------	----------	1.04071	1.04079	----------	----------
30 carbon compound OH	----------	----------	1.00378	1.00375	----------	----------
30 carbon compound OI	----------	----------	0.83874	0.83837	0.06553	0.06596
30 carbon compound OJ	----------	----------	1.14285	1.14286	----------	----------
30 carbon compound OL	0.05747	0.05761	----------	----------	0.20509	0.20578
30 carbon compound OM	----------	----------	0.20961	0.20979	----------	----------
30 carbon compound ON	0.03776	0.03769	----------	----------	----------	----------
30 carbon compound OO	----------	----------	0.06678	0.06659	----------	----------
30 carbon compound OR	----------	----------	0.10229	0.10287	----------	----------
30 carbon compound OS	0.08674	0.08653	1.58924	1.58949	----------	----------
30 carbon compound OT	----------	----------	----------	----------	0.15351	0.15340
30 carbon compound OV	----------	----------	0.15291	0.15276	----------	----------
31 carbon compound OX	----------	----------	3.03864	3.03879	----------	----------
31 carbon compound OZ	----------	----------	----------	----------	0.07098	0.07085

Table A-7.--Relative amount (picomoles) of glycolipids present in anal sacs of *Panthera tigris* (tiger). Data represent three samples that were collected at the same time from the same individual.

Compounds	Panthera tigris		
	Sample 1	Sample 2	Sample 3
11 carbon compound I	0.084447	0.084044	0.084200
11 carbon compound J	0.019879	0.019100	0.019431
12 carbon compound Q	0.012059	0.012655	0.012831
12 carbon compound W	0.012780	0.012569	0.012473
12 carbon compound X	0.074725	0.074710	0.074966
12 carbon compound AB	0.045506	0.045708	0.045266
13 carbon compound AC	0.037093	0.037565	0.037103
13 carbon compound AM	0.002533	0.002137	0.002104
13 carbon compound AN	0.067891	0.067131	0.067103
Tetradecanoic acid	0.066163	0.066975	0.066191
Pentadecanoic acid	0.022675	0.022197	0.022960
15 carbon compound BT	0.001738	0.001191	0.001232
Hexadecanoic acid	0.039482	0.039809	0.039340
16 carbon compound BV	0.033348	0.033188	0.033081
16 carbon compound BZ	0.052065	0.052412	0.052404
16 carbon compound CG	0.158011	0.158055	0.158679
Heptadecanoic acid	1.002679	1.002259	1.002419
Octadecanoic acid	0.010496	0.010316	0.010075
18 carbon compound CW	0.005982	0.005832	0.005041
18 carbon compound DC	0.024648	0.024239	0.024487
19 carbon compound DG	0.057541	0.057126	0.057735
2-Hydroxy-Octanoic acid	0.162772	0.162223	0.162755
19 carbon compound DK	0.580461	0.580278	0.580347
X,X-Eicosadienoic acid	0.056882	0.056336	0.056255
19 carbon compound DS	0.009895	0.009654	0.009422
Eicosanoic acid	0.159299	0.159771	0.159629
20 carbon compound EH	0.038734	0.038750	0.038079
21 carbon compound EU	0.827760	0.827488	0.827879
21 carbon compound EZ	0.312891	0.312551	0.312851
21 carbon compound FD	0.073737	0.073947	0.073136
22 carbon compound FI	12.028050	12.028240	12.028520
22 carbon compound FP	0.209922	0.209276	0.209153
22 carbon compound FU	0.046888	0.046262	0.046118
22 carbon compound FZ	0.169986	0.169868	0.169260
22 carbon compound GA	0.012993	0.012176	0.012201
23 carbon compound GE	0.019181	0.019967	0.019977
23 carbon compound GJ	0.103814	0.103166	0.103540
23 carbon compound GL	0.145977	0.145665	0.145839
Tetracosanoic acid	0.103661	0.103591	0.103413
25 carbon compound HK	0.205658	0.205547	0.205510
25 carbon compound HT	0.418514	0.418256	0.418350
X-Hexacosanoic acid	0.037003	0.037212	0.037254
25 carbon compound IB	4.103516	4.103180	4.103658
26 carbon compound ID	0.087510	0.087209	0.087801
26 carbon compound IH	0.056403	0.056748	0.056063

Table A-7.--(continued)

Compounds	Panthera tigris		
	Sample 1	Sample 2	Sample 3
26 carbon compound IN	0.059187	0.059071	0.059964
26 carbon compound IV	0.038513	0.038825	0.038418
26 carbon compound IW	5.697495	5.697050	5.697282
27 carbon compound JC	0.345754	0.345352	0.345868
27 carbon sterol	10.010860	10.01097	10.01047
27 carbon compound JH	0.423055	0.423506	0.423346
27 carbon compound JO	0.017633	0.017097	0.017459
28 carbon compound KI	0.054756	0.054679	0.054650
28 carbon compound KT	10.498440	10.498120	10.498160
28 carbon compound KU	0.036686	0.036682	0.036236
28 carbon compound KY	0.010586	0.010513	0.010523
29 carbon compound LP	0.021974	0.021364	0.021084
29 carbon compound LT	0.105673	0.105472	0.105330
30 carbon compound LX	0.032677	0.032060	0.032626
30 carbon compound MN	0.302676	0.302108	0.302867
31 carbon compound MR	0.036404	0.036868	0.036777

Table A-8.--Relative amount (picomoles) of neutral lipids present in anal sacs of *Panthera tigris* (tiger). Data represent three samples that were collected at the same time from the same individual.

Compounds	*Panthera tigris*		
	Sample 1	Sample 2	Sample 3
10 carbon compound A	0.097330	0.011833	0.029843
10 carbon compound C	0.014635	0.055121	0.033985
10 carbon compound D	0.022125	0.028563	0.016805
10 carbon compound G	0.023260	0.024385	0.029108
11 carbon compound H	0.068291	0.099386	0.017006
11 carbon compound S	0.092900	0.028101	0.014047
11 carbon compound T	0.977077	0.916795	0.910608
11 carbon compound Y	0.049582	0.080588	0.029138
12 carbon compound Z	0.090309	0.040288	0.019227
12 carbon compound AB	0.068063	0.062774	0.056945
12 carbon compound AH	1.143275	1.295651	1.051780
12 carbon compound AJ	0.012190	0.053571	0.029096
12 carbon compound AM	0.294463	0.246468	0.214660
12 carbon compound AO	0.015895	0.013279	0.099631
12 carbon compound AS	0.879029	0.814690	0.850798
12 carbon compound AV	0.147344	0.126382	0.182729
13 carbon compound AZ	0.062596	0.027616	0.059882
X-branched Tridecanoic acid	10.014100	10.007540	9.195864
13 carbon compound BH	0.014349	0.014543	0.030990
13 carbon compound BK	0.008486	0.001348	0.004527
13 carbon compound BM	0.015377	0.020141	0.040001
13 carbon compound BO	0.133444	0.178157	0.166379
1,1'-(1,2-cyclobutanediyl)bis-, cis-Benzene	0.041140	0.030061	0.084174
13 carbon compound BQ	0.188132	0.125919	0.103079
Tetradecanoic acid	0.025750	0.023242	0.039236
14 carbon compound BS	0.261757	0.211686	0.271390
14 carbon compound BW	8.023244	10.887640	10.020080
14 carbon compound BX	0.109889	0.129608	0.106236
14 carbon compound CC	0.063392	0.065809	0.074121
14 carbon compound CE	3.064462	3.132701	3.360717
14 carbon compound CF	0.458787	0.496994	0.418620
14 carbon compound CG	15.468180	15.523800	15.031120
15 carbon compound CV	0.418489	0.404778	0.437886
15 carbon compound CW	0.200576	0.210511	0.204021
15 carbon compound CY	8.158605	8.025641	8.019551
15 carbon compound DB	0.002909	0.005980	0.003727
Nonadecanoic acid	0.067167	0.010119	0.063207
15 carbon compound DD	0.023959	0.095034	0.069818
15 carbon compound DF	0.069935	0.077481	0.087143
Hexadecanoic acid	0.081190	0.056958	0.087595
16 carbon compound DL	0.455596	0.469563	0.411238
16 carbon compound DM	0.012096	0.037458	0.083874
16 carbon compound DN	3.011396	3.015473	3.019310
16 carbon compound DQ	0.362145	0.310397	0.325567

Table A-8.–(continued)

Compounds	Panthera tigris		
	Sample 1	Sample 2	Sample 3
16 carbon compound DS	1.036771	1.007116	1.140410
16 carbon compound DT	0.012438	0.049471	0.010503
16 carbon compound EA	0.216139	0.207214	0.294383
16 carbon compound EH	1.023695	1.034488	1.618819
17 carbon compound EJ	0.206452	0.231305	0.202512
17 carbon compound EN	1.046582	1.012453	1.010368
17 carbon compound EP	0.102772	0.127959	0.124727
17 carbon compound ES	0.031034	0.030032	0.062418
17 carbon compound ET	0.031811	0.013743	0.073840
17 carbon compound EU	2.010091	2.077903	2.023692
X-Octadecanoic acid	0.002601	0.001668	0.005802
17 carbon compound EV	0.029168	0.087484	0.016745
17 carbon compound EY	0.052086	0.041016	0.025862
Octadecanoic acid	0.095465	0.011409	0.011838
18 carbon compound FC	0.085856	0.012764	0.040241
18 carbon compound FD	0.016325	0.015799	0.012183
18 carbon compound FH	0.411614	0.435167	0.416520
18 carbon compound FJ	0.101990	0.114252	0.120916
18 carbon compound FL	0.138792	0.159280	0.106527
18 carbon compound FN	1.013465	1.036691	1.111902
18 carbon compound FX	0.906623	0.949148	0.954045
18 carbon compound FY	0.613309	0.683029	0.679227
18 carbon compound GB	0.017896	0.015016	0.031179
19 carbon alcohol	0.052070	0.023373	0.047413
19 carbon compound GJ	0.074215	0.056114	0.021981
19 carbon compound GP	1.014335	1.135731	1.010473
19 carbon compound GR	0.061741	0.035574	0.064278
19 carbon compound GS	0.032806	0.037964	0.045731
19 carbon compound GT	0.107743	0.109427	0.148473
Eicosanoic acid	0.153723	0.113498	0.144737
20 carbon compound HC	0.088997	0.047398	0.073872
20 carbon compound HE	0.015284	0.019455	0.055891
20 carbon compound HG	0.145416	0.182150	0.152920
20 carbon compound HI	0.054573	0.060488	0.099028
20 carbon compound HM	0.025223	0.029398	0.084984
20 carbon compound HR	0.240641	0.265287	0.214074
21 carbon compound HU	0.272090	0.238568	0.208805
21 carbon compound HZ	2.307088	2.007182	2.201061
21 carbon compound ID	1.163705	1.043856	1.015679
21 carbon compound IH	0.136569	0.109108	0.136865
21 carbon compound IL	0.019093	0.038291	0.078645
21 carbon compound IP	3.006235	3.026914	3.082328
Docosanoic acid	0.006384	0.001055	0.008355
22 carbon compound IU	0.058636	0.010364	0.056764
22 carbon compound IX	0.067960	0.019374	0.059195
22 carbon compound JB	0.029743	0.099073	0.019941
22 carbon compound JD	0.042695	0.016256	0.021111

Table A-8.--(continued)

Compounds	Panthera tigris		
	Sample 1	Sample 2	Sample 3
22 carbon compound JG	0.086913	0.021871	0.021426
22 carbon compound JI	0.238683	0.241718	0.210533
22 carbon compound JM	0.022374	0.093360	0.027518
22 carbon compound JO	0.066545	0.042387	0.047143
23 carbon compound JS	0.025923	0.037598	0.012273
23 carbon compound JU	0.019964	0.084921	0.055666
23 carbon compound JX	2.011801	2.089583	2.025267
23 carbon compound JZ	0.210520	0.238590	0.215454
23 carbon compound KC	0.922140	0.923760	0.907382
23 carbon compound KD	0.647410	0.623742	0.641877
23 carbon compound KG	0.010433	0.023754	0.032094
23 carbon compound KI	1.020026	1.034760	1.021306
3,7,11-trimethyl-(E,E)-2,6,10-Dodecatrien-1-ol	0.074286	0.023745	0.079946
24 carbon compound KT	0.016175	0.032752	0.020676
24 carbon compound LB	0.046228	0.075989	0.017825
24 carbon compound LD	0.006804	0.004782	0.004636
24 carbon compound LI	7.021801	7.032883	7.013354
25 carbon compound LK	0.838552	0.835984	0.802284
25 carbon compound LO	0.297116	0.275824	0.218162
25 carbon compound LY	0.156011	0.198562	0.102029
25 carbon compound MC	0.155561	0.123760	0.145133
25 carbon compound MH	0.304178	0.323786	0.304666
26 carbon compound MU	0.287363	0.275373	0.209903
26 carbon compound MY	0.042792	0.037598	0.012048
26 carbon compound NA	0.213984	0.234799	0.281653
26 carbon compound ND	0.030879	0.075240	0.017315
Cholesterol	0.087118	0.023760	0.023797
27 carbon compound NH	0.044983	0.075024	0.044587
27 carbon compound NO	0.024967	0.034876	0.012559
28 carbon compound OA	0.001969	0.003476	0.001526
28 carbon compound OE	0.525807	0.534790	0.524607
28 carbon compound OL	0.163586	0.123490	0.156716
28 carbon compound OO	0.019325	0.034760	0.094485
28 carbon compound OT	0.531749	0.503475	0.599073
28 carbon compound OW	0.012063	0.037854	0.012934
29 carbon compound PB	0.083427	0.027847	0.031944
29 carbon compound PE	0.034798	0.037824	0.065764
29 carbon compound PI	0.057892	0.037893	0.040485
29 carbon compound PK	0.023748	0.075892	0.084051
29 carbon compound PM	0.275676	0.205786	0.270556
29 carbon compound PQ	0.074982	0.035782	0.053748
30 carbon compound PW	1.723570	1.002376	1.190899
30 carbon compound QB	0.017211	0.023746	0.080378

Table A-9.--Relative amount (picomoles) of phospholipids present in anal sacs of *Panthera tigris* (tiger). Data represent three samples that were collected at the same time from the same individual.

Compounds	*Panthera tigris*		
	Sample 1	Sample 2	Sample 3
11 carbon compound J	0.064547	0.064438	0.064067
11 carbon compound K	0.120430	0.120312	0.120975
12 carbon compound P	1.007976	1.007927	1.007828
13 carbon compound AG	0.182375	0.182377	0.182343
X-methyl Pentadecanoic acid	3.047398	3.047948	3.047410
13 carbon compound AP	1.231106	1.231236	1.231443
13 carbon compound AT	0.006047	0.006564	0.006371
13 carbon compound AW	0.132427	0.132886	0.132573
Tetradecanoic acid	0.111467	0.111047	0.111962
14 carbon compound BC	0.026902	0.026703	0.026431
14 carbon compound BG	0.138272	0.138457	0.138221
14 carbon compound BO	2.022522	2.022466	2.022081
14 carbon compound BQ	0.182983	0.182418	0.182899
14 carbon compound BS	0.024484	0.024269	0.024406
15 carbon compound BU	0.212422	0.212308	0.212318
15 carbon compound BW	0.034408	0.034903	0.034286
15 carbon compound CA	0.149072	0.149563	0.149731
15 carbon compound CC	0.245535	0.245133	0.245988
15 carbon compound CD	0.027327	0.027994	0.027304
15 carbon compound CF	0.217946	0.217145	0.217787
15 carbon compound CG	1.045469	1.045552	1.045981
(Z)-7-Hexadecenoic acid	0.932938	0.932963	0.932107
15 carbon compound CJ	0.065272	0.065335	0.065249
15 carbon compound CN	0.071320	0.071114	0.071312
Hexadecanoic acid	0.079299	0.079917	0.079221
16 carbon compound CS	0.204486	0.204059	0.204135
16 carbon compound CX	0.024702	0.024941	0.024145
16 carbon compound DA	0.266042	0.266694	0.266059
16 carbon compound DD	0.128620	0.128369	0.128666
16 carbon compound DE	0.027157	0.027846	0.027903
16 carbon compound DF	0.514475	0.514204	0.514066
16 carbon compound DG	0.205532	0.205830	0.205845
16 carbon compound DI	1.036105	1.036583	1.036722
16 carbon compound DJ	0.055818	0.055314	0.055852
17 carbon compound DM	0.064673	0.640077	0.640798
17 carbon compound DN	0.218490	0.218696	0.218551
17 carbon compound DQ	0.144905	0.144904	0.144148
17 carbon compound DS	0.031746	0.031811	0.031078
17 carbon compound DU	2.215669	2.215854	2.215707
17 carbon compound DW	2.170270	2.170874	2.170941
17 carbon compound DX	0.008553	0.008572	0.008754
17 carbon compound DZ	0.173015	0.173035	0.173503
17 carbon compound EB	0.214344	0.214973	0.214906
17 carbon compound EC	0.094194	0.945937	0.945766
17 carbon compound ED	0.237225	0.237236	0.237572

Table A-9.--(continued)

Compounds	*Panthera tigris*		
	Sample 1	Sample 2	Sample 3
17 carbon compound EE	0.044949	0.04492	0.044392
Octadecanoic acid	0.069504	0.069928	0.069770
18 carbon compound EJ	0.709835	0.709176	0.709406
18 carbon compound EM	0.211928	0.211663	0.211889
18 carbon compound EP	0.149473	0.149667	0.149442
18 carbon compound ER	0.019700	0.019432	0.019992
18 carbon compound EU	0.245410	0.245798	0.245555
18 carbon compound EW	0.076588	0.076844	0.076694
18 carbon compound EY	0.143621	0.143774	0.143257
18 carbon compound FA	0.012400	0.012277	0.012750
19 carbon compound FD	0.218838	0.218426	0.218092
19 carbon compound FE	1.080037	1.080138	1.080667
19 carbon compound FJ	0.030539	0.030023	0.030509
19 carbon compound FL	0.099049	0.099319	0.099066
19 carbon compound FM	0.092958	0.092512	0.092438
19 carbon compound FP	0.003391	0.003438	0.003255
19 carbon compound FR	0.006671	0.060716	0.060926
19 carbon compound FT	0.163803	0.163137	0.163668
19 carbon compound FV	0.102954	0.102030	0.102491
19 carbon compound FX	0.026678	0.026043	0.026472
19 carbon compound FZ	0.232797	0.232920	0.232565
20 carbon compound GC	0.130286	0.130916	0.130749
20 carbon compound GE	0.204777	0.204979	0.204093
20 carbon compound GH	1.005662	1.005719	1.005384
20 carbon compound GJ	0.032068	0.032675	0.032249
20 carbon compound GL	0.871177	0.871648	0.871347
20 carbon compound GN	0.016625	0.016221	0.016994
20 carbon compound GO	0.235530	0.235712	0.235560
20 carbon compound GQ	0.092302	0.092515	0.092341
20 carbon compound GW	0.210680	0.210363	0.210983
20 carbon compound GY	0.108641	0.108653	0.108659
21 carbon compound GZ	0.104750	0.104570	0.104108
21 carbon compound HB	0.149406	0.149474	0.149687
21 carbon compound HD	0.260541	0.260950	0.260265
21 carbon compound HE	0.011204	0.011840	0.011618
21 carbon compound HG	0.231478	0.231365	0.231472
21 carbon compound HK	0.268162	0.268331	0.268404
21 carbon compound HL	0.014156	0.014794	0.014425
21 carbon compound HN	0.011963	0.011918	0.011228
21 carbon compound HQ	0.211432	0.211403	0.211145
21 carbon compound HR	0.107514	0.107468	0.107573
21 carbon compound HT	0.123722	0.123394	0.123852
22 carbon compound HX	0.154301	0.154651	0.154057
22 carbon compound HZ	1.027211	1.027633	1.027677
22 carbon compound IA	2.137800	2.137577	2.137815
22 carbon compound ID	0.024635	0.024162	0.024984
22 carbon compound IE	0.171986	0.171353	0.171141

Table A-9.–(continued)

Compounds	*Panthera tigris*		
	Sample 1	Sample 2	Sample 3
22 carbon compound IG	0.623937	0.623515	0.623849
22 carbon compound II	0.133544	0.133385	0.133045
22 carbon compound IJ	1.005823	1.005745	1.005829
22 carbon compound IK	0.117832	0.117579	0.117363
23 carbon compound IO	0.207192	0.207511	0.207107
23 carbon compound IP	0.027050	0.027283	0.027675
23 carbon compound IR	0.109372	0.109837	0.109039
23 carbon compound IT	0.165268	0.165540	0.165476
23 carbon compound IW	0.292260	0.292534	0.292390
23 carbon compound IX	0.015229	0.015867	0.015752
23 carbon compound JA	0.206655	0.206260	0.206906
23 carbon compound JC	0.010533	0.010967	0.010048
23 carbon compound JE	0.203144	0.203399	0.203615
24 carbon compound JH	0.139995	0.139463	0.139760
24 carbon compound JI	0.042391	0.042528	0.042345
24 carbon compound JO	1.129301	1.129280	1.129616
24 carbon compound JR	0.061647	0.061694	0.061428
24 carbon compound JS	1.525254	1.525165	1.525729
24 carbon compound JU	0.942427	0.942622	0.942294
24 carbon compound JV	0.110025	0.110069	0.110006
24 carbon compound JW	0.088718	0.088531	0.088741
24 carbon compound JY	0.215565	0.215699	0.215017
25 carbon compound KB	0.134118	0.134024	0.134501
25 carbon compound KC	0.230702	0.230761	0.230676
25 carbon compound KE	0.968007	0.968835	0.968424
25 carbon compound KK	0.109504	0.109062	0.109455
25 carbon compound KM	0.049284	0.049653	0.049125
25 carbon compound KO	0.294474	0.294027	0.294153
25 carbon compound KS	2.030834	2.030041	2.030791
26 carbon compound KV	0.965805	0.965418	0.965485
26 carbon compound LA	0.134284	0.134207	0.134267
26 carbon compound LC	5.933249	5.933578	5.933717
26 carbon compound LD	6.437196	6.437947	6.437780
26 carbon compound LG	0.820990	0.820665	0.820770
26 carbon compound LI	1.021160	1.021141	1.021180
26 carbon compound LJ	1.335030	1.335844	1.335919
26 carbon compound LL	0.852041	0.852010	0.852105
26 carbon compound LM	1.276933	1.276149	1.276770
27 carbon compound LQ	0.287581	0.287584	0.287050
27 carbon compound LT	0.038099	0.038624	0.038122
27 carbon compound LV	0.153544	0.153894	0.153492
27 carbon compound LY	1.423482	1.423987	1.423722
27 carbon compound LZ	0.145710	0.145316	0.145812
27 carbon compound MC	3.022699	3.022839	3.022333
27 carbon compound ME	1.019228	1.019782	1.019622
27 carbon compound MI	0.006134	0.006724	0.006581
27 carbon compound MK	0.148514	0.148504	0.148971

Table A-9.–(continued)

Compounds	*Panthera tigris*		
	Sample 1	Sample 2	Sample 3
28 carbon compound ML	0.128218	0.128381	0.128608
28 carbon compound MN	0.056815	0.056447	0.056194
28 carbon compound MP	0.169344	0.169472	0.169069
28 carbon compound MR	2.046155	2.046112	2.046008
28 carbon compound MU	0.173673	0.173080	0.173419
28 carbon compound MZ	0.083988	0.083495	0.083997
28 carbon compound NB	0.207833	0.207894	0.207101
28 carbon compound ND	0.026037	0.026091	0.026637
28 carbon compound NE	0.140870	0.140421	0.140121
28 carbon compound NH	0.203859	0.203703	0.203318
29 carbon compound NM	0.051068	0.051955	0.051511
29 carbon compound NP	0.211479	0.211522	0.211661
29 carbon compound NR	1.199087	1.199775	1.199853
29 carbon compound NT	0.932180	0.932494	0.932988
29 carbon compound NV	0.092110	0.092179	0.092218
29 carbon compound NZ	0.046334	0.046086	0.046196
29 carbon compound OB	0.078953	0.078057	0.078440
30 carbon compound OD	0.291715	0.291166	0.291990
30 carbon compound OI	0.040859	0.040609	0.040662
30 carbon compound OL	0.212640	0.212072	0.212438
30 carbon compound OT	0.164760	0.164094	0.164415
31 carbon compound OZ	0.046271	0.046795	0.046849

Table A-10.--Average amount (picomoles) of glycolipids present in pre-reproductive and reproductive female *Panthera uncia* (snow leopards) and *P. leo* (lions). Dashed lines represent the absence of a compound. Asterisks between pre-reproductive and reproductive females represent a significant difference between the two for a particular species.

Compounds	*Panthera uncia*			*Panthera leo*		
	Pre-Repro F		Repro. F	Pre-Repro F		Repro. F
10 carbon compound B	----------		----------	0.036338	*	0.100261
10 carbon compound D	----------		----------	0.043591	*	0.154574
11 carbon compound I	----------		----------	0.002663		0.004959
11 carbon compound J	0.316661		0.267964	----------		----------
12 carbon compound Q	0.649122	*	0.037721	0.002806	*	0.045059
12 carbon compound R	0.051926		0.053010	----------		----------
2,6-bis(1,1-dimethylethyl)-4-ethyl-Phenol	0.277995	*	0.040803	----------		----------
12 carbon compound W	----------		----------	0.013675	*	0.052603
12 carbon compound X	3.669547	*	0.045478	0.069573	*	1.242574
12 carbon compound AB	0.995879	*	0.139593	----------		----------
13 carbon compound AC	4.881355	*	0.363773	----------		----------
13 carbon compound AH	----------		----------	0.069576	*	0.148163
13 carbon compound AM	1.804182	*	0.369197	----------		----------
13 carbon compound AP	----------		----------	0.277493	*	0.148495
Tetradecanoic acid	0.432590	*	0.656034	0.022878	*	0.005381
14 carbon compound AY	----------		----------	0.044532	*	1.288186
14 carbon compound BF	----------		----------	0.352056	*	0.244858
14 carbon compound BG	----------		----------	0.020427	*	3.258760
Pentadecanoic acid	0.160860	*	0.070059	----------		----------
15 carbon compound BQ	----------		----------	0.038925	*	4.246872
15 carbon compound BT	0.163228	*	0.050683	----------		----------
Hexadecanoic acid	3.922462	*	0.136375	0.026443	*	0.243369
16 carbon compound BV	0.199460	*	0.370434	----------		----------
16 carbon compound BY	----------		----------	0.047819	*	0.152045
16 carbon compound BZ	0.110074		0.166307	0.024844	*	1.294389
16 carbon compound CG	0.165208		0.156950	----------		----------
16 carbon compound CH	----------		----------	0.056357	*	0.240736
Heptadecanoic acid	0.039246		0.041972	0.013028	*	0.138226
17 carbon compound CI	----------		----------	0.003474	*	0.036958
17 carbon compound CP	----------		----------	0.022109	*	0.052635
X-Octadecanoic acid	----------		----------	0.042042	*	0.948258
17 carbon compound CR	----------		----------	0.059140		0.033456
Octadecanoic acid	0.583396		0.937414	0.152224		0.150832
18 carbon compound CW	0.178427	*	0.038437	----------		----------
18 carbon compound CY	0.067255		0.048392	----------		----------
18 carbon compound DA	0.241720	*	0.370885	----------		----------
X-methyl Octadecanoic acid	----------		----------	0.167976	*	0.246985
18 carbon compound DC	6.140956	*	0.052685	0.002270	*	0.045355
18 carbon compound DF	0.153002	*	0.064058	----------		----------
19 carbon compound DG	0.198061		0.168563	0.002859	*	0.045625
19 carbon compound DI	----------		----------	0.156442		0.140457
19 carbon compound DK	0.146629		0.140497	----------		----------
19 carbon compound DM	0.084649	*	0.033765	----------		----------

Table A-10.--(continued)

Compounds	*Panthera uncia*			*Panthera leo*		
	Pre-Repro F		**Repro. F**	**Pre-Repro F**		**Repro. F**
X,X-Eicosadienoic acid	0.137049		0.141652	----------		----------
X-Eicosanoic acid	----------		----------	0.002263		0.004461
19 carbon compound DP	----------		----------	0.152390	*	0.044826
19 carbon compound DS	0.297608	*	0.057290	----------		----------
Eicosanoic acid	0.534118	*	0.054522	0.051756	*	0.151508
20 carbon compound DX	0.359415	*	0.452171	----------		----------
20 carbon compound ED	----------		----------	0.257590	*	4.317618
20 carbon compound EH	0.379200	*	0.130543	----------		----------
20 carbon compound EK	----------		----------	0.067829	*	0.148246
21 carbon compound EQ	----------		----------	6.075090	*	0.145819
21 carbon compound EU	0.569188		0.639802	0.065734	*	0.243311
21 carbon compound FA	----------		----------	3.301591	*	0.151048
21 carbon compound FB	0.246047		0.252797	----------		----------
21 carbon compound FD	0.236037	*	0.338622	----------		----------
21 carbon compound FE	----------		----------	3.465210	*	0.032720
21 carbon compound FH	0.167017	*	0.129746	----------		----------
22 carbon compound FI	----------		----------	1.284977	*	0.239353
22 carbon compound FL	----------		----------	0.003103		0.004278
22 carbon compound FO	1.604593	*	0.050662	----------		----------
22 carbon compound FP	----------		----------	0.077566	*	0.155961
22 carbon compound FU	0.033606		0.044950	0.021213	*	0.236652
22 carbon compound FZ	0.271235		0.344358	----------		----------
22 carbon compound GA	0.527500	*	1.299791	----------		----------
22 carbon compound GB	----------		----------	0.039459	*	0.151859
23 carbon compound GE	0.029395		0.058002	----------		----------
23 carbon compound GJ	0.331924	*	0.537604	----------		----------
23 carbon compound GL	3.659479	*	7.073685	----------		----------
23 carbon compound GM	----------		----------	0.061671	*	0.136201
23 carbon compound GO	----------		----------	0.005519	*	0.243814
Tetracosanoic acid	0.786719		1.149099	0.050002	*	0.136083
24 carbon compound GS	----------		----------	0.002594		0.005061
24 carbon compound HB	----------		----------	0.034086	*	1.172282
25 carbon compound HK	----------		----------	0.134495	*	0.251893
25 carbon compound HO	----------		----------	0.059996	*	0.144717
25 carbon compound HP	----------		----------	0.050640	*	0.151133
25 carbon compound HT	4.963081		9.277029	----------		----------
X-Hexacosanoic acid	1.652238		3.219043	----------		----------
25 carbon compound HX	----------		----------	0.152571	*	0.250781
25 carbon compound IB	0.145709		0.244055	----------		----------
25 carbon compound IC	----------		----------	0.004420	*	0.040958
26 carbon compound ID	0.222544		0.366704	0.004237	*	0.041328
26 carbon compound IE	----------		----------	0.322531	*	0.039998
26 carbon compound IH	0.233797		0.234038	----------		----------
26 carbon compound II	----------		----------	0.047253	*	0.004889
26 carbon compound IJ	----------		----------	0.637453	*	0.038189
26 carbon compound IN	3.803828	*	7.486939	----------		----------
26 carbon compound IO	----------		----------	0.167219		0.152124

Table A-10.--(continued)

Compounds	*Panthera uncia*			*Panthera leo*		
	Pre-Repro F		Repro. F	Pre-Repro F		Repro. F
26 carbon compound IP	----------		----------	0.051062		0.045322
26 carbon compound IS	----------		----------	0.062498	*	0.245189
26 carbon compound IV	0.148210	*	0.053073	----------		----------
26 carbon compound IW	0.130064	*	0.063489	----------		----------
26 carbon compound IX	----------		----------	0.045197	*	0.233286
27 carbon compound JC	0.197987		0.269853	----------		----------
27 carbon compound JD	----------		----------	0.027657	*	1.213891
Cholesterol	----------		----------	0.187102		0.147277
27 carbon sterol	0.063581		0.057299	0.049480	*	0.038024
27 carbon compound JH	0.291871		0.256882	----------		----------
27 carbon compound JI	----------		----------	0.048841	*	0.249419
27 carbon compound JO	0.417851		0.355864	----------		----------
27 carbon compound JP	----------		----------	0.043220	*	0.149004
27 carbon compound JR	----------		----------	0.141904		0.151536
27 carbon compound JW	----------		----------	0.377216	*	0.004302
27 carbon compound JX	----------		----------	0.048671	*	0.166214
28 carbon compound KI	0.692360	*	0.066060	----------		----------
28 carbon compound KJ	----------		----------	0.048324		0.029893
28 carbon compound KK	----------		----------	0.038545	*	0.147223
28 carbon compound KM	----------		----------	0.052870	*	0.241514
28 carbon compound KT	0.191638		0.157627	----------		----------
28 carbon compound KU	5.167992		10.051760	0.051497		0.041694
28 carbon compound KY	0.280038		0.219288	----------		----------
29 carbon compound KZ	----------		----------	0.721713	*	0.135827
29 carbon compound LI	0.203735		0.265280	----------		----------
29 carbon compound LM	----------		----------	11.536330	*	3.414349
29 carbon compound LP	0.124883		0.171433	----------		----------
29 carbon compound LQ	0.172193		0.161295	----------		----------
29 carbon compound LR	0.826451	*	0.138067	----------		----------
29 carbon compound LU	----------		----------	0.048952	*	0.051321
29 carbon compound LW	0.342838		0.563569	----------		----------
30 carbon compound LX	0.615427	*	1.225668	0.158864	*	0.249636
30 carbon compound LZ	----------		----------	0.030042		0.047784
30 carbon compound MD	----------		----------	0.022405		0.033001
30 carbon compound MF	0.260332		0.368312	----------		----------
30 carbon compound MN	0.341483	*	0.657252	----------		----------
31 carbon compound MR	0.279821	*	0.551398	0.229719	*	0.051417

Table A-11.–Average amount (picomoles) of neutral lipids present in anal sacs of pre-reproductive and reproductive female *Panthera uncia* (snow leopards) and *P. leo* (lions). Dashed lines represent the absence of a compound. Asterisks between pre-reproductive and reproductive females represent a significant difference between the two for a particular species.

Compounds	*Panthera uncia*			*Panthera leo*		
	Pre-Repro F		Repro. F	Pre-Repro F		Repro. F
10 carbon compound A	0.221627		0.342672	----------		----------
10 carbon compound C	0.024124	*	0.004231	----------		----------
10 carbon compound D	0.037612		0.052363	----------		----------
10 carbon compound G	0.091034		0.048587	----------		----------
11 carbon compound H	0.070077		0.057703	0.006130	*	3.386160
11 carbon compound J	0.305049		0.341627	----------		----------
11 carbon compound L	0.054652		0.058909	----------		----------
11 carbon compound N	0.011422	*	0.003671	----------		----------
11 carbon compound O	0.055418		0.053054	----------		----------
11 carbon compound S	0.147482	*	0.045987	0.022468	*	1.426708
11 carbon compound T	0.193237		0.148335	----------		----------
11 carbon compound V	0.199719	*	0.051677	----------		----------
11 carbon compound W	----------		----------	0.039432		0.041989
11 carbon compound Y	0.009480		0.006097	----------		----------
12 carbon compound Z	0.267481	*	0.554296	0.025215	*	0.749216
12 carbon compound AB	0.065666		0.050660	----------		----------
12 carbon compound AG	----------		----------	0.028015	*	0.257695
12 carbon compound AH	0.117354		0.164472	----------		----------
12 carbon compound AJ	0.020294		0.038054	----------		----------
12 carbon compound AK	----------		----------	0.039944		0.045216
12 carbon compound AL	----------		----------	0.026912	*	0.051217
12 carbon compound AM	0.050730		0.042914	0.005132	*	0.152430
12 carbon compound AO	0.120834		0.149778	----------		----------
12 carbon compound AP	----------		----------	0.008512	*	0.149260
12 carbon compound AQ	0.037198		0.036506	----------		----------
12 carbon compound AS	0.404739		0.852148	----------		----------
12 carbon compound AV	0.039098		0.004668	----------		----------
13 carbon compound AX	0.125429		0.049600	----------		----------
13 carbon compound AY	----------		----------	0.022260	*	0.147807
13 carbon compound AZ	0.031472		0.050110	0.033714		0.041063
13 carbon compound BA	----------		----------	0.032562	*	0.154546
X-branched Tridecanoic acid	0.002476		0.005509	0.003630	*	0.140987
13 carbon compound BE	0.044058		0.040050	----------		----------
13 carbon compound BF	----------		----------	0.006323	*	0.161051
13 carbon compound BH	0.042384		0.067010	----------		----------
13 carbon compound BJ	----------		----------	0.031809	*	2.463794
13 carbon compound BK	0.473424	*	0.144719	----------		----------
13 carbon compound BM	0.103377		0.140076	----------		----------
13 carbon compound BO	0.017087		0.054947	----------		----------
1,1'-(1,2-cyclobutanediyl)bis-,cis-Benzene	0.130318		0.227126	0.003505	*	1.449359
13 carbon compound BQ	0.105430		0.051700	----------		----------
Tetradecanoic acid	0.004511		0.004180	0.005395	*	0.165996
14 carbon compound BR	----------		----------	0.028736	*	0.242688

Table A-11.--(continued)

Compounds	*Panthera uncia*			*Panthera leo*		
	Pre-Repro F		Repro. F	Pre-Repro F		Repro. F
14 carbon compound BS	0.024158		0.024918	----------		----------
14 carbon compound BW	0.010207		0.004499	----------		----------
14 carbon compound BX	0.137513	*	0.256268	0.954647	*	8.256447
14 carbon compound CC	0.016590		0.056282	0.149954	*	2.260652
14 carbon compound CE	0.308333	*	0.005252	----------		----------
14 carbon compound CF	0.015892		0.050965	0.028519	*	0.468353
14 carbon compound CG	0.011028		0.004110	----------		----------
15 carbon compound CT	----------		----------	0.022394	*	3.363648
15 carbon compound CV	0.026904		0.033587	0.029003	*	4.204144
15 carbon compound CW	0.013201		0.065582	0.004462	*	2.296126
15 carbon compound CY	0.101701		0.229673	----------		----------
15 carbon compound DB	0.085193	*	0.137957	0.004193	*	0.049817
Nonadecanoic acid	0.535326	*	0.138368	----------		----------
15 carbon compound DC	----------		----------	0.003171	*	1.408786
15 carbon compound DD	0.094464		0.059353	0.046596	*	2.437158
15 carbon compound DF	0.041927		0.057254	----------		----------
Hexadecanoic acid	0.024504		0.055198	0.035577	*	0.562791
16 carbon compound DL	0.054621		0.043393	0.003657	*	0.209116
16 carbon compound DM	0.024281		0.060566	0.025052		0.051505
16 carbon compound DN	0.498318	*	0.848871	----------		----------
16 carbon compound DQ	0.107045		0.249994	0.144740		0.510005
16 carbon compound DT	38.113180	*	0.155197	----------		----------
16 carbon compound DV	----------		----------	0.062007	*	0.161369
16 carbon compound EA	0.523768	*	1.390720	0.547981	*	6.972165
16 carbon compound EF	----------		----------	0.037731		0.032179
16 carbon compound EH	0.058107	*	0.007026	----------		----------
17 carbon compound EJ	0.226312	*	0.051394	----------		----------
17 carbon compound EL	----------		----------	0.004537	*	0.040195
17 carbon compound EN	0.397996	*	0.146616	----------		----------
17 carbon compound EP	0.051341		0.048869	----------		----------
17 carbon compound ES	0.177088	*	0.033895	----------		----------
17 carbon compound ET	0.029215	*	0.053676	0.021886	*	1.340869
17 carbon compound EU	0.252880		0.330782	0.041430	*	1.319445
X-Octadecanoic acid	2.392295	*	4.168672	0.026306	*	0.158391
17 carbon compound EV	0.114743		0.259286	0.002970	*	0.159615
17 carbon compound EX	----------		----------	0.069611	*	0.557398
17 carbon compound EY	2.550855		4.169799	----------		----------
Octadecanoic acid	0.023342		0.058711	0.026349		0.048644
18 carbon compound FC	0.321238		0.644139	0.062386	*	0.139463
18 carbon compound FD	0.176217		0.277554	1.601426		1.494828
18 carbon compound FG	----------		----------	0.025629	*	2.522959
18 carbon compound FH	0.096515		0.050133	0.163128	*	1.449582
18 carbon compound FJ	0.174652		0.153597	----------		----------
18 carbon compound FK	----------		----------	0.004985	*	0.167466
18 carbon compound FL	5.612115		10.406170	----------		----------
18 carbon compound FN	0.317958		0.648298	0.004093	*	0.052106
18 carbon compound FT	----------		----------	0.036293	*	0.363079

Table A-11.--(continued)

Compounds	*Panthera uncia*			*Panthera leo*		
	Pre-Repro F		Repro. F	Pre-Repro F		Repro. F
18 carbon compound FY	0.170466	*	0.363932	0.056204	*	0.246720
18 carbon compound GA	----------		----------	0.174247	*	0.040417
18 carbon compound GB	0.214066		0.260934	----------		----------
19 carbon alcohol	0.124233		0.051584	0.050061	*	0.458027
19 carbon compound GJ	0.172949		0.050431	0.863072	*	1.628705
19 carbon compound GO	----------		----------	0.006044	*	0.146078
19 carbon compound GP	0.045450		0.048983	----------		----------
19 carbon compound GQ	----------		----------	0.028890	*	0.259799
19 carbon compound GR	0.035736		0.064744	0.164211	*	0.949063
19 carbon compound GS	0.020509		0.064404	----------		----------
19 carbon compound GT	0.018275		0.048901	0.029108	*	0.152573
19 carbon compound GY	----------		----------	0.166915	*	1.695894
Eicosanoic acid	0.152630	*	0.253036	0.028827	*	0.341228
20 carbon compound GZ	----------		----------	0.008163	*	0.148209
20 carbon compound HC	0.051350		0.050652	0.529749	*	0.262150
20 carbon compound HD	----------		----------	0.251737	*	2.684343
20 carbon compound HE	0.019857	*	0.044294	----------		----------
20 carbon compound HG	0.077532	*	0.130923	----------		----------
20 carbon compound HH	----------		----------	0.018643	*	0.152285
20 carbon compound HI	0.050573		0.062107	----------		----------
20 carbon compound HK	----------		----------	0.025873	*	0.252132
20 carbon compound HL	----------		----------	0.034650	*	0.244572
20 carbon compound HM	0.015054		0.049391	----------		----------
20 carbon compound HR	0.144775	*	0.235526	----------		----------
21 carbon compound HU	0.061740		0.063539	0.006845	*	0.053037
21 carbon compound HZ	0.072756		0.167933	----------		----------
21 carbon compound ID	0.112523		0.124431	----------		----------
21 carbon compound IH	0.326495	*	0.557940	----------		----------
21 carbon compound IL	0.153781		0.151380	0.003524	*	0.742312
21 carbon compound IO	----------		----------	0.032981		0.052748
21 carbon compound IP	0.821831		1.290548	0.043395	*	0.227585
Docosanoic acid	0.075067		0.037650	2.577661	*	0.247560
22 carbon compound IU	0.304749		0.340461	----------		----------
22 carbon compound IW	----------		----------	0.030579	*	0.156227
22 carbon compound IX	1.100378	*	0.265240	----------		----------
22 carbon compound IY	----------		----------	0.047726	*	0.171025
22 carbon compound JB	0.135410		0.264286	----------		----------
22 carbon compound JD	0.203473		0.346874	----------		----------
22 carbon compound JF	----------		----------	0.004027	*	2.428544
22 carbon compound JG	0.379327		0.737878	0.006004	*	0.032014
22 carbon compound JH	----------		----------	0.283132	*	0.453236
22 carbon compound JI	0.100987		0.159846	----------		----------
22 carbon compound JM	1.888167	*	3.219304	----------		----------
22 carbon compound JN	----------		----------	0.080063	*	0.266535
22 carbon compound JO	0.100192		0.138056	----------		----------
23 carbon compound JP	----------		----------	0.004011	*	0.154247
23 carbon compound JS	0.100372		0.142779	0.004601	*	0.050134

Table A-11.--(continued)

Compounds	*Panthera uncia*			*Panthera leo*		
	Pre-Repro F		Repro. F	Pre-Repro F		Repro. F
23 carbon compound JU	0.095904		0.054824	7.359967	*	0.250796
23 carbon compound JV	----------		----------	0.145382	*	0.949879
23 carbon compound JX	0.375358	*	0.051200	----------		----------
23 carbon compound JZ	0.027042		0.038216	----------		----------
23 carbon compound KC	0.988430		0.247607	----------		----------
23 carbon compound KD	0.348959		0.237249	0.040351	*	0.941198
23 carbon compound KG	0.411763		0.541593	0.026802	*	0.258096
23 carbon compound KI	0.152593		0.255251	----------		----------
3,7,11-trimethyl-(E,E)-2,6,10-Dodecatrien-1-ol	1.050693		1.354532	0.041733	*	2.438430
24 carbon compound KT	4.387401		2.131100	----------		----------
24 carbon compound LB	0.606420	*	1.224220	0.036030	*	0.554385
24 carbon compound LC	----------		----------	0.042465	*	1.380636
24 carbon compound LD	0.302368		0.578498	----------		----------
24 carbon compound LH	----------		----------	0.036134		0.045562
24 carbon compound LI	0.028484		0.046389	----------		----------
25 carbon compound LJ	----------		----------	13.602560	*	0.254113
25 carbon compound LK	0.073736		0.147509	----------		----------
25 carbon compound LM	----------		----------	0.024118	*	0.745839
25 carbon compound LO	0.052004		0.032849	0.137518	*	0.051467
25 carbon compound LR	----------		----------	0.255941	*	0.156673
25 carbon compound LT	----------		----------	0.032779	*	1.407964
25 carbon compound LU	0.045716		0.035305	----------		----------
25 carbon compound LV	----------		----------	0.058532	*	0.738175
25 carbon compound LY	0.009609		0.005243	18.301630	*	0.055560
25 carbon compound MC	0.221039		0.331005	0.056342	*	0.430637
25 carbon compound MF	0.068184		0.053449	----------		----------
25 carbon compound MH	2.250451		4.178443	0.005415	*	0.035933
26 carbon compound MK	----------		----------	0.039559	*	0.443350
26 carbon compound MR	0.058364		0.046284	----------		----------
26 carbon compound MU	0.102585		0.132597	----------		----------
26 carbon compound MY	32.703020	*	1.103662	----------		----------
26 carbon compound NA	0.178372		0.150264	----------		----------
26 carbon compound ND	0.576561	*	0.044494	0.061573	*	0.250614
Cholesterol	0.084658		0.048712	----------		----------
27 carbon compound NF	----------		----------	0.005073	*	0.348289
27 carbon compound NG	----------		----------	0.047536	*	0.159870
27 carbon compound NH	0.213439		0.239620	19.256150	*	0.051857
27 carbon compound NN	----------		----------	0.038648		0.048252
27 carbon compound NO	1.040686		1.135835	----------		----------
27 carbon compound NP	----------		----------	0.055696	*	1.440607
27 carbon compound NV	----------		----------	0.044837	*	1.403325
27 carbon compound NW	0.083653		0.055733	----------		----------
27 carbon compound NX	----------		----------	0.033486	*	0.146473
27 carbon compound NY	0.188633	*	0.254477	----------		----------
28 carbon compound NZ	----------		----------	0.371659	*	0.046624
28 carbon compound OA	0.085040		0.046109	14.061100	*	0.146628

Table A-11.–(continued)

Compounds	*Panthera uncia*		*Panthera leo*	
	Pre-Repro F	**Repro. F**	**Pre-Repro F**	**Repro. F**
28 carbon compound OC	0.515976	0.545676	----------	----------
28 carbon compound OE	0.158572	0.256916	----------	----------
28 carbon compound OL	1.003481	1.172447	0.185428 *	0.456951
28 carbon compound OO	1.206716 *	2.178865	----------	----------
28 carbon compound OR	0.546518 *	0.832547	----------	----------
28 carbon compound OT	0.136291	0.248526	0.047636	0.042328
28 carbon compound OW	0.304328	0.546559	----------	----------
29 carbon compound PB	1.350645 *	0.153915	----------	----------
29 carbon compound PE	0.043419	0.047270	----------	----------
29 carbon compound PF	----------	----------	0.050139 *	1.465518
29 carbon compound PI	0.480955	0.948964	----------	----------
29 carbon compound PK	0.198752	0.143698	----------	----------
29 carbon compound PL	----------	----------	0.032119	0.039898
29 carbon compound PM	0.104305	0.039341	----------	----------
29 carbon compound PQ	0.033387	0.033437	----------	----------
29 carbon compound PS	0.057969	0.047324	----------	----------
30 carbon compound PW	0.122454 *	0.030951	----------	----------
30 carbon compound PY	----------	----------	8.134676 *	0.453703
30 carbon compound PZ	----------	----------	0.025674 *	0.486589
30 carbon compound QD	----------	----------	0.456653 *	0.751410
30 carbon compound QG	----------	----------	0.025212 *	0.152459
30 carbon compound QI	----------	----------	0.056786	0.055597
31 carbon compound QL	----------	----------	0.029100	0.051912

Table A-12.--Average amount (picomoles) of phospholipids present in anal sacs of pre-reproductive and reproductive female *Panthera uncia* (snow leopards) and *P. leo* (lions). Dashed lines represent the absence of a compound. Asterisks between pre-reproductive and reproductive females represent a significant difference between the two for a particular species.

Compounds	Panthera uncia			Panthera leo		
	Pre-Repro F		Repro. F	Pre-Repro F		Repro. F
11 carbon compound E	0.017717		0.044454	----------		----------
11 carbon compound G	0.088481		0.065338	----------		----------
11 carbon compound H	0.192614		0.246007	----------		----------
11 carbon compound K	0.023820		0.060417	----------		----------
12 carbon compound N	----------		----------	0.951796	*	0.255453
12 carbon compound P	0.234769		0.260982	----------		----------
12 carbon compound Q	----------		----------	0.004677	*	2.327826
12 carbon compound S	1.166201	*	0.155609	----------		----------
12 carbon compound U	0.115094	*	0.049622	----------		----------
12 carbon compound X	0.284706		0.549045	----------		----------
12 carbon compound AA	----------		----------	0.066129		0.153311
13 carbon compound AG	0.235791		0.223478	----------		----------
13 carbon compound AH	1.007931		1.128267	----------		----------
13 carbon compound AK	----------		----------	0.042221		0.043731
13 carbon compound AN	0.106584		0.065697	----------		----------
X-methyl pentadecanoic acid	----------		----------	0.030978	*	0.138957
13 carbon compound AP	0.153638	*	0.036141	0.033771	*	0.249937
13 carbon compound AQ	----------		----------	0.054490		0.046353
13 carbon compound AR	----------		----------	0.022379	*	0.169793
13 carbon compound AS	----------		----------	0.030083	*	1.311732
13 carbon compound AT	0.134523		0.247067	----------		----------
13 carbon compound AW	0.180497		0.138926	----------		----------
13 carbon compound AX	----------		----------	0.357952	*	0.757869
Tetradecanoic acid	0.794469	*	0.055708	0.058072	*	2.484813
14 carbon compound AZ	----------		----------	0.039694	*	0.163235
14 carbon compound BC	1.805370		2.105526	----------		----------
14 carbon compound BE	----------		----------	0.006073	*	0.052124
14 carbon compound BF	----------		----------	0.036931	*	0.158330
14 carbon compound BG	1.029779	*	2.322407	----------		----------
14 carbon compound BI	0.015966		0.005709	----------		----------
14 carbon compound BJ	----------		----------	0.034485	*	0.158669
14 carbon compound BL	----------		----------	0.040287	*	0.260727
14 carbon compound BN	0.078980		0.136150	----------		----------
14 carbon compound BO	----------		----------	0.030395		0.047098
14 carbon compound BS	0.223676		0.265510	----------		----------
14 carbon compound BT	----------		----------	0.024915	*	0.554805
Pentadecanoic acid	----------		----------	0.021683	*	0.257702
15 carbon compound BU	0.039072		0.061725	0.019042	*	0.660453
15 carbon alcohol	----------		----------	0.027404	*	0.058599
15 carbon compound BW	0.279306		0.277024	----------		----------
15 carbon compound CA	----------		----------	0.037288	*	1.328278
15 carbon compound CC	0.139824	*	0.037691	0.085191	*	0.552805
15 carbon compound CE	0.029913		0.052311	0.264555	*	0.040140
15 carbon compound CG	----------		----------	0.019917	*	0.649599

Table A-12.--(continued)

Compounds	Panthera uncia			Panthera leo		
	Pre-Repro F		Repro. F	Pre-Repro F		Repro. F
15 carbon compound CH	0.622743		0.758965	----------		----------
15 carbon compound CI	0.263421		0.239452	0.047235	*	1.328303
15 carbon compound CL	1.020489	*	0.138900	0.002857	*	0.154106
15 carbon compound CN	0.035664		0.047114	----------		----------
15 carbon compound CO	----------		----------	0.044768	*	8.534144
Hexadecanoic acid	0.139775		0.242941	1.492182	*	0.523122
16 carbon compound CU	0.181912	*	0.058105	----------		----------
16 carbon compound CW	----------		----------	0.554549	*	0.052373
16 carbon compound CX	0.124450		0.140235	----------		----------
16 carbon compound CZ	----------		----------	0.029777		0.042906
16 carbon compound DB	0.056727		0.062619	----------		----------
16 carbon compound DD	1.575483	*	0.252887	0.030059		0.049087
16 carbon compound DF	1.742269		1.301470	0.036603		0.054825
16 carbon compound DH	----------		----------	0.031964	*	0.152379
16 carbon compound DJ	0.016283	*	0.064968	----------		----------
17 carbon compound DM	0.094288	*	0.006828	0.669569	*	0.467391
17 carbon compound DN	0.136608	*	0.060300	----------		----------
17 carbon compound DO	----------		----------	0.377334	*	0.049348
17 carbon compound DQ	0.018400	*	0.004890	----------		----------
17 carbon compound DR	0.142825	*	0.004668	----------		----------
17 carbon compound DS	----------		----------	0.048088	*	0.155356
17 carbon compound DU	0.112744		0.139399	----------		----------
17 carbon compound DW	0.080264	*	0.143275	0.028383	*	0.154220
17 carbon compound DZ	0.391172	*	0.058074	1.434833	*	0.556750
(Z,Z)-9,12-Octadecadienoic acid	----------		----------	0.147292	*	0.267065
17 carbon compound EB	0.268037		0.261989	1.729537		1.464292
17 carbon compound EC	0.153444		0.179632	0.564443	*	0.161916
17 carbon compound ED	----------		----------	0.370762		0.166931
17 carbon compound EF	0.118368	*	0.270145	----------		----------
17 carbon compound EG	----------		----------	0.176466		0.158213
Octadecanoic acid	0.885564		1.068753	9.511654	*	2.701835
18 carbon compound EK	0.076110		0.045032	----------		----------
18 carbon compound EM	0.480689		0.849442	----------		----------
18 carbon compound EO	0.082832	*	0.164094	----------		----------
18 carbon compound EP	----------		----------	0.032660		0.041608
18 carbon compound ER	0.189891	*	0.060034	----------		----------
18 carbon compound EU	0.705707	*	0.259864	----------		----------
18 carbon compound EW	0.051883		0.047348	0.162015	*	0.552520
18 carbon compound EZ	0.073743	*	0.157383	----------		----------
19 carbon compound FC	----------		----------	64.359480	*	13.334770
19 carbon compound FD	0.102956		0.163093	----------		----------
19 carbon compound FF	----------		----------	0.377627	*	0.053841
19 carbon compound FG	0.082544		0.180596	----------		----------
19 carbon compound FH	0.138466		0.231727	----------		----------
19 carbon compound FL	0.125371	*	0.045408	0.273184		0.249616
19 carbon compound FN	0.210529		0.251397	----------		----------
19 carbon compound FP	----------		----------	0.045910	*	0.260969

Table A-12.--(continued)

Compounds	Panthera uncia			Panthera leo		
	Pre-Repro F		Repro. F	Pre-Repro F		Repro. F
19 carbon compound FR	0.134711		0.226787	----------		----------
19 carbon compound FS	----------		----------	1.442859	*	0.158393
19 carbon compound FT	0.180353	*	0.077330	----------		----------
19 carbon compound FV	----------		----------	0.377611	*	0.055671
19 carbon compound FW	0.139839	*	0.072711	----------		----------
19 carbon compound FX	0.259120		0.239842	----------		----------
19 carbon compound GA	0.818125	*	0.150467	0.178812	*	0.350366
20 carbon compound GC	0.094773		0.145179	4.689100	*	0.665775
20 carbon compound GH	0.484713		0.138548	0.183689	*	0.463364
20 carbon compound GJ	0.886111		1.193264	----------		----------
20 carbon compound GL	----------		----------	0.047557		0.058500
20 carbon compound GM	1.051919		2.058959	----------		----------
20 carbon compound GN	0.177023	*	0.037565	----------		----------
20 carbon compound GP	0.113286		0.142251	----------		----------
20 carbon compound GR	0.437950		0.639222	----------		----------
20 carbon compound GW	0.168652		0.154284	----------		----------
20 carbon compound GX	----------		----------	0.188610		0.160838
20 carbon compound GY	0.840228		1.081317	----------		----------
21 carbon compound GZ	0.179290		0.136541	0.939886	*	0.147420
21 carbon compound HC	----------		----------	0.054720	*	0.160512
21 carbon compound HD	0.113616		0.233185	----------		----------
21 carbon compound HF	0.165149	*	0.037888	----------		----------
21 carbon compound HG	0.231383		0.140016	----------		----------
21 carbon compound HK	0.086200		0.150942	----------		----------
21 carbon compound HL	----------		----------	0.018026	*	0.046315
21 carbon compound HN	0.138503		0.262766	----------		----------
21 carbon compound HQ	0.133639		0.041705	----------		----------
21 carbon compound HT	0.156115		0.228028	----------		----------
21 carbon compound HV	----------		----------	0.559673		0.560586
21 carbon compound HW	0.135171	*	0.047986	----------		----------
22 carbon compound HX	0.202782		0.240742	2.487246	*	0.460252
22 carbon compound IC	----------		----------	0.036929		0.041955
22 carbon compound IF	0.593592	*	0.188451	----------		----------
22 carbon compound IH	1.303582	*	0.058670	----------		----------
22 carbon compound IL	0.960771		1.365455	----------		----------
22 carbon compound IM	----------		----------	0.162616	*	0.252375
22 carbon compound IN	0.101806	*	0.061623	----------		----------
23 carbon compound IO	----------		----------	0.467511	*	0.847610
23 carbon compound IQ	----------		----------	0.003808	*	0.556910
23 carbon compound IR	1.270409		1.101991	----------		----------
23 carbon compound IV	0.568380		0.920439	----------		----------
23 carbon compound IY	----------		----------	0.002633	*	0.048558
23 carbon compound JB	0.683492		0.157241	----------		----------
23 carbon compound JE	0.103755	*	0.049902	----------		----------
23 carbon compound JF	----------		----------	0.174319	*	0.250748
24 carbon compound JH	0.224935		0.245510	0.649279	*	0.041720
24 carbon compound JJ	0.073671	*	0.145707	0.004153		0.039659

Table A-12.--(continued)

Compounds	Panthera uncia		Panthera leo	
	Pre-Repro F	Repro. F	Pre-Repro F	Repro. F
24 carbon compound JP	----------	----------	0.058569 *	0.156942
24 carbon compound JR	0.214770	0.214271	----------	----------
25 carbon compound JS	----------	----------	0.040108 *	0.165014
24 carbon compound JT	0.558908	0.951578	----------	----------
24 carbon compound JY	0.202673	0.119423	----------	----------
25 carbon compound KB	0.028436	0.057942	----------	----------
25 carbon compound KD	0.254674	0.279906	----------	----------
25 carbon compound KG	1.009951	1.147063	----------	----------
25 carbon compound KH	0.589485	0.962246	----------	----------
25 carbon compound KK	0.160557	0.127516	----------	----------
25 carbon compound KO	2.811366	5.325521	----------	----------
25 carbon compound KQ	----------	----------	0.004382 *	0.051153
25 carbon compound KS	3.926627	6.315271	----------	----------
25 carbon compound KU	0.421267	0.835839	----------	----------
26 carbon compound KX	1.541686	1.243965	----------	----------
26 carbon compound KZ	----------	----------	0.043801 *	0.155575
26 carbon compound LA	1.341618	1.114316	----------	----------
26 carbon compound LB	----------	----------	0.036451	0.044600
26 carbon compound LH	0.506402	0.818393	----------	----------
26 carbon sterol	0.863397 *	1.250838	----------	----------
26 carbon compound LN	0.258414	0.250641	----------	----------
Cholesterol	0.115080	0.067032	----------	----------
27 carbon compound LP	----------	----------	0.940749 *	0.753851
27 carbon compound LQ	0.170973	0.140063	0.027533	0.044144
27 carbon compound LS	1.030880	1.098672	----------	----------
27 carbon compound LT	----------	----------	0.031387 *	1.407574
27 carbon compound LV	0.165772	0.139676	----------	----------
27 carbon compound LX	1.587741	3.189924	----------	----------
27 carbon compound LZ	0.679885 *	1.070764	----------	----------
27 carbon compound MB	0.620693	0.252566	----------	----------
27 carbon compound MC	----------	----------	0.050188 *	0.363995
27 carbon compound MD	0.473490	0.056031	----------	----------
27 carbon compound MF	0.176066	0.245020	----------	----------
27 carbon compound MG	2.613622 *	0.149183	----------	----------
27 carbon compound MJ	3.122889 *	0.050049	----------	----------
28 carbon compound ML	1.035816	1.095077	----------	----------
28 carbon compound MM	0.659453 *	0.028068	----------	----------
28 carbon compound MO	1.447666 *	1.055766	----------	----------
28 carbon compound MP	0.887059	0.931296	----------	----------
28 carbon compound MS	0.810889 *	0.135093	----------	----------
28 carbon compound MT	0.130779	0.026736	----------	----------
28 carbon compound MX	0.122022 *	0.261752	----------	----------
28 carbon compound NA	0.158012	0.144151	----------	----------
28 carbon compound NC	1.110841 *	0.250927	----------	----------
28 carbon compound ND	----------	----------	0.028226 *	0.284608
28 carbon compound NE	0.563177	0.941475	----------	----------
28 carbon compound MF	----------	----------	0.003650 *	0.550113

Table A-12.--(continued)

Compounds	Panthera uncia			Panthera leo	
	Pre-Repro F		Repro. F	Pre-Repro F	Repro. F
28 carbon compound NG	1.980705	*	0.144347	----------	----------
28 carbon compound NI	0.654204		0.050061	----------	----------
29 carbon compound NK	0.120440		0.230271	----------	----------
29 carbon compound NL	0.809344		1.163947	----------	----------
29 carbon compound NN	0.523311	*	0.934771	----------	----------
29 carbon compound NQ	0.089834		0.127848	----------	----------
29 carbon compound NV	2.975505		5.172419	----------	----------
29 carbon compound OA	4.444340		6.189112	----------	----------
29 carbon compound OC	0.515624		0.840741	----------	----------
30 carbon compound OF	0.699447		1.080598	----------	----------
30 carbon compound OH	0.809015		1.078212	----------	----------
30 carbon compound OI	0.428121		0.842697	----------	----------
30 carbon compound OJ	0.801124		1.188463	----------	----------
30 carbon compound OM	0.225795		0.249160	----------	----------
30 carbon compound OO	0.044568		0.048094	----------	----------
30 carbon compound OR	0.175131		0.127150	----------	----------
30 carbon compound OS	1.283573		1.244321	----------	----------
30 carbon compound OV	0.574302	*	0.143941	----------	----------
31 carbon compound OX	1.585493		3.202704	----------	----------

Table A-13.--Average amount (picomoles) of glycolipids present in anal sacs of reproductive female (RF) and reproductive male (RM) *Acinonyx jubatus* (cheetah), *Panthera uncia* (snow leopard), *P. tigris* (tiger), and *P. leo* (lion). Dashed lines represent the absence of a compound. Asterisks beside amount for reproductive females and reproductive males represent a significant difference between the two for a particular species.

Compounds	A. jubatus	P. uncia	P. tigris	P. leo
	RF/RM	RF/RM	RF/RM	RF/RM
10 carbon compound B	----------	----------	----------	0.1003/0.1268
X-oxo-Nonanoic acid	*0.3358/0.1210	----------	----------	----------
10 carbon compound D	----------	----------	----------	0.1546/0.1334
11 carbon compound I	----------	----------	*0.4397/0.0459	0.0050/0.0049
11 carbon compound J	----------	*0.2680/0.7540	*0.2588/0.0394	----------
12 carbon compound Q	----------	0.0377/0.0451	*0.1557/0.0459	0.0451/0.0243
12 carbon compound R	0.0398/0.0313	0.0530/0.0586	----------	----------
2,6-bis(1,1-dimethylethyl)-4-ethyl-Phenol	0.0279/0.0577	0.0408/0.0515	----------	----------
12 carbon compound W	----------	----------	0.0342/0.0323	0.0526/0.0699
12 carbon compound X	----------	0.0455/0.0477	*0.0259/0.0577	1.2426/1.1388
12 carbon compound AB	----------	*0.1396/1.3519	*0.0042/0.0503	----------
13 carbon compound AC	----------	*0.3638/0.0456	*0.1487/0.0335	----------
13 carbon compound AH	----------	----------	----------	0.1482/0.1390
13 carbon compound AI	1.2547/0.0581	----------	----------	----------
13 carbon compound AM	----------	*0.3692/0.8524	*0.0348/0.0713	----------
13 carbon compound AN	----------	----------	0.0400/0.0449	----------
13 carbon compound AP	----------	----------	----------	0.1485/0.1643
Tetradecanoic acid	*0.0141/0.1294	*0.6560/0.2503	0.0551/0.1890	0.0054/0.0040
14 carbon compound AZ	*0.2421/0.0714	----------	----------	1.2882/1.1819
14 carbon compound BF	----------	----------	----------	0.2449/0.2605
14 carbon compound BG	----------	----------	----------	3.2588/3.1934
Pentadecanoic acid	----------	*0.0701/0.1523	*0.1494/0.0377	----------
15 carbon compound BM	*0.9076/0.0704	----------	----------	----------
15 carbon compound BN	*0.4312/0.1441	----------	----------	----------
15 carbon compound BQ	----------	----------	----------	4.2469/4.2909
15 carbon compound BT	*0.0455/0.7385	*0.0507/0.1237	*0.0315/0.0048	----------
Hexadecanoic acid	*1.4038/0.0291	*0.1364/2.1436	*0.0077/0.0281	0.2434/0.2367
16 carbon compound BV	----------	*0.3704/0.2576	*0.0050/0.0417	----------
16 carbon compound BY	----------	----------	----------	0.1520/0.1427
16 carbon compound BZ	----------	*0.1663/0.2366	*0.0056/0.0436	1.2944/1.1520
16 carbon compound CA	*0.3429/0.0673	----------	----------	----------
16 carbon compound CG	----------	*0.1570/0.4478	*0.0052/0.1448	----------
16 carbon compound CH	----------	----------	----------	0.2407/0.2357
Heptadecanoic acid	*0.2365/0.1363	*0.0420/13.383	*0.0452/1.1967	0.1382/0.1415
17 carbon compound CI	*2.3205/0.0463	----------	----------	----------
17 carbon compound CK	----------	----------	----------	0.0370/0.0489
17 carbon compound CP	----------	----------	----------	0.0526/0.0506
X-Octadecanoic acid	----------	----------	----------	*0.9483/0.9282
17 carbon compound CR	----------	----------	----------	*0.0335/0.0588
Octadecanoic acid	*0.6252/0.0482	*0.9374/0.0629	*0.0632/0.0255	0.1508/0.1628
18 carbon compound CW	----------	*0.0384/0.2304	*0.0448/0.0053	----------
18 carbon compound CX	*0.3583/0.1632	----------	----------	----------
18 carbon compound CY	*0.5503/0.9522	*0.0484/0.1629	----------	----------

Table A-13.–(continued)

Compounds	A. jubatus	P. uncia	P. tigris	P. leo
	RF/RM	RF/RM	RF/RM	RF/RM
18 carbon compound DA	----------	0.3709/0.3418	----------	----------
X-methyl Octadecanoic acid	----------	----------	----------	0.2470/0.2483
18 carbon compound DC	----------	*0.0527/0.1678	0.0392/0.0299	0.0454/0.0565
18 carbon compound DF	0.0249/0.0507	*0.0641/0.1388	----------	----------
19 carbon compound DG	*0.4245/0.0386	*0.1686/0.2654	0.0251/0.0456	0.0456/0.0512
2-hydroxy-octanoic acid	----------	----------	*0.0249/0.1531	----------
19 carbon compound DI	----------	----------	----------	0.1405/0.1440
19 carbon compound DK	----------	*0.1405/0.0453	*0.0479/0.5618	----------
19 carbon compound DM	----------	*0.0338/2.3034	----------	----------
X,X-Eicosadienoic acid	*1.4966/0.3439	*0.1417/0.3347	0.0279/0.0467	----------
X-Eicosanoic acid	----------	----------	----------	0.0045/0.0047
19 carbon compound DP	----------	----------	----------	0.0448/0.0561
19 carbon compound DS	----------	0.0573/10.493	*0.1449/0.0054	----------
Eicosanoic acid	*0.1653/2.1031	*0.0545/0.0399	*0.0358/0.1538	0.1515/0.1617
20 carbon compound DV	*2.3011/0.0636	----------	----------	----------
20 carbon compound DX	----------	*0.4522/0.9392	----------	----------
20 carbon compound ED	----------	----------	----------	4.3176/4.1771
20 carbon compound EH	----------	*0.1305/0.3258	0.0346/0.0470	----------
20 carbon compound EK	----------	----------	----------	0.1482/0.1632
21 carbon compound EQ	----------	----------	----------	0.1458/0.1457
21 carbon compound ER	0.0854/0.0552	----------	----------	----------
21 carbon compound EU	----------	*0.6398/0.2541	*0.6633/0.8403	0.2433/0.2509
21 carbon compound EX	*0.1386/0.0543	----------	----------	----------
21 carbon compound EY	*4.3247/0.2232	----------	----------	----------
21 carbon compound EZ	----------	----------	*0.0370/0.3344	----------
21 carbon compound FA	----------	----------	----------	0.1510/0.1498
21 carbon compound FB	----------	*0.2528/2.3988	----------	----------
21 carbon compound FD	----------	*0.3386/0.0439	*0.0053/0.0494	----------
21 carbon compound FE	----------	----------	----------	0.0327/0.0438
21 carbon compound FH	*2.0844/0.3594	0.1297/0.1123	----------	----------
22 carbon compound FI	----------	----------	*0.0043/13.047	0.2394/0.2369
22 carbon compound FL	*2.1384/0.0276	----------	----------	0.0043/0.0046
22 carbon compound FO	----------	*0.0507/2.3059	----------	----------
22 carbon compound FP	*0.0089/0.1562	----------	*0.0434/0.2396	0.1560/0.1417
22 carbon compound FU	*7.4713/0.2537	0.0450/0.0455	*0.1611/0.0473	0.2367/0.2398
22 carbon compound FZ	----------	*0.3444/1.1305	*0.0479/0.1467	----------
22 carbon compound GA	----------	*1.2998/0.3596	*0.0419/0.0268	----------
22 carbon compound GB	----------	----------	----------	0.1519/0.1431
23 carbon compound GE	----------	*0.0580/0.1474	*0.2530/0.0309	----------
23 carbon compound GH	*0.0714/0.6683	----------	----------	----------
23 carbon compound GJ	----------	*0.5376/0.6369	*0.2580/0.1357	----------
23 carbon compound GK	0.8439/0.1307	----------	----------	----------
23 carbon compound GL	----------	*7.0737/6.2288	*0.1682/0.0771	----------
23 carbon compound GM	----------	----------	----------	0.1362/0.1406
23 carbon compound GO	----------	----------	----------	0.2438/0.2482
Tetracosanoic acid	*0.0386/0.2384	*1.1491/0.1517	*0.0270/0.1289	0.1361/0.1566
24 carbon compound GS	----------	----------	----------	0.0051/0.0052

Table A-13.–(continued)

Compounds	A. jubatus	P. uncia	P. tigris	P. leo
	RF/RM	RF/RM	RF/RM	RF/RM
24 carbon compound GU	*0.0420/0.2583	----------	----------	----------
24 carbon compound GX	*0.0075/0.6481	----------	----------	----------
24 carbon compound HB	----------	----------	----------	1.1723/1.1958
24 carbon compound HJ	*0.1759/0.0435	----------	----------	----------
25 carbon compound HK	----------	----------	*0.1505/0.2348	0.2519/0.2451
25 carbon compound HO	----------	----------	----------	0.1447/0.1574
25 carbon compound HP	----------	----------	----------	0.1511/0.1413
25 carbon compound HS	*0.6404/2.1584	----------	----------	----------
25 carbon compound HT	----------	*9.2770/0.5713	*0.0499/0.4238	----------
X-Hexacosanoic acid	----------	*3.2190/0.5488	*0.0526/0.0356	----------
25 carbon compound HX	----------	----------	----------	0.2508/0.2621
25 carbon compound HZ	0.1358/0.1495	----------	----------	----------
25 carbon compound IB	----------	*0.2441/0.0347	*0.0383/4.2024	----------
25 carbon compound IC	----------	----------	----------	0.0410/0.0429
26 carbon compound ID	*0.9225/1.2667	*0.3667/0.0690	*0.1534/0.0557	0.0413/0.052
26 carbon compound IE	----------	----------	----------	0.0400/0.055
26 carbon compound IH	*2.5392/0.1573	*0.2340/0.0733	*0.3522/0.0464	----------
26 carbon compound II	----------	----------	----------	0.0049/0.0043
26 carbon compound IJ	----------	----------	----------	*0.0382/0.0565
26 carbon compound IN	----------	*7.4869/0.2423	0.0483/0.0501	----------
26 carbon compound IO	----------	----------	----------	0.1521/0.1486
26 carbon compound IP	----------	----------	----------	0.0453/0.0554
26 carbon compound IS	----------	----------	----------	0.2452/0.2513
26 carbon compound IV	----------	0.0531/0.0585	0.0480/0.0420	----------
26 carbon compound IW	----------	*0.0635/0.1519	*8.4594/4.3633	----------
26 carbon compound IX	----------	----------	----------	0.2333/0.2455
27 carbon compound JC	----------	*0.2699/0.2291	*0.2621/0.3500	----------
27 carbon compound JD	----------	----------	----------	*1.2139/1.1213
Cholesterol	*0.6136/0.2389	----------	----------	----------
27 carbon sterol	----------	----------	----------	*0.1473/0.1716
27 carbon sterol	----------	*0.0573/0.3403	*0.0613/11.206	0.0380/0.0544
27 carbon compound JG	*0.8823/11.656	----------	----------	----------
27 carbon compound JH	----------	*0.2569/1.1724	*0.0047/0.4464	----------
27 carbon compound JI	----------	----------	----------	*0.2494/0.2185
27 carbon compound JL	*0.1781/0.7270	----------	----------	----------
27 carbon compound JO	----------	*0.3559/0.0434	*0.0065/0.0339	----------
27 carbon compound JP	----------	----------	----------	0.1490/0.1644
27 carbon compound JR	----------	----------	----------	0.1515/0.1428
27 carbon compound JU	0.2895/0.2605	----------	----------	----------
27 carbon compound JW	----------	----------	----------	0.0043/0.0058
27 carbon compound JX	----------	----------	----------	*0.1662/0.1489
Cholest-4-ene-3-one	*4.3894/0.1676	----------	----------	----------
28 carbon compound KI	----------	*0.0661/0.1535	*0.1692/0.05800	----------
28 carbon compound KJ	----------	----------	----------	0.0299/0.0366
28 carbon compound KK	----------	----------	----------	0.1472/0.1389
28 carbon compound KM	----------	----------	----------	0.2415/0.2411
28 carbon compound KS	*0.5185/0.1740	----------	----------	----------

Table A-13.–(continued)

Compounds	A. jubatus	P. uncia	P. tigris	P. leo
	RF/RM	RF/RM	RF/RM	RF/RM
28 carbon compound KT	----------	*0.1576/0.3297	*0.0416/10.164	----------
28 carbon compound KU	----------	*10.052/0.5287	0.0525/0.0361	0.0417/0.0499
28 carbon compound KY	----------	*0.2193/0.0598	0.0368/0.0362	----------
29 carbon compound KZ	----------	----------	----------	*0.1358/0.1599
29 carbon compound LC	*0.6228/0.0596	----------	----------	----------
29 carbon compound LI	----------	*0.2653/0.0449	----------	----------
29 carbon compound LM	*0.0901/0.1472	*0.1714/0.7209	----------	----------
29 carbon compound LP	----------	*0.1613/0.9401	*0.0463/0.0308	----------
29 carbon compound LQ	----------	----------	----------	3.4143/3.3657
29 carbon compound LR	*0.3337/0.8286	*0.1381/0.0482	----------	----------
29 carbon compound LU	----------	----------	*0.2620/0.1326	0.0513/0.0526
29 carbon compound LW	----------	*0.5636/0.0551	----------	----------
30 carbon compound LX	*8.3811/0.7327	*1.2257/0.2523	*0.1688/0.0387	0.2496/0.2679
30 carbon compound LZ	----------	----------	----------	0.0478/0.0533
30 carbon compound MD	----------	----------	----------	0.0330/0.0507
30 carbon compound MF	----------	*0.3683/2.1294	----------	----------
30 carbon compound MH	*2.5701/0.2589	----------	----------	----------
30 carbon compound MN	----------	*0.6573/0.0549	*0.0815/0.3351	----------
31 carbon compound MR	----------	*0.5514/0.2580	*0.2594/0.0368	0.0514/0.0413
31 carbon compound MV	*6.5055/0.9322	----------	----------	----------

Table A-14.--Average amount (picomoles) of neutral lipids present in anal sacs of reproductive female (RF) and reproductive male (RM) *Acinonyx jubatus* (cheetah), *Panthera uncia* (snow leopard), *P. tigris* (tiger), and *P. leo* (lion). Dashed lines represent the absence of a compound. Asterisks beside amount for reproductive females and reproductive males represent a significant difference between the two for a particular species.

Compounds	*A. jubatus*	*P. uncia*	*P. tigris*	*P. leo*
	RF/RM	RF/RM	RF/RM	RF/RM
10 carbon compound A	----------	*0.3427/0.0758	0.0505/0.0389	----------
10 carbon compound C	----------	*0.0042/0.5434	0.0866/0.0436	----------
10 carbon compound D	----------	*0.0524/0.3533	*0.1513/0.0356	----------
10 carbon compound G	----------	*0.0486/0.3577	*0.0056/0.0351	----------
11 carbon compound H	----------	*0.0577/0.3601	*0.0047/0.0498	*3.3862/0.4474
11 carbon compound J	----------	*0.3416/0.0649	----------	----------
11 carbon compound L	----------	*0.0589/1.1964	----------	----------
11 carbon compound N	----------	*0.0037/0.5368	----------	----------
11 carbon compound O	----------	*0.0531/0.5638	----------	----------
11 carbon compound S	*0.2656/0.1672	*0.0460/1.1945	*0.0058/0.0564	*1.4267/0.0592
11 carbon compound T	----------	0.1483/0.1231	*0.0434/0.9370	----------
11 carbon compound V	----------	*0.0517/2.1905	----------	----------
11 carbon compound W	----------	----------	----------	*0.0420/2.4411
11 carbon compound Y	----------	*0.0061/0.5548	*0.0048/0.0412	----------
12 carbon compound Z	*0.1415/0.0450	*0.5543/0.0600	0.0549/0.0533	*0.7492/1.2734
12 carbon compound AB	----------	0.0507/0.0656	*0.1485/0.0549	----------
12 carbon compound AG	----------	----------	----------	*0.2577/0.5434
12 carbon compound AH	----------	*0.1645/0.2375	*0.0521/1.2320	----------
12 carbon compound AJ	*0.0296/0.1681	*0.0381/0.1438	*0.0061/0.0519	----------
12 carbon compound AK	----------	----------	----------	0.0452/0.0526
12 carbon compound AL	----------	----------	----------	0.0512/0.0453
12 carbon compound AM	0.1382/0.1595	*0.0429/0.2454	*0.0035/0.2482	*0.1524/0.0516
12 carbon compound AO	*0.1599/0.0525	*0.1498/0.0622	*0.0062/0.0389	----------
12 carbon compound AP	----------	----------	----------	*0.1493/0.0619
12 carbon compound AQ	0.0462/0.0650	*0.0365/0.1525	----------	----------
12 carbon compound AS	----------	*0.8521/1.2973	*0.0455/0.8241	----------
12 carbon compound AV	----------	*0.0047/1.1644	*0.0586/0.1415	----------
13 carbon compound AX	*0.0603/0.2273	*0.0496/1.1741	----------	----------
13 carbon compound AY	*1.0960/0.0297	----------	----------	*0.1478/0.5424
13 carbon compound AZ	*0.1489/0.3641	*0.0501/1.2250	0.0613/0.0474	*0.0411/0.5524
13 carbon compound BA	----------	----------	----------	*0.1545/0.5618
13 carbon compound BB	0.0498/0.0717	----------	----------	----------
X-branched Tridecanoic acid	*1.5269/0.1401	0.0055/0.1559	*0.0605/10.272	*0.1410/0.4474
13 carbon compound BE	----------	*0.0400/4.2433	----------	----------
13 carbon compound BF	----------	----------	----------	*0.1611/0.0371
13 carbon compound BG	*0.0259/0.5679	----------	----------	----------
13 carbon compound BH	----------	*0.0670/0.9411	0.0558/0.0485	----------
13 carbon compound BJ	*0.0394/0.4648	----------	----------	*2.4638/0.3567
13 carbon compound BK	----------	*0.1447/0.9510	*0.0074/0.0047	----------
13 carbon compound BM	----------	0.1401/0.1348	0.0419/0.0406	----------
13 carbon compound BO	*0.2404/0.0728	0.0549/0.0652	0.1358/0.1539	----------
1,1'-(1,2-cyclobutanediyl)bis-, cis-Benzene	*0.3823/0.1634	*0.2271/1.2644	0.0641/0.0558	*1.4494/0.2465
13 carbon compound BQ	*0.3256/0.0630	0.0517/0.0586	*0.0394/0.1472	----------

Table A-14.–(continued)

Compounds	*A. jubatus*	*P. uncia*	*P. tigris*	*P. leo*
	RF/RM	RF/RM	RF/RM	RF/RM
Tetradecanoic acid	*1.7624/17.016	*0.0042/0.2155	0.0488/0.0986	*0.1660/0.0484
14 carbon compound BR	----------	----------	----------	*0.2427/0.0486
14 carbon compound BS	----------	*0.0249/0.3513	*0.0508/0.2372	----------
14 carbon compound BW	----------	*0.0045/0.2560	*0.0360/8.5388	----------
14 carbon compound BX	0.3011/0.1533	*0.2563/0.1487	*1.3979/0.1328	*8.2564/0.5642
14 carbon compound CC	*0.1509/0.0512	0.0563/0.0615	*0.0308/0.0527	*2.2607/0.0501
14 carbon compound CE	----------	*0.0053/0.0571	*0.0379/3.1522	----------
14 carbon compound CF	0.0641/0.0611	*0.0510/0.1487	*0.0063/0.4478	*0.4684/6.5557
14 carbon compound CG	----------	*0.0041/0.2124	*0.0054/15.301	----------
14 carbon compound CH	*2.4955/0.0684	----------	----------	----------
15 carbon compound CO	0.2524/0.1406	----------	----------	----------
15 carbon compound CT	----------	----------	----------	*3.3636/0.5506
15 carbon compound CV	*0.9328/0.0429	*0.0336/1.1880	*0.0522/0.4477	*4.2041/0.4534
15 carbon compound CW	----------	*0.0656/0.6526	*0.0579/0.2495	*2.2961/0.5471
15 carbon compound CY	0.0440/0.0630	*0.2297/1.2590	*0.0616/8.1346	----------
15 carbon compound DB	*5.5307/0.1475	0.1380/0.1264	*0.0565/0.0060	*0.0498/0.4550
Nonadecanoic acid	0.1703/0.1246	*0.1384/2.2117	*0.2344/0.0471	----------
15 carbon compound DC	----------	----------	----------	*1.4088/0.4635
15 carbon compound DD	*0.8616/0.0503	*0.0594/0.4716	*0.5567/0.0619	*2.4372/0.0462
15 carbon compound DF	0.0634/0.0596	*0.0573/0.3426	*0.5555/0.0556	----------
Hexadecanoic acid	*0.0059/0.1698	*0.0552/0.2528	*0.0357/0.0551	*0.5628/0.0542
16 carbon compound DL	----------	*0.0434/0.7217	*0.6510/0.4538	*0.2091/0.1563
16 carbon compound DM	*0.1357/0.9531	0.0606/0.0351	*1.2848/0.0467	*0.0515/0.4385
16 carbon compound DN	----------	*0.8489/0.7398	*0.0373/3.1930	----------
16 carbon compound DQ	*0.6940/0.1638	*0.2500/0.4749	*0.0518/0.3311	*0.5100/0.0548
16 carbon compound DS	----------	----------	*0.1421/1.2198	----------
16 carbon compound DT	----------	*0.1552/0.0646	*0.0054/0.0524	----------
16 carbon compound DV	----------	----------	----------	*0.1614/0.7505
16 carbon compound DZ	*1.5437/0.0454	----------	----------	----------
16 carbon compound EA	*1.3076/0.2484	*1.3907/0.4873	*0.0467/0.2470	*6.9722/4.4149
16 carbon compound EF	----------	----------	----------	*0.0322/0.4564
16 carbon compound EH	----------	*0.0070/0.0669	*0.3554/1.1384	----------
17 carbon compound EJ	----------	0.0514/0.0391	*0.3540/0.2423	----------
17 carbon compound EL	----------	----------	----------	*0.0402/0.4477
17 carbon compound EN	*0.3123/0.0495	*0.1466/0.4613	*0.6419/1.2183	----------
17 carbon compound EP	----------	*0.0489/16.155	*0.3671/0.1511	----------
17 carbon compound ER	*0.0069/0.1568	----------	----------	----------
17 carbon compound ES	----------	*0.0339/1.2166	*1.2104/0.0433	----------
17 carbon compound ET	----------	*0.0537/0.1502	*0.1419/0.0455	*1.3409/0.2379
17 carbon compound EU	*6.3869/0.1633	0.3308/0.3597	*0.0464/2.4719	*1.3194/0.4545
X-Octadecenoic acid	*0.2419/0.1810	*4.1687/0.4352	*0.0610/0.0046	*0.1584/0.0335
17 carbon compound EV	----------	*0.2593/0.1253	0.0493/0.0541	*0.1596/0.0491
17 carbon compound EX	----------	----------	----------	*0.5574/0.0509
17 carbon compound EY	*0.4681/0.6455	*4.1698/0.0053	*9.2031/0.0392	----------
Octadecanoic acid	*0.2694/0.3615	*0.0587/3.3625	*0.0057/0.0502	0.0486/0.0467
18 carbon compound FC	----------	*0.6441/0.1498	*0.3493/0.0399	*0.1395/5.3888
18 carbon compound FD	----------	*0.2776/0.0582	0.0425/0.0434	*1.4948/0.4464

Table A-14.--(continued)

Compounds	*A. jubatus*	*P. uncia*	*P. tigris*	*P. leo*
	RF/RM	RF/RM	RF/RM	RF/RM
18 carbon compound FG	----------	----------	----------	*2.5230/0.1481
18 carbon compound FH	----------	*0.0501/0.1426	*0.0565/0.4444	*1.4496/0.3474
18 carbon compound FJ	----------	*0.1536/0.2474	*0.0487/0.1296	----------
18 carbon compound FK	----------	----------	----------	*0.1675/0.0493
18 carbon compound FL	----------	*10.406/0.0439	*0.0479/0.1442	----------
18 carbon compound FN	----------	*0.6483/0.0611	*0.1420/1.3038	0.0521/0.0347
18 carbon compound FT	----------	----------	----------	*0.3631/0.1353
18 carbon compound FX	----------	----------	*0.3400/0.9319	----------
18 carbon compound FY	----------	*0.3639/0.5324	*0.0484/0.6521	0.2467/0.2567
18 carbon compound GA	----------	----------	----------	*0.0404/0.1502
18 carbon compound GB	----------	*0.2609/0.3335	0.0442/0.0506	----------
19 carbon compound GD	*0.0795/0.1639	----------	----------	----------
19 carbon alcohol	*4.8817/0.1549	*0.0516/0.3625	*0.1516/0.0547	*0.4580/0.2377
19 carbon compound GF	3.4568/3.5185	----------	----------	----------
19 carbon compound GJ	----------	*0.0504/0.3603	*0.9493/0.0377	*1.6287/2.3988
19 carbon compound GO	----------	----------	----------	*0.1461/0.2617
19 carbon compound GP	----------	0.0490/0.0730	1.2266/1.2558	----------
19 carbon compound GQ	----------	----------	----------	*0.2598/0.0529
19 carbon compound GR	----------	*0.0647/1.3229	*0.4400/0.0542	*0.9491/0.4453
19 carbon compound GS	*4.3062/0.0399	*0.0644/0.5410	0.0380/0.0449	----------
19 carbon compound GT	*1.4391/0.1894	*0.0489/0.5448	*0.2307/0.1425	*0.1526/1.4303
19 carbon compound GY	----------	----------	----------	*1.6959/0.0454
Eicosanoic acid	*11.808/0.0480	*0.2530/1.3795	*1.1788/0.1366	*0.3412/0.1582
20 carbon compound GZ	----------	----------	----------	0.1482/0.1419
20 carbon compound HC	*2.3567/0.2533	*0.0507/0.1348	*0.9399/0.0548	*0.2621/0.1623
20 carbon compound HD	----------	----------	----------	*2.6843/1.4336
20 carbon compound HE	----------	*0.0443/2.1983	0.0395/0.0485	----------
20 carbon compound HG	----------	*0.1309/0.5755	*6.1520/0.1471	----------
20 carbon compound HH	----------	----------	----------	*0.1523/0.0050
20 carbon compound HI	----------	0.0621/0.0431	*0.1562/0.0448	----------
20 carbon compound HK	----------	----------	----------	*0.2521/3.2421
20 carbon compound HL	----------	----------	----------	*0.2446/0.1494
20 carbon compound HM	----------	0.0494/0.0542	*5.1902/0.0473	----------
20 carbon compound HR	----------	*0.2355/0.3509	*1.1483/0.2618	----------
21 carbon compound HU	*0.0598/1.7143	*0.0635/0.1486	*1.1245/0.2453	0.0530/0.0402
21 carbon compound HZ	*0.0053/2.6547	*0.1679/0.2720	*0.1456/2.2288	----------
21 carbon compound IB	*0.0298/1.4998	----------	----------	----------
21 carbon compound ID	----------	*0.1244/0.0508	*8.2043/1.1385	----------
21 carbon compound IH	*0.0465/1.2655	*0.5579/0.1440	*1.3505/0.1334	----------
21 carbon compound IL	*0.0393/0.1613	*0.1514/1.2863	*13.320/0.0409	*0.7423/0.8591
21 carbon compound IM	*0.3587/0.1646	----------	----------	----------
21 carbon compound IO	----------	----------	----------	0.0527/0.0664
21 carbon compound IP	*0.1361/1.3688	1.2905/1.3661	*1.2879/3.1647	*0.2276/0.0555
Docosanoic acid	*0.2864/0.0490	*0.0376/1.3790	*0.1636/0.0043	*0.2476/0.0624
22 carbon compound IU	----------	*0.3405/1.3191	0.0391/0.0545	----------
22 carbon compound IW	----------	----------	----------	*0.1562/0.7579
22 carbon compound IX	----------	*0.2652/0.1512	*0.0654/0.0385	----------

Table A-14.--(continued)

Compounds	*A. jubatus*	*P. uncia*	*P. tigris*	*P. leo*
	RF/RM	RF/RM	RF/RM	RF/RM
22 carbon compound IY	----------	----------	----------	*0.1710/0.1415
22 carbon compound JB	----------	*0.2643/5.2457	*0.2481/0.0478	----------
22 carbon compound JC	*1.6882/0.0581	----------	----------	----------
22 carbon compound JD	----------	*0.3469/0.9305	*3.3439/0.0546	----------
22 carbon compound JF	----------	----------	----------	*2.4285/0.1673
22 carbon compound JG	*1.5333/0.2705	*0.7379/0.8577	0.0523/0.0512	*0.0320/0.5542
22 carbon compound JH	----------	----------	----------	*0.4532/0.1716
22 carbon compound JI	*1.2884/0.5571	0.1598/0.1491	*0.0605/0.2366	----------
22 carbon compound JM	----------	*3.2193/0.0616	0.0482/0.0493	----------
22 carbon compound JN	----------	----------	----------	*0.2665/3.3063
22 carbon compound JO	----------	*0.1381/1.5431	0.0378/0.0533	----------
23 carbon compound JP	*0.4465/0.0687	----------	----------	*0.1542/0.2561
23 carbon compound JR	*0.4451/0.0466	----------	----------	----------
23 carbon compound JS	----------	*0.1428/0.0410	0.0640/0.0429	0.0501/0.0588
23 carbon compound JU	----------	*0.0548/0.2461	*0.0046/0.0569	*0.2508/0.0608
23 carbon compound JV	----------	----------	----------	0.9499/0.9570
23 carbon compound JX	----------	*0.0512/0.3402	*0.0554/2.1090	----------
23 carbon compound JZ	----------	*0.0382/0.3375	*0.0430/0.2531	----------
23 carbon compound KC	----------	*0.2476/0.1359	*0.1511/0.9399	----------
23 carbon compound KD	*0.7237/10.434	*0.2372/0.0621	*0.2633/0.6413	*0.9412/0.6472
23 carbon compound KG	*0.2336/0.4655	*0.5416/0.0308	*0.6510/0.0503	*0.2581/0.0570
23 carbon compound KI	----------	*0.2553/0.1466	*0.0484/1.0861	----------
3,7,11-trimethyl-(E,E)-2,6,10-Dodecatrien-1-ol	*0.1463/0.2780	*1.3545/0.2488	0.0525/0.045	*2.4384/0.0511
24 carbon compound KT	----------	2.1311/2.5583	*0.5415/0.0492	----------
24 carbon compound LA	*1.5335/0.1590	----------	----------	----------
24 carbon compound LB	*10.902/0.0596	*1.2242/0.657	*0.2704/0.0499	0.5544/0.5458
24 carbon compound LC	----------	----------	----------	*1.3806/0.1671
24 carbon compound LD	----------	*0.5785/1.2279	*9.2577/0.0047	----------
24 carbon compound LH	----------	----------	----------	0.0456/0.0610
24 carbon compound LI	*2.6839/0.1530	*0.0464/0.1796	*0.0265/7.1245	----------
25 carbon compound LJ	----------	----------	----------	*0.2541/0.1483
25 carbon compound LK	----------	*0.1475/2.0427	*4.1949/0.8297	----------
25 carbon compound LM	----------	----------	----------	*0.7458/0.2551
25 carbon compound LN	*5.6701/0.4626	----------	----------	----------
25 carbon compound LO	*9.0940/1.5156	*0.0328/0.5446	*1.2323/0.2429	*0.0515/0.2460
25 carbon compound LR	----------	----------	----------	*0.1567/5.4079
25 carbon compound LT	----------	----------	----------	*1.4080/0.9603
25 carbon compound LU	----------	*0.0353/0.4666	----------	----------
25 carbon compound LV	----------	----------	----------	*0.7382/0.0540
25 carbon compound LW	*4.1937/0.5445	----------	----------	----------
25 carbon compound LY	----------	*0.0052/0.2532	0.1576/0.1449	*0.0556/0.4470
25 carbon compound MC	----------	*0.3310/0.8724	0.1497/0.1357	*0.4306/0.9549
25 carbon compound MF	----------	0.0534/0.0346	----------	----------
25 carbon compound MH	----------	*4.1784/0.7364	*0.7482/0.3349	*0.0359/0.5474
26 carbon compound MK	----------	----------	----------	0.4433/0.4591
26 carbon compound MR	----------	*0.0463/0.4574	----------	----------

Table A-14.–(continued)

Compounds	*A. jubatus*	*P. uncia*	*P. tigris*	*P. leo*
	RF/RM	RF/RM	RF/RM	RF/RM
26 carbon compound MS	----------	0.1326/0.0536	0.2420/0.2422	----------
26 carbon compound MT	0.8481/0.5640	----------	----------	----------
26 carbon compound MY	----------	*1.1037/0.4545	*0.1546/0.0374	----------
26 carbon compound NA	----------	*0.1503/0.0663	*0.0323/0.2386	----------
26 carbon compound ND	----------	0.0445/0.0405	*0.3690/0.0512	*0.2506/0.5496
cholesterol	----------	*0.0487/0.4431	*0.7404/0.0418	----------
27 carbon compound NF	----------	----------	----------	*0.3483/0.0501
27 carbon compound NG	----------	----------	----------	*0.1599/0.0387
27 carbon compound NH	----------	*0.2396/17.361	*0.9597/0.0519	*0.0519/0.1515
27 carbon compound NN	----------	----------	----------	*0.0483/0.1582
27 carbon compound NO	----------	1.1358/1.3564	*0.3493/0.0341	----------
27 carbon compound NP	----------	----------	----------	*1.4406/0.9266
27 carbon compound NV	----------	----------	----------	*1.4033/0.0429
27 carbon compound NW	----------	*0.0557/0.1537	----------	----------
27 carbon compound NX	----------	----------	----------	*0.1465/0.0515
27 carbon compound NY	----------	*0.2545/0.4442	----------	----------
28 carbon compound NZ	----------	----------	----------	*0.0466/4.2581
28 carbon compound OA	----------	*0.0461/0.5441	0.0053/0.0041	*0.1466/0.0302
28 carbon compound OC	----------	*0.5457/0.1320	----------	----------
28 carbon compound OE	----------	*0.2569/0.1497	*0.0405/0.5362	----------
28 carbon compound OL	----------	*1.1724/0.0496	*0.0448/0.1474	*0.4570/1.5198
28 carbon compound OO	----------	*2.1789/0.6634	*0.0037/0.0486	----------
28 carbon compound OR	----------	*0.8325/0.1582	----------	----------
28 carbon compound OT	----------	*0.2485/0.0672	*0.0598/0.5424	*0.0423/1.2444
28 carbon compound OW	----------	*0.5466/6.3276	*0.0064/0.0468	----------
29 carbon compound PB	----------	*0.1539/0.2432	0.0413/0.0569	----------
29 carbon compound PE	----------	0.0473/0.0453	*0.7574/0.0345	----------
29 carbon compound PF	----------	----------	----------	1.4655/1.4272
29 carbon compound PI	----------	*0.9490/0.0555	0.0365/0.0451	----------
29 carbon compound PK	----------	*0.1437/0.0490	0.0337/0.0398	----------
29 carbon compound PL	----------	----------	----------	*0.0399/0.8448
29 carbon compound PM	----------	*0.0393/0.5587	*0.0419/0.2443	----------
29 carbon compound PQ	----------	*0.0334/0.1549	0.0505/0.0450	----------
29 carbon compound PS	----------	0.0473/0.0529	----------	----------
30 carbon compound PW	----------	*0.0310/0.2747	*0.2509/1.2013	----------
30 carbon compound PY	----------	----------	----------	*0.4537/0.0512
30 carbon compound PZ	----------	----------	----------	0.4866/0.1662
30 carbon compound QB	----------	----------	0.0509/0.0470	----------
30 carbon compound QD	----------	----------	----------	*0.7514/0.0546
30 carbon compound QG	----------	----------	----------	*0.1525/0.0615
30 carbon compound QI	----------	----------	----------	*0.0556/0.4372
31 carbon compound QL	----------	----------	----------	*0.0519/0.5587

Table A-15.--Average amount (picomoles) of phospholipids present in anal sacs of reproductive female (RF) and reproductive male (RM) *Panthera uncia* (snow leopard), *Acinonyx jubatus* (cheetah), *P. tigris* (tiger), and *P. leo* (lion). Dashed lines represent the absence of a compound. Asterisks beside amount for reproductive females and reproductive males represent a significant difference between the two for a particular species.

Compounds	*P. uncia*	*A. jubatus*	*P. tigris*	*P. leo*
	RF/RM	RF/RM	RF/RM	RF/RM
11 carbon compound E	*0.0445/0.6687	----------	----------	----------
11 carbon compound G	0.0653/0.0594	----------	----------	----------
11 carbon compound H	*0.2460/0.8524	----------	----------	----------
11 carbon compound J	----------	----------	*0.2719/0.0465	----------
11 carbon compound K	*0.0604/0.0214	----------	*0.0519/0.1383	----------
12 carbon compound N	----------	----------	----------	0.2555/0.2525
12 carbon compound P	*0.2610/0.3607	----------	*0.0507/1.3187	----------
12 carbon compound Q	----------	----------	----------	*2.3278/0.0404
12 carbon compound S	*0.1556/0.2590	----------	----------	----------
12 carbon compound U	0.0496/0.0570	----------	----------	----------
12 carbon compound X	*0.5490/2.2582	----------	----------	----------
12 carbon compound AA	----------	----------	----------	0.1533/0.1421
13 carbon compound AG	*0.2235/0.1629	----------	*0.0652/0.1515	----------
13 carbon compound AH	*1.1283/3.8548	----------	----------	----------
13 carbon compound AK	----------	----------	----------	*0.0437/0.1415
13 carbon compound AN	*0.0657/0.6660	----------	----------	----------
x-methyl pentadecanoic acid	----------	----------	*0.0038/3.2255	*0.1390/0.2443
13 carbon compound AP	*0.0361/0.2592	----------	*0.3643/1.3474	*0.2499/0.0438
13 carbon compound AQ	----------	----------	----------	0.0464/0.0409
13 carbon compound AR	----------	0.3044/0.1479	----------	0.1698/0.1700
13 carbon compound AS	----------	----------	----------	*1.3117/0.1621
13 carbon compound AT	*0.2471/0.0653	----------	*0.4443/0.0053	----------
13 carbon compound AV	----------	*1.1474/0.0491	----------	----------
13 carbon compound AW	*0.1389/0.0415	----------	*0.0426/0.1508	----------
13 carbon compound AX	----------	----------	----------	*0.7579/0.3359
Tetradecanoic acid	*0.0557/6.9509	*0.2696/0.8472	0.1449/0.1408	*2.4848/0.6940
14 carbon compound AZ	----------	----------	----------	*0.1632/0.0447
14 carbon compound BC	*2.1055/0.0355	----------	0.0383/0.0484	----------
14 carbon compound BE	----------	----------	----------	0.0521/0.0607
14 carbon compound BF	----------	----------	----------	*0.1583/0.1537
14 carbon compound BG	*2.3224/0.0691	----------	*0.0610/0.1462	----------
14 carbon compound BI	*0.0057/0.0311	----------	----------	----------
14 carbon compound BJ	----------	----------	----------	*0.1587/0.3492
14 carbon compound BL	----------	*2.7202/0.1616	----------	*0.2607/0.6621
14 carbon compound BN	*0.1361/0.0732	----------	----------	----------
14 carbon compound BO	----------	*2.3878/0.5467	0.0364/2.1059	*0.0471/0.8454
14 carbon compound BQ	----------	----------	*0.9336/0.1449	----------
14 carbon compound BS	*0.2655/0.0551	----------	*0.0047/0.0391	----------
14 carbon compound BT	----------	----------	----------	*0.5548/0.0590
Pentadecanoic acid	----------	----------	----------	*0.2577/0.3560
15 carbon compound BU	*0.0617/0.1618	*3.9943/1.3590	*0.0772/0.2472	*0.6605/0.0482
15 carbon alcohol	----------	----------	----------	*0.0586/0.1432
15 carbon compound BW	*0.2770/0.0478	----------	*0.0050/0.0482	----------
15 carbon compound CA	----------	----------	*0.0434/0.1367	*1.3283/0.3454
15 carbon compound CC	*0.0377/0.1638	----------	*0.0673/0.2500	*0.5528/0.6455

Table A-15.–(continued)

Compounds	*P. uncia*	*A. jubatus*	*P. tigris*	*P. leo*
	RF/RM	RF/RM	RF/RM	RF/RM
15 carbon compound CD	----------	----------	*0.3589/0.0532	----------
15 carbon compound CE	0.0523/0.0275	----------	----------	0.0401/0.0602
15 carbon compound CF	----------	----------	*0.0554/0.2407	----------
15 carbon compound CG	*0.7590/3.7366	*5.1064/0.0683	*0.0054/1.1832	*0.6496/0.0542
(z)-7-Hexadecanoic acid	----------	----------	*0.0552/0.9230	----------
15 carbon compound CI	*0.2395/0.0157	----------	----------	*1.3283/0.0310
15 carbon compound CJ	----------	*3.4087/0.4385	0.0481/0.0502	----------
15 carbon compound CL	*0.1389/0.0319	----------	----------	*0.1541/0.2600
15 carbon compound CN	*0.0471/0.3731	----------	0.0493/0.0429	----------
15 carbon compound CO	----------	----------	----------	*8.5341/0.0315
Hexadecanoic acid	*0.2429/0.0176	*12.032/1.3952	*0.0045/0.0519	0.5231/8.4195
16 carbon compound CS	----------	----------	*0.0037/0.2381	----------
16 carbon compound CU	0.0581/0.0347	----------	----------	----------
16 carbon compound CW	----------	----------	----------	*0.0524/0.0321
16 carbon compound CX	*0.1402/0.0580	----------	*0.0051/0.0360	----------
16 carbon compound CZ	----------	----------	----------	*0.0429/0.1448
16 carbon compound DA	----------	----------	0.3598/0.2521	----------
16 carbon compound DB	*0.0626/0.0042	----------	----------	----------
16 carbon compound DD	*0.2529/0.1739	----------	*0.4499/0.1411	*0.0491/0.1450
16 carbon compound DE	----------	----------	*0.1483/0.0489	----------
16 carbon compound DF	*1.3015/0.1576	*5.4316/0.0452	*0.0353/0.5437	*0.0548/0.2606
16 carbon compound DG	----------	*0.5748/0.1635	*0.1394/0.2313	----------
16 carbon compound DH	----------	----------	----------	*0.1524/0.2532
16 carbon compound DI	----------	----------	1.1808/1.4261	----------
16 carbon compound DJ	*0.0650/0.3370	*0.9298/0.4592	*0.1548/0.0475	----------
17 carbon compound DM	*0.0068/0.1398	1.1275/1.3515	0.0540/0.1314	*0.4674/0.7444
17 carbon compound DN	*0.0603/0.2852	----------	*0.0555/0.2391	----------
17 carbon compound DO	----------	*1.4847/3.5554	----------	*0.0493/0.2565
17 carbon compound DQ	*0.0049/0.0569	----------	*0.0579/0.1430	----------
17 carbon compound DR	*0.0047/0.3756	----------	----------	----------
17 carbon compound DS	----------	----------	*0.4578/0.0528	*0.1554/0.2543
17 carbon compound DU	0.1394/0.1396	----------	*0.0059/2.3280	----------
17 carbon compound DW	*0.1433/3.3215	----------	*0.2477/2.1944	*0.1542/0.0699
17 carbon compound DX	----------	0.0486/30.888	*0.0540/0.0064	----------
17 carbon compound DZ	*0.0581/0.0172	*1.3142/5.3805	*0.0618/0.1538	*0.5567/3.3694
(Z,Z)-9,12-octadecanoic acid	----------	*12.930/0.1396	----------	*0.2671/0.5616
17 carbon compound EA	----------	*9.0080/0.6392	----------	1.4643/2.6138
17 carbon compound EB	*0.2620/0.0190	*4.4731/0.8669	*0.0634/0.2306	*0.1619/1.5338
X-octadecanoic acid	0.1796/0.1479	*7.8359/0.1507	0.4646/0.1823	----------
17 carbon compound EC	----------	*21.686/0.2681	----------	----------
17 carbon compound ED	----------	----------	*0.3457/0.2477	*0.1669/0.1513
17 carbon compound EE	----------	----------	*0.3422/0.0346	----------
17 carbon compound EF	*0.2701/0.0261	----------	----------	----------
17 carbon compound EG	----------	----------	----------	*0.1582/0.0555
Octadecanoic acid	*1.0688/0.0415	*9.6234/0.6639	*0.1465/0.0522	*2.7018/6.7635
18 carbon compound EJ	----------	----------	*0.1500/0.7239	----------
18 carbon compound EL	0.0450/0.0545	----------	----------	----------
18 carbon compound EM	*0.8494/0.0183	----------	*0.5527/0.2542	----------
18 carbon compound EO	*0.1641/0.0547	----------	----------	----------

Table A-15.–(continued)

Compounds	*P. uncia*	*A. jubatus*	*P. tigris*	*P. leo*
	RF/RM	RF/RM	RF/RM	RF/RM
18 carbon compound EP	----------	----------	0.1473/0.1542	*0.0416/0.8450
18 carbon compound ER	0.0600/0.0440	----------	*0.0051/0.0436	----------
18 carbon compound EU	*0.2599/0.0045	----------	*0.1542/0.2445	----------
18 carbon compound EW	0.0473/0.0446	----------	*0.2675/0.0559	*0.5525/0.1567
18 carbon compound EY	----------	----------	*0.0606/0.1291	----------
18 carbon compound EZ	*0.1574/0.5712	----------	----------	----------
18 carbon compound FA	----------	----------	0.0388/0.0329	----------
19 carbon compound FC	----------	----------	----------	*13.335/26.024
19 carbon compound FD	*0.1631/0.0449	----------	*0.0505/0.2429	----------
19 carbon compound FE	----------	----------	*0.0056/1.1961	----------
19 carbon compound FF	----------	*1.9089/0.3569	----------	*0.0538/0.1427
19 carbon compound FG	*0.1806/0.0164	*0.1597/1.2023	----------	----------
19 carbon compound FH	*0.2317/0.0179	----------	----------	----------
19 carbon compound FJ	----------	0.4967/0.3697	*0.3417/0.0568	----------
19 carbon compound FL	0.0454/0.0393	----------	*0.4442/0.0678	*0.2496/0.0479
19 carbon compound FM	----------	----------	0.0450/0.0515	----------
19 carbon compound FN	*0.2514/0.1805	----------	----------	----------
19 carbon compound FP	----------	----------	*0.1497/0.0052	*0.2610/0.1535
19 carbon compound FR	*0.2268/0.1707	----------	*0.0438/0.0124	----------
19 carbon compound FS	----------	----------	----------	0.1584/0.1552
19 carbon compound FT	*0.0773/0.0468	----------	*0.0512/0.1520	----------
19 carbon compound FU	----------	*0.6153/41.030	----------	----------
19 carbon compound FV	----------	----------	*0.0468/0.1476	*0.0557/0.3465
19 carbon compound FW	0.0727/0.0346	----------	----------	----------
19 carbon compound FX	*0.2398/0.0759	----------	*0.9287/0.0463	----------
19 carbon compound FY	----------	----------	0.0047/0.2494	----------
19 carbon compound GA	*0.1505/0.0552	----------	----------	*0.3504/0.0420
20 carbon compound GC	*0.1452/1.4587	*31.327/1.6754	*0.0043/0.1447	*0.6658/4.2084
20 carbon compound GE	----------	----------	*0.0051/0.2438	----------
20 carbon compound GH	*0.1385/0.0366	*3.2754/0.1415	*0.0471/1.1751	*0.4634/1.2725
20 carbon compound GJ	*10.933/0.0370	----------	*0.0386/0.0570	----------
20 carbon compound GL	----------	----------	*0.3603/0.8521	*0.0585/0.1489
20 carbon compound GM	*2.0590/0.0355	----------	----------	----------
20 carbon compound GN	0.0376/0.0359	----------	0.0480/0.0481	----------
20 carbon compound GO	----------	----------	*0.0062/0.2266	----------
20 carbon compound GP	*0.1423/0.0151	----------	----------	----------
20 carbon compound GQ	----------	----------	0.0506/0.0663	----------
20 carbon compound GT	*0.6392/0.0258	----------	----------	----------
20 carbon compound GW	*0.1543/0.0246	----------	*0.0672/0.2344	----------
20 carbon compound GX	----------	----------	----------	*0.1608/0.2470
20 carbon compound GY	*1.0813/0.2600	----------	*0.0482/0.1406	----------
21 carbon compound GZ	*0.1365/0.0064	*0.0346/1.3268	*0.0041/0.1259	*0.1474/0.7295
21 carbon compound HB	----------	*0.8405/0.5480	*0.0040/0.1480	----------
21 carbon compound HC	----------	----------	----------	*0.1605/0.6462
21 carbon compound HD	*0.2332/0.0174	----------	*0.0044/0.2504	----------
21 carbon compound HE	----------	----------	*0.3346/0.0474	----------
21 carbon compound HF	*0.0379/0.0054	----------	----------	----------
21 carbon compound HG	*0.1400/0.0172	----------	*0.4371/0.2414	----------
21 carbon compound HH	----------	*12.787/0.6654	----------	----------

Table A-15.–(continued)

Compounds	*P. uncia*	*A. jubatus*	*P. tigris*	*P. leo*
	RF/RM	RF/RM	RF/RM	RF/RM
21 carbon compound HK	0.1509/0.1792	----------	*0.1545/0.2632	----------
21 carbon compound HL	----------	----------	0.0593/0.0386	*0.0463/0.3561
21 carbon compound HN	*0.2628/0.1882	----------	*0.1475/0.0409	----------
21 carbon compound HQ	0.0417/0.0248	----------	*1.2544/0.2376	----------
21 carbon compound HR	----------	----------	0.1455/0.1400	----------
21 carbon compound HT	*0.2280/0.0420	----------	*0.0563/0.1412	----------
21 carbon compound HV	----------	----------	----------	*0.5606/1.4707
21 carbon compound HW	*0.0480/0.5520	----------	----------	----------
22 carbon compound HX	*0.2407/0.0324	*11.780/0.1493	*0.0569/0.1489	*0.4603/1.5350
22 carbon compound HZ	----------	----------	*0.0497/1.1948	----------
22 carbon compound IA	----------	----------	*0.4482/2.1784	----------
22 carbon compound IC	----------	----------	----------	*0.0420/0.4508
22 carbon compound ID	----------	----------	*0.0062/0.0405	----------
22 carbon compound IE	----------	----------	*0.2511/0.1510	----------
22 carbon compound IF	*0.1885/0.0166	----------	----------	----------
22 carbon compound IG	----------	----------	*0.0533/0.6314	----------
22 carbon compound IH	0.0587/0.0343	----------	----------	----------
22 carbon compound II	----------	----------	*0.0556/0.1467	----------
22 carbon compound IJ	----------	----------	*0.0603/1.1321	----------
22 carbon compound IK	----------	----------	*0.4465/0.1321	----------
22 carbon compound IL	*1.3655/0.0444	----------	----------	----------
22 carbon compound IM	----------	----------	----------	*0.2524/0.0555
22 carbon compound IN	0.0616/0.0234	----------	----------	----------
23 carbon compound IO	----------	----------	*0.3578/0.2370	*0.8476/0.2603
23 carbon compound IP	----------	----------	*0.3384/0.0353	----------
23 carbon compound IQ	----------	----------	----------	*0.5569/1.4230
23 carbon compound IR	*1.1020/0.0254	----------	0.1354/0.1449	----------
23 carbon compound IT	----------	----------	0.1422/0.1524	----------
23 carbon compound IV	*0.9204/0.0716	----------	----------	----------
23 carbon compound IW	----------	----------	*0.5597/0.2588	----------
23 carbon compound IX	----------	----------	*0.1458/0.0487	----------
23 carbon compound IY	----------	----------	----------	*0.0486/0.3423
23 carbon compound JA	----------	----------	*0.0056/0.2385	----------
23 carbon compound JB	*0.1572/0.0261	----------	----------	----------
23 carbon compound JC	----------	----------	*0.1496/0.0465	----------
23 carbon compound JE	0.0499/0.0454	----------	0.2455/0.2275	----------
23 carbon compound JF	----------	----------	----------	*0.2507/0.0533
24 carbon compound JH	*0.2455/0.1527	2.1270/0.9327	*0.0688/0.1391	*0.0417/0.3515
24 carbon compound JI	----------	----------	0.0494/0.0480	----------
24 carbon compound JJ	0.1457/0.1660	----------	----------	----------
24 carbon compound JO	----------	----------	*0.0508/1.2698	----------
24 carbon compound JP	0.0397/4.4293	----------	----------	----------
24 carbon compound JR	*0.2143/0.0283	----------	*0.0054/0.0501	----------
24 carbon compound JS	----------	----------	0.3442/1.3423	----------
24 carbon compound JT	*0.9516/1.1792	----------	----------	----------
24 carbon compound JU	----------	----------	*0.4540/0.9489	----------
24 carbon compound JV	----------	----------	*0.0559/0.1320	----------
24 carbon compound JW	----------	----------	0.1679/0.0602	----------
24 carbon compound JY	0.1194/0.1527	----------	*0.0339/0.2401	----------

Table A-15.--(continued)

Compounds	*P. uncia*	*A. jubatus*	*P. tigris*	*P. leo*
	RF/RM	RF/RM	RF/RM	RF/RM
25 carbon compound KB	*0.0579/0.0043	----------	*0.0434/0.1533	----------
25 carbon compound KC	----------	----------	*0.0481/0.2477	----------
25 carbon compound KD	*0.2799/0.0063	----------	----------	----------
25 carbon compound KE	----------	----------	0.9316/0.9491	----------
25 carbon compound KG	*1.1471/0.0293	----------	----------	----------
25 carbon compound KH	*0.9622/0.0156	----------	----------	----------
25 carbon compound KK	0.1275/0.1685	----------	*0.0059/0.1497	*0.1569/0.6293
25 carbon compound KL	----------	----------	0.0037/0.0669	----------
25 carbon compound KN	----------	----------	----------	*0.1650/0.0421
25 carbon compound KO	----------	----------	*0.0038/0.2580	----------
25 carbon compound KP	*5.3255/0.0035	----------	----------	----------
25 carbon compound KQ	----------	----------	----------	*0.0512/0.0449
25 carbon compound KS	*6.3153/25.789	----------	----------	----------
25 carbon compound KT	----------	----------	*0.0924/2.1995	----------
25 carbon compound KU	*0.8358/27.485	----------	----------	----------
26 carbon compound KV	----------	----------	*0.0537/0.9380	----------
26 carbon compound KX	*1.2440/0.1655	----------	----------	----------
26 carbon compound KZ	----------	----------	----------	*0.1556/2.1674
26 carbon compound LA	*1.1143/0.0166	----------	*0.3479/0.1540	----------
26 carbon compound LB	----------	----------	----------	*0.0446/0.2478
26 carbon compound LC	----------	----------	*0.0583/5.3832	----------
26 carbon compound LD	----------	----------	*0.0073/6.3384	----------
26 carbon compound LG	----------	----------	*0.0423/0.8347	----------
26 carbon compound LH	*0.8184/0.3577	----------	----------	----------
26 carbon compound LI	----------	----------	0.0488/1.2488	----------
26 carbon compound LJ	----------	----------	*0.0528/1.3403	----------
26 carbon compound LL	1.2508/1.2217	----------	*0.0051/0.8405	----------
26 carbon compound LM	----------	----------	*0.0049/1.2832	----------
26 carbon compound LN	*0.2506/0.3826	----------	----------	----------
27 carbon compound LP	0.0670/0.0384	1.7243/1.5865	----------	*0.7539/4.5685
27 carbon compound LQ	*0.1401/0.0168	----------	*0.0056/0.2582	0.0441/8.2622
27 carbon compound LS	*1.0987/0.0409	----------	----------	----------
27 carbon compound LT	----------	----------	*0.3672/0.0432	*1.4076/2.1694
27 carbon compound LV	*0.1397/0.0035	----------	*0.4488/0.1487	----------
27 carbon compound LX	*3.1899/0.0240	----------	----------	----------
27 carbon compound LY	----------	----------	*0.1523/1.4410	----------
27 carbon compound LZ	*1.0708/0.0722	----------	*0.0485/0.1577	----------
27 carbon compound MB	*0.2526/0.1740	----------	----------	----------
27 carbon compound MC	----------	----------	*0.1591/3.2302	*0.3640/0.6431
27 carbon compound MD	*0.0560/0.6587	----------	----------	----------
27 carbon compound ME	----------	----------	1.1820/1.3025	----------
27 carbon compound MF	*0.2450/0.0329	----------	----------	----------
27 carbon compound MG	*0.1492/0.8517	----------	----------	----------
27 carbon compound MI	----------	----------	*0.1408/0.0055	----------
27 carbon compound MJ	0.0500/0.0554	----------	----------	----------
27 carbon compound MK	----------	----------	*0.0714/0.1399	----------
28 carbon compound ML	*1.0951/0.5355	----------	*0.0472/0.1364	----------
28 carbon compound MM	*0.0281/0.2528	----------	----------	----------
28 carbon compound MN	----------	----------	0.0418/0.0586	----------

Table A-15.--(continued)

Compounds	*P. uncia*	*A. jubatus*	*P. tigris*	*P. leo*
	RF/RM	RF/RM	RF/RM	RF/RM
28 carbon compound MO	*1.0558/0.0369	----------	----------	----------
28 carbon compound MP	*0.9313/2.0688	----------	*0.4578/0.1555	----------
28 carbon compound MR	----------	----------	*0.0062/2.1831	----------
28 carbon compound MS	0.1351/0.1363	----------	----------	----------
28 carbon compound MT	*0.0267/3.0530	----------	----------	----------
28 carbon compound MU	----------	----------	*0.2321/0.1524	----------
28 carbon compound MX	*0.2618/0.6377	----------	----------	----------
28 carbon compound MZ	----------	----------	0.0389/0.0593	----------
28 carbon compound NA	*0.1442/0.2627	----------	----------	----------
28 carbon compound NB	----------	----------	*0.0472/0.2424	----------
28 carbon compound NC	*0.2509/0.0571	----------	----------	----------
28 carbon compound ND	----------	----------	0.0481/0.0386	*0.2846/0.1584
28 carbon compound NE	*0.9415/0.0550	----------	*0.4558/0.1446	----------
28 carbon compound NF	----------	----------	----------	*0.5501/0.9492
28 carbon compound NG	*0.1443/6.3686	----------	----------	----------
28 carbon compound NH	----------	----------	*0.3614/0.2216	----------
28 carbon compound NI	0.0501/0.0394	----------	----------	----------
29 carbon compound NK	*0.2303/0.0452	----------	----------	----------
29 carbon compound NL	*1.1639/0.0286	----------	----------	----------
29 carbon compound NM	----------	----------	*0.3518/0.0508	----------
29 carbon compound NN	*0.9348/0.0869	----------	----------	----------
29 carbon compound NP	----------	----------	*0.1547/0.2452	----------
29 carbon compound NQ	*0.1278/0.0360	----------	----------	----------
29 carbon compound NR	----------	----------	*0.1472/1.3223	----------
29 carbon compound NT	----------	----------	*0.5408/0.9496	----------
29 carbon compound NV	*5.1724/0.1526	----------	*0.1494/0.0668	----------
29 carbon compound NZ	----------	----------	*0.0061/0.0512	----------
29 carbon compound OA	*6.1891/0.0425	----------	----------	----------
29 carbon compound OB	----------	----------	*0.1423/0.0557	----------
29 carbon compound OC	*0.8407/0.1521	----------	----------	----------
30 carbon compound OD	----------	----------	0.2522/0.2606	----------
30 carbon compound OF	*1.0806/0.0560	----------	----------	----------
30 carbon compound OH	*1.0782/3.0773	----------	----------	----------
30 carbon compound OI	*0.8427/0.0518	----------	0.0629/0.0585	----------
30 carbon compound OJ	*1.1885/0.0477	----------	----------	----------
30 carbon compound OL	----------	----------	*0.0508/0.2380	----------
30 carbon compound OM	*0.2492/0.3540	----------	----------	----------
30 carbon compound OO	0.0481/0.0697	----------	----------	----------
30 carbon compound OR	*0.1272/0.0417	----------	----------	----------
30 carbon compound OS	*1.2443/0.0399	----------	----------	----------
30 carbon compound OT	----------	----------	*0.0351/0.1503	----------
30 carbon compound OV	*0.1439/0.0040	----------	----------	----------
31 carbon compound OX	*3.2027/0.1263	----------	----------	----------
31 carbon compound OZ	----------	----------	*0.0042/0.0487	----------

Table A-16.--Average amount (picomoles) of glycolipids present in anal sacs of dominant female (Dom. F) and subordinate female (Sub. F) *Panthera uncia* (snow leopard) and *P. leo* (lion). Dashed lines represent the absence of a compound. Asterisks between subordinate and dominant females represent a significant difference between the two for a particular species.

Compounds	*Panthera uncia*		*Panthera leo*	
	Sub. F	Dom. F	Sub. F	Dom. F
10 carbon compound B	----------	----------	0.086680	0.144498
10 carbon compound D	----------	----------	0.127750	0.146814
11 carbon compound I	----------	----------	0.004844	0.002437
11 carbon compound J	0.285041	0.265431	----------	----------
12 carbon compound Q	0.239300	0.044385	0.032148	0.055798
12 carbon compound R	0.041523 *	0.086387	----------	----------
2,6-bis(1,1-dimethylethyl)-4-ethyl-Phenol	0.116638	0.050491	----------	----------
12 carbon compound W	----------	----------	0.038631	0.057593
12 carbon compound X	1.258192	0.031405	0.912554	1.257753
12 carbon compound AB	0.420435	0.153353	----------	----------
13 carbon compound AC	1.864653	0.378715	----------	----------
13 carbon compound AH	----------	----------	0.127754	0.148939
13 carbon compound AM	0.857573	0.339054	----------	----------
13 carbon compound AP	----------	----------	0.184791 *	0.128670
Tetradecanoic acid	0.584292	0.647817	0.009839	0.004547
14 carbon compound AY	----------	----------	0.847461	1.228083
14 carbon compound BF	----------	----------	0.272918	0.234548
14 carbon compound BG	----------	----------	2.309837	3.376869
Pentadecanoic acid	0.103870	0.059425	----------	----------
15 carbon compound BQ	----------	----------	3.111516	4.191206
15 carbon compound BT	0.084162	0.062791	----------	----------
Hexadecanoic acid	1.398471	0.136173	0.183601	0.237870
16 carbon compound BV	0.321724	0.345592	----------	----------
16 carbon compound BY	----------	----------	0.118791	0.153321
16 carbon compound BZ	0.153038	0.149881	0.862782	1.156593
16 carbon compound CG	0.163405	0.145846	----------	----------
16 carbon compound CH	----------	----------	0.187614	0.262443
Heptadecanoic acid	0.042911	0.036430	0.107425 *	0.149283
17 carbon compound CK	----------	----------	0.026127	0.032538
17 carbon compound CP	----------	----------	0.040893	0.064441
X-Octadecenoic acid	----------	----------	0.704555	0.960672
17 carbon compound CR	----------	----------	0.042504 *	0.019109
Octadecanoic acid	0.827356	0.913570	0.150041	0.132478
X-methyl Octadecanoic acid	----------	----------	0.221988	0.266953
18 carbon compound CW	0.093494 *	0.013255	----------	----------
18 carbon compound CY	0.056625	0.042557	----------	----------
18 carbon compound DA	0.324819	0.379918	----------	----------
18 carbon compound DC	2.085626	0.042134	0.035236	0.054997
18 carbon compound DF	0.098293	0.050297	----------	----------
19 carbon compound DG	0.186140	0.145331	0.036823	0.039594
19 carbon compound DI	----------	----------	0.142076	0.138717
19 carbon compound DK	0.134678	0.164086	----------	----------
19 carbon compound DM	0.046696	0.045858	----------	----------

Table A-16.--(continued)

Compounds	*Panthera uncia*		*Panthera leo*	
	Sub. F	**Dom. F**	**Sub. F**	**Dom. F**
X,X-Eicosadienoic acid	0.142356	0.134937	----------	----------
X-Eicosanoic acid	----------	----------	0.004537	0.003087
19 carbon compound DP	----------	----------	0.074561	0.049652
19 carbon compound DS	0.130358	0.078403	----------	----------
Eicosanoic acid	0.206636	0.077777	0.126475	0.141573
20 carbon compound DX	0.411097 *	0.482635	----------	----------
20 carbon compound ED	----------	----------	3.247010	4.041047
20 carbon compound EH	0.207969	0.146924	----------	----------
20 carbon compound EK	----------	----------	0.119933	0.147719
21 carbon compound EQ	----------	----------	1.722430	0.160064
21 carbon compound EU	0.613998	0.646598	0.191513	0.256963
21 carbon compound FA	----------	----------	0.988104	0.143855
21 carbon compound FB	0.243970	0.272526	----------	----------
21 carbon compound FD	0.298573	0.356184	----------	----------
21 carbon compound FE	----------	----------	0.947226	0.043632
21 carbon compound FH	0.140390	0.135087	----------	----------
22 carbon compound FI	----------	----------	0.520424 *	0.207007
22 carbon compound FL	----------	----------	0.004246	0.003575
22 carbon compound FO	0.572715	0.038433	----------	----------
22 carbon compound FP	----------	----------	0.135399	0.153563
22 carbon compound FU	0.030896 *	0.075767	0.175348	0.236659
22 carbon compound FZ	0.319306	0.346392	----------	----------
22 carbon compound GA	1.005637	1.409960	----------	----------
22 carbon compound GB	----------	----------	0.122980	0.147804
23 carbon compound GE	0.056075	0.035175	----------	----------
23 carbon compound GJ	0.469044	0.537603	----------	----------
23 carbon compound GL	5.929660	7.091555	----------	----------
23 carbon compound GM	----------	----------	0.120325	0.111989
23 carbon compound GO	----------	----------	0.173812	0.229926
Tetracosanoic acid	1.037477	1.121587	0.113078	0.115339
24 carbon compound GS	----------	----------	0.003856	0.004443
24 carbon compound HB	----------	----------	0.841001	1.029789
25 carbon compound HK	----------	----------	0.212303	0.262827
25 carbon compound HO	----------	----------	0.125020	0.132727
25 carbon compound HP	----------	----------	0.122305	0.169742
25 carbon compound HT	7.855800	9.226767	----------	----------
X-Hexacosanoic acid	2.606893 *	3.488690	----------	----------
25 carbon compound HX	----------	----------	0.221386	0.237160
25 carbon compound IB	0.221004	0.214860	----------	----------
25 carbon compound IC	----------	----------	0.029623	0.051958
26 carbon compound ID	0.328276	0.337830	0.032076 *	0.051353
26 carbon compound IE	----------	----------	0.112038	0.023191
26 carbon compound IH	0.241530 *	0.211320	----------	----------
26 carbon compound II	----------	----------	0.016661	0.001793
26 carbon compound IJ	----------	----------	0.194847	0.068280
26 carbon compound IN	6.312405	7.327431	----------	----------
26 carbon compound IO	----------	----------	0.146717	0.162316

Table A-16.--(continued)

Compounds	*Panthera uncia*		*Panthera leo*	
	Sub. F	Dom. F	Sub. F	Dom. F
26 carbon compound IP	----------	----------	0.043850	0.046594
26 carbon compound IS	----------	----------	0.193065	0.237039
26 carbon compound IV	0.089163	0.039942	----------	----------
26 carbon compound IW	0.090096	0.050240	----------	----------
26 carbon compound IX	----------	----------	0.179941	0.211864
27 carbon compound JC	0.250518	0.255993	----------	----------
27 carbon compound JD	----------	----------	0.899183	1.101346
Cholesterol	----------	----------	0.157259	0.149277
27 carbon sterol	0.061379	0.051341	0.038392	0.032754
27 carbon compound JH	0.265788	0.265153	----------	----------
27 carbon compound JI	----------	----------	0.191873	0.278416
27 carbon compound JO	0.384547	0.331800	----------	----------
27 carbon compound JP	----------	----------	0.118072	0.169069
27 carbon compound JR	----------	----------	0.148213	0.141478
27 carbon compound JW	----------	----------	0.103671	0.005293
27 carbon compound JX	----------	----------	0.130174	0.160214
28 carbon compound KI	0.277691	0.057465	----------	----------
28 carbon compound KJ	----------	----------	0.034510	0.027153
28 carbon compound KK	----------	----------	0.114439	0.140029
28 carbon compound KM	----------	----------	0.192142	0.256549
28 carbon compound KT	0.172914	0.145778	----------	----------
28 carbon compound KU	8.426364	10.044190	0.040118	0.040736
28 carbon compound KY	0.232426	0.240624	----------	----------
29 carbon compound KZ	----------	----------	0.286951	0.137733
29 carbon compound LI	0.234459 *	0.296197	----------	----------
29 carbon compound LM	0.151924	0.183410	----------	----------
29 carbon compound LP	0.160544	0.174448	----------	----------
29 carbon compound LQ	----------	----------	5.615687	3.362164
29 carbon compound LR	0.369002	0.133647	----------	----------
29 carbon compound LU	----------	----------	0.052565	0.041315
29 carbon compound LW	0.492263	0.556754	----------	----------
30 carbon compound LX	1.000325	1.291455	0.232470	0.242568
30 carbon compound LZ	----------	----------	0.040743	0.043877
30 carbon compound MD	----------	----------	0.028236	0.048841
30 carbon compound MF	0.336608	0.355444	----------	----------
30 carbon compound MN	0.559600	0.634439	----------	----------
31 carbon compound MR	0.457800	0.560614	0.104516	0.049768

Table A-17.--Average amount (picomoles) of neutral lipids present in anal sacs of dominant females (Dom. F) and subordinate females (Sub. F) for *Panthera uncia* and *Panthera leo*. Dashed lines represent the absence of a compound. Asterisks between subordinate and dominant females represent a significant difference between the two for a particular species.

Compounds	*P. uncia*		*P. leo*	
	Sub. F	Dom. F	Sub. F	Dom. F
10 carbon compound A	0.308556	0.323974	----------	----------
10 carbon compound C	0.011455	0.002454	----------	----------
10 carbon compound D	0.043638	0.063787	----------	----------
10 carbon compound G	0.057238	0.065082	----------	----------
11 carbon compound H	0.054666	0.079190	2.405521	3.312809
11 carbon compound J	0.327398	0.347735	----------	----------
11 carbon compound L	0.056391	0.062205	----------	----------
11 carbon compound N	0.006415	0.003187	----------	----------
11 carbon compound O	0.049561	0.065897	----------	----------
11 carbon compound S	0.084837	0.030932	0.944168	1.589121
11 carbon compound T	0.153349	0.178193	----------	----------
11 carbon compound V	0.096838	0.064239	----------	----------
11 carbon compound W	----------	----------	0.043959	0.032983
11 carbon compound Y	0.007372	0.005656	----------	----------
12 carbon compound Z	0.449629	0.581482	0.556117	0.727724
12 carbon compound AB	0.050960	0.064764	----------	----------
12 carbon compound AG	----------	----------	0.192075	0.248799
12 carbon compound AH	0.141944	0.184938	----------	----------
12 carbon compound AJ	0.034704	0.030346	----------	----------
12 carbon compound AK	----------	----------	0.043994	0.031974
12 carbon compound AL	----------	----------	0.048583	0.048461
12 carbon compound AM	0.048912	0.032734	0.118607	0.128892
12 carbon compound AO	0.144913	0.135428	----------	----------
12 carbon compound AP	----------	----------	0.113563	0.138802
12 carbon compound AQ	0.040010	0.026686	----------	----------
12 carbon compound AS	0.701980	* 0.855243	----------	----------
12 carbon compound AV	0.016104	0.004790	----------	----------
13 carbon compound AX	0.077269	0.042423	----------	----------
13 carbon compound AY	----------	----------	0.111449	0.148921
13 carbon compound AZ	0.050883	0.029151	0.040276	0.038153
13 carbon compound BA	----------	----------	0.121769	0.164194
X-branched Tridecanoic acid	0.004286	0.006147	0.113242	0.140076
13 carbon compound BE	0.047543	0.021579	----------	----------
13 carbon compound BF	----------	----------	0.122468	0.175147
13 carbon compound BH	0.060414	0.062171	----------	----------
13 carbon compound BJ	----------	----------	1.713356	2.441797
13 carbon compound BK	0.253817	* 0.146131	----------	----------
13 carbon compound BM	0.131104	0.130295	----------	----------
13 carbon compound BO	0.037497	0.069439	----------	----------
1,1'-(1,2-cyclobutanediyl)bis-, cis-Benzene	0.195271	0.225883	1.016626	1.445982
13 carbon compound BQ	0.071846	0.044991	----------	----------
Tetradecanoic acid	0.004304	0.004141	0.118536	0.178549
14 carbon compound BR	----------	----------	0.179781	0.259905

Table A-17.--(continued)

Compounds	*P. uncia*		*P. leo*	
	Sub. F	Dom. F	Sub. F	Dom. F
14 carbon compound BS	0.027390	0.016743	----------	----------
14 carbon compound BW	0.005597	0.006912	----------	----------
14 carbon compound BX	0.212932	0.267520	6.274118	8.207117
14 carbon compound CC	0.041185	0.061881	1.619808	2.174353
14 carbon compound CE	0.106813	0.003648	----------	----------
14 carbon compound CF	0.049929	0.019003	0.353630	0.465275
14 carbon compound CG	0.006329	0.004371	----------	----------
15 carbon compound CT	----------	----------	2.439418	3.362414
15 carbon compound CV	0.032209	0.031036	3.076489	4.137208
15 carbon compound CW	0.048363	0.064856	1.624006	2.162301
15 carbon compound CY	0.188292	0.225843	----------	----------
15 carbon compound DB	0.114816	0.154617	0.040445	0.062699
Nonadecanoic acid	0.267845 *	0.146892	----------	----------
15 carbon compound DC	----------	----------	0.931278	1.333376
15 carbon compound DD	0.066733	0.072323	1.769259	2.487639
15 carbon compound DF	0.048946	0.066852	----------	----------
Hexadecanoic acid	0.054246	0.027359	0.417826	0.581711
16 carbon compound DL	0.051626	0.029921	0.229022	0.042538
16 carbon compound DM	0.044415	0.072733	0.046735	0.027982
16 carbon compound DN	0.733601	0.844128	----------	----------
16 carbon compound DQ	0.199260	0.259245	0.271732	0.172934
16 carbon compound DT	12.808060	0.154583	----------	----------
16 carbon compound DV	----------	----------	0.132403	0.150640
16 carbon compound EA	1.089356	1.427860	5.319794	7.471409
16 carbon compound EF	----------	----------	0.031448	0.040496
16 carbon compound EH	0.024078	0.006951	----------	----------
17 carbon compound EJ	0.119043	0.023366	----------	----------
17 carbon compound EL	----------	----------	0.028904	0.035045
17 carbon compound EN	0.233851	0.136292	----------	----------
17 carbon compound EP	0.059919	0.018190	----------	----------
17 carbon compound ES	0.081588	0.034009	----------	----------
17 carbon compound ET	0.053331	0.030251	0.941260	1.332343
17 carbon compound EU	0.302874	0.336607	0.979103	1.344882
X-Octadecanoic acid	3.591204	4.124699	0.120667	0.163967
17 carbon compound EV	0.215934	0.244801	0.116868	0.145432
17 carbon compound EX	----------	----------	0.423827	0.572891
17 carbon compound EY	3.609302	4.232347	----------	----------
Octadecanoic acid	0.048268	0.054671	0.042503	0.039556
18 carbon compound FC	0.539400 *	0.635453	0.118643	0.155379
18 carbon compound FD	0.247458	0.266504	1.475590 *	1.455118
18 carbon compound FG	----------	----------	1.855313	2.371602
18 carbon compound FH	0.068627	0.041033	1.032292	1.476754
18 carbon compound FJ	0.156011	0.167411	----------	----------
18 carbon compound FK	----------	----------	0.128049	0.150115
18 carbon compound FL	8.622326	10.96365	----------	----------
18 carbon compound FN	0.541267	0.63905	0.042788	0.040278
18 carbon compound FT	----------	----------	0.276135	0.359299

Table A-17.--(continued)

Compounds	*P. uncia*		*P. leo*	
	Sub. F	Dom. F	Sub. F	Dom. F
18 carbon compound FY	0.297507	0.369739	0.189396	0.236241
18 carbon compound GA	----------	----------	0.074345	0.059523
18 carbon compound GB	0.247921	0.253105	----------	----------
19 carbon alcohol	0.077281	0.047143	0.348457	0.440228
19 carbon compound GJ	0.087393	0.062062	1.333681	1.827383
19 carbon compound GO	----------	----------	0.112445	0.122799
19 carbon compound GP	0.053763	0.031109	----------	----------
19 carbon compound GQ	----------	----------	0.193764	0.270047
19 carbon compound GR	0.052644	0.072036	0.737430	0.966733
19 carbon compound GS	0.046621	0.073857	----------	----------
19 carbon compound GT	0.032478 *	0.067543	0.117640	0.138021
19 carbon compound GY	----------	----------	1.229668	1.679191
Eicosanoic acid	0.225303	0.235829	0.251962	0.342491
20 carbon compound GZ	----------	----------	0.111046	0.130466
20 carbon compound HC	0.053954	0.041445	0.336066	0.228770
20 carbon compound HD	----------	----------	2.009412	2.658307
20 carbon compound HE	0.038363 *	0.037651	----------	----------
20 carbon compound HG	0.107729	0.147114	----------	----------
20 carbon compound HH	----------	----------	0.109376	0.177935
20 carbon compound HI	0.066816	0.036445	----------	----------
20 carbon compound HK	----------	----------	0.187484	0.264542
20 carbon compound HL	----------	----------	0.184823	0.219050
20 carbon compound HM	0.037169	0.051719	----------	----------
20 carbon compound HR	0.202461	0.243972	----------	----------
21 carbon compound HU	0.061071	0.069144	0.042828 *	0.061670
21 carbon compound HZ	0.126740 *	0.196334	----------	----------
21 carbon compound ID	0.123042	0.116689	----------	----------
21 carbon compound IH	0.484341	0.547292	----------	----------
21 carbon compound IL	0.143452	0.177564	0.548780	0.717627
21 carbon compound IO	----------	----------	0.042370	0.063515
21 carbon compound IP	1.101310	1.389544	0.168479	0.228104
Docosanoic acid	0.052238	0.031301	0.862058	0.247050
22 carbon compound IU	0.326727	0.345952	----------	----------
22 carbon compound IW	----------	----------	0.121896	0.137528
22 carbon compound IX	0.541252	0.272342	----------	----------
22 carbon compound IY	----------	----------	0.138419	0.169158
22 carbon compound JB	0.215140	0.282848	----------	----------
22 carbon compound JD	0.300326	0.343115	----------	----------
22 carbon compound JF	----------	----------	1.692818	2.220646
22 carbon compound JG	0.610582	0.761214	0.022930	0.033534
22 carbon compound JH	----------	----------	0.405514	0.436951
22 carbon compound JI	0.146466	0.141125	----------	----------
22 carbon compound JM	2.823238	3.076366	----------	----------
22 carbon compound JN	----------	----------	0.217310	0.248894
22 carbon compound JO	0.120038	0.154244	----------	----------
23 carbon compound JP	----------	----------	0.112655	0.160561
23 carbon compound JS	0.126981	0.147764	0.033664	0.064719

Table A-17.--(continued)

Compounds	*P. uncia*		*P. leo*	
	Sub. F	Dom. F	Sub. F	Dom. F
23 carbon compound JU	0.060961	0.077491	2.147447	0.248059
23 carbon compound JV	----------	----------	0.735176	0.950158
23 carbon compound JX	0.164884	0.034305	----------	----------
23 carbon compound JZ	0.035183 *	0.036141	----------	----------
23 carbon compound KC	0.496902	0.240547	----------	----------
23 carbon compound KD	0.277940	0.226885	0.698055	0.941249
23 carbon compound KG	0.492937	0.557730	0.197178	0.263274
23 carbon compound KI	0.229960	0.228466	----------	----------
3,7,11-trimethyl-(E,E)-2,6-Dodecatrien-1-ol	1.331501	1.119786	1.748154	2.419801
24 carbon compound KT	2.908429	2.055412	----------	----------
24 carbon compound LB	1.040305	1.158165	0.412149	0.559612
24 carbon compound LC	----------	----------	0.921331	1.306997
24 carbon compound LD	0.480393	0.596683	----------	----------
24 carbon compound LH	----------	----------	0.044246	0.034509
24 carbon compound LI	0.043588	0.036889	----------	----------
25 carbon compound LJ	----------	----------	3.815640	0.253091
25 carbon compound LK	0.120086	0.156006	----------	----------
25 carbon compound LM	----------	----------	0.551336	0.742655
25 carbon compound LO	0.039353	0.032494	0.071046	0.054383
25 carbon compound LR	----------	----------	0.177504	0.165495
25 carbon compound LT	----------	----------	0.970247	1.345670
25 carbon compound LU	0.038417	0.036380	----------	----------
25 carbon compound LV	----------	----------	0.554359	0.741246
25 carbon compound LY	0.006531	0.005745	4.922645	0.056450
25 carbon compound MC	0.286253	0.355293	0.326037	0.428535
25 carbon compound MF	0.054105	0.066218	----------	----------
25 carbon compound MH	3.446904	4.445068	0.027342	0.039127
26 carbon compound MK	----------	----------	0.339286	0.434046
26 carbon compound MR	0.044843	0.062689	----------	----------
26 carbon compound MU	0.121778	0.135042	----------	----------
26 carbon compound MY	11.641500	1.089510	----------	----------
26 carbon compound NA	0.160598	0.147371	----------	----------
26 carbon compound ND	0.218405	0.054828	0.195335	0.271748
Cholesterol	0.067170 *	0.029282	----------	----------
27 carbon compound NF	----------	----------	0.257928	0.328278
27 carbon compound NG	----------	----------	0.129590	0.155946
27 carbon compound NH	0.237007	0.221277	5.169852	0.063438
27 carbon compound NN	----------	----------	0.050714	0.020672
27 carbon compound NO	1.109185	1.120637	----------	----------
27 carbon compound NP	----------	----------	0.971906	1.374444
27 carbon compound NV	----------	----------	0.933751	1.431767
27 carbon compound NW	0.069603	0.042044	----------	----------
27 carbon compound NX	----------	----------	0.118731	0.149377
27 carbon compound NY	0.242093	0.225785	----------	----------
28 carbon compound NZ	----------	----------	0.132762	0.054864
28 carbon compound OA	0.063663	0.032377	3.859291	0.143027

Table A-17.–(continued)

Compounds	*P. uncia*		*P. leo*	
	Sub. F	Dom. F	Sub. F	Dom. F
28 carbon compound OC	0.529543	0.564374	----------	----------
28 carbon compound OE	0.213865	0.287724	----------	----------
28 carbon compound OL	1.100556	1.219152	0.384706	0.439247
28 carbon compound OO	1.900020	2.043252	----------	----------
28 carbon compound OR	0.738995	0.827173	----------	----------
28 carbon compound OT	0.211969	0.245961	0.051293	0.014863
28 carbon compound OW	0.471582	0.529258	----------	----------
29 carbon compound PB	0.554160	0.149912	----------	----------
29 carbon compound PE	0.051248	0.031486	----------	----------
29 carbon compound PF	----------	----------	1.005094	1.539566
29 carbon compound PI	0.796167	0.939345	----------	----------
29 carbon compound PK	0.154861	0.165261	----------	----------
29 carbon compound PL	----------	----------	0.040553	0.018078
29 carbon compound PM	0.060797	0.039938	----------	----------
29 carbon compound PQ	0.037267	0.021895	----------	----------
29 carbon compound PS	0.054939	0.035126	----------	----------
30 carbon compound PW	0.064427 *	0.022024	----------	----------
30 carbon compound PY	----------	----------	2.501074	0.447608
30 carbon compound PZ	----------	----------	0.219169	0.158188
30 carbon compound QD	----------	----------	0.664400	0.766334
30 carbon compound QG	----------	----------	0.109571	0.149777
30 carbon compound QI	----------	----------	0.053215	0.063816
31 carbon compound QL	----------	----------	0.047174	0.056766

Table A-18.--Average amount (picomoles) of phospholipids present in anal sacs of dominant female (Dom. F) and subordinate female (Sub. F) *Panthera leo* (lion). Asterisks between subordinate and dominant females represent a significant difference between the two.

Compounds	*Panthera leo*		
	Sub. F		Dom. F
12 carbon compound N	0.409122		0.260289
12 carbon compound Q	1.811964		2.326055
12 carbon compound AA	0.132195		0.161150
13 carbon compound AK	0.046505		0.029735
X-methyl Pentadecanoic acid	0.112840		0.148501
13 carbon compound AP	0.201494		0.251765
13 carbon compound AQ	0.051382		0.031859
13 carbon compound AR	0.133472		0.185822
13 carbon compound AS	1.053540		1.191945
13 carbon compound AX	0.670239		0.752285
Tetradecanoic acid	1.950520		2.462393
14 carbon compound AZ	0.133701		0.172598
14 carbon compound BE	0.034352	*	0.086046
14 carbon compound BF	0.127426		0.175998
14 carbon compound BJ	0.125603	*	0.183285
14 carbon compound BL	0.209580		0.270448
14 carbon compound BO	0.045372		0.038166
14 carbon compound BT	0.432232	*	0.576493
Pentadecanoic acid	0.203034		0.267690
15 carbon compound BU	0.519526		0.653214
15 carbon compound BV	0.055687		0.040508
15 carbon compound CA	1.046359		1.305924
15 carbon compound CC	0.449570		0.549748
15 carbon compound CE	0.090606		0.037460
15 carbon compound CG	0.506746		0.662754
15 carbon compound CI	1.004295	*	1.505273
15 carbon compound CL	0.118775		0.161846
15 carbon compound CO	6.500323	*	9.196962
Hexadecanoic acid	0.770224		0.380226
16 carbon compound CW	0.166404		0.041413
16 carbon compound CZ	0.038916		0.047730
16 carbon compound DD	0.046483		0.041774
16 carbon compound DF	0.053832		0.041076
16 carbon compound DH	0.121540		0.170739
17 carbon compound DM	0.511752		0.469946
17 carbon compound DO	0.123956		0.041597
17 carbon compound DR	0.125606		0.181961
17 carbon compound DW	0.121631		0.175031
17 carbon compound DZ	0.751807	*	0.557079
(Z,Z)-9,12-Octadecanoic acid	0.241973		0.260203
17 carbon compound EB	1.482422		1.647951
17 carbon compound EC	0.248400		0.175264
17 carbon compound ED	0.178290		0.319647

Table A-18.--(continued)

Compounds	*Panthera leo*		
	Sub. F		**Dom. F**
17 carbon compound EG	0.163446		0.152920
Octadecanoic acid	4.190937		2.810695
18 carbon compound EP	0.040458		0.037835
18 carbon compound EW	0.463068		0.564550
19 carbon compound FC	24.405490		14.541250
19 carbon compound FF	0.126371		0.051241
19 carbon compound FL	0.252303		0.261094
19 carbon compound FP	0.215875		0.248833
19 carbon compound FS	0.443673		0.159099
19 carbon compound FV	0.132211		0.033179
19 carbon compound GA	0.315014		0.337899
20 carbon compound GC	1.583031		0.561447
20 carbon compound GH	0.400858		0.464967
20 carbon compound GL	0.056107		0.058327
20 carbon compound GX	0.166925		0.161219
21 carbon compound GZ	0.322781		0.150763
21 carbon compound HC	0.135428		0.167602
21 carbon compound HL	0.038825		0.051729
21 carbon compound HV	0.558335		0.569806
22 carbon compound HX	0.911017		0.458805
22 carbon compound IC	0.042678		0.033678
22 carbon compound IM	0.229741		0.264469
23 carbon compound IO	0.761109		0.856764
23 carbon compound IQ	0.436323		0.546447
23 carbon compound IY	0.040122		0.040596
23 carbon compound JF	0.231424		0.261275
24 carbon compound JH	0.180590	*	0.024363
24 carbon compound JP	0.034420		0.027729
25 carbon compound KK	0.136046		0.152603
25 carbon compound KN	0.131393	*	0.191402
25 carbon compound KQ	0.038900		0.059518
26 carbon compound KZ	0.128395		0.166111
26 carbon compound LB	0.042397		0.046367
27 carbon compound LP	0.793949		0.760306
27 carbon compound LR	0.043974		0.028295
27 carbon compound LT	1.035882	*	1.703997
27 carbon compound MC	0.297257		0.350509
28 carbon compound ND	0.220233		0.317915
28 carbon compound NF	0.428045		0.552954

Table A-19.--Average amount (picomoles) of glycolipids present in anal sacs of dominant male (Dom. M) and subordinate male (Sub. M) *Panthera leo* (lions). Asterisks represent significant differences between dominant and subordinate males.

Compounds	*Panthera leo*		
	Sub. M		Dom. M
10 carbon compound B	0.129895		0.145234
10 carbon compound D	0.136151		0.121004
11 carbon compound I	0.005466		0.040878
12 carbon compound Q	0.020374		0.026416
12 carbon compound W	0.067152		0.095749
12 carbon compound X	1.087827		1.027218
13 carbon compound AH	0.132553		0.133114
13 carbon compound AP	0.161901		0.286584
Tetradecanoic acid	0.004366		0.008077
14 carbon compound AY	1.303524		1.091756
14 carbon compound BF	0.264538		0.349872
14 carbon compound BG	3.103123		2.813750
15 carbon compound BQ	4.183187		3.743213
Hexadecanoic acid	0.244768		0.232220
16 carbon compound BY	0.125372		0.147092
16 carbon compound BZ	1.164137		1.010788
16 carbon compound CH	0.244139		0.330183
Heptadecanoic acid	0.155193		0.132886
17 carbon compound CK	0.058714		0.041198
17 carbon compound CP	0.049601		0.083914
X-Octadecanoic acid	0.931080		1.084404
17 carbon compound CR	0.065101		0.185511
Octadecanoic acid	0.174920		0.262690
X-methyl Octadecanoic acid	0.258253		0.963737
18 carbon compound DC	0.076667		0.908668
19 carbon compound DG	0.043037	*	0.148171
19 carbon compound DI	0.145926		0.290502
X-Eicosanoic acid	0.006367		0.197016
19 carbon compound DP	0.057507		0.164307
Eicosanoic acid	0.161103		0.411078
20 carbon compound ED	4.230357		3.591631
20 carbon compound EK	0.171191		0.141987
21 carbon compound EQ	0.162126		0.134424
21 carbon compound EU	0.245006		0.368799
21 carbon compound FA	0.162250		0.148053
21 carbon compound FE	0.046897		0.511950
22 carbon compound FI	0.232816		0.365638
22 carbon compound FL	0.002719		0.005169
22 carbon compound FP	0.117213		0.150683
22 carbon compound FU	0.246451		0.219221
22 carbon compound GB	0.141811		0.124980
23 carbon compound GM	0.130529		0.153369
23 carbon compound GO	0.263062		0.491063

Table A-19.--(continued)

Compounds	*Panthera leo*		
	Sub. M		**Dom. M**
Tetracosanoic acid	0.177188		0.150050
24 carbon compound GS	0.004918		0.012050
24 carbon compound HB	1.343803		0.968982
25 carbon compound HK	0.232724		0.225036
25 carbon compound HO	0.159334		0.155286
25 carbon compound HP	0.151361		0.154163
25 carbon compound HX	0.256760		0.229944
25 carbon compound IC	0.048070		0.067414
26 carbon compound ID	0.065548		0.293004
26 carbon compound IE	0.053860		0.177204
26 carbon compound II	0.003348		0.017989
26 carbon compound IJ	0.045982	*	0.063306
26 carbon compound IO	0.154743		0.127889
26 carbon compound IP	0.043886		0.091017
26 carbon compound IS	0.268818	*	0.208121
26 carbon compound IX	0.238740		0.243089
27 carbon compound JD	1.128087		0.982228
Cholesterol	0.159811		0.163843
27 carbon sterol	0.049370		0.133241
27 carbon compound JI	0.217357		0.228164
27 carbon compound JP	0.136682		0.365180
27 carbon compound JR	0.120715		0.141581
27 carbon compound JW	0.005113		0.014570
27 carbon compound JX	0.136970		0.169675
28 carbon compound KJ	0.050185		0.038037
28 carbon compound KK	0.153334		0.120915
28 carbon compound KM	0.245653		0.385830
28 carbon compound KU	0.061769		0.331128
29 carbon compound KZ	0.174736	*	0.129356
29 carbon compound LQ	3.461987		2.847019
29 carbon compound LU	0.045955		0.086838
30 carbon compound LX	0.280766		0.227688
30 carbon compound LZ	0.048500		0.079551
30 carbon compound MD	0.037007		0.064871
31 carbon compound MR	0.051853		0.032077

Table A-20.--Average amount (picomoles) of phospholipids present in anal sacs of dominant male (Dom. M) and subordinate male (Sub. M) *Panthera leo* (lions). Asterisks represent significant differences between dominant and subordinate males.

Compounds	*Panthera leo*		
	Sub. M		Dom. M
12 carbon compound N	0.270309		0.210905
12 carbon compound Q	0.029982		0.041169
12 carbon compound AA	0.142149		0.671773
13 carbon compound AK	0.151218		0.121188
X-methyl pentadecanoic acid	0.252572		0.207971
13 carbon compound AP	0.044865		0.206855
13 carbon compound AQ	0.033260		0.266443
13 carbon compound AR	0.179716		0.145731
13 carbon compound AS	0.188916		0.129852
13 carbon compound AX	0.342352		0.289681
Tetradecanoic acid	0.683896		0.601140
14 carbon compound AZ	0.052708	*	0.038403
14 carbon compound BE	0.054955		0.060846
14 carbon compound BF	0.152692	*	0.132910
14 carbon compound BJ	0.346221		1.279440
14 carbon compound BL	0.651612		3.914227
14 carbon compound BO	0.843555		0.731389
14 carbon compound BT	0.063127		0.053697
Pentadecanoic acid	0.370041		0.364843
15 carbon compound BU	0.033909		0.054107
15 carbon alcohol	0.153188		0.122596
15 carbon compound CA	0.343872		0.353366
15 carbon compound CC	0.635966		0.563839
15 carbon compound CE	0.061370		0.094618
15 carbon compound CG	0.059212	*	0.623407
15 carbon compound CI	0.016862		0.040206
15 carbon compound CL	0.283283	*	0.214235
15 carbon compound CO	0.017255		0.050703
Hexadecanoic acid	8.202986		7.346017
16 carbon compound CW	0.030899		0.035099
16 carbon compound CZ	0.139069		0.132857
16 carbon compound DD	0.158828		0.251563
16 carbon compound DF	0.260094		0.230552
16 carbon compound DH	0.261361		0.212946
17 carbon compound DM	0.741750		0.646533
17 carbon compound DO	0.259274		0.230491
17 carbon compound DR	0.248831		0.221752
17 carbon compound DW	0.066347		0.068953
17 carbon compound DZ	3.336398		2.913817
(Z,Z)-9,12-Octadecadienoic acid	0.541569		0.505129
17 carbon compound EB	2.616674		2.243785
17 carbon compound EC	1.531178		1.321659
17 carbon compound ED	0.150256		0.137209

Table A-20.--(continued)

Compounds	*Panthera leo*		
	Sub. M		Dom. M
17 carbon compound EG	0.052094		0.056061
Octadecanoic acid	6.658470		5.940804
18 carbon compound EP	0.844091		0.847266
18 carbon compound EW	0.156967		0.199668
19 carbon compound FC	27.124410		21.684440
19 carbon compound FF	0.141939		0.129697
19 carbon compound FL	0.034501		0.049386
19 carbon compound FP	0.149525		0.134737
19 carbon compound FS	0.168044		0.132575
19 carbon compound FV	0.368461		0.291025
19 carbon compound GA	0.049808		0.038590
20 carbon compound GC	4.431942		3.849258
20 carbon compound GH	1.282552		1.093552
20 carbon compound GK	0.135668		0.147512
20 carbon compound GX	0.256669		0.213203
21 carbon compound GZ	0.725988		0.641010
21 carbon compound HC	0.631096		0.570895
21 carbon compound HL	0.360276		0.315151
21 carbon compound HV	1.701785	*	1.135116
22 carbon compound HX	1.540421		1.326576
22 carbon compound IC	0.460801		0.452821
22 carbon compound IM	0.060619		0.051632
23 carbon compound IO	0.264360		0.227720
23 carbon compound IQ	1.380768		1.250465
23 carbon compound IY	0.341127		0.352033
23 carbon compound JF	0.048941		0.056440
24 carbon compound JH	0.348411		0.472918
24 carbon compound JP	4.254771		3.980497
25 carbon compound KK	0.624514		0.639944
25 carbon compound KN	0.030432		0.056840
25 carbon compound KQ	0.038917	*	0.178258
26 carbon compound KZ	2.275530		1.808198
26 carbon compound LB	0.250224	*	0.219522
27 carbon compound LP	4.946660		3.712079
27 carbon compound LQ	8.320520		7.077722
27 carbon compound LT	2.240155		1.859590
27 carbon compound MC	0.649525		0.552592
28 carbon compound ND	0.158372		0.139876
28 carbon compound NF	0.946992		0.819880

APPENDIX B

IDENTIFICATION OF COMPOUNDS

CONTENTS--APPENDIX B

B-1. Glycolipids present in anal sacs of felid species.. 256

B-2 Neutral lipids present in anal sacs of felid species..... 265

B-3 Phospholipids present in anal sacs of felid species..... 275

Table B-1.–Glycolipids present in anal sacs of felid species. The retention index (RI), diagnostic ions (DI) and quality identification is given for each compound.

Compounds	RI	DI	Quality
10 carbon compound A	1055	----------	----------
10 carbon compound B	1060	43,55,98,115,130	----------
X-Oxo-Nonanoic acid	1075	55, 71, 98, 115, 130, 15	83%
10 carbon compound C	1084	43, 55, 74, 87	----------
10 carbon compound D	1090	55, 74, 87	----------
11 carbon compound E	1100	----------	----------
11 carbon compound F	1110	43, 55, 74, 87	----------
11 carbon compound G	1125	----------	----------
11 carbon compound H	1134	----------	----------
11 carbon compound I	1143	----------	----------
11 carbon compound J	1155	----------	----------
11 carbon compound K	1161	----------	----------
11 carbon compound L	1165	----------	----------
11 carbon compound M	1170	----------	----------
11 carbon compound N	1180	----------	----------
11 carbon compound O	1185	----------	----------
11 carbon compound P	1190	74, 55, 163	----------
Dodecanoic acid	1200	74, 87, 143, 171	87%
Nonadecanoic acid	1205	----------	----------
12 carbon compound Q	1210	----------	----------
12 carbon compound R	1215	----------	----------
12 carbon compound S	1220	----------	----------
12 carbon compound T	1226	----------	----------
12 carbon compound U	1234	----------	----------
2,6-bis(1,1-dimethylethyl)-4-ethyl Phenol	1239	41, 57, 219, 234	93%
12 carbon compound V	1247	----------	----------
12 carbon compound W	1252	----------	----------
12 carbon compound X	1257	----------	----------
12 carbon compound Y	1268	55, 74, 143, 185	----------
12 carbon compound Z	1274	----------	----------
12 carbon compound AA	1282	----------	----------
12 carbon compound AB	1288	----------	----------
Tridecanoic acid	1300	74, 87, 143, 185	97%
13 carbon compound AC	1308	----------	----------
13 carbon compound AD	1315	----------	----------
13 carbon compound AE	1320	----------	----------
13 carbon compound AF	1331	----------	----------
13 carbon compound AG	1335	----------	----------
13 carbon compound AH	1340	----------	----------
13 carbon compound AI	1345	----------	----------
13 carbon compound AJ	1350	----------	----------
13 carbon compound AK	1356	----------	----------
13 carbon compound AL	1361	55, 74, 143, 199	----------
13 carbon compound AM	1365	----------	----------
13 carbon compound AN	1370	----------	----------
13 carbon compound AO	1375	----------	----------
13 carbon compound AP	1381	55, 74, 96, 166, 255	----------
13 carbon compound AQ	1385	55, 74, 87, 97	----------

Table B-1.--(continued)

Compounds	RI	DI	Quality
13 carbon compound AR	1391	55, 74, 143, 199	----------
Tetradecanoic acid	1400	74, 87, 143, 199	97%
14 carbon compound AS	1409	----------	----------
14 carbon compound AT	1414	----------	----------
14 carbon compound AU	1421	----------	----------
14 carbon compound AV	1427	----------	----------
14 carbon compound AW	1433	----------	----------
14 carbon compound AX	1440	----------	----------
14 carbon compound AY	1445	----------	----------
14 carbon alcohol	1451	55, 69, 83, 97, 111, 125	----------
14 carbon compound AZ	1455	----------	----------
14 carbon compound BA	1461	55, 74, 143, 213, 255	----------
14 carbon compound BB	1467	55, 74, 87, 143, 199	----------
14 carbon compound BC	1470	55, 74, 87, 143, 199	----------
14 carbon compound BD	1480	----------	----------
14 carbon compound BE	1485	----------	----------
14 carbon compound BF	1492	----------	----------
14 carbon compound BG	1496	----------	----------
Pentadecanoic acid	1500	74, 87, 143, 213	94%
15 carbon compound BH	1504	----------	----------
15 carbon compound BI	1510	55, 69, 97, 199	----------
X-Hydroxy-Tetradecanoic acid	1515	55, 69, 97, 111, 199	----------
15 carbon compound BJ	1525	55, 58, 95, 109, 255	----------
15 carbon compound BK	1530	57, 58, 83, 97, 104	----------
15 carbon compound BL	1535	----------	----------
15 carbon compound BM	1540	57, 70, 83, 97, 98, 111	----------
15 carbon compound BN	1544	----------	----------
15 carbon compound BO	1548	57, 71, 90, 103, 213	----------
15 carbon alcohol	1552	55, 69, 83, 97, 111, 125	----------
15 carbon compound BP	1557	74, 87, 143, 227, 270	----------
15 carbon compound BQ	1562	55, 74, 143, 227	----------
X-Hexadecenoic acid	1566	55, 74, 87, 96, 110	94%
15 carbon compound BR	1570	55, 74, 97, 123, 152	----------
X-Hexadecanoic acid	1575	55, 69, 83, 96, 194, 236	99%
15 carbon compound BS	1580	55, 69, 97, 255	----------
15 carbon compound BT	1585	55, 74, 87, 96, 236	----------
15 carbon compound BU	1591	57, 69, 83, 97, 111, 213	----------
Hexadecanoic acid	1600	43, 55, 74, 87	98%
16 carbon compound BV	1606	55, 69, 97, 213, 255	----------
16 carbon compound BW	1610	55, 69, 97, 111, 213	----------
16 carbon compound BX	1621	----------	----------
16 carbon compound BY	1631	57, 69, 83, 97, 111, 213	----------
16 carbon compound BZ	1635	55, 98, 115, 130, 209	----------
16 carbon compound CA	1640	----------	----------
16 carbon compound CB	1650	----------	----------
16 carbon alcohol	1656	55, 83, 97, 111, 125	----------
16 carbon compound CC	1660	----------	----------
16 carbon compound CD	1667	----------	----------
14-methyl Hexadecanoic acid	1671	55, 74, 87, 143, 241, 28	96%
X-Hydroxy Hexadecanoic acid	1676	57, 69, 97, 111, 227	90%

Table B-1.--(continued)

Compounds	RI	DI	Quality
16 carbon compound CE	1680	57, 83, 97, 111, 127	----------
16 carbon compound CF	1685	55, 69, 97, 111, 227	----------
16 carbon compound CG	1691	55, 67, 81, 95, 109, 225	----------
16 carbon compound CH	1695	55, 81, 95, 111, 225	----------
Heptadecanoic acid	1700	74, 143, 241, 284	98%
17 carbon compound CI	1707	55, 69, 81, 95, 109, 225	----------
17 carbon compound CJ	1712	57, 83, 97, 111, 227	----------
17 carbon compound CK	1717	57, 83, 97, 111, 227	----------
17 carbon alcohol	1725	55, 82, 96, 109, 124	----------
17 carbon compound CL	1730	----------	----------
17 carbon compound CM	1736	----------	----------
17 carbon compound CN	1741	----------	----------
17 carbon compound CO	1745	----------	----------
17 carbon compound CP	1750	57, 71, 90, 97, 227, 241	----------
X,X-Octadecadienoic acid	1755	67, 81, 95, 263, 294	99%
9,12-Octadecanoic acid	1758	41, 55, 67, 95, 109	99%
X-Octadecanoic acid	1764	55, 74, 83, 97, 264	99%
X-Octadecenoic acid	1768	55, 83, 97, 222, 264	99%
X-Octadecenoic acid	1772	55, 83, 97, 222, 265	99%
17 carbon compound CQ	1776	55, 69, 83, 97, 264	----------
X-Octadecanoic acid	1783	55, 69, 87, 97, 264	----------
17 carbon compound CR	1786	55, 69, 83, 97, 125, 239	----------
17 carbon compound CS	1795	----------	----------
Octadecanoic acid	1800	55, 74, 87, 143, 255	99%
18 carbon compound CT	1813	57, 69, 83, 97, 127	----------
18 carbon compound CU	1818	----------	----------
18 carbon compound CV	1825	----------	----------
18 carbon compound CW	1832	----------	----------
18 carbon compound CX	1842	----------	----------
18 carbon compound CY	1846	----------	----------
18 carbon compound CZ	1853	----------	----------
18 carbon compound DA	1860	----------	----------
X-methyl Octadecanoic acid	1865	57, 74, 87, 143, 269	93%
18 carbon compound DB	1870	55, 74, 87, 143	----------
18 carbon compound DC	1874	55, 57, 90, 97, 255	----------
18 carbon compound DD	1880	55, 57, 90, 97, 255	----------
18 carbon compound DE	1887	55, 67, 81, 109, 253	----------
18 carbon compound DF	1892	41, 55, 69, 90, 253	----------
19 carbon compound DG	1905	----------	----------
19 carbon compound DH	1910	55, 79, 91, 106, 150	----------
X,X,X,X-Eicosatetraenoic acid	1915	67, 79, 105, 119, 150	94%
2-Hydroxy-Octanoic acid	1921	43, 57, 83, 97, 255	----------
19 carbon compound DI	1926	55, 67, 79, 95, 121, 135	----------
19 carbon compound DJ	1933	----------	----------
19 carbon compound DK	1939	55, 67, 95, 109, 124	----------
19 carbon compound DL	1946	----------	----------
19 carbon compound DM	1950	----------	----------
19 carbon compound DN	1955	55, 83, 97, 111	----------
X,X-Eicosadienoic acid	1960	55, 67, 81, 109	94%
X-Eicosanoic acid	1965	55, 69, 83, 111, 292	99%

Table B-1.--(continued)

Compounds	RI	DI	Quality
19 carbon compound DO	1969	55, 69, 97, 111, 292	----------
X-Eicosanoic acid	1972	55, 69, 83, 110, 292	90%
19 carbon compound DP	1975	55, 69, 83, 97, 292	----------
19 carbon compound DQ	1978	----------	----------
19 carbon compound DR	1980	----------	----------
19 carbon compound DS	1984	----------	----------
19 carbon compound DT	1987	55, 69, 83, 111, 125	----------
19 carbon compound DU	1990	----------	----------
Eicosanoic acid	2000	74, 87, 143, 283	99%
20 carbon compound DV	2006	----------	----------
20 carbon compound DW	2010	----------	----------
20 carbon compound DX	2014	----------	----------
20 carbon compound DY	2020	----------	----------
20 carbon compound DZ	2025	----------	----------
20 carbon compound EA	2030	57, 70, 97, 111	----------
20 carbon compound EB	2036	----------	----------
20 carbon compound EC	2040	----------	----------
20 carbon compound ED	2045	----------	----------
20 carbon compound EE	2050	----------	----------
20 carbon compound EF	2055	----------	----------
20 carbon compound EG	2062	57, 85, 111, 255	----------
20 carbon compound EH	2065	----------	----------
20 carbon compound EI	2068	----------	----------
20 carbon compound EJ	2072	55, 74, 87, 143	----------
20 carbon compound EK	2078	----------	----------
20 carbon compound EL	2081	----------	----------
20 carbon compound EM	2085	----------	----------
20 carbon compound EN	2089	----------	----------
20 carbon compound EO	2093	----------	----------
21 carbon compound EP	2100	55, 74, 87, 143, 297	----------
21 carbon compound EQ	2104	----------	----------
21 carbon compound ER	2108	----------	----------
21 carbon compound ES	2111	55, 67, 79, 93, 119, 150	----------
21 carbon compound ET	2115	55, 79, 91, 119, 133	----------
Docosanoic acid	2120	43, 74, 87, 354	----------
21 carbon compound EU	2125	55, 67, 95, 107, 121	----------
21 carbon compound EV	2130	55, 79, 95, 108, 121	----------
21 carbon compound EW	2135	----------	----------
21 carbon compound EX	2141	----------	----------
21 carbon compound EY	2146	----------	----------
21 carbon compound EZ	2151	----------	----------
21 carbon compound FA	2155	----------	----------
21 carbon compound FB	2160	----------	----------
X-Docosenoic acid	2165	55, 74, 111, 125, 320	99%
21 carbon compound FC	2168	55, 69, 97, 111, 320	----------
21 carbon compound FD	2172	----------	----------
X-Docosenoic acid	2176	55, 69, 97, 111, 320	96%
21 carbon compound FE	2182	----------	----------
21 carbon compound FF	2187	----------	----------
21 carbon compound FG	2190	----------	----------

Table B-1.--(continued)

Compounds	RI	DI	Quality
21 carbon compound FH	2195	55, 74, 87, 143, 311	----------
Docosanoic acid	2200	74, 87, 143, 311, 354	98%
22 carbon compound FI	2206	57, 74, 87, 143, 354	----------
22 carbon compound FJ	2209	----------	----------
22 carbon compound FK	2215	----------	----------
22 carbon compound FL	2220	----------	----------
22 carbon compound FM	2226	----------	----------
22 carbon compound FN	2231	----------	----------
22 carbon compound FO	2234	57, 71, 97, 111, 125	----------
22 carbon compound FP	2241	----------	----------
22 carbon compound FQ	2244	----------	----------
22 carbon compound FR	2249	----------	----------
22 carbon compound FS	2256	----------	----------
22 carbon compound FT	2260	----------	----------
22 carbon compound FU	2264	----------	----------
22 carbon compound FV	2268	----------	----------
22 carbon compound FW	2273	57, 74, 97, 111, 143	----------
22 carbon compound FX	2276	----------	----------
22 carbon compound FY	2279	----------	----------
22 carbon compound FZ	2283	----------	----------
22 carbon compound GA	2286	----------	----------
22 carbon compound GB	2292	----------	----------
22 carbon compound GC	2295	----------	----------
23 carbon compound GD	2300	74, 87, 143, 325, 368	----------
23 carbon compound GE	2307	55, 74, 97, 143	----------
23 carbon compound GF	2310	----------	----------
23 carbon compound GG	2316	----------	----------
X-Eicosene	2320	57, 69, 83, 97, 111	91%
23 carbon compound GH	2325	55, 67, 81, 95, 121, 135	----------
23 carbon compound GI	2330	----------	----------
23 carbon compound GJ	2336	55, 67, 95, 109	----------
23 carbon compound GK	2344	55, 69, 82, 97, 123	----------
23 carbon compound GL	2349	----------	----------
23 carbon compound GM	2355	----------	----------
23 carbon compound GN	2361	55, 74, 97, 143	----------
23 carbon compound GO	2366	55, 74, 97, 143	----------
X-Tetracosenoic acid	2370	55, 69, 97, 348	91%
X-Tetracosenoic acid	2376	55, 69, 97, 348	95%
23 carbon compound GP	2384	55, 69, 97, 111, 348	----------
23 carbon compound GQ	2387	55, 69, 97, 109, 189	----------
23 carbon compound GR	2392	----------	----------
Tetracosanoic acid	2400	57, 74, 143	99%
24 carbon compound GS	2410	----------	----------
24 carbon compound GT	2414	----------	----------
24 carbon compound GU	2421	----------	----------
24 carbon compound GV	2425	----------	----------
24 carbon compound GW	2431	----------	----------
24 carbon compound GX	2435	57, 83, 97, 125	----------
24 carbon compound GY	2443	----------	----------
24 carbon compound GZ	2454	----------	----------

Table B-1.--(continued)

Compounds	RI	DI	Quality
24 carbon compound HA	2458	----------	----------
24 carbon compound HB	2464	57, 74, 143, 396	----------
24 carbon compound HC	2470	57, 74, 143, 396	----------
24 carbon compound HD	2474	----------	----------
24 carbon compound HE	2479	----------	----------
24 carbon compound HF	2483	----------	----------
24 carbon compound HG	2486	----------	----------
24 carbon compound HH	2490	----------	----------
24 carbon compound HI	2495	55, 74, 143, 396	----------
24 carbon compound HJ	2498	----------	----------
25 carbon compound HK	2503	----------	----------
25 carbon compound HL	2510	----------	----------
25 carbon compound HM	2514	----------	----------
25 carbon compound HN	2520	----------	----------
25 carbon compound HO	2525	57, 69, 97, 111	----------
25 carbon compound HP	2530	55, 69, 96, 110, 189	----------
25 carbon compound HQ	2535	55, 69, 96, 123, 189	----------
25 carbon compound HR	2540	----------	----------
25 carbon compound HS	2545	----------	----------
25 carbon compound HT	2550	57, 74, 143	----------
X-Hexacosanoic acid	2555	57, 74, 97, 143	94%
25 carbon compound HU	2560	55, 69, 97, 376	----------
25 carbon compound HV	2565	55, 69, 97, 376	----------
X-Tetracosenoic acid	2570	55, 69, 97, 376	87%
25 carbon compound HW	2574	55, 85, 111, 304, 330	----------
25 carbon compound HX	2580	----------	----------
25 carbon compound HY	2583	----------	----------
25 carbon compound HZ	2586	57, 74, 143	----------
25 carbon compound IA	2589	57, 85, 97	----------
25 carbon compound IB	2593	----------	----------
25 carbon compound IC	2596	----------	----------
26 carbon compound ID	2600	----------	----------
26 carbon compound IE	2606	----------	----------
26 carbon compound IF	2611	----------	----------
26 carbon compound IG	2614	----------	----------
26 carbon compound IH	2617	----------	----------
26 carbon compound II	2621	----------	----------
26 carbon compound IJ	2624	55, 57, 83, 111, 125	----------
26 carbon compound IK	2627	----------	----------
26 carbon compound IL	2631	----------	----------
26 carbon compound IM	2634	----------	----------
26 carbon compound IN	2637	----------	----------
26 carbon compound IO	2641	----------	----------
26 carbon compound IP	2646	----------	----------
26 carbon compound IQ	2650	----------	----------
26 carbon compound IR	2656	----------	----------
26 carbon compound IS	2660	57, 74, 143	----------
26 carbon compound IT	2663	----------	----------
26 carbon compound IU	2666	----------	----------
26 carbon compound IV	2669	----------	----------

Table B-1.--(continued)

Compounds	RI	DI	Quality
26 carbon compound IW	2674	----------	----------
26 carbon compound IX	2678	----------	----------
26 carbon compound IY	2683	----------	----------
26 carbon compound IZ	2686	----------	----------
26 carbon compound JA	2690	----------	----------
26 carbon compound JB	2695	----------	----------
27 carbon compound JC	2701	----------	----------
27 carbon compound JD	2705	----------	----------
27 carbon sterol	2710	55, 57, 105, 145, 275	----------
Cholesterol	2713	43, 55, 275, 301, 386	99%
27 carbon sterol	2716	43, 81, 95, 145, 275, 39	98%
27 carbon sterol	2720	55, 57, 91, 105, 145	----------
27 carbon compound JE	2724	55, 69, 97, 165	----------
27 carbon compound JF	2727	----------	----------
27 carbon compound JG	2730	----------	----------
27 carbon compound JH	2735	----------	----------
27 carbon compound JI	2738	----------	----------
27 carbon compound JJ	2742	----------	----------
27 carbon compound JK	2746	55, 81, 91, 255, 386	----------
27 carbon compound JL	2751	----------	----------
27 carbon compound JM	2757	----------	----------
27 carbon compound JN	2760	----------	----------
27 carbon compound JO	2764	----------	----------
27 carbon compound JP	2767	----------	----------
27 carbon compound JQ	2770	----------	----------
27 carbon compound JR	2773	----------	----------
27 carbon compound JS	2776	----------	----------
27 carbon compound JT	2780	----------	----------
27 carbon compound JU	2787	----------	----------
27 carbon compound JV	2791	----------	----------
27 carbon compound JW	2794	----------	----------
27 carbon compound JX	2797	----------	----------
28 carbon compound JY	2800	----------	----------
28 carbon compound JZ	2804	----------	----------
28 carbon compound KA	2807	----------	----------
28 carbon compound KB	2812	----------	----------
28 carbon compound KC	2815	----------	----------
Cholest-4-ene-3-one	2818	43, 55, 124, 229, 384	99%
28 carbon compound KD	2821	----------	----------
28 carbon compound KE	2824	----------	----------
28 carbon compound KF	2827	----------	----------
28 carbon compound KG	2830	----------	----------
28 carbon compound KH	2833	----------	----------
28 carbon compound KI	2837	----------	----------
28 carbon compound KJ	2840	----------	----------
28 carbon compound KK	2844	----------	----------
28 carbon compound KL	2848	----------	----------
28 carbon compound KM	2852	----------	----------
28 carbon compound KN	2855	----------	----------
28 carbon compound KO	2860	----------	----------

Table B-1.--(continued)

Compounds	RI	DI	Quality
28 carbon compound KP	2863	----------	----------
28 carbon compound KQ	2866	----------	----------
28 carbon compound KR	2869	----------	----------
28 carbon compound KS	2872	----------	----------
28 carbon compound KT	2875	----------	----------
28 carbon compound KU	2880	----------	----------
28 carbon compound KV	2884	----------	----------
28 carbon compound KW	2887	----------	----------
28 carbon compound KX	2891	----------	----------
28 carbon compound KY	2896	----------	----------
29 carbon compound KZ	2900	----------	----------
29 carbon compound LA	2904	----------	----------
29 carbon compound LB	2907	----------	----------
29 carbon compound LC	2910	----------	----------
29 carbon compound LD	2915	----------	----------
29 carbon compound LE	2920	----------	----------
29 carbon compound LF	2927	----------	----------
29 carbon compound LG	2930	----------	----------
29 carbon compound LH	2933	----------	----------
29 carbon compound LI	2937	----------	----------
29 carbon compound LJ	2940	----------	----------
29 carbon compound LK	2944	----------	----------
29 carbon compound LL	2947	----------	----------
29 carbon compound LM	2950	----------	----------
29 carbon compound LN	2954	----------	----------
29 carbon compound LO	2957	----------	----------
29 carbon compound LP	2961	----------	----------
29 carbon compound LQ	2965	----------	----------
29 carbon compound LR	2970	----------	----------
29 carbon compound LS	2975	----------	----------
29 carbon compound LT	2978	----------	----------
29 carbon compound LU	2981	----------	----------
29 carbon compound LV	2988	----------	----------
29 carbon compound LW	2991	----------	----------
30 carbon compound LX	3000	----------	----------
30 carbon compound LY	3005	----------	----------
30 carbon compound LZ	3012	----------	----------
30 carbon compound MA	3015	----------	----------
30 carbon compound MB	3023	----------	----------
30 carbon compound MC	3038	----------	----------
30 carbon compound MD	3041	----------	----------
30 carbon compound ME	3044	----------	----------
30 carbon compound MF	3052	----------	----------
30 carbon compound MG	3056	----------	----------
30 carbon compound MH	3063	----------	----------
30 carbon compound MI	3068	----------	----------
30 carbon compound MJ	3073	----------	----------
30 carbon compound MK	3078	----------	----------
30 carbon compound ML	3081	----------	----------
30 carbon compound MM	3087	----------	----------

Table B-1.--(continued)

Compounds	RI	DI	Quality
30 carbon compound MN	3091	----------	----------
30 carbon compound MO	3099	----------	----------
31 carbon compound MP	3107	----------	----------
31 carbon compound MQ	3111	----------	----------
31 carbon compound MR	3114	----------	----------
31 carbon compound MS	3119	----------	----------
31 carbon compound MT	3125	----------	----------
31 carbon compound MU	3128	----------	----------
31 carbon compound MV	3148	----------	----------

Table B-2.--Neutral lipids present in anal sacs of felid species. The retention index (RI), diagnostic ions (DI) and quality identification is given for each compound.

Compounds	RI	DI	Quality
10 carbon compound A	1056	----------	----------
10 carbon compound B	1058	----------	----------
10 carbon compound C	1066	----------	----------
10 carbon compound D	1075	----------	----------
10 carbon compound E	1079	----------	----------
10 carbon compound F	1081	----------	----------
10 carbon compound G	1089	----------	----------
11 carbon compound H	1100	----------	----------
11 carbon compound I	1106	----------	----------
11 carbon compound J	1111	----------	----------
11 carbon compound K	1117	----------	----------
11 carbon compound L	1120	----------	----------
11 carbon compound M	1132	----------	----------
11 carbon compound N	1135	----------	----------
11 carbon compound O	1150	----------	----------
11 carbon compound P	1154	----------	----------
11 carbon compound Q	1159	----------	----------
11 carbon compound R	1167	----------	----------
11 carbon compound S	1170	----------	----------
11 carbon compound T	1178	----------	----------
11 carbon compound U	1181	----------	----------
11 carbon compound V	1184	----------	----------
11 carbon compound W	1188	----------	----------
11 carbon compound X	1191	----------	----------
11 carbon compound Y	1194	----------	----------
12 carbon compound Z	1200	----------	----------
12 carbon compound AA	1204	----------	----------
12 carbon compound AB	1207	----------	----------
12 carbon compound AC	1212	----------	----------
12 carbon compound AD	1215	----------	----------
12 carbon compound AE	1220	----------	----------
12 carbon compound AF	1224	----------	----------
12 carbon compound AG	1229	----------	----------
12 carbon compound AH	1232	----------	----------
12 carbon compound AI	1236	----------	----------
12 carbon compound AJ	1239	----------	----------
12 carbon compound AK	1244	----------	----------
12 carbon compound AL	1248	----------	----------
12 carbon compound AM	1252	----------	----------
12 carbon compound AN	1257	----------	----------
12 carbon compound AO	1260	----------	----------
12 carbon compound AP	1264	----------	----------
12 carbon compound AQ	1268	----------	----------
12 carbon compound AR	1274	----------	----------
12 carbon compound AS	1278	----------	----------
12 carbon compound AT	1283	----------	----------
12 carbon compound AU	1288	----------	----------
12 carbon compound AV	1291	----------	----------
12 carbon compound AW	1295	----------	----------

Table B-2.--(continued)

Compounds	RI	DI	Quality
13 carbon compound AX	1300	----------	----------
13 carbon compound AY	1303	----------	----------
13 carbon compound AZ	1311	----------	----------
13 carbon compound BA	1319	----------	----------
13 carbon compound BB	1322	----------	----------
13 carbon compound BC	1326	----------	----------
13 carbon compound BD	1330	----------	----------
X-branched Tridecanoic acid	1335	74, 87, 143, 199, 242	----------
X,X-diphenyl-cyclobutane	1343	78, 104, 208	91%
13 carbon compound BE	1346	----------	----------
13 carbon compound BF	1349	----------	----------
13 carbon compound BG	1352	----------	----------
13 carbon compound BH	1355	----------	----------
13 carbon compound BI	1359	----------	----------
13 carbon compound BJ	1362	----------	----------
13 carbon compound BK	1366	----------	----------
13 carbon compound BL	1370	----------	----------
13 carbon compound BM	1374	----------	----------
13 carbon compound BN	1377	91, 104, 130, 193, 208	----------
13 carbon compound BO	1380	----------	----------
1,1'-(1,2-cyclobutanediyl) bis-cis-Benzene	1385	78, 104, 178, 208	91%
13 carbon compound BP	1392	----------	----------
13 carbon compound BQ	1396	74, 87, 143, 213, 256	----------
Tetradecanoic acid	1400	78, 104, 178, 208	----------
14 carbon compound BR	1405	----------	----------
14 carbon compound BS	1410	----------	----------
14 carbon compound BT	1415	----------	----------
14 carbon compound BU	1418	----------	----------
14 carbon compound BV	1421	----------	----------
Methyl 9-methyltetradecanoate	1427	74, 87, 143, 213, 256	----------
14 carbon compound BW	1431	----------	----------
14 carbon compound BX	1434	41, 43, 74, 87, 199	----------
14 carbon compound BY	1438	----------	----------
X-hydroxy Tetradecanoic acid	1442	97, 111, 199, 235	----------
14 carbon compound BZ	1448	----------	----------
14 carbon compound CA	1451	----------	----------
14 carbon compound CB	1453	----------	----------
14 carbon compound CC	1456	----------	----------
14 carbon compound CD	1462	----------	----------
14 carbon compound CE	1465	----------	----------
14 carbon compound CF	1470	----------	----------
14 carbon compound CG	1474	----------	----------
14 carbon compound CH	1477	----------	----------
14 carbon compound CI	1483	----------	----------
14 carbon compound CJ	1486	----------	----------
14 carbon compound CK	1491	----------	----------
14 carbon compound CL	1495	----------	----------
15 carbon compound CM	1500	----------	----------
15 carbon compound CN	1504	----------	----------

Table B-2.–(continued)

Compounds	RI	DI	Quality
15 carbon compound CO	1508	----------	----------
15 carbon compound CP	1512	----------	----------
15 carbon compound CQ	1515	----------	----------
15 carbon compound CR	1521	----------	----------
15 carbon compound CS	1524	----------	----------
15 carbon compound CT	1528	----------	----------
15 carbon compound CU	1531	----------	----------
15 carbon compound CV	1535	74, 87, 143, 227, 270	----------
15 carbon compound CW	1539	----------	----------
15 carbon compound CX	1542	----------	----------
15 carbon compound CY	1546	----------	----------
15 carbon compound CZ	1550	----------	----------
15 carbon compound DA	1554	----------	----------
15 carbon compound DB	1560	----------	----------
Nonadecanoic acid	1565	43, 55, 74	95%
15 carbon compound DC	1568	41, 55, 74, 84, 96	----------
15 carbon compound DD	1572	----------	----------
15 carbon compound DE	1578	----------	----------
15 carbon compound DF	1581	----------	----------
15 carbon compound DG	1584	----------	----------
15 carbon compound DH	1587	----------	----------
15 carbon compound DI	1593	----------	----------
15 carbon compound DJ	1596	----------	----------
Hexadecanoic acid	1600	43, 74, 87, 143	----------
16 carbon compound DK	1604	----------	----------
16 carbon compound DL	1608	----------	----------
16 carbon compound DM	1611	----------	----------
16 carbon compound DN	1614	----------	----------
16 carbon compound DO	1621	----------	----------
16 carbon compound DP	1625	----------	----------
16 carbon compound DQ	1630	----------	----------
16 carbon compound DR	1638	----------	----------
16 carbon compound DS	1643	----------	----------
16 carbon compound DT	1646	----------	----------
16 carbon compound DU	1651	----------	----------
16 carbon compound DV	1654	83, 97, 225	----------
16 carbon compound DW	1658	----------	----------
16 carbon compound DX	1661	----------	----------
16 carbon compound DY	1662	----------	----------
16 carbon compound DZ	1668	----------	----------
16 carbon compound EA	1671	43, 55, 69, 90	----------
16 carbon compound EB	1674	----------	----------
16 carbon compound EC	1677	----------	----------
16 carbon compound ED	1380	----------	----------
16 carbon compound EE	1685	74, 87, 147, 281	----------
16 carbon compound EF	1688	----------	----------
16 carbon compound EG	1691	----------	----------
16 carbon compound EH	1696	----------	----------
17 carbon compound EI	1700	55, 57, 74, 87	----------
17 carbon compound EJ	1703	----------	----------

Table B-2.–(continued)

Compounds	RI	DI	Quality
17 carbon compound EK	1706	81, 96, 109, 263	----------
17 carbon compound EL	1710	41, 57, 69, 90, 97, 111	----------
2-Hydroxy-Hexadecanoic acid	1715	43, 57, 69, 97, 227	94%
X-Octadecanoic acid	1718	74, 87, 97, 123, 180	----------
17 carbon compound EM	1721	----------	----------
17 carbon compound EN	1725	----------	----------
17 carbon compound EO	1730	----------	----------
17 carbon compound EP	1735	----------	----------
17 carbon compound EQ	1740	----------	----------
17 carbon compound ER	1745	----------	----------
17 carbon compound ES	1750	----------	----------
X-Octadecanoic acid	1755	74, 87, 143, 199, 255	----------
17 carbon compound ET	1758	41, 67, 81, 96, 136	----------
9,12-Octadecanoic acid	1761	41, 55, 67, 95, 109	95%
17 carbon compound EU	1764	41, 43, 55, 67, 81, 95	----------
X-Octadecanoic acid	1767	43, 74, 87, 143	90%
X-Octadecanoic acid	1770	41, 55, 87, 96, 264	93%
17 carbon compound EV	1774	----------	----------
17 carbon compound EW	1777	----------	----------
17 carbon compound EX	1780	----------	----------
17 carbon compound EY	1785	----------	----------
17 carbon compound EZ	1788	----------	----------
17 carbon compound FA	1792	----------	----------
17 carbon compound FB	1797	41, 43, 55, 57, 74, 87	----------
Octadecanoic acid	1800	43, 55, 74, 87	99%
18 carbon compound FC	1805	----------	----------
18 carbon compound FD	1809	----------	----------
18 carbon compound FE	1812	----------	----------
18 carbon compound FF	1815	----------	----------
18 carbon compound FG	1818	----------	----------
18 carbon compound FH	1821	----------	----------
18 carbon compound FI	1825	----------	----------
18 carbon compound FJ	1828	----------	----------
18 carbon compound FK	1831	----------	----------
18 carbon compound FL	1834	----------	----------
18 carbon compound FM	1838	----------	----------
18 carbon compound FN	1841	----------	----------
18 carbon compound FO	1844	----------	----------
18 carbon compound FP	1847	----------	----------
18 carbon compound FQ	1850	----------	----------
18 carbon compound FR	1854	----------	----------
18 carbon compound FS	1858	----------	----------
18 carbon compound FT	1861	43, 55, 74, 143	----------
18 carbon compound FU	1864	----------	----------
18 carbon compound FV	1868	----------	----------
18 carbon compound FW	1872	74, 87, 143	----------
18 carbon compound FX	1875	----------	----------
18 carbon compound FY	1878	----------	----------
18 carbon compound FZ	1881	----------	----------
18 carbon compound GA	1885	----------	----------

Table B-2.--(continued)

Compounds	RI	DI	Quality
18 carbon compound GB	1890	----------	----------
19 carbon compound GC	1903	----------	----------
19 carbon compound GD	1907	----------	----------
19 carbon compound GE	1911	----------	----------
19 carbon alcohol	1914	43, 57, 69, 83, 97, 255	----------
19 carbon compound GF	1919	----------	----------
19 carbon compound GG	1922	----------	----------
19 carbon compound GH	1925	----------	----------
19 carbon compound GI	1929	----------	----------
19 carbon compound GJ	1932	----------	----------
19 carbon compound GK	1938	----------	----------
19 carbon compound GL	1941	----------	----------
19 carbon compound GM	1945	----------	----------
19 carbon compound GN	1949	----------	----------
19 carbon compound GO	1953	91, 105, 129, 194, 207	----------
19 carbon compound GP	1956	----------	----------
19 carbon compound GQ	1962	43, 55, 74, 143, 326	----------
19 carbon compound GR	1965	----------	----------
19 carbon compound GS	1968	41, 55, 69, 84, 292	----------
19 carbon compound GT	1974	----------	----------
19 carbon compound GU	1980	74, 87, 148, 283, 326	----------
19 carbon compound GV	1983	----------	----------
19 carbon compound GW	1986	----------	----------
19 carbon compound GX	1989	----------	----------
19 carbon compound GY	1992	----------	----------
Eicosanoic acid	2000	43, 55, 74, 143, 326	91%
20 carbon compound GZ	2008	----------	----------
20 carbon compound HA	2011	----------	----------
20 carbon compound HB	2016	----------	----------
20 carbon compound HC	2020	----------	----------
20 carbon compound HD	2028	----------	----------
20 carbon compound HE	2031	----------	----------
20 carbon compound HF	2036	----------	----------
20 carbon compound HG	2041	----------	----------
20 carbon compound HH	2047	----------	----------
20 carbon compound HI	2050	----------	----------
20 carbon compound HJ	2054	----------	----------
20 carbon compound HK	2058	----------	----------
20 carbon compound HL	2061	91, 117, 207	----------
20 carbon compound HM	2064	----------	----------
20 carbon compound HN	2070	----------	----------
20 carbon compound HO	2073	91, 117, 194, 207	----------
20 carbon compound HP	2079	----------	----------
20 carbon compound HQ	2082	----------	----------
20 carbon compound HR	2085	----------	----------
20 carbon compound HS	2090	----------	----------
20 carbon compound HT	2095	----------	----------
21 carbon compound HU	2100	----------	----------
21 carbon compound HV	2106	----------	----------
21 carbon compound HW	2109	----------	----------

Table B-2.--(continued)

Compounds	RI	DI	Quality
21 carbon compound HX	2112	----------	----------
21 carbon compound HY	2116	----------	----------
X-Tetracosenoic acid	2119	43, 55, 83, 97, 123, 348	93%
21 carbon compound HZ	2122	----------	----------
21 carbon compound IA	2126	----------	----------
21 carbon compound IB	2129	----------	----------
21 carbon compound IC	2132	----------	----------
21 carbon compound ID	2135	91, 129, 206, 207	----------
21 carbon compound IE	2141	----------	----------
21 carbon compound IF	2144	----------	----------
21 carbon compound IG	2150	91, 105, 129, 207	----------
21 carbon compound IH	2154	91, 129, 207	----------
21 carbon compound II	2159	----------	----------
21 carbon compound IJ	2162	----------	----------
21 carbon compound IK	2166	----------	----------
21 carbon compound IL	2170	91, 129, 207	----------
21 carbon compound IM	2176	91, 105, 129, 206, 207	----------
21 carbon compound IN	2181	----------	----------
21 carbon compound IO	2184	----------	----------
21 carbon compound IP	2187	91, 105, 129, 206, 207	----------
21 carbon compound IQ	2190	----------	----------
21 carbon compound IR	2194	87, 143, 311, 354	----------
Docosanoic acid	2200	43, 74, 87, 143, 354	94%
22 carbon compound IS	2205	43, 74, 87, 382	----------
22 carbon compound IT	2210	----------	----------
22 carbon compound IU	2215	----------	----------
22 carbon compound IV	2221	----------	----------
22 carbon compound IW	2225	----------	----------
22 carbon compound IX	2229	----------	----------
22 carbon compound IY	2232	----------	----------
22 carbon compound IZ	2237	----------	----------
22 carbon compound JA	2241	----------	----------
22 carbon compound JB	2245	----------	----------
22 carbon compound JC	2248	----------	----------
22 carbon compound JD	2252	----------	----------
22 carbon compound JE	2255	----------	----------
22 carbon compound JF	2259	104, 208, 312	----------
22 carbon compound JG	2262	----------	----------
22 carbon compound JH	2267	91, 104, 129, 207, 312	----------
22 carbon compound JI	2272	----------	----------
22 carbon compound JJ	2275	----------	----------
22 carbon compound JK	2279	----------	----------
22 carbon compound JL	2283	----------	----------
22 carbon compound JM	2286	----------	----------
22 carbon compound JN	2289	91, 129, 180, 207, 312	----------
22 carbon compound JO	2295	----------	----------
23 carbon compound JP	2300	----------	----------
23 carbon compound JQ	2305	----------	----------
23 carbon compound JR	2310	----------	----------
23 carbon compound JS	2315	74, 87, 143, 339, 382	----------

Table B-2.--(continued)

Compounds	RI	DI	Quality
23 carbon compound JT	2320	----------	----------
23 carbon compound JU	2325	----------	----------
23 carbon compound JV	2331	----------	----------
23 carbon compound JW	2335	----------	----------
23 carbon compound JX	2338	----------	----------
23 carbon compound JY	2343	----------	----------
23 carbon compound JZ	2347	----------	----------
23 carbon compound KA	2351	----------	----------
23 carbon compound KB	2354	----------	----------
23 carbon compound KC	2357	----------	----------
23 carbon compound KD	2362	74, 143, 410	----------
23 carbon compound KE	2370	43, 55, 83, 111, 348	----------
23 carbon compound KF	2374	----------	----------
23 carbon compound KG	2377	----------	----------
23 carbon compound KH	2382	----------	----------
23 carbon compound KI	2385	----------	----------
23 carbon compound KJ	2389	----------	----------
23 carbon compound KK	2394	----------	----------
3,7,11-trimethyl-(E,E)-2,6,10-Dodecatrien-1-ol	2400	41, 55, 69, 95	88%
24 carbon compound KL	2406	91, 105, 121, 145, 213	----------
24 carbon compound KM	2410	----------	----------
24 carbon compound KN	2415	----------	----------
24 carbon compound KO	2418	----------	----------
24 carbon compound KP	2422	----------	----------
24 carbon compound KQ	2425	----------	----------
24 carbon compound KR	2429	----------	----------
24 carbon compound KS	2433	----------	----------
24 carbon compound KT	2436	----------	----------
24 carbon compound KU	2440	----------	----------
24 carbon compound KV	2446	----------	----------
24 carbon compound KW	2450	----------	----------
24 carbon compound KX	2455	----------	----------
24 carbon compound KY	2460	----------	----------
24 carbon compound KZ	2465	----------	----------
24 carbon compound LA	2468	----------	----------
24 carbon compound LB	2471	91, 129, 180, 207, 312	----------
24 carbon compound LC	2475	----------	----------
24 carbon compound LD	2478	----------	----------
24 carbon compound LE	2481	----------	----------
24 carbon compound LF	2484	----------	----------
24 carbon compound LG	2487	43, 55, 83, 111, 376	----------
24 carbon compound LH	2490	----------	----------
24 carbon compound LI	2495	----------	----------
25 carbon compound LJ	2501	----------	----------
25 carbon compound LK	2508	----------	----------
25 carbon compound LL	2511	----------	----------
25 carbon compound LM	2514	----------	----------
25 carbon compound LN	2519	----------	----------
25 carbon compound LO	2522	----------	----------

Table B-2.--(continued)

Compounds	RI	DI	Quality
25 carbon compound LP	2525	----------	----------
25 carbon compound LQ	2528	----------	----------
25 carbon compound LR	2531	----------	----------
25 carbon compound LS	2535	----------	----------
25 carbon compound LT	2539	91, 129, 180, 207, 312	----------
25 carbon compound LU	2542	----------	----------
25 carbon compound LV	2547	----------	----------
25 carbon compound LW	2550	----------	----------
25 carbon compound LX	2553	----------	----------
25 carbon compound LY	2556	----------	----------
25 carbon compound LZ	2560	----------	----------
25 carbon compound MA	2563	----------	----------
25 carbon compound MB	2566	----------	----------
25 carbon compound MC	2570	----------	----------
25 carbon compound MD	2573	91, 117, 193, 207, 298	----------
25 carbon compound ME	2577	----------	----------
25 carbon compound MF	2580	----------	----------
25 carbon compound MG	2584	----------	----------
25 carbon compound MH	2589	91, 117, 193, 207, 298	----------
25 carbon compound MI	2596	----------	----------
26 carbon compound MJ	2600	----------	----------
26 carbon compound MK	2605	----------	----------
26 carbon compound ML	2608	----------	----------
26 carbon compound MM	2612	----------	----------
26 carbon compound MN	2615	----------	----------
26 carbon compound MO	2621	----------	----------
26 carbon compound MP	2624	----------	----------
26 carbon compound MQ	2627	----------	----------
26 carbon compound MR	2632	----------	----------
26 carbon compound MS	2640	----------	----------
26 carbon compound MT	2645	----------	----------
26 carbon compound MU	2649	----------	----------
26 carbon compound MV	2653	----------	----------
26 carbon compound MW	2656	----------	----------
26 carbon compound MX	2660	----------	----------
26 carbon compound MY	2665	----------	----------
26 carbon compound MZ	2670	----------	----------
26 carbon compound NA	2675	----------	----------
26 carbon compound NB	2680	----------	----------
26 carbon compound NC	2685	----------	----------
26 carbon compound ND	2690	----------	----------
26 carbon compound NE	2696	----------	----------
Cholesterol	2701	43, 275, 301, 386,	93%
27 carbon compound NF	2705	43, 55, 57, 74, 87	----------
27 carbon compound NG	2709	----------	----------
27 carbon compound NH	2712	43, 55, 69, 74, 87, 97	----------
27 carbon sterol	2717	43, 57, 275, 386	----------
27 carbon compound NI	2721	----------	----------
27 carbon compound NJ	2725	----------	----------
27 carbon compound NK	2731	----------	----------

Table B-2.--(continued)

Compounds	RI	DI	Quality
27 carbon compound NL	2736	----------	----------
27 carbon compound NM	2741	----------	----------
27 carbon compound NN	2745	----------	----------
27 carbon compound NO	2750	----------	----------
27 carbon compound NP	2757	----------	----------
27 carbon compound NQ	2760	----------	----------
27 carbon compound NR	2765	----------	----------
27 carbon compound NS	2770	----------	----------
27 carbon compound NT	2776	----------	----------
27 carbon compound NU	2781	----------	----------
27 carbon compound NV	2786	----------	----------
27 carbon compound NW	2791	----------	----------
27 carbon compound NX	2795	----------	----------
27 carbon compound NY	2798	----------	----------
28 carbon compound NZ	2800	----------	----------
28 carbon compound OA	2805	----------	----------
28 carbon compound OB	2810	----------	----------
28 carbon compound OC	2813	----------	----------
28 carbon compound OD	2816	----------	----------
28 carbon compound OE	2820	----------	----------
28 carbon compound OF	2825	----------	----------
28 carbon compound OG	2828	----------	----------
28 carbon compound OH	2831	----------	----------
28 carbon compound OI	2834	----------	----------
28 carbon compound OJ	2838	----------	----------
28 carbon compound OK	2841	----------	----------
28 carbon compound OL	2844	----------	----------
28 carbon compound OM	2847	----------	----------
28 carbon compound ON	2850	----------	----------
28 carbon compound OO	2853	----------	----------
28 carbon compound OP	2856	----------	----------
28 carbon compound OQ	2864	----------	----------
28 carbon compound OR	2867	----------	----------
28 carbon compound OS	2870	----------	----------
28 carbon compound OT	2874	----------	----------
28 carbon compound OU	2880	----------	----------
28 carbon compound OV	2883	----------	----------
28 carbon compound OW	2886	----------	----------
28 carbon compound OX	2890	----------	----------
29 carbon compound OY	2900	----------	----------
29 carbon compound OZ	2906	----------	----------
29 carbon compound PA	2910	----------	----------
29 carbon compound PB	2915	----------	----------
29 carbon compound PC	2920	----------	----------
29 carbon compound PD	2925	----------	----------
29 carbon compound PE	2930	----------	----------
29 carbon compound PF	2935	----------	----------
29 carbon compound PG	2940	----------	----------
29 carbon compound PH	2943	----------	----------
29 carbon compound PI	2946	----------	----------

Table B-2.–(continued)

Compounds	RI	DI	Quality
29 carbon compound PJ	2949	----------	----------
29 carbon compound PK	2953	----------	----------
29 carbon compound PL	2956	----------	----------
29 carbon compound PM	2960	----------	----------
29 carbon compound PN	2968	----------	----------
29 carbon compound PO	2972	----------	----------
29 carbon compound PP	2976	----------	----------
29 carbon compound PQ	2979	----------	----------
29 carbon compound PR	2983	----------	----------
29 carbon compound PS	2988	----------	----------
29 carbon compound PT	2993	----------	----------
30 carbon compound PU	3000	----------	----------
30 carbon compound PV	3007	----------	----------
30 carbon compound PW	3010	----------	----------
30 carbon compound PX	3015	----------	----------
30 carbon compound PY	3019	----------	----------
30 carbon compound PZ	3022	----------	----------
30 carbon compound QA	3034	----------	----------
30 carbon compound QB	3055	----------	----------
30 carbon compound QC	3061	----------	----------
30 carbon compound QD	3065	----------	----------
30 carbon compound QE	3074	----------	----------
30 carbon compound QF	3081	----------	----------
30 carbon compound QG	3084	----------	----------
30 carbon compound QH	3091	----------	----------
30 carbon compound QI	3097	----------	----------
31 carbon compound QJ	3103	----------	----------
31 carbon compound QK	3119	----------	----------
31 carbon compound QL	3124	----------	----------
31 carbon compound QM	3154	----------	----------

Table B-3.--Phospholipids present in anal sacs of felid species. The retention index (RI), diagnostic ions (DI) and quality identification is given for each compound.

Compounds	RI	DI	Quality
11 carbon compound A	1110	----------	----------
11 carbon compound B	1123	----------	----------
11 carbon compound C	1126	----------	----------
11 carbon compound D	1134	----------	----------
11 carbon compound E	1148	----------	----------
11 carbon compound F	1152	----------	----------
11 carbon compound G	1156	----------	----------
11 carbon compound H	1166	----------	----------
11 carbon compound I	1174	----------	----------
11 carbon compound J	1178	----------	----------
11 carbon compound K	1181	----------	----------
11 carbon compound L	1187	----------	----------
11 carbon compound M	1193	----------	----------
12 carbon compound N	1200	----------	----------
12 carbon compound O	1208	----------	----------
12 carbon compound P	1215	----------	----------
12 carbon compound Q	1219	----------	----------
12 carbon compound R	1224	----------	----------
12 carbon compound S	1228	----------	----------
12 carbon compound T	1235	----------	----------
12 carbon compound U	1238	----------	----------
12 carbon compound V	1244	----------	----------
12 carbon compound W	1247	----------	----------
12 carbon compound X	1251	----------	----------
12 carbon compound Y	1259	----------	----------
12 carbon compound Z	1267	----------	----------
12 carbon compound AA	1270	----------	----------
12 carbon compound AB	1274	----------	----------
12 carbon compound AC	1278	----------	----------
12 carbon compound AD	1286	74, 143, 149, 163, 199	----------
12 carbon compound AE	1294	----------	----------
12 carbon compound AF	1298	----------	----------
13 carbon compound AG	1302	----------	----------
13 carbon compound AH	1308	----------	----------
13 carbon compound AI	1315	----------	----------
13 carbon compound AJ	1322	----------	----------
13 carbon compound AK	1327	----------	----------
13 carbon compound AL	1330	----------	----------
13 carbon compound AM	1335	----------	----------
13 carbon compound AN	1341	----------	----------
13 carbon compound AO	1344	----------	----------
X-methyl pentadecanoic acid	1347	74, 87, 143, 227, 270	----------
13 carbon compound AP	1353	----------	----------
13 carbon compound AQ	1357	57, 82, 96, 123	----------
13 carbon compound AR	1360	----------	----------
13 carbon compound AS	1369	----------	----------

Table B-3.–(continued)

Compounds	RI	DI	Quality
13 carbon compound AT	1373	----------	----------
13 carbon compound AU	1378	----------	----------
13 carbon compound AV	1382	----------	----------
13 carbon compound AW	1386	----------	----------
13 carbon compound AX	1391	----------	----------
13 carbon compound AY	1394	----------	----------
Tetradecanoic acid	1400	43, 55, 74, 87	98%
14 carbon compound AZ	1407	----------	----------
14 carbon compound BA	1411	----------	----------
14 carbon compound BB	1416	----------	----------
14 carbon compound BC	1420	----------	----------
14 carbon compound BD	1423	----------	----------
14 carbon compound BE	1428	----------	----------
14 carbon compound BF	1434	----------	----------
14 carbon compound BG	1438	----------	----------
14 carbon compound BH	1442	----------	----------
14 carbon compound BI	1447	----------	----------
14 carbon compound BJ	1450	----------	----------
14 carbon compound BK	1453	----------	----------
14 carbon compound BL	1460	43, 55, 74, 87, 143, 213	----------
14 carbon compound BM	1464	74, 87, 143, 199, 213	----------
14 carbon compound BN	1467	41, 55, 74, 87	----------
14 carbon compound BO	1470	----------	----------
14 carbon compound BP	1475	----------	----------
14 carbon compound BQ	1478	41, 55, 68, 90, 95, 197	----------
14 carbon compound BR	1483	----------	----------
14 carbon compound BS	1486	----------	----------
14 carbon compound BT	1490	----------	----------
Pentadecanoic acid	1495	43, 55, 74, 87	96%
15 carbon compound BU	1500	----------	----------
15 carbon compound BV	1504	----------	----------
15 carbon alcohol	1510	43, 55, 69, 97, 199	----------
15 carbon compound BW	1514	----------	----------
15 carbon compound BX	1518	----------	----------
15 carbon compound BY	1522	----------	----------
15 carbon compound BZ	1528	----------	----------
15 carbon compound CA	1534	----------	----------
15 carbon compound CB	1537	----------	----------
15 carbon compound CC	1540	----------	----------
15 carbon compound CD	1546	----------	----------
15 carbon compound CE	1550	----------	----------
15 carbon compound CF	1556	----------	----------
15 carbon compound CG	1560	74, 87, 143, 227, 270	----------
15 carbon compound CH	1564	----------	----------
(Z)-7-Hexadecenoic acid	1567	41, 55, 74, 84, 97, 194	81%
15 carbon compound CI	1570	55, 69, 84, 87, 110, 152	----------
15 carbon compound CJ	1573	69, 83, 96, 152, 194, 237	----------
15 carbon compound CL	1576	----------	----------

Table B-3.--(continued)

Compounds	RI	DI	Quality
15 carbon compound CM	1582	41, 55, 69, 90, 213	----------
15 carbon compound CN	1585	----------	----------
15 carbon compound CO	1588	----------	----------
15 carbon compound CP	1592	----------	----------
X-methyl pentadcanoic acid	1595	74, 87, 143, 227, 270	----------
Hexadecanoic acid	1600	43, 55, 74, 87	98%
16 carbon compound CQ	1604	----------	----------
16 carbon compound CR	1609	----------	----------
16 carbon compound CS	1612	----------	----------
16 carbon compound CT	1615	----------	----------
16 carbon compound CU	1619	----------	----------
16 carbon compound CV	1629	----------	----------
16 carbon compound CW	1636	----------	----------
16 carbon compound CX	1639	----------	----------
16 carbon compound CY	1642	----------	----------
16 carbon compound CZ	1645	----------	----------
16 carbon compound DA	1649	----------	----------
16 carbon compound DB	1655	----------	----------
16 carbon compound DC	1659	----------	----------
16 carbon compound DD	1663	----------	----------
16 carbon compound DE	1666	----------	----------
16 carbon compound DF	1670	74, 87, 97, 143, 241, 284	----------
16 carbon compound DG	1675	----------	----------
16 carbon compound DH	1679	----------	----------
16 carbon compound DI	1684	87, 113, 237, 252	----------
16 carbon compound DJ	1687	----------	----------
16 carbon compound DK	1691	----------	----------
16 carbon compound DL	1695	74, 87, 143, 241, 284	----------
17 carbon compound DM	1700	74, 87, 143, 241, 284	----------
17 carbon compound DN	1709	----------	----------
17 carbon compound DO	1712	----------	----------
17 carbon compound DP	1721	----------	----------
17 carbon compound DQ	1724	----------	----------
17 carbon compound DR	1729	----------	----------
17 carbon compound DS	1733	----------	----------
17 carbon compound DT	1736	----------	----------
17 carbon compound DU	1739	----------	----------
17 carbon compound DV	1742	----------	----------
17 carbon compound DW	1745	----------	----------
17 carbon compound DX	1750	----------	----------
17 carbon compound DY	1754	67, 95, 96, 263, 294	----------
17 carbon compound DZ	1758	67, 81, 96, 150, 263, 294	----------
(Z,Z)-9,12-Octadecadienoic acid	1761	41, 55, 67, 95, 109	99%
17 carbon compound EA	1764	----------	----------
17 carbon compound EB	1767	74, 87, 96, 180, 222, 264	----------
X-Octadecanoic acid	1770	41, 55, 87, 97, 264	99%
17 carbon compound EC	1774	74, 96, 97, 180, 222, 264	----------

Table B-3.--(continued)

Compounds	RI	DI	Quality
17 carbon compound ED	1778	----------	----------
17 carbon compound EE	1783	----------	----------
17 carbon compound EF	1787	----------	----------
17 carbon compound EG	1793	----------	----------
17 carbon compound EH	1797	----------	----------
Octadecanoic acid	1800	74, 87, 143, 255, 298	98%
18 carbon compound EI	1805	----------	----------
18 carbon compound EJ	1813	----------	----------
18 carbon compound EK	1826	----------	----------
18 carbon compound EL	1829	----------	----------
18 carbon compound EM	1834	----------	----------
18 carbon compound EN	1837	----------	----------
18 carbon compound EO	1845	87, 113, 222, 265	----------
18 carbon compound EP	1848	----------	----------
18 carbon compound EQ	1851	----------	----------
18 carbon compound ER	1854	----------	----------
18 carbon compound ES	1858	----------	----------
18 carbon compound ET	1862	----------	----------
18 carbon compound EU	1865	----------	----------
18 carbon compound EV	1870	----------	----------
18 carbon compound EW	1873	----------	----------
18 carbon compound EX	1877	----------	----------
18 carbon compound EY	1881	----------	----------
18 carbon compound EZ	1885	----------	----------
18 carbon compound FA	1888	----------	----------
18 carbon compound FB	1891	----------	----------
19 carbon compound FC	1904	----------	----------
19 carbon compound FD	1907	----------	----------
19 carbon compound FE	1911	----------	----------
19 carbon compound FF	1914	----------	----------
19 carbon compound FG	1917	79, 91, 119, 133, 150	----------
19 carbon compound FH	1921	----------	----------
19 carbon compound FI	1924	----------	----------
19 carbon compound FJ	1927	----------	----------
19 carbon compound FK	1931	----------	----------
19 carbon compound FL	1934	----------	----------
19 carbon compound FM	1938	----------	----------
19 carbon compound FN	1941	81, 95, 121, 150, 219	----------
19 carbon compound FO	1944	----------	----------
19 carbon compound FP	1947	79, 95, 108, 121, 150	----------
19 carbon compound FQ	1950	81, 95, 109, 150, 164	----------
19 carbon compound FR	1954	----------	----------
19 carbon compound FS	1957	----------	----------
19 carbon compound FT	1962	----------	----------
19 carbon compound FU	1966	----------	----------
19 carbon compound FV	1969	----------	----------
19 carbon compound FW	1972	----------	----------
19 carbon compound FX	1980	81, 95, 109, 123, 322	----------

Table B-3.--(continued)

Compounds	RI	DI	Quality
19 carbon compound FY	1984	----------	----------
19 carbon compound FZ	1988	----------	----------
19 carbon compound GA	1991	74, 97, 208, 250, 292	----------
19 carbon compound GB	1995	----------	----------
20 carbon compound GC	2000	74, 87, 143, 283, 326	----------
20 carbon compound GD	2005	----------	----------
20 carbon compound GE	2008	----------	----------
20 carbon compound GF	2014	----------	----------
20 carbon compound GG	2017	----------	----------
20 carbon compound GH	2020	----------	----------
20 carbon compound GI	2024	----------	----------
20 carbon compound GJ	2028	----------	----------
20 carbon compound GK	2031	----------	----------
20 carbon compound GL	2034	----------	----------
20 carbon compound GM	2037	----------	----------
20 carbon compound GN	2041	----------	----------
20 carbon compound GO	2047	----------	----------
20 carbon compound GP	2050	----------	----------
20 carbon compound GQ	2054	----------	----------
20 carbon compound GR	2059	----------	----------
20 carbon compound GS	2067	----------	----------
20 carbon compound GT	2070	----------	----------
20 carbon compound GU	2074	----------	----------
20 carbon compound GV	2082	----------	----------
20 carbon compound GW	2085	----------	----------
20 carbon compound GX	2088	----------	----------
20 carbon compound GY	2093	----------	----------
21 carbon compound GZ	2100	----------	----------
21 carbon compound HA	2109	----------	----------
21 carbon compound HB	2112	----------	----------
21 carbon compound HC	2115	----------	----------
21 carbon compound HD	2118	----------	----------
21 carbon compound HE	2125	----------	----------
21 carbon compound HF	2129	----------	----------
21 carbon compound HG	2133	----------	----------
21 carbon compound HH	2136	----------	----------
21 carbon compound HI	2139	----------	----------
21 carbon compound HJ	2142	----------	----------
21 carbon compound HK	2145	----------	----------
21 carbon compound HL	2150	----------	----------
21 carbon compound HM	2154	----------	----------
21 carbon compound HN	2159	----------	----------
21 carbon compound HO	2162	----------	----------
21 carbon compound HP	2167	91, 105, 119, 159, 252	----------
21 carbon compound HQ	2170	----------	----------
21 carbon compound HR	2176	----------	----------
21 carbon compound HS	2182	79, 91, 119, 150, 208	----------
21 carbon compound HT	2185	----------	----------

Table B-3.--(continued)

Compounds	RI	DI	Quality
21 carbon compound HU	2188	79, 91, 119, 133	----------
21 carbon compound HV	2191	----------	----------
21 carbon compound HW	2195	----------	----------
22 carbon compound HX	2200	----------	----------
22 carbon compound HY	2207	67, 95, 109, 121, 205	----------
22 carbon compound HZ	2216	79, 95, 108, 121, 217	----------
22 carbon compound IA	2219	82, 95, 109	----------
22 carbon compound IB	2227	----------	----------
22 carbon compound IC	2234	----------	----------
22 carbon compound ID	2240	----------	----------
22 carbon compound IE	2244	----------	----------
22 carbon compound IF	2247	----------	----------
22 carbon compound IG	2251	----------	----------
22 carbon compound IH	2259	----------	----------
22 carbon compound II	2263	----------	----------
22 carbon compound IJ	2270	----------	----------
22 carbon compound IK	2280	----------	----------
22 carbon compound IL	2284	----------	----------
22 carbon compound IM	2290	----------	----------
22 carbon compound IN	2295	----------	----------
23 carbon compound IO	2300	----------	----------
23 carbon compound IP	2305	----------	----------
23 carbon compound IQ	2309	----------	----------
23 carbon compound IR	2318	----------	----------
23 carbon compound IS	2323	----------	----------
23 carbon compound IT	2328	----------	----------
23 carbon compound IU	2335	----------	----------
23 carbon compound IV	2340	----------	----------
23 carbon compound IW	2343	----------	----------
23 carbon compound IX	2347	----------	----------
23 carbon compound IY	2350	----------	----------
23 carbon compound IZ	2353	----------	----------
23 carbon compound JA	2356	----------	----------
23 carbon compound JB	2361	----------	----------
23 carbon compound JC	2369	----------	----------
23 carbon compound JD	2372	----------	----------
23 carbon compound JE	2383	----------	----------
23 carbon compound JF	2386	----------	----------
23 carbon compound JG	2397	----------	----------
23 carbon compound JH	2400	----------	----------
24 carbon compound JI	2408	----------	----------
24 carbon compound JJ	2412	----------	----------
24 carbon compound JK	2422	----------	----------
24 carbon compound JL	2431	----------	----------
24 carbon compound JM	2435	----------	----------
24 carbon compound JN	2441	----------	----------
24 carbon compound JO	2444	----------	----------
24 carbon compound JP	2453	----------	----------

Table B-3.--(continued)

Compounds	RI	DI	Quality
24 carbon compound JQ	2459	----------	----------
24 carbon compound JR	2463	----------	----------
24 carbon compound JS	2471	----------	----------
24 carbon compound JT	2475	----------	----------
24 carbon compound JU	2480	----------	----------
24 carbon compound JV	2485	----------	----------
24 carbon compound JW	2488	----------	----------
24 carbon compound JX	2493	----------	----------
24 carbon compound JY	2496	----------	----------
24 carbon compound JZ	2501	----------	----------
25 carbon compound KA	2508	----------	----------
25 carbon compound KB	2511	----------	----------
25 carbon compound KC	2515	----------	----------
25 carbon compound KD	2520	----------	----------
25 carbon compound KE	2524	----------	----------
25 carbon compound KF	2530	----------	----------
25 carbon compound KG	2534	----------	----------
25 carbon compound KH	2543	----------	----------
25 carbon compound KI	2546	----------	----------
25 carbon compound KJ	2549	----------	----------
25 carbon compound KK	2552	----------	----------
25 carbon compound KL	2556	----------	----------
25 carbon compound KM	2559	----------	----------
25 carbon compound KN	2568	----------	----------
25 carbon compound KO	2571	85, 97, 111, 304, 330	----------
25 carbon compound KP	2575	----------	----------
25 carbon compound KQ	2579	----------	----------
25 carbon compound KR	2585	----------	----------
25 carbon compound KS	2588	----------	----------
25 carbon compound KT	2592	----------	----------
25 carbon compound KU	2598	----------	----------
25 carbon compound KV	2601	----------	----------
26 carbon compound KW	2606	----------	----------
26 carbon compound KX	2611	----------	----------
26 carbon compound KY	2614	----------	----------
26 carbon compound KZ	2620	----------	----------
26 carbon compound LA	2623	----------	----------
26 carbon compound LB	2627	----------	----------
26 carbon compound LC	2631	----------	----------
26 carbon compound LD	2638	----------	----------
26 carbon compound LE	2641	----------	----------
26 carbon compound LF	2644	----------	----------
26 carbon compound LG	2650	----------	----------
26 carbon compound LH	2655	----------	----------
26 carbon compound LI	2662	----------	----------
26 carbon compound LJ	2666	----------	----------
26 carbon compound LK	2672	----------	----------
26 carbon compound LL	2676	----------	----------

Table B-3.–(continued)

Compounds	RI	DI	Quality
26 carbon sterol	2680	108, 147, 215, 257, 370	----------
26 carbon compound LM	2687	----------	----------
26 carbon compound LN	2690	----------	----------
26 carbon compound LO	2696	----------	----------
26 carbon compound LP	2700	----------	----------
Cholesterol	2705	145, 213, 247, 368	----------
27 carbon compound LQ	2710	----------	----------
27 carbon compound LR	2716	----------	----------
27 carbon compound LS	2719	----------	----------
27 carbon compound LT	2722	----------	----------
27 carbon compound LU	2725	----------	----------
27 carbon compound LV	2728	----------	----------
27 carbon compound LW	2731	----------	----------
27 carbon compound LX	2735	----------	----------
27 carbon compound LY	2738	----------	----------
27 carbon compound LZ	2743	----------	----------
27 carbon compound MA	2747	----------	----------
27 carbon compound MB	2751	----------	----------
27 carbon compound MC	2757	----------	----------
27 carbon compound MD	2762	----------	----------
27 carbon compound ME	2766	----------	----------
27 carbon compound MF	2771	----------	----------
27 carbon compound MG	2781	----------	----------
27 carbon compound MH	2784	----------	----------
27 carbon compound MI	2790	----------	----------
27 carbon compound MJ	2793	----------	----------
27 carbon compound MK	2798	----------	----------
27 carbon compound ML	2803	----------	----------
28 carbon compound MM	2807	----------	----------
28 carbon compound MN	2813	----------	----------
28 carbon compound MO	2818	----------	----------
28 carbon compound MP	2824	----------	----------
28 carbon compound MQ	2827	----------	----------
28 carbon compound MR	2830	----------	----------
28 carbon compound MS	2833	----------	----------
28 carbon compound MT	2842	----------	----------
28 carbon compound MU	2846	----------	----------
28 carbon compound MV	2850	----------	----------
28 carbon compound MW	2854	----------	----------
28 carbon compound MX	2857	----------	----------
28 carbon compound MY	2860	----------	----------
28 carbon compound MZ	2863	----------	----------
28 carbon compound NA	2866	----------	----------
28 carbon compound NB	2869	----------	----------
28 carbon compound NC	2873	----------	----------
28 carbon compound ND	2876	----------	----------
28 carbon compound NE	2882	----------	----------
28 carbon compound NF	2885	----------	----------

Table B-3.–(continued)

Compounds	RI	DI	Quality
28 carbon compound NG	2890	----------	----------
28 carbon compound NH	2893	----------	----------
28 carbon compound NI	2897	----------	----------
28 carbon compound NJ	2900	----------	----------
29 carbon compound NK	2904	----------	----------
29 carbon compound NL	2911	----------	----------
29 carbon compound NM	2920	----------	----------
29 carbon compound NN	2923	----------	----------
29 carbon compound NO	2932	----------	----------
29 carbon compound NP	2935	----------	----------
29 carbon compound NQ	2938	----------	----------
29 carbon compound NR	2941	----------	----------
29 carbon compound NS	2946	----------	----------
29 carbon compound NT	2952	----------	----------
29 carbon compound NU	2955	----------	----------
29 carbon compound NV	2958	----------	----------
29 carbon compound NW	2962	----------	----------
29 carbon compound NX	2966	----------	----------
29 carbon compound NY	2974	----------	----------
29 carbon compound NZ	2983	----------	----------
29 carbon compound OA	2986	----------	----------
29 carbon compound OB	2990	----------	----------
29 carbon compound OC	2996	----------	----------
29 carbon compound OD	3002	----------	----------
30 carbon compound OE	3005	----------	----------
30 carbon compound OF	3009	----------	----------
30 carbon compound OG	3016	----------	----------
30 carbon compound OH	3019	----------	----------
30 carbon compound OI	3026	----------	----------
30 carbon compound OJ	3035	----------	----------
30 carbon compound OK	3040	----------	----------
30 carbon compound OL	3045	----------	----------
30 carbon compound OM	3050	----------	----------
30 carbon compound ON	3057	----------	----------
30 carbon compound OO	3061	----------	----------
30 carbon compound OP	3068	----------	----------
30 carbon compound OQ	3072	----------	----------
30 carbon compound OR	3083	----------	----------
30 carbon compound OS	3086	----------	----------
30 carbon compound OT	3090	----------	----------
30 carbon compound OU	3097	----------	----------
30 carbon compound OV	3103	----------	----------
30 carbon compound OW	3110	----------	----------
31 carbon compound OX	3124	----------	----------
31 carbon compound OY	3132	----------	----------
31 carbon compound OZ	3136	----------	----------
31 carbon compound PA	3155	----------	----------
31 carbon compound PB	3179	----------	----------

VITAE

Denise M. Decker was born in Troy, Pennsylvania on July 3, 1965. She attended grade school at Ridgebury Elementary School and graduated from SRU High School in June 1983. She entered Shippensburg University in the Fall of 1983 and received a Bachelor of Science degree in Biology in May 1987. From June 1987 through August 1987, she held a fellowship at the Smithsonian Institution in Washington D.C. which allowed her to complete a senior research project and to begin collecting data for her Masters degree. She went to Memphis State University in August 1987 to complete a Master of Science degree in Zoology which she obtained in May 1990. She then went to The University of Tennessee to pursue a doctoral degree in Life Sciences.

While obtaining her doctoral degree at The University of Tennessee, Denise worked as an instructor/tutor for the Upward Bound Program. She is currently the Associate Director of the Pre-College Math and Science Regional Center at The University of Tennessee.