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AN ANALYSIS OF MASKED BOBWHITE COLLECTION LOCALES AND HABITAT CHARACTERISTICS

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ABSTRACT

We evaluated the collecting locales of 251 masked bobwhite (*Colinus virginianus ridgwayi*) specimens in museum collections. Eighteen were from 4 sites in Arizona—all collected by Herbert Brown. The vast majority (93%) of specimens were from the Mexican State of Sonora. We visited and photographed each of the Arizona collection locations and most of the sites in Sonora. Collector descriptions indicate the bird's principal habitat affiliations were with tall grass-weed (= forb) pastures, savannas, and farm fields. All historic localities visited were either in grass-forb habitats along drainages or in present or former savannas adjacent to woody cover and/or agricultural fields between 240 and 1,060 m elevation. These sites were remarkably similar to other bobwhite habitats in subtropic-tropic South Texas and Oaxaca, Mexico. Masked bobwhite habitat was a diverse tropic-subtropic grassland within or adjacent to dense woody cover (thornscrub) and/or farmland. These habitats experienced alterations and loss of the tall grass-weed component due to livestock husbandry. Some former habitat sites appear to have recovered, however, and restoration of the subspecies might be possible if suitable stock exists. Unfortunately, this bird may now be functionally extinct.

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Key words: Arizona, Buenos Aires National Wildlife Refuge, *Colinus virginianus ridgwayi*, domestic quail, endangered species, grass, grassland, masked bobwhite, museum collections, savanna, Sonora

INTRODUCTION

“It is doubtless properly a Mexican species, which extends northward for only a short distance beyond the Arizona line, and southward into Mexico for an unknown distance, where possibly—we may almost say probably—it merges into C. graysoni.”

J. A. Allen 1886a: 287

Few events generated more interest within the ornithological community than discovery in Arizona of the masked bobwhite by Herbert Brown on 6 March 1884 (Brown 1884; Grinnell 1884; Allen 1886a, b, c; 1887). That all of the U.S. specimens of this unique subspecies of a favorite American bird originated with Herbert Brown, and that his identification was twice challenged by Robert Ridgway of the U.S. National Museum, created an aura of mystique that continues to this day (Ridgway 1884, 1886). Especially intriguing to naturalists was the bird's isolation

from other bobwhite populations and restricted range in 1 U.S. and 1 Mexican state (Aldrich and Duvall 1955). This isolation, coupled with the bird's disappearance from Arizona by 1900, generated a number of conservation efforts, none of which succeeded.

Describing masked bobwhite habitat requirements is difficult since the bird's original habitats have been greatly altered. Only one scientific study of wild birds has been conducted (Tomlinson 1972a, b), and that of a relict population discovered in Sonora after the bird was thought to have vanished (Gallizioli et al. 1967). This population also appears to have vanished, and reintroduction attempts on and off Buenos Aires National Wildlife Refuge in Arizona, appear to have been unsuccessful (Unpublished reports, U.S. Fish and Wildlife Service, Albuquerque, NM, USA). Locating wild birds and maintaining a wild population of masked bobwhites are essential if the taxon is to survive.

We reasoned the key to locating any relict populations of masked bobwhite depends on being able to define and locate suitable habitats where birds may survive. That such an evaluation remains possible is due to the bird's

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collectors, Herbert Brown, H. C. Benson, J. C. Cahoon, Frank Stephens, Robert T. Moore, J. T. Wright, W. W. Brown, David M. Gorsuch, J. Stokley Ligon, Louis L. Lawson, and A. J. Van Rossem, who, cognizant of the bird's unique character, not only plotted the localities of their collections but, in many cases, described the bird's habitat affinities. Also helpful were the observations of earlier investigators such as Neff (1947), who observed a covey of ~ 30 birds a few kilometers south of Punta Agua in the north end of the Valle de Agua Caliente, Sonora.

METHODS

We examined all available museum records, articles, field notes, and correspondence accompanying masked bobwhite collection locales. The location of each collection was mapped and data from the nearest weather station having mean monthly precipitation and temperatures were recorded. The collector's notes and publications were reviewed along with any descriptions of the elevation, landscape physiognomy, and vegetation composition/structure. Our intention was to describe what constituted masked bobwhite habitat at the time the collections were made.

Facilitating this effort in Arizona was former University of Arizona bird collection curator Tom Huels' (2009) transcription of Herbert Brown's field notes and specimen records, data that he generously shared. We visited collections holding masked bobwhite at the San Diego Natural History Museum, Moore Laboratory of Zoology at Occidental College, University of California, Los Angeles, University of Arizona, Los Angeles County Museum of Natural History, U. S. National Museum, University of New Mexico, and the British Museum of Natural History. We extracted any habitat information including habitat descriptions by Robert Moore at Occidental College. All collection locales were mapped (Fig. 1).

We arranged two flights with Sandy Lanham of Environmental Flying Services (Tucson, AZ) to survey all former collection locales in Sonora not previously visited on the ground and historically difficult of access such as the Yaqui Indian lands (Table 1). This was accomplished by flying a general survey over mapped collection sites, and conducting low-level (120–150 m) transects ~ 2 km apart over the most promising appearing sites with abundant grass and/or forb cover. Flights were in a 4-seat Cessna aircraft, the observers (DEB and KBC) directing the pilot to re-survey areas having good grass and/or weed cover. Flight paths were recorded with a Global Positioning System (GPS) unit and positions and photographs taken of the most promising sites.

Our first flight covered most of the bobwhite range in Sonora and identified several promising areas for further investigation. Small rivers such as the Ríos Moctezuma and Sonora at the northern end of the range showed extensive agricultural areas with fallow fields and river bottoms supporting abundant grass and weed cover. Another area worthy of further investigation included the volcanic mesas southeast of Moctezuma near the town

of Tepache. This area supports varying densities of shrub cover interspersed with savanna-like herblands (Fig. 2). The volcanic rock nature of these mesas limits water development and the ability of cattle to disperse, resulting in dense patches of herbaceous vegetation in openings and underneath the scrub.

The second flight included habitats in the Valle Agua Caliente east of Sierra Bacatete. This area is south of Rancho Las Arenas where W. W. Brown collected > 100 specimens in December 1905 and January 1906 (Appendix). Areas south of Rancho Las Arenas have been difficult to access due to their status as Yaqui Indian territory (Moore 1932). Our over-flight in December 2011 revealed potential habitat continues south of Las Arenas for ~ 20 km, in the vicinity of Rancho Agua Caliente. These lands, mostly on the Yaqui Indian Reservation, contained the most promising sites seen to date and necessitated a ground survey before making any evaluation of the bird's status in Sonora.

All collection locales in Arizona were visited on the ground as were the most important sites in Sonora. Photographs and GPS locations of what appeared to have been bobwhite habitat were taken in the immediate vicinity of the collection locales with notes taken on the date, elevation, vegetation present, and overall habitat condition. These photographs were compared to descriptions of the earlier collectors with both positive and negative changes noted.

On 23, 24, and 25 February 2012, we (DEB, RAB, KBC) conducted a ground survey on the Yaqui Indian lands based on historic collection locales and an aerial reconnaissance. Sites selected represented both *sabana* (savanna) and *bajío* (bottomland) habitats and included the best appearing bobwhite habitats remaining in Sonora. Ing. Cristina Melendez and Eberado Sanchez Camero (Comisión de Ecología y Desarrollo Sustentable del Estado de Sonora [CEDES]) coordinated the survey led by Anibella Carlón Flores, representing the Yaqui Nation. Accompanying us at all times were Yaqui Vigilancias: Jefe Guadalupe (Pluma Blanca) Ochoa, José Juan Terán Enríquez, Isábel Lugo (Chabelo) Molina, Eladio Molina (Layo) Azvala, and Marco Antonio Carlén Flores, who also assisted in the search and bird identification.

We conducted 8 separate surveys, each with a pair of trained hunting dogs (English pointers), in the vicinity of Rancho Agua Caliente. All 12 hrs of survey time were during the early morning or late afternoon to prevent the dogs from overheating. Six surveys were in the vicinity of GPS locations having abundant grass and/or tall, weedy vegetation within open thornscrub with another in the vicinity of a reservoir. One morning was spent surveying an *Amaranthus*-choked bottomland bordered by savanna and thornscrub. Several verdin (*Auriparus flaviceps*) and cactus wren (*Campylorhynchus brunneicapillus*) nests were examined, and those feathers that could not be identified as not belonging to bobwhite collected for comparison to museum specimens. In toto, 20.76 km of surveys were conducted covering 159 ha of habitat.

We (DEB, RDB, KBC) also visited and photographed bobwhite habitat sites in tropical arid environments in the vicinity of Salina Cruz, Oaxaca, and Laguna Atascosa

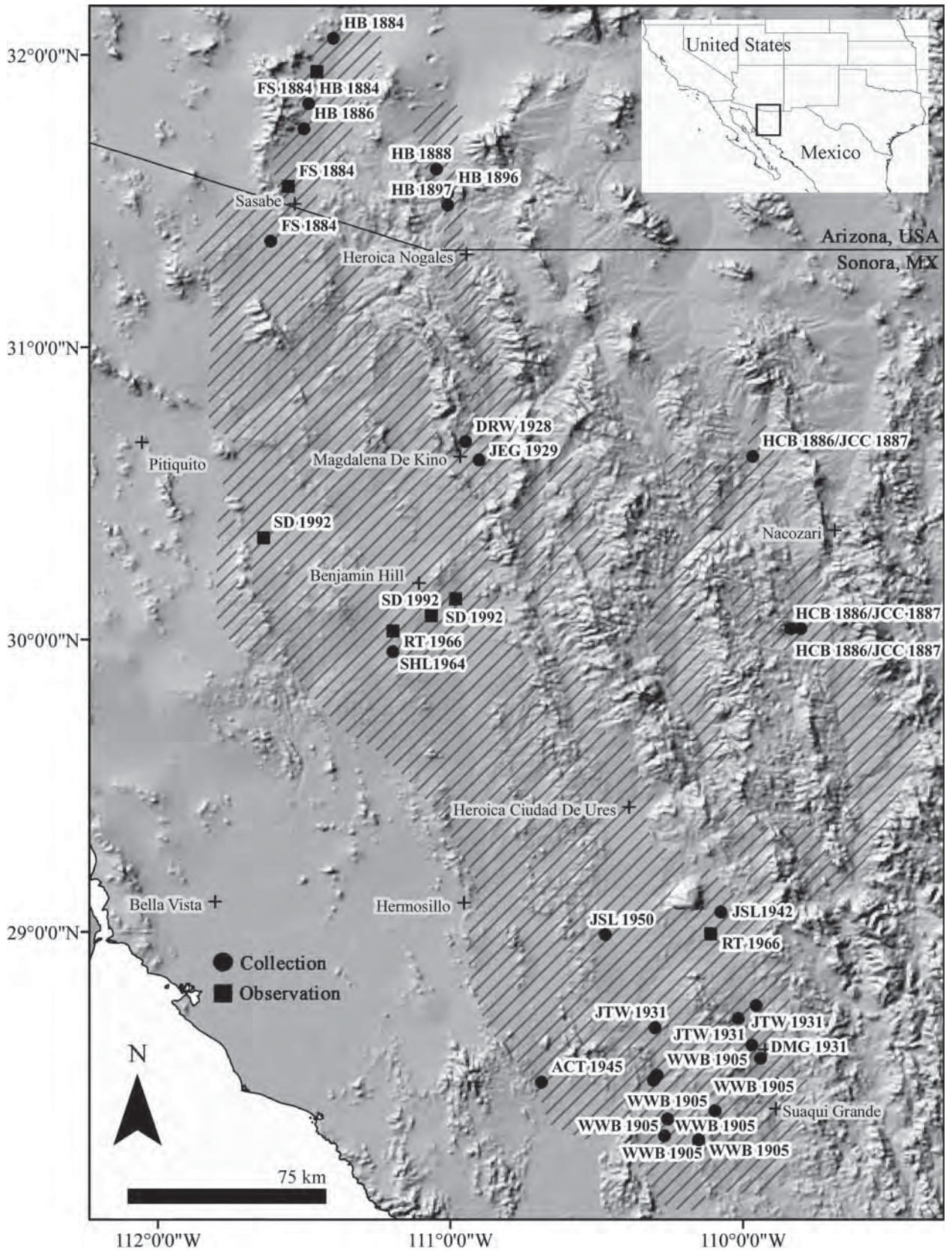


Fig. 1. Locations and years of masked bobwhite collections in southern Arizona and Sonora, Mexico, 1884–1992.

Table 1. Aerial and ground surveys for masked bobwhite habitat field work, 2009–2012.

Dates	Locations	Purpose
Aerial reconnaissance 14–17 Dec 2009	Overview of all historic collection locales in Sonora	Assess current condition of vegetation and locate potential sites for ground visits
Ground reconnaissance 19–20 Jan 2010	Rancho Carrizo, Rancho El Arpa, Rancho El Cuervo, Benjamin Hill, Sonora	Assess habitat of last remaining wild population of masked bobwhite
Ground reconnaissance 29 Aug-4 Sep 2010	San Marcial and La Misa vicinities; Rancho El Triguito, Rancho Las Arenas areas in Sonora	Ground check habitat of promising locales seen from over flight
Ground reconnaissance 7-11 Feb 2011	Salina Cruz, Oaxaca	Assess habitat of healthy tropical bobwhite population
Ground reconnaissance 16 Jul-21 Aug 2011	Tubac, Calabasas, Altar Valley, Arizona	Assess habitat in historic collection locales in AZ
Ground reconnaissance 12–16 Oct 2011	Laguna Atascosa NWR, Sal del Ray NWR, Texas	Assess habitat of healthy subtropical bobwhite population
Ground reconnaissance 19–23 Oct 2011	Cumpas, Moctezuma, Bacoachi, Arizpe, Sonora	Assess habitat in historic collection locales in northern Sonora.
Aerial reconnaissance 29 Nov-2 Dec 2011	Valle Agua Caliente, Sonora	Overflight of potential habitat at southern edge of historic range.
Ground search with bird dogs 23–25 Feb 2012	Valle del Agua Caliente area of Yaqui Indian Reservation, Sonora	Search for presence of masked bobwhite



Fig. 2. Savanna vegetation on the volcanic mesa between Moctezuma and Tepache, Sonora at ~ 650 m elevation. Arid, and difficult to develop for water, such sites retain much of their original character and would be promising locales to look for bobwhites. Photograph by D. E. Brown.

National Wildlife Refuge in Texas where good populations of similar races of bobwhites occur. These sites were photographed and the elevations, landscape physiognomy, and plant species structure recorded for comparison with masked bobwhite collection locales.

Mean monthly precipitation, annual temperature, and number of days above freezing were obtained from climatological stations nearest to the collection locales maintained by the National Oceanic and Atmospheric Administration (U. S. Department of Commerce 2010) or from Hastings and Humphrey (1969) for Sonora. Similar data were collected for habitats where bobwhites had been observed in Texas and Oaxaca.

COLLECTION LOCALES

We located 251 masked bobwhite specimens in 19 museum collections including locations reported by Tomlinson (1972b; Appendix, Fig. 1). The vast majority of sites (> 99%) where birds were collected were in tropic-subtropical environments below 1,060 m elevation with mean annual temperatures of 18 °C or above. All sites were characterized by annual precipitation > 350 mm with 250 mm (70%+) occurring during June through September (Table 2; Koss et al. 1968, U.S. Department of Commerce 2010).

Bobwhite Collections in and Adjacent to Altar Valley, Arizona

Herbert Brown and his agents collected at least 18 masked bobwhite in Altar Valley including 2 partial specimens sent to the U. S. National Museum. Two males and 2 females were provided to the American Museum of Natural History in New York (Appendix), and 5 males and 5 females were sent to George B. Sennett and another pair to Manly Hardy of Brewer, Maine (Allen 1886a, Brown 1887).

Brown (1885: 445) described a collection trip he made to Altar Valley in September 1885:

“We entered the Altar Valley at a point about twenty-eight miles southwest of Tucson, followed the valley southward fifteen miles then turned westward toward the peak, which over a smooth grass-covered mesa was here distant twenty odd miles. By noon on the 27th we were camped under the shadow of the great rock [Baboquivari Peak]. . .”

Brown (1885: 445) goes on to describe the importance of grass to the quails' habitats:

“The ‘hooded quail’ (Colinus ridgwayi) was three years since [1882], abundant in the neighborhood of Bolle’s Well, a stage station on the Quijotoa road, near the northern end of the Barboquavari [sic] range, twenty-nine miles southwest of Tucson, and about forty miles north of the Mexican boundary line [An 1890 map in the Arizona State Library Archives shows Bolles

Table 2. Climatological information for select masked bobwhite collection locales compared with locations where bobwhites were observed in South Texas and Oaxaca.

Location	Mean monthly precipitation												Σ June-Sep			Σ annual			Habitat type	
													Precip. mm	Σ # days <0° C	Temp °C	Alt	Lat	Long		
	J	F	M	A	M	J	J	A	S	O	N	D								
Tumacacori (Tubac-Calab.)	21	15	17	6	3	10	101	92	34	18	15	30	361	237	119	18.7	996	31°34'	111°03'	river bottom
Anvil Ranch (Bolles Well)	20	18	18	7.6	30	7.6	64	61	36	20	13	23	317.4	169	53	19.0	2,750	31°58'	111°23'	bajio-sabana
7 mi NW Sasabe (Syc. Mesa)	31	25	18	7	3	6	98	94	50	14	25	58	428	248		17.5	1,094	31°29'	111°13'	bajio-sabana
Nacozaari (18 mi. n Cumpas)	35	25	27.4	13	6	30	147	90	59	37	17	56	541.8	326		18.9	1,100	30°23'	109°41'	river bottom
Bacoachi	7	19	13	5	3	19	132	112	34	24	16	29	436	297		17.6	1,050	33°30'	109°58'	river bottom
Rancho Carrizo	16	7	8	2	1	7	96	121	43	14	8	21	344	267		22.9	732	30°03'	115°15'	bajio-sabana
Moctezuma	31	15	12.5	3.4	2.4	27	152	119	61	28	5.9	27	484.1	359		21.3	609	29°48'	109°41.5'	sabana/river
Raymondville, TX	41	33	22	39.1	95	68	33	69	130	68	35	24	655	300	23	22.9	9	26°30'	97°48'	savanna
Hondo (Laguna Atascosa) TX	66	30	39	24	220	96	187	81	110	28	7.4	3.6	892.8	474	40	23.2	9	29°20.5'	99°83'	coastal grass
Salina Cruz, OX	9	4	3	2	63	286	135	198	300	66	24	9	1,099	919	0	28.0	13	16°16'	95°20'	sabana



Fig. 3. Former masked bobwhite habitat ~ 10 km south of Bolles Ranch along Brawley Wash in Altar Valley, Arizona, where Herbert Brown collected a masked bobwhite. Photograph by D. E. Brown.

Ranch about 1.6 km west of present day Three Points]. As the station was then comparatively new, the grass thereabouts was high, and these quail could be had for the taking; but now that stock has eaten away the grass, the birds have not, for a year or more, been seen about the place.”

“Ten miles south of Bolle’s in the Altar Valley, we came across a small covey—there were, perhaps, a dozen in all... We secured but one, a male, the rest secreting themselves in the tall sacaton grass, which at this point was between four and five feet high, and as we had no dog we did not follow them. Our next place to find them was on the mesa southeast of the Peak, where we camped to hunt for them but they were scarce.”

Brown (1885: 445) described the physiognomy of the preferred habitats for 3 species of Arizona quail emphasizing that bobwhites preferred both level mesas and open valleys:

“The base of the Barboquivari [sic] range is at intervals broken into immense canyons, which lie at right angles with the main body of the mountains, and stretch far to the plains below.

For a mile or more after leaving the base proper they are filled with an almost impenetrable growth of underbrush, weeds and grass. Lower down, however, they flatten out and largely lose their canyon characteristics, but seldom sufficiently so to be the feeding ground of *Colinus ridgwayi*. To determine this point we worked these canyons for two consecutive days in vain, inasmuch as we failed to see or hear one, other than those on the intervening mesas. Arizona quail-*Lophortyx gambeli* on the other hand, seem partial to a rough country, where such country is possible with them. In the canyons they swarmed by thousands. In this respect I think them peculiar. On our way out we found them plentiful in the rough passes of the Tucson Mountains, but on the plains beyond and in Altar Valley they disappeared and gave place to the scaled or blue quail (*Callipepla squamata*). These were likewise plentiful, but they too disappeared almost with the first rise in the mesa.

In the canyons, twenty miles above here, we as elsewhere stated, again met with the Gambels, but we found none of the scaled quail until we again returned to the valley. Between the feeding grounds of these two birds I never saw a line



Fig. 4. Mesa southeast of Baboquivari Peak and northeast of old Sycamore Ranch thought to be the approximate site of the last masked bobwhite collected in Altar Valley. This photograph, taken in August 2011, shows a semi-desert grassland savanna at 1,060 m elevation, which is thought to be at the upper elevation range for this race of bobwhite. Photograph by D. E. Brown.

more clearly drawn. In this respect they differ from the ridgwayi, which were found both in the valley and on the mesa.”

In a letter dated 9 February 1886 Brown wrote Allen (1886a:288) that the collectors whom he had sent out especially for these birds reported to him the locations as:

“...having found but one small flock in a tramp of four days, and out of it they succeeded in getting the five [sent to Allen]. This was in the Altar Valley.”

In a later letter on 24 April 1886, Brown stated the quail he had sent Allen (1886a: 288) were “*taken at least eighteen miles north of the Sonora line [3.2 km north of Brown Canyon]... Thirty-three or thirty-five miles is the farthest north of the line that I have ever known this quail*” [9.6 km south of Bolles Ranch or ~ 53 km north of the border]; (Fig. 3).

The birds were decidedly scarce by fall 1886, and in December 1886, Herbert Brown (1900: 32) received his last bobwhite from the Altar Valley area (UA 3953):

“to my surprise, high up on the eastern slope of the Baboquivari Mountains. Heretofore I had

never known them to range higher than the foothills.”

Specimen data indicate this bird was taken on a mesa northeast of Sycamore Ranch in Brown Canyon (no relation) at an elevation of ~ 1,060 m (3,480 ft.). This location at the lower edge of semidesert grassland appears atypical as befits the occurrence of a remnant individual no longer finding its preferred areas suitable (Fig. 4). Brown’s descriptions indicate most bobwhites in Altar Valley were in the level plains and mesas at the lower, more subtropic elevations <1,000 m.

Collections from Santa Cruz Valley, Arizona

Not all of the bobwhites collected in Arizona came from Altar Valley. Nor was the bird taken on 14 December 1886, the last bobwhite taken in Arizona. Brown’s specimen records show at least two bobwhites (UA 3954 and UA 3955) collected “*near Tubac 70 miles south of Tucson*” on 10 October 1888 (T. R. Huels, personal communication). These birds, which were almost certainly sent to Brown by someone else, would have been taken in the Santa Cruz River Valley at an altitude of ~ 984 m at the upper elevation limits of the Sonoran Desert.

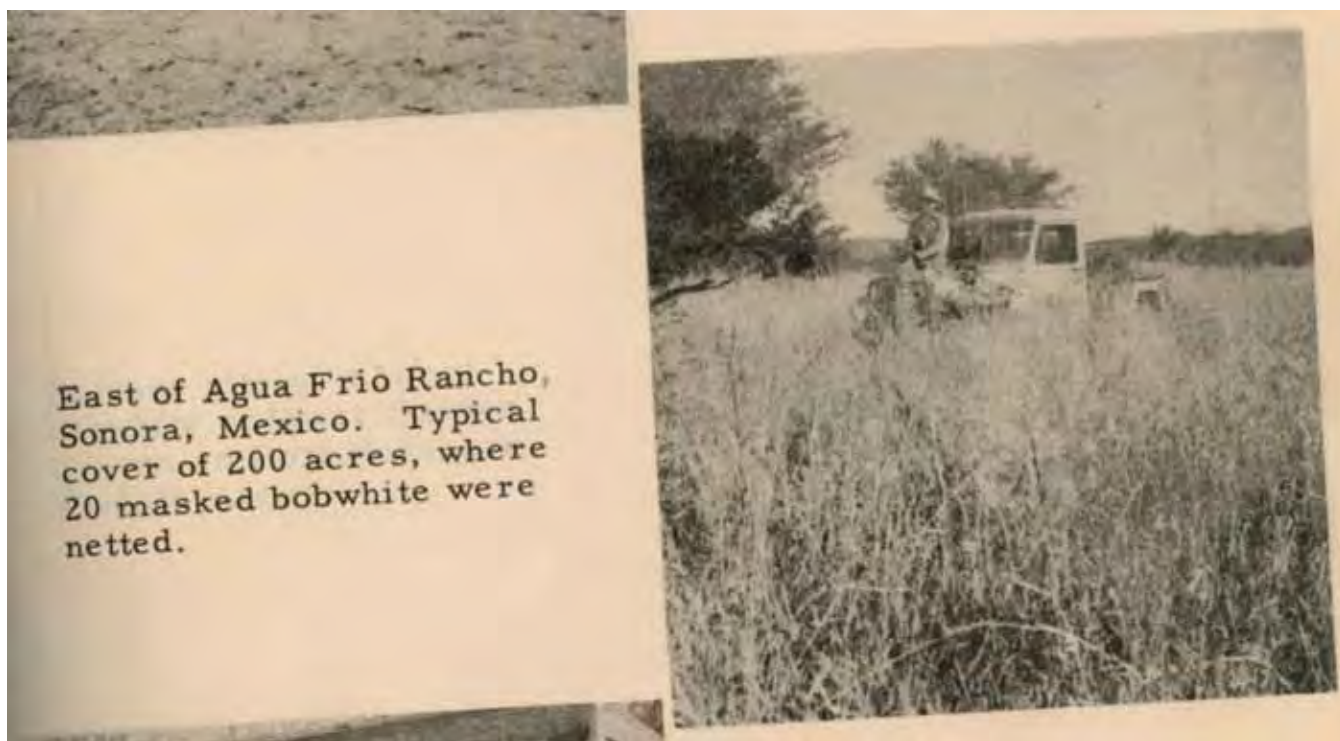


Fig. 5. Photograph by L. L. Lawson of a pasture where he and J. Stokley Ligon trapped 25 masked bobwhite in 1950. Note the tall grasses and dense herbaceous cover.

More birds were collected nearly a decade later in the Santa Cruz Valley. On 22 November 1896, Brown was “pleasantly surprised” to receive 4 of 6 birds killed by George Atkinson from a covey of ~ 20 that “were feeding in a field near Calabasas” (T. R. Huels, personal communication). This location proved viable for at least 1 more year when Brown added 3 more bobwhite from Calabasas to his collection including UA 3958 and 3959 on 29 December 1897. These birds, the last to be collected in the U.S., were taken in a retired farm field, and had what were probably the seeds of *Amaranthus palmeri* in their crops (T. R. Huels, personal communication). This river bottom location, at 1,058 m elevation, while within the range of tropic-subtropical vegetation, represents, along with the bird on Sycamore Mesa southeast of Baboquivari Peak, the highest collection locales.

Later reports by Brown (1900, 1904: 213) summed up his opinion why the masked bobwhite disappeared:

“The causes leading to the extermination of the Arizona Masked Bob-white (Colinus ridgwayi) are due to overstocking of the country with cattle, supplemented by several rainless years. This combination practically stripped the country bare of vegetation. Of their range the Colinus occupied only certain restricted portions, and when their food and shelter had been trodden out of existence by thousands of hunger-dying stock, there was nothing left for poor little Bob-white to do but go out with them. As the conditions in Sonora were similar to those in Arizona, birds and cattle suffered in common.”

The Arizona Bob-white would have thrived well in the agricultural country, in brushy fence corners, tangled thickets and weed covered fields, but such things were not to be had in their habitat. Unless a few can still be found on the upper Santa Cruz we can, in truth, bid them a final good-bye.”

It appears that masked bobwhite habitat in Arizona consisted of grassland, grass-forb pastures, and farm fields. Brown’s explanation for the demise of the birds would be repeated dozens of times in the years to come by collectors and ornithologists in both Arizona and Sonora (e.g., Breninger 1904, Sheffler 1931, Lawson 1951, Ligon 1952, Tomlinson 1972a).

Habitats in Sonora, Mexico

Those who collected masked bobwhite in Sonora reiterated the relationships with grasses, grass-forb-pastures, and farm fields. For example, Frank Stephens (1885), who collected the type specimen, emphasized the bird’s association with grass and grassland, both where he had seen birds in Arizona and where he collected his specimen 28.8 km southwest of the custom house at Sasabe at an elevation of ~ 850 m (Brewster 1885). Previous to entering Sonora, Stephens (1885: 227) mentions awakening to the calls of “bob-white” on 30–31 August in a camp in “the best grass we saw on the route”. That morning he attempted to collect a bobwhite in the “open prairie,” and spent a day just north of Sasabe



Fig. 6. Rancho Carrizo's llanos as they appeared in 1966 and described by Tomlinson (1972b). Photograph by D. E. Brown taken in 1968.

in good grass searching for bobwhites but failed to find any—the area he described being close to 1,220 m.

That farm fields could provide a favorite haunt for masked bobwhite was shown by Lt. H. C. Benson a year later when he collected a series of masked bobwhite and elegant quail (*Callipepla douglasi* = *elegans*) ~ 30 km north of Cumpas where he found masked bobwhite “fairly abundant,” but that “they only frequented cultivated fields, where wheat and barley had been raised.” (Brown 2010:21). The following year, 1887, Benson returned with J. C. Cahoon to the same site (~ 850 m asl) and to fields in the vicinity of Bacoachi, Sonora (1,050 m asl), where Cahoon told Brewster (1887:160) that they found both elegant quail and masked bobwhite “abundant (several large coveys were seen and eight specimens shot in one day), haunting patches of weeds in gardens and barren ‘sand wastes.’ where they fed on the seeds of a plant called ‘red-root’”(Amaranthus palmeri; Kearney and Peebles 1960).

Masked bobwhites were subsequently collected near San Marcial, Suaqui Grande, Moctezuma, and other tropic-subtropic locations in south-central Sonora (Fig.1). R. T. Moore (1932:74): collected 8 males and 8 females at Rancho Carrizo southwest of Noria on the Southern Pacific de Mexico railroad where he found the

birds “scarce” during the nesting season on 31 July in “luxuriant growth along the washes (arroyos) affording cover for protection and nesting, feeding on insects lady bugs, small white grubs, grasshoppers and buds of pig-weed” [*Amaranthus palmeri*].

Moore (1932: 74) took 2 females from a covey of 8 near Tecoripa (Noria) “an extensive rolling area bounded on the south by the Sierra de BacaTete (Yaqui country); on the north by a low broken mountain range. . . The sides and gentle slopes at the foot of the mountains are covered with brush—largely mesquite. The rolling area is covered with grass (at least six species) with brush, mesquite, cat-claw, etc., along the washes. The height of the grass varies from knee to shoulder high, the latter height being predominant.”

J. T. Wright, who also collected masked bobwhite at Rancho Noria de Pesqueira in 1931, told Tomlinson (1972a: 298) that “the country at that time consisted of wide, grass-covered valleys with certain grasses reaching over the heads of the native white-tailed deer.” Bobwhites were then moderately plentiful but disappeared due to grazing.

Van Rossem (1931, 1945: 72), the foremost authority on the birds of Sonora, stated the masked bobwhite was



Fig. 7. Habitat of *Colinus virginianus coylocos* near the village of Montecillo Santa Cruz, Oaxaca. Note the savanna-like aspect of the vegetation with grasses and tropical deciduous trees, such as *Crescentia alata*. Two coveys of bobwhite were seen and photographed at this site in February 2011. Photograph by R. D. Babb.



Fig. 8. Texas bobwhite savanna on Sal del Rey National Wildlife Refuge near Raymondville, Texas—October aspect. Three coveys of bobwhites were seen in the vicinity. The dominant understory grass is buffelgrass; the trees are Texas honey mesquite. Photograph by D. E. Brown.



Fig. 9. Former masked bobwhite habitat across the Santa Cruz River from the Tubac, Arizona graveyard in June 2011—Elevation 983 m; July aspect. One suspects that bobwhite would survive in this area today if wild birds were introduced here. Photograph by D. E. Brown.

“resident of grass plains, river valleys and foothills in the lower Sonoran zone.”

Ligon (1942, 1952:48), who had located and captured several populations, said: *“this quail is definitely a dweller of deep-grass-weed habitat, a type of cover incompatible with heavy use by livestock.”* Ligon (1952: 48) stated that in 1937, *“after a careful investigation of the Tecoripa section . . . two small coveys of the quail were located and netted.”* But it was not until he talked to a ranchman at San Marcial that he was told to go to the “Llanos” (flat, grassy plains) to look for bobwhite. As Ligon (1952: 48) noted, *“this lead proved to be profitable as the birds were quite numerous over a limited area that was still in practically primitive state. More than a hundred were obtained.”*

Ligon (1952: 48) also explained how the rapid decline of the birds in the Agua Caliente Valley came about: *“Although the birds were present in considerable numbers on the “Llanos” segment of the wide Yaqui Valley . . . their doom was already foreshadowed by the upsurge in the cattle business which was resulting in the development of ranches where previously the land had been practically unused. This quail is definitely a dweller of a deep grass-weed habitat, a type of cover incompatible with heavy use by livestock. Subsequent visits sustained*

our most extreme fears—the face of the land had deteriorated into a state of desolation.”

Lawson (1951:4) agreed that the Bobwhite quail was doomed to extinction in Mexico; *“especially so if the drought and over-grazing continues. The “spreadouts” and “bottoms” with deep grass and weeds where the masked bobwhite were formerly found are rapidly disappearing [Fig. 5]. To be certain that this bird isn’t extirpated, a section or two of land within its historical range should be set aside and fenced against grazing by live stock.”*

Phillips et al. (1964: 28) described masked bobwhite as inhabiting *“tall grass-mesquite plains,”* and Gallizioli et al (1967:571) noted that *“early references and recent observations in Sonora indicate that dense stands of perennial grasses are an important component of masked bobwhite habitat.”*

More recently, Tomlinson (1972a: 300) described a western, arid fasciation of the masked bobwhite’s habitat on Rancho El Carrizo south of Benjamin Hill as *“former mesquite-grassland range at an elevation of approximately 2,400 feet. The habitat is a Sonoran plains type which consists mainly of annual grasses and forbs with woody shrubs and trees in and surrounding the water drainages. The grassy ‘llanos’ have been steadily invaded*



Fig. 10. Calabasas—this site at an elevation of 1,058 m is where the last masked bobwhites were collected in Arizona in 1897. It is June and the Mexican elder-berries (*Sambucus mexicana*) are flowering at this historic location, which was recently burned and will soon be converted to an industrial park. Photograph by D. E. Brown.

by woody species because of overgrazing by livestock and a lack of fire.”

Tomlinson’s (1972a, b; 2006) evaluations, which, while pertaining to the western edge of the bird’s range, then being re-constituted by brush-clearing, are the only detailed descriptions of the vegetation present when wild masked bobwhite were still present. Hence, his observations of the grasses present are particularly valuable even though Rancho Carrizo lacked the taller grasses found in more mesic areas farther east and south (Fig. 6).

Brown and Ellis (1977: 4), based on their own and Tomlinson’s testimony, observed that “*masked bobwhite use the more open grasslands during the summer and early fall for nesting cover. Weedy plants and numerous legumes are important sources of food. During the winter, bobwhite coveys may use tangled thickets for screening or dense patches of coarse weeds and grasses for resting and protection.*”

Garza-Salazar et al. (1992) termed the habitats where they found five populations of masked bobwhite, “*Sonoran Savanna Grassland*” based on a definition proposed by Brown (1982: 471).

EVALUATION OF HISTORIC HABITATS

We interpreted descriptions and photographs of historic masked bobwhite habitat to consist of grassy *llanos* (plains) and weedy *bajios* (lowland depressions) interspersed with copses of woody trees and scrub in a savanna or bottomland setting populated by annual and perennial grasses and forbs from 50 to 100 cm tall. Annual precipitation ranged from 300–350 to 500 mm with mean summer precipitation usually > 200 mm with mean annual temperatures > 18 °C. Environments were subtropical to tropical with elevations ranging from ~ 240 m northeast of Guaymas, Sonora to 1,060 m in southern Arizona. All historic localities in Arizona and Sonora were deficient in precipitation when compared to analogous tropical bobwhite habitats near Salina Cruz, Oaxaca, and South Texas (Table 2; Figs 7, 8).

A large percentage of the birds in both Arizona and Sonora were collected in farmlands along watercourses where rank grasses and forbs grew in pastures adjacent to farm plots and dense riparian vegetation. Examples include birds collected in Arizona in the Santa Cruz Valley (Figs. 9, 10), and in Sonora, 29 km north of Cumpas (Fig. 11), the vicinity of Bacoachi (Fig. 12), and



Fig. 11. Former masked bobwhite habitat 25.6 km north of Cumpas, Sonora, where Lt. H. C. Benson and J. C. Cahoon collected both masked bobwhite and elegant quail. The fallow fields at an elevation of 850 m had residual stalks of both barley and maize while grasses and forbs, especially *Amaranthus palmeri*, grow rank along the edges, which are bordered by velvet mesquites (*Prosopis velutina*).

near the town of Moctezuma. Here, numerous pastures with dense *Amaranthus* (1.2 to 1.8 m tall) occur adjacent to grassy fields and wooded riversides. We can only speculate that pasturing of livestock in these areas during droughts, possibly combined with subsistence trapping of quail, led to the disappearance of masked bobwhite from these areas.

An investigation of other collection locales showed the species also occurred in savannas where both suitable escape cover and food plants were present. In addition to Rancho Carrizo, such areas once occurred in Altar Valley, Arizona; south of San Marcial; and on the volcanic mesa between Moctezuma and Tepache, Sonora (Fig. 2). Most valley sites such as those in the vicinity of Mazatán have been severely impacted by water development and appear heavily grazed, but a few areas still support open savanna type vegetation. Most of these sites occur in the Valle del Agua Caliente where suitable conditions may still be found.

Nearly all of the early collectors emphasized the importance of grasses with tall grass-forb pastures and savannas being prominently mentioned. Grasses in or near former bobwhite habitat were mostly tropic-subtropical annuals such as *Bouteloua rothrockii* and *Aristida* spp. mixed in, or supplanted by *Cathartum erectum*, *Spor-*

obolus cryptandrus, *S. wrightii*, *Muhlenbergia porteri*, *Trichachne californica*, and other bunchgrasses. The actual composition of these rapidly disappearing grasslands has yet to be documented.

Do potentially suitable habitats remain? The sole remaining habitats 'restored' for masked bobwhites are within Buenos Aires National Wildlife Refuge (BANWR) in southern Arizona, and on or near Rancho Carrizo south of Benjamin Hill, Sonora, Mexico, where the last known wild population was centered (Kuvlesky et al. 2000, Hernández et al. 2006, Tomlinson 2006). Perennial grasses are abundant on BANWR, but we fear most of the refuge is too high in elevation and marginal masked bobwhite habitat (Russell 1984). This interpretation is based on the paucity of collected specimens in Arizona above 1,060 m and the early disappearance of the subspecies from Altar Valley in the 1880s—coincident with arrival of large numbers of livestock but prior to the great droughts of the 1890s (Turner et al. 2003).

We also consider the Rancho Carrizo area near Benjamin Hill as marginal habitat as this area is relatively dry, at the lower edge of the precipitation required for bobwhite and at the western periphery of the bird's historic range (Table 2, Fig.1). Masked bobwhites likely survived here not because it was prime habitat, but more



Fig. 12. Small fields, waste corners, and copses of riparian vegetation just upstream from the village of Bacoachi, Sonora, in October 2011. Despite this area's appearance of being ideal quail habitat neither bobwhite nor Gambel's quail were heard or seen leaving one to wonder if local trapping might be impacting their numbers.

due to delayed water development and year-long livestock use (Tomlinson 1972a). Rancho Carrizo and its environs, while the site of some of the most recent observations, were not necessarily the best habitat, but one of the last habitats to be exploited. Unfortunately, this site in Mexico may no longer support masked bobwhite, as no birds have been detected on surveys here within at least the last 3+ years (Dan Cohan, personal communication). The prime habitats for masked bobwhites occurred near the center of the bird's distribution, where most birds were collected (Fig. 1, Appendix).

The primary cause of the masked bobwhite's demise has been habitat loss, i.e., the destruction of subtropical grasslands in Arizona after 1890, and in Sonora after 1945 through livestock grazing and fire suppression (Brown and Glinski 2009). Grazing became ubiquitous after 1900 in Arizona and after 1950 in Sonora, a practice facilitated by wells and water development (Lawson 1951, Ligon 1952, Gallizioli et al. 1967, Tomlinson 1972b). Livestock removed the fine fuels, which resulted in cessation of fires and invasion of woody plants (Swetnam and Baisan 1996). Bahre (1985) noted that large fires within the confines of what is now the Sonoran Desert virtually ceased in the 1880s in Arizona. Tomlinson (1972a) and Brown (1989) described a similar situation in Sonora

beginning in the 1930s. By 1975, even those few relict grasslands remaining, such as those at Rancho Carrizo south of Benjamin Hill, were either being grazed or converted to buffelgrass (*Pennisetum ciliare*) pasture (Lanham 1994) with the result that all masked bobwhite habitats in Sonora are managed for livestock instead of bobwhites (Hernández et al. 2006).

Masked bobwhite habitats may yet persist, however, even though the birds may not. Sites such as the former collecting locales north of Cumpas and around Bacoachi appear to have recovered to the point that masked bobwhite could survive there if wild birds were available. These localities and numerous small farms within former masked bobwhite habitat in Sonora again appear suitable for bobwhite. There are even sites (e.g., Tubac and Calabazas) in the Santa Cruz Valley in Arizona, based on the descriptions of historical habitats, which appear suitable for the species. These latter two sites are endangered, however, as one is adjacent to residential developments and the other is about to become an industrial park.

Probably the best habitats remaining for the masked bobwhite today are in the Agua Caliente Valley in and adjacent to the Yaqui Indian Reservation where both *sabana* and *bajío* habitats persist in altered form. We



Fig. 13. Former *savana* being invaded by cholla and thornscrub on the Yaqui Indian Reservation near Agua Caliente Valley, Sonora. Although such sites appeared promising, the only quail located were elegant quail and Gambel's quail. This site appears to be a remnant savanna on sandy substrate. Photograph by Anibella Carlón Flores.

conducted 20.76 km of foot surveys covering 159 ha of the best appearing habitat in an attempt to learn if masked bobwhite might still be present on the Yaqui Reservation. Six coveys of Gambel's quail (*Callipepla gambelii*) and 4 coveys of elegant quail were located but no bobwhite. Nor did any of the gallinaceous bird feathers obtained from verdin and cactus wren nests belong to masked bobwhite on comparing them with museum specimens of *C. elegans*. Evidence that we and the dogs were searching optimum habitats was indicated by incidental sightings of rufous-winged (*Peucaea carpalis*) and five-striped (*Amphispiza quinquestriata*) sparrows. One white-tailed hawk (*Buteo albicaudatus*) was observed over the Agua Caliente Valley on the first aerial reconnaissance.

The habitats we visited are believed to represent the best masked bobwhite sites remaining in Sonora, but these areas were heavily influenced by past livestock use. The remaining savanna habitats no longer have tall, ungrazed grasses, and are much reduced in extent due to the encroachment of cacti and woody plants. This disclimax thornscrub, while heavily invaded by cholla (*Opuntia fulgida* var. *mammilata*) continues to contain pastures heavily populated by Rothrock grama and other fine-stemmed grasses (Fig. 13). The bottomlands, composed of *Amaranthus palmeri*, *Sesbania herbacea*, *Acacia angus-*

tissima, and other tall-weeds have also been heavily used by horses and cattle, and lack an understory of fine-stemmed grasses and forbs (Fig. 14).

We believe the possibility is increasingly remote that masked bobwhite may still exist in Sonora. All of the areas visited have been heavily impacted by livestock at some time and no one we interviewed has definitive knowledge of the presence of *las mascaritas*. Our evaluations of the Yaqui lands and other potential habitats were not exhaustive and should be followed by call-count surveys and other investigations during the breeding season. If a population of birds can be located, management actions such as reductions in grazing intensity and controlled burns could promote the bird's recovery. Until such time as a population of birds is located, this race of bobwhite must be considered functionally extinct.

ACKNOWLEDGMENTS

We are indebted to Seymour Levy, Steve Gallizioli, Roy Tomlinson, and Steve Dobrott for sharing their insights about masked bobwhite in Sonora, and to Steve Dobrott, Dan Cohan, and Mary Hunnicut for their recent



Fig. 14. A weedy *bajío* in the Valle del Agua Caliente—another former favorite masked bobwhite haunt now heavily impacted by livestock, in this case horses. Photograph by Anibella Carlón Flores. Not finding any sign of bobwhite here despite a 4-hr search was a major disappointment.

observations of behaviors of captive and released birds in Arizona. Also helpful to our investigations were Alberto Burquez and Ray Turner, who provided photographs of historic habitat in Sonora and accompanied us on 2 visits to former masked bobwhite locales. Eduardo Gomez accompanied us in the field for 2 days where he was of great assistance in locating and evaluating habitats north of the Las Arenas area. Consuelo Lorenzo Monterrubio graciously facilitated our visit to her study area in Oaxaca. Josh Smith hosted us in South Texas and showed us many excellent sites at Laguna Atascosa National Wildlife Refuge, and Mitch Sternberg showed us bobwhite habitat at Sal Del Rey and other area refuges.

Sandra Landham was not only essential for our aerial surveys, her extensive Mexican contacts enabled Biologos Cristina Melendez and Eberado Sánchez Camero to arrange our visit to the Yaqui country with Anibella Carlón Flores. Sra Flores not only provided the necessary permits and escorts, but also took excellent photographs of our activities on the Yaqui Reservation where we were accompanied at all times by Yaqui Vigilancias: Jefe Guadalupe (Pluma Blanca) Ochoa, José Juan Terán Enríquez, Isábel Lugo (Chabelo) Molina, Eladio Molina (Layo) Azvala, and Marco Antonio Carlén Flores.

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APPENDIX

Institution	Accession	Country	State	Location	Sex	Collector	Date	Notes
AMNH	751313	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	22 Dec 1905	
AMNH	751314	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	21 Nov 1905	
AMNH	751312	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	15 Dec 1905	
AMNH	751316	Mexico	Sonora	Bacuachi	Female	Cahoon, John C.	08 Feb 1887	
AMNH	751315	Mexico	Sonora	Bacuachi	Male	Cahoon, John C.	08 Feb 1887	
AMNH	751311	USA	Arizona	Baboquivari Mts.	Female		08 Feb 1886	Submitted by Herbert Brown
AMNH	751310	USA	Arizona	Baboquivari Mts.	Male		08 Feb 1886	Submitted by Herbert Brown
ANSP	70761	Mexico	Sonora	Las Arenas	Male			
BMNH	1888.10.102795	USA	Arizona	Baboquivari Mts.	Male	Brown, H.		Accessioned 10 Oct 1888
BMNH	1888.10.102796	USA	Arizona	Baboquivari Mts.	Male	Brown, H.		Accessioned 10 Oct 1888
BMNH	1913.5.16.3	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	09 Dec 1905	
BMNH	1913.5.16.4	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	18 Dec 1905	
BMNH	1913.5.16.1	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	05 Jan 1906	
BMNH	1913.5.16.2	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	09 Dec 1905	
BMNH	1939.12.9.290	Mexico	Sonora	La Bonancita	Male	Brown Jr., W. W.	15 Dec 1905	
BMNH	1887.1.27.82.	Mexico	Sonora	28 km southwest of Sasabe	Male	Stephens, F.	11 Aug 1884	Donated by G. R. Morcom
CAS	33888	Mexico	Sonora	Rancho Carrizo	Female	Wright, J. T.	04 Jul 1931	Site near Tecoripa
CAS	33889	Mexico	Sonora	Rancho Carrizo	Male	Wright, J. T.	10 Jul 1931	Site near Tecoripa
CMNH	27860	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	03 Dec 1905	
CMNH	26873	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	28 Nov 1905	
CMNH	130169	Mexico	Sonora	Moreno (72 km SE Agua Caliente)	Female	Twomey, A. C.	06 May 1945	
CMNH	130168	Mexico	Sonora	Moreno (72 km SE Agua Caliente)	Male	Twomey, A. C.	06 May 1945	
DMNH	18536	Mexico	Sonora	San Marcial, 22.4 km SE	Female	Gorsuch, D.	19 Dec 1937	
DMNH	18537	Mexico	Sonora	San Marcial, 22.4 km SE	Female	Gorsuch, D.	19 Dec 1937	
DMNH	18538	Mexico	Sonora	San Marcial, 22.4 km SE	Female	Gorsuch, D.	17 Dec 1937	
DMNH	18539	Mexico	Sonora	San Marcial, 22.4 km SE	Male	Gorsuch, D.	19 Dec 1937	
DMNH	54824	Mexico	Sonora	Hermosillo, 96 km E; Feliciano Ranch	Male	Ligon, J. S.	08 Dec 1950	
DMNH	23799	Mexico	Sonora	Tecoripa, slightly N	Female	Wooddell, Les	01 Mar 1937	
DMNH	23797	Mexico	Sonora	Tecoripa, slightly N	Male	Wooddell, Les	01 Mar 1937	
FMNH	36739	USA	Arizona		Female			Cory Collection 6434
FMNH	77247	Mexico	Sonora		Female			
FMNH	77362	Mexico	Sonora	Tecoripa	Female			
FMNH	127890	Mexico	Sonora	Rancho Carrizo	Female			
FMNH	409092	Mexico	Sonora	Rancho Carrizo, 24 km SW of Noria	Female			
FMNH	409094	Mexico	Sonora	Rancho Carrizo, 24 km SW of Noria	Female			
FMNH	409095	Mexico	Sonora	Rancho Carrizo, 24 km SW of Noria	Female			
FMNH	409098	Mexico	Sonora	Rancho Carrizo, 24 km SW of Noria	Female			
FMNH	409099	Mexico	Sonora	Rancho Carrizo, 24 km SW of Noria	Female			
FMNH	409293	Mexico	Sonora	Tecoripa	Female			
FMNH	409295	Mexico	Sonora	Tecoripa	Female			
FMNH	409297	Mexico	Sonora	Tecoripa	Female			
FMNH	409301	Mexico	Sonora	Tecoripa	Female			
FMNH	409302	Mexico	Sonora	Tecoripa	Female			
FMNH	409303	Mexico	Sonora	Tecoripa	Female			

L. B. Bishop Collection 48097

MASKED BOBWHITE COLLECTION LOCALE HABITATS

APPENDIX. Continued.

Institution	Accession	Country	State	Location	Sex	Collector	Date	Notes
FMNH	409304	Mexico	Sonora	Tecoripa	Female		31 Oct 1931	
FMNH	409305	Mexico	Sonora	Tecoripa	Female		31 Oct 1931	
FMNH	77246	Mexico	Sonora		Male		03 Jul 1931	
FMNH	77361	Mexico	Sonora	Tecoripa	Male		03 Nov 1931	
FMNH	127891	Mexico	Sonora	Rancho Carrizo	Male		05 Jul 1931	L. B. Bishop Collection 48096
FMNH	409091	Mexico	Sonora	Rancho Carrizo, 24 km SW of Noria	Male		04 Jul 1931	
FMNH	409093	Mexico	Sonora	Rancho Carrizo, 24 km SW of Noria	Male		05 Jul 1931	
FMNH	409096	Mexico	Sonora	Rancho Carrizo, 24 km SW of Noria	Male		09 Jul 1931	
FMNH	409097	Mexico	Sonora	Rancho Carrizo, 24 km SW of Noria	Male		10 Jul 1931	
FMNH	409100	Mexico	Sonora	Rancho Carrizo, 24 km SW of Noria	Male		12 Jul 1931	
FMNH	409292	Mexico	Sonora	Tecoripa	Male		20 Oct 1931	
FMNH	409294	Mexico	Sonora	Tecoripa	Male		20 Oct 1931	
FMNH	409296	Mexico	Sonora	Tecoripa	Male		29 Oct 1931	
FMNH	409298	Mexico	Sonora	Tecoripa	Male		29 Oct 1931	
FMNH	409299	Mexico	Sonora	Tecoripa	Male		30 Oct 1931	
FMNH	409300	Mexico	Sonora	Tecoripa	Male		30 Oct 1931	
FMNH	409306	Mexico	Sonora	Tecoripa	Male		31 Oct 1931	
FMNH	409307	Mexico	Sonora	Tecoripa	Male		02 Nov 1931	
FMNH	409308	Mexico	Sonora	Tecoripa	Male		02 Nov 1931	
FMNH	409309	Mexico	Sonora	Tecoripa	Male		03 Nov 1931	
FMNH	409310	Mexico	Sonora	Tecoripa	Male		03 Nov 1931	
KU	73199	Mexico	Sonora		Male	Cink, C. L.	03 Nov 1931	Skeleton
KU	73026	Mexico	Sonora		Male	Smart, G.		"caught in Sonora, Mexico and died in September 1971"
KU	73020	Mexico	Sonora		Male	Smart, G.		"raised in captivity" died in 1972
LSU	86248	Mexico	Sonora	200 km south of Nogales, Highway 15 west side	Male	Levy, S. H.	27 Jun 1964	SHL No. 1046; testes enlarged
MCZ	253944	Mexico	Sonora		Male	Benson, H. C.		Smithsonian Institution # 1105121
MCZ	114746	Mexico	Sonora	La Bonancita	Male	Brown Jr., W. W.	15 Dec 1905	
MCZ	114744	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	27 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	114745	Mexico	Sonora	Las Capomas	Female	Brown Jr., W. W.	12 Oct 1905	John E. Thayer Expedition of 1904-5
MCZ	302412	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	29 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302413	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	27 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302414	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	07 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302415	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	11 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302416	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	20 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302417	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	12 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302418	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	12 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302419	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	05 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302420	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	04 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302437	Mexico	Sonora	Las Arenas	Female	Brown, Jr., W. W.	09 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302438	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	31 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302439	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	03 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302440	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	01 Dec 1905	John E. Thayer Expedition of 1904-5

APPENDIX. Continued.

Institution	Accession	Country	State	Location	Sex	Collector	Date	Notes
MCZ	302442	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	15 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302444	Mexico	Sonora	San Marcial	Female	Brown Jr., W. W.	08 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302445	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	06 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302447	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	30 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302449	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	18 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302466	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	23 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302467	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	10 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302468	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	21 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302469	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	19 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302470	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	24 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302471	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	03 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302472	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	18 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302473	Mexico	Sonora	San Marcial	Female	Brown, Jr., W. W.	12 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302474	Mexico	Sonora	San Marcial	Female	Brown Jr., W. W.	10 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302475	Mexico	Sonora	La Bonancilla	Female	Brown Jr., W. W.	17 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302477	Mexico	Sonora	San Marcial	Female	Brown Jr., W. W.	11 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302478	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	09 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302480	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	20 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302481	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	28 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302482	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	24 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302483	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	15 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302484	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	26 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302486	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	05 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302487	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	15 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302488	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	23 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302500	Mexico	Sonora	Las Capomas	Female	Brown Jr., W. W.	05 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302518	Mexico	Sonora	Las Arenas	Female	Brown Jr., W. W.	15 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	114742	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	21 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	114743	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	25 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302423	Mexico	Sonora	San Marcial	Male	Brown Jr., W. W.	10 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302424	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	10 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302425	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	01 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302426	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	01 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302427	Mexico	Sonora	Near Batamote	Male	Brown Jr., W. W.	02 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302428	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	17 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302429	Mexico	Sonora	La Bonacita	Male	Brown Jr., W. W.	18 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302432	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	01 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302433	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	10 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302434	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	02 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302435	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	01 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302454	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	11 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302455	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	27 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302456	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	28 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302458	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	31 Dec 1905	John E. Thayer Expedition of 1904-5

MASKED BOBWHITE COLLECTION LOCALE HABITATS

APPENDIX. Continued.

Institution	Accession	Country	State	Location	Sex	Collector	Date	Notes
MCZ	302459	Mexico	Sonora	Las Arenas	Male	Brown, Jr., W. W.	16 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302460	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	02 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302462	Mexico	Sonora	La Bonancita	Male	Brown Jr., W. W.	01 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302463	Mexico	Sonora	La Bonancita	Male	Brown Jr., W. W.	18 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302464	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	04 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302465	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	04 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302489	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	31 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302490	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	18 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302491	Mexico	Sonora	La Bonancita	Male	Brown Jr., W. W.	16 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302492	Mexico	Sonora	San Marcial	Male	Brown Jr., W. W.	07 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302493	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	14 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302494	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	03 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302495	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	18 Jan 1905	John E. Thayer Expedition of 1904-5
MCZ	302496	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	30 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302497	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	10 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302498	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	10 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302499	Mexico	Sonora	La Bonancita	Male	Brown Jr., W. W.	25 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302501	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	22 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302502	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	13 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302503	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	19 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302504	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	11 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302506	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	20 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302507	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	20 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302508	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	30 Nov 1906	John E. Thayer Expedition of 1904-5
MCZ	302509	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	12 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302510	Mexico	Sonora	San Marcial	Male	Brown Jr., W. W.	15 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302511	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	05 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302514	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	02 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302515	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	11 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302516	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	10 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302519	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	01 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302520	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	15 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302521	Mexico	Sonora	Las Cinches	Male	Brown Jr., W. W.	24 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302522	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	18 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302523	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	27 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302524	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	08 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302525	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	17 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302526	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	17 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302527	Mexico	Sonora	Las Capomas	Male	Brown Jr., W. W.	03 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302529	Mexico	Sonora	San Marcial	Male	Brown Jr., W. W.	08 Nov 1905	John E. Thayer Expedition of 1904-5
MCZ	302530	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	26 Dec 1905	John E. Thayer Expedition of 1904-5
MCZ	302531	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	06 Jan 1906	John E. Thayer Expedition of 1904-5
MCZ	302532	Mexico	Sonora	Las Arenas	Male	Brown Jr., W. W.	30 Dec 1905	John E. Thayer Expedition of 1904-5

APPENDIX. Continued.

Institution	Accession	Country	State	Location	Sex	Collector	Date	Notes
MCZ	225000	Mexico	Sonora	Cumpas	Female	Cahoon, J. C.	02 Feb 1887	
MCZ	224995	Mexico	Sonora	Cumpas	Male	Cahoon, J. C.	02 Feb 1887	
MCZ	224996	Mexico	Sonora	Cumpas	Male	Cahoon, J. C.	02 Feb 1887	
MCZ	224997	Mexico	Sonora	Cumpas	Male	Cahoon, J. C.	02 Feb 1887	
MCZ	224998	Mexico	Sonora	Cumpas	Male	Cahoon, J. C.	02 Feb 1887	
MCZ	224999	Mexico	Sonora	Cumpas	Male	Cahoon, J. C.	02 Feb 1887	
MCZ	225001	Mexico	Sonora	Bacuachi	Male	Cahoon, J. C.	02 Feb 1887	
MCZ	225003	Mexico	Sonora	Bacuachi	Male	Cahoon, J. C.	02 Feb 1887	
MCZ	47971	Mexico	Sonora		Female	Toussaint, F. J.		
MCZ	331764	Mexico	Sonora		Female		01 Nov 1906	
MCZ	331765	Mexico	Sonora		Female		01 Nov 1906	
MLZ	6620	Mexico	Sonora	Mina Noche Buena	Male	Wright, J. T.	24 Mar 1932	
MLZ	6637	Mexico	Sonora	Tecoripa (Noria)	Female	Wright, J. T.	21 Oct 1931	
MLZ	6640	Mexico	Sonora	Mina Noche Buena	Female	Wright, J. T.	24 Mar 1932	
MLZ	6628	Mexico	Sonora	Tecoripa (Noria)	Female	Wright, J. T.	29 Oct 1931	
MVZ	93594	Mexico	Sonora	Tecaripa	Male	Ligon, J. S.	25 Oct 1944	
MVZ	70414	Mexico	Sonora	Tecoripa, "Noria"		Wright, J. T.	09 Feb 1931	
MVZ	100357	Mexico	Sonora	Las Capomas		Wright, J. T.	06 Dec 1905	
MVZ	100354	Mexico		No specific locality recorded			15 Sep 1937	
MVZ	93593	Mexico	Sonora	Tecaripa			24 Dec 1942	
MVZ	70415	Mexico	Sonora	Tecoripa, "Noria"			09 Feb 1931	
MVZ	70417	Mexico	Sonora	Tecoripa, "Noria"			09 Feb 1931	
MVZ	100356	Mexico		No specific locality recorded			01 Sep 1937	
MVZ	100358	Mexico	Sonora	Las Arenas			07 Jan 1906	
MVZ	100355	Mexico		No specific locality recorded			01 Sep 1937	
MVZ	70416	Mexico	Sonora	Tecoripa, "Noria"			09 Feb 1931	
SDNHM	20374	Mexico	Sonora	144 km S Nogales	Female	Green, J. E.	01 Mar 1929	
SDNHM	20375	Mexico	Sonora	144 km S Nogales	Male	Green, J. E.	01 Mar 1929	
SDNHM	12324	Mexico	Sonora	Near Magdalena	Male	Woodell, D. R.	15 Mar 1928	
SDNHM	12326	Mexico	Sonora	Near Magdalena	Female	Woodell, D. R.	15 Mar 1928	
SDNHM	12325	Mexico	Sonora	Near Magdalena	Male	Woodell, D. R.	15 Mar 1928	
UA	UAZ-003953	USA	Arizona	Mesa East of Baboquivari Mtns.	Female	Brown, H.	14 Dec 1886	
UA	UAZ-003954	USA	Arizona	Near Tubac	Female	Brown, H.	10 Oct 1888	
UA	UAZ-003957	USA	Arizona	Calabasas	Female	Brown, H.	22 Nov 1896	
UA	UAZ-003956	USA	Arizona	Calabasas	Male	Brown, H.	22 Nov 1896	
UA	UAZ-003958	USA	Arizona	Calabasas	Male	Brown, H.	29 Dec 1897	
UA	UAZ-003959	USA	Arizona	Calabasas	Male	Brown, H.	29 Dec 1897	
UA	UAZ-003955	USA	Arizona	Tubac	Male	Brown, H.	10 Oct 1888	
UA	UAZ-001137	Mexico	Sonora	9.6 km West Tecoripa	Female	Gorsuch, D.	20 Oct 1931	
UA	UAZ-001138	Mexico	Sonora	9.6 km West Tecoripa	Male	Gorsuch, D.	20 Oct 1931	
UA	UAZ-001156	Mexico	Sonora	9.6 km West Tecoripa	Female	Gorsuch, D.	20 Oct 1931	
UA	UAZ-001136	Mexico	Sonora	9.6 km West Tecoripa	Female	Gorsuch, D.	20 Oct 1931	
UA	UAZ-001157	Mexico	Sonora	9.6 km West Tecoripa	Male	Gorsuch, D.	21 Oct 1931	

MASKED BOBWHITE COLLECTION LOCALE HABITATS

APPENDIX. Continued.

Institution	Accession	Country	State	Location	Sex	Collector	Date	Notes
UA	UAZ-001158	Mexico	Sonora	9.6 km West Tecoripa	Male	Gorsuch, D.	21 Oct 1931	
UA	UAZ-016725	USA	Arizona	Pozo Nuevo, BANWR	Female	Shifflet, W.	09 Jun 1993	
UA	UAZ-001350	USA	Arizona	Tucson		Vorhies, C. T.	15 Jan 1936	
UCLA	30729	Mexico	Sonora	Nogales, 144 km South	Female	Green, J. E.	00 Mar 1929	Donated by G Bancroft
UCLA	27876	Mexico	Sonora	Magdalena	Male	Green, J. E.	00 Aug 1929	Died in captivity. Caught 12 Jul 1928 by G. Bancroft
UMMZ	121779	Mexico	Sonora	Magdalena	Male	Bancroft Jr., Griffing	07 Mar 1929	
UMMZ	121780	Mexico	Sonora	Magdalena	Male	Bancroft Jr., Griffing	07 Mar 1929	
UMMZ	122858	Mexico	Sonora	Magdalena	Female	Bancroft Jr., Griffing	07 Mar 2029	
UMMZ	121776	Mexico	Sonora	Nogales, 144 km South	Male	Green, J Elton	00 Mar 1929	
UMMZ	121777	Mexico	Sonora	Nogales, 144 km South	Male	Green, J Elton	00 Feb 1929	
UMMZ	121778	Mexico	Sonora	Nogales, 144 km South	Male	Green, J Elton	00 Feb 1929	
UMMZ	69959	Mexico	Sonora	Tecoripa	Female	Wright, John T	29 Oct 1931	
UMMZ	69958	Mexico	Sonora	Tecoripa	Male	Wright, John T	00 Oct 1931	
UNM	934	Mexico	Sonora	Hermosilla; 96 km E	Female	Ligon, J. S.	30 Nov 1946	Masked bobwhite; died 02 Jul 1952
UNM	935	Mexico	Sonora	Hermosilla; 128 km SE, near Aqua Fria	Female	Ligon, J. S.	30 Nov 1946	Masked bobwhite; died 06 Jul 1952
UNM	936	Mexico	Sonora	San Marcial; 22.4 km SE	Female	Ligon, J. S.	18 Dec 1933	Masked bobwhite
UNM	944	Mexico	Sonora	San Marcial; 22.4 km SE	Male	Ligon, J. S.	18 Dec 1933	Masked bobwhite
UNM	948	Mexico	Sonora	Hermosilla; 128 km SE, near Aqua Fria	Male	Ligon, J. S.	13 Dec 1946	Masked Bobwhite; died 16 Jun 1952
UNM	14665	Mexico	Sonora	No specific locality recorded.	Female		16 Aug 1961	
USNM	110514	Mexico	Sonora	Mexico	Female	Benson, H. C.		
USNM	110515	Mexico	Sonora	Mexico	Female	Benson, H. C.		
USNM	110934	Mexico	Sonora	Mexico	Female	Benson, H. C.		
USNM	110932	Mexico	Sonora	Locality Unknown	Female	Benson, H. C.		
USNM	110507	Mexico	Sonora	Mexico	Male	Benson, H. C.		
USNM	110509	Mexico	Sonora	Mexico	Male	Benson, H. C.		
USNM	110510	Mexico	Sonora	Mexico	Male	Benson, H. C.		
USNM	110511	Mexico	Sonora	Mexico	Male	Benson, H. C.		
USNM	110929	Mexico	Sonora	Mexico	Male	Benson, H. C.	31 Jan 1887	
USNM	110930	Mexico	Sonora	Mexico	Male	Benson, H. C.	3 Feb 1887	
USNM	110928	Mexico	Sonora	Locality Unknown	Male	Benson, H. C.	28 Jan 1887	
USNM	329855	Mexico	Sonora	Mexico	Female	Brown Jr., W. W.	27 Dec 1905	
USNM	329854	Mexico	Sonora	Mexico	Male	Brown Jr., W. W.	2 Dec 1905	
YPM	6549	Mexico	Sonora		Female	Conover, H. B.	11 Jul 1931	
YPM	6548	Mexico	Sonora		Male	Conover, H. B.	10 Jul 1931	
YPM	70184	Mexico	Sonora	Hermosillo	Female	Ligon, J. S.	04 Nov 1951	

Institution

AMNH	American Museum of Natural History, New York
ANSP	Academy of Natural Sciences, Philadelphia
BMNH	British Museum of Natural History, London
CAS	California Academy of Sciences

APPENDIX. Continued.

Institution	Accession	Country	State	Location	Sex	Collector	Date	Notes
CMNH	Carnegie Museum of Natural History							
DMNH	Delaware Valley Museum of Natural History							
FMNH	Field Museum of Natural History, Chicago							
KU	University of Kansas							
LAM	Los Angeles County Museum of Natural History							
LSU	Louisiana State University							
MCZ	Museum of Comparative Zoology, Harvard							
MLZ	Moore Laboratory of Zoology, Occidental College, Los Angeles							
SDNHM	San Diego Natural History Museum							
UA	University of Arizona, Tucson							
UCLA	University of California at Los Angeles							
UMMZ	University of Michigan Museum of Zoology							
UNM	University of New Mexico							
USNM	U. S. National Museum, Smithsonian Institution, Washington, D.C.							
YPM	Yale Peabody Museum							