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Source: Bulletin of the British Ornithologists' Club, 138(4) : 318-334

Published By: British Ornithologists' Club

URL: <https://doi.org/10.25226/bboc.v138i4.2018.a4>

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Sixty years on: birds of the Sierra del Carmen, Coahuila, Mexico, revisited

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Received 5 July 2018; revised 29 October 2018; published 14 December 2018

<http://zoobank.org/urn:lsid:zoobank.org:pub:E0E3C102-6602-41CB-89E7-D244B09CB8B4>

SUMMARY.—The rugged peaks of the Sierra del Carmen, Coahuila, visible from the Chisos Mountains in Texas, have tempted birdwatchers for decades, yet few have accessed the range, and its avifauna is poorly known. Based primarily on our own observations, supplemented by the literature, museum holdings and eBird records, we present an updated list of the region's avifauna. This list comprises 301 species, 137 of which breed in the region. As in previous surveys, we found bird species characteristic of both the intermontane West and tropical mountains to the south. We confirm that the Sierra del Carmen is slightly less speciose than sky islands of the Sierra Madre Occidental. Nevertheless, it is the northernmost outpost or migratory stopover of several regionally and globally rare species, and could serve as a stepping stone for species moving north with climate change. Although not a centre of endemism, the Sierra del Carmen is a vital and unique region for avian diversity.

Large online citizen science initiatives such as eBird (Sullivan *et al.* 2009) have successfully documented global biodiversity, with >500 million observations in its database, representing all countries and 99% of extant avian diversity. Yet, eBird coverage is still highly biased toward well-visited areas, leaving the avifauna across large swathes of the Americas, especially Central and South America, poorly known. Directly across the US border from Big Bend National Park in Texas is the Sierra del Carmen, an isolated mountain range in northern Coahuila, Mexico. Its rugged physiognomy and forested expanses are visible from the Chisos Mountains of Big Bend National Park, but travel there from the USA has always been challenging, making it far more remote and unknown than its distance from major birding areas alone. The Sierra del Carmen forms part of a chain of sky-island mountain ranges extending north from the Sierra Madre Oriental, much like the well-known Madrean Sky Islands north of the Sierra Madre Occidental, and it is the largest forested highland area for many kilometres in any direction. The Chisos Mountains, a well-known birdwatching hotspot, lie 64 km to the north-west and the almost unknown Sierra la Encantada 32 km to the south-east, but these forested highlands are significantly smaller in total area than the Sierra del Carmen. To date, the avifauna of the Sierra del Carmen is little known except to the few people that have lived in the area for years.

Sixty years ago, Alden Miller, Aldo Starker Leopold and Ward Russell spent a month in the Sierra del Carmen collecting and observing birds (Miller 1955b). Since then, there has been just one published bird list from the Sierra del Carmen (Wauer & Ligon 1977). As of 1 March 2017, there were only 128 checklists for the Sierra del Carmen in eBird's database (59 of them by ourselves). These checklists, as well as research papers on the ecology and evolution of birds in the Sierra del Carmen (Wauer & Ligon 1977, McCormack & Smith 2008) appear to confirm observations first made by Miller (1955b): the absence of certain species that would appear to possess suitable habitat in the range, and niche expansion

into these vacant habitats by other species. Given that recent studies of the avifauna of nearby regions have documented new and surprising records (Benson *et al.* 1989, Contreras-Balderas *et al.* 2004, McCormack *et al.* 2007, Ruvalcaba-Ortega & González-Rojas 2009, Sánchez-González 2013), we have endeavoured here to synthesise a complete checklist for the Sierra del Carmen.

Methods

Location.—The Sierra del Carmen is in northern Coahuila, Mexico (Fig. 1) and largely lies within the 200,000-ha Maderas del Carmen Flora and Fauna Protected Area. The majority of the land is owned and managed by the international cement company CEMEX, which has, since the late 1990s, managed it as a biological preserve (McKinney 2012). Elevation in this region spans 560 m (where Boquillas Canyon empties into the Rio Grande) to the highest peaks above 2,700 m. Los Pilares field station, the base for much recent field work, is at 1,150 m in the west of the range, in Chihuahuan Desert habitat near the mouth of Cañón El Alamo, site of the former Rancho San Isidro.

The Sierra del Carmen is a sky island at the north end of the Sierra Madre Oriental, part of a corridor linking the Mexican highlands to the Rocky Mountains (McKinney 2012). Vegetation in the region can be broadly classified into five major associations: desert shrub, grasslands, chaparral, pine–oak woodland and fir–pine forest. The lowest desert elevations contain creosotebush *Larrea tridentata*, honey mesquite *Prosopis glandulosa*, prickly pear cactus *Opuntia* spp., lechuguilla *Agave lechuguilla*, native grasses Poaceae spp. and candelilla *Euphorbia antisiphilitica*. In a transition zone above this, native grasslands, *Yucca* spp., sotol *Dasylirion wheeleri* and beargrass *Nolina texana* dominate. The higher canyons are characterised by pine–oak–juniper *Pinus–Quercus–Juniperus* woodland, with large stands of American basswood *Tilia americana*, dogwood *Cornus* sp., ninebark *Physocarpus monogynus* and other deciduous woodland species in riparian areas. The highest elevations are dominated by Douglas fir *Pseudotsuga* sp., Coahuila fir *Abies durangensis* var. *coahuilensis*, Arizona cypress *Cupressus arizonica*, along with several stands of blue spruce *Picea* sp., quaking aspen *Populus tremuloides*, oaks and pines. The high escarpments of the sierra trap moisture-laden Gulf Coast air masses, with most rainfall during mid to late summer. Snow and ice storms can occur in winter (McKinney 2012). As a testament to the diversity of habitat types, some authors have divided Mexico into seven major life zones below the Artic–alpine belt (Goldman & Moore 1945); five of these occur in the Sierra del Carmen.

Data collection methods.—Our checklist is a synthesis of our own visual observations and mist-net records, eBird records, museum holdings and published reports (Marsh 1936, Marsh & Stevenson 1938, Taylor *et al.* 1945, Miller 1955b, Van Hoose 1955, Urban 1959, Ely 1962, Wauer & Ligon 1977, Garza de León *et al.* 2007). We follow current eBird taxonomy (<https://ebird.org/news/2018-ebird-taxonomy-update>), which is closely aligned to current AOS taxonomy, except that eBird recognises Mexican Duck *Anas diazi* as a species distinct from Mallard *A. platyrhynchos*. Records are assigned to one of four seasons: spring (March–May), summer (June–August), autumn (September–November) and winter (December–February). Most of our observations are made by BRM, who worked as wildlife coordinator in 2001–13 (McKinney 2012). JEM conducted field work in the region for months at a time between 2002 and 2008. We obtained eBird records by querying the database for all records from Coahuila, then selected a subset of records from a region bounded by the USA / Mexico border to the north, by Mexican highway 53 to the west and south (which runs from Boquillas del Carmen towards Santa Rosa de Múzquiz), and by the road between La Linda, Coahuila, Mexico, and highway 53 to the east. Most of our unusual observations and breeding records were documented with photographs or sound-recordings. A few of

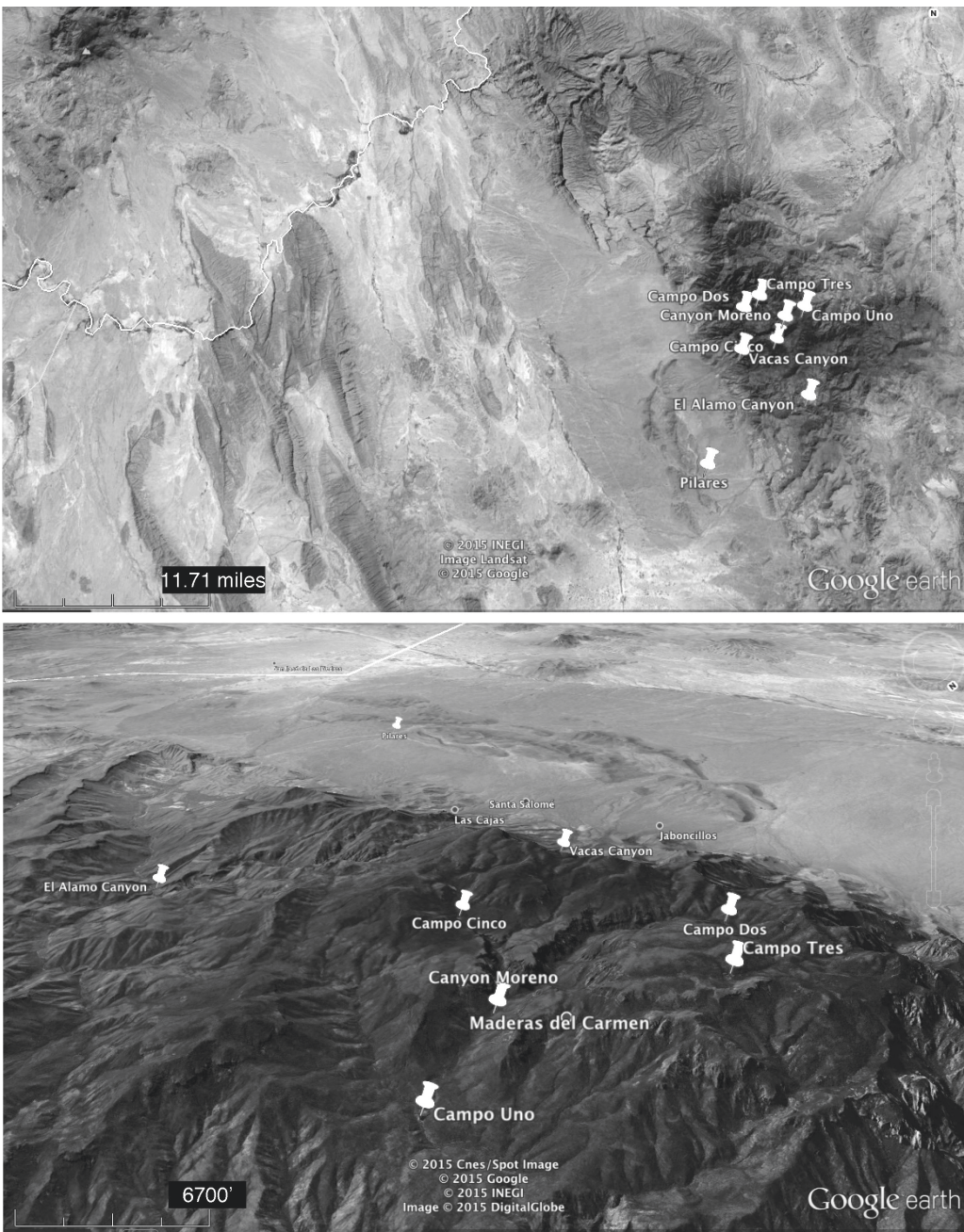


Figure 1. Map of the Sierra del Carmen, with relevant locations in the study area denoted by yellow markers. Note that north changes between panels. The upper panel shows the study area from directly above, with the USA / Mexico border demarcated in yellow. The isolated, sky-island nature of the range is apparent here. The lower panel shows the study area from a closer position to the north-east. Some of the dramatic topographical relief is evidenced here. (Map adapted from Google Earth; satellite image courtesy of Google Inc. All rights reserved © 2018.)

our observations are unusual in respect to what has been published to date for the Sierra del Carmen, but are of birds known to occur, albeit rarely, in the Big Bend area; we note these cases. We also note when historical records are associated with museum specimens.

Results

The comprehensive list of the avifauna of the Sierra del Carmen comprises 301 species, 137 of which are confirmed breeders, and an additional four might breed in the area (Table 1). The only species we have excluded from the list are Pine Flycatcher *Empidonax affinis* (Taylor *et al.* 1945), which we consider to represent a misidentification, Woodhouse's Scrub Jay *Aphelocoma woodhouseii*, which was previously reported in error to eBird, and Imperial Woodpecker *Campephilus imperialis*. Based on indirect evidence (large nest cavities and discussion with a local hunter), R. Wauer believed that the species might formerly have occurred in the Sierra del Carmen (Nelson 2002), but we have found no evidence to support its presence and do not include it here. Below, we provide details of notable records.

Species accounts.—Noteworthy records primarily fall into two categories: significant northward range extensions of species that might routinely occur in small numbers, and species that have experienced recent regional range expansions and are now fairly common in the area.

LEAST GREBE *Tachybaptus dominicus*

A female with a chick on its back was observed in summer 2002 at Tanque Zacatosa, near Rancho Pilares. Also documented to the south-east near Sierra Encantada (McCormack *et al.* 2007). Considered a rare resident but vacates the area when water tanks dry up during long droughts.

TRICOLOURED HERON *Egretta tricolor*

There have been a couple of sightings of this uncommon to rare autumn migrant in the Sierra del Carmen. There are a handful of previous records from Chihuahua, where it is considered a rare autumn migrant (Moreno-Contreras *et al.* 2015).

SWALLOW-TAILED KITE *Elanoides forficatus*

Observed on 20 May 2007 on the road between Pilares and Múzquiz, flapping and gliding steadily north. This record is well west of the species' regular migration route, and probably involved a vagrant.

COMMON BLACK HAWK *Buteogallus anthracinus*

The first nesting record was in May 2002, when BRM & J. Delgadillo Villalobos observed a pair at a nest near Campo Uno. The nest, in a Ponderosa pine *Pinus ponderosa*, held two young, and an immature was photographed nearby in June 2002. This nest was used annually until 2013. Also in May 2002 pairs were observed in Cañón Carboneras, Cañón Juárez and midway along Cañón El Oso. The species has undergone a range contraction throughout the south-west USA and is considered threatened in Mexico, endangered in New Mexico, threatened in Texas, and is a candidate for listing in Arizona (Schnell 1994), although it breeds infrequently in the Davis Mountains and Big Bend area (Benson & Arnold 2001). It probably occurs sparsely throughout suitable riparian habitat in the Sierra del Carmen, and was first noted from these mountains in the mid-20th century (Taylor *et al.* 1945).

SOLITARY EAGLE *Buteogallus solitarius*

The first observation was in March 2003 in upper Juárez Canyon, by BRM & J. Delgadillo Villalobos. Thereafter, BRM saw at least three others: singles at Campo Uno flying around El Mirador, near Campo Cinco, and in flight near Campo Tres. At least one or two were

TABLE 1

Complete bird checklist, with breeding status, of the Sierra del Carmen, Coahuila, Mexico, including the authors' observations in 2001–15. BRM was a resident in the area in 2001–13. Status abbreviations: RB = resident breeder, M = migrant non-breeder, MB = migrant breeder, H = hypothetical breeder.

English name	Scientific name	Spring	Summer	Autumn	Winter	Status
Snow Goose	<i>Anser caerulescens</i>			x		M
Canada Goose	<i>Branta canadensis</i>			x		M
Wood Duck	<i>Aix sponsa</i>			x	x	M
Blue-winged Teal	<i>Spatula discors</i>	x		x	x	M
Cinnamon Teal	<i>Spatula cyanoptera</i>			x	x	M
Northern Shoveler	<i>Spatula clypeata</i>	x	x	x	x	M
Gadwall	<i>Mareca strepera</i>	x		x	x	M
American Wigeon	<i>Mareca americana</i>	x		x	x	M
Mallard × Mexican Duck	<i>Anas platyrhynchos</i> × <i>diazii</i>	x	x	x	x	M
Northern Pintail	<i>Anas acuta</i>			x	x	M
Green-winged Teal	<i>Anas crecca</i>	x		x	x	M
Canvasback	<i>Aythya valisineria</i>	x		x	x	M
Redhead	<i>Aythya americana</i>			x	x	M
Ring-necked Duck	<i>Aythya collaris</i>	x		x	x	M
Greater Scaup	<i>Aythya marila</i>			x	x	M
Lesser Scaup	<i>Aythya affinis</i>	x		x	x	M
Bufflehead	<i>Bucephala albeola</i>	x		x	x	M
Common Goldeneye	<i>Bucephala clangula</i>				x	M
Common Merganser	<i>Mergus merganser</i>			x	x	M
Ruddy Duck	<i>Oxyura jamaicensis</i>			x	x	M
Northern Bobwhite	<i>Colinus virginianus</i>	x	x	x	x	RB
Scaled Quail	<i>Callipepla squamata</i>	x	x	x	x	RB
Montezuma Quail	<i>Cyrtonyx montezumae</i>	x	x	x	x	RB
Wild Turkey	<i>Meleagris gallopavo</i>	x	x	x	x	RB
Least Grebe	<i>Tachybaptus dominicus</i>		x		x	MB
Pied-billed Grebe	<i>Podilymbus podiceps</i>	x	x	x	x	RB
Eared Grebe	<i>Podiceps nigricollis</i>	x			x	M
Double-crested Cormorant	<i>Phalacrocorax auritus</i>		x	x		M
American White Pelican	<i>Pelecanus erythrorhynchos</i>	x				M
American Bittern	<i>Botaurus lentiginosus</i>	x		x		M
Least Bittern	<i>Ixobrychus exilis</i>				x	M
Great Blue Heron	<i>Ardea herodias</i>	x	x	x	x	RB
Great Egret	<i>Ardea alba</i>	x		x		M
Snowy Egret	<i>Egretta thula</i>	x	x	x		M
Tricoloured Heron	<i>Egretta tricolor</i>			x		M
Cattle Egret	<i>Bubulcus ibis</i>	x	x	x		M
Green Heron	<i>Butorides virescens</i>	x	x	x		M
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	x		x		M
Yellow-crowned Night Heron	<i>Nyctanassa violacea</i>		x			M
White-faced Ibis	<i>Plegadis chihi</i>	x		x		M
Black Vulture	<i>Coragyps atratus</i>	x	x	x	x	MB
Turkey Vulture	<i>Cathartes aura</i>	x	x	x	x	MB
Osprey	<i>Pandion haliaetus</i>	x	x	x		M
Swallow-tailed Kite	<i>Elanoides forficatus</i>	x				M
Golden Eagle	<i>Aquila chrysaetos</i>	x	x	x	x	RB

English name	Scientific name	Spring	Summer	Autumn	Winter	Status
Mississippi Kite	<i>Ictinia mississippiensis</i>			x		M
Northern Harrier	<i>Circus hudsonius</i>	x	x	x	x	RB
Sharp-shinned Hawk	<i>Accipiter striatus</i>	x	x		x	M
Cooper's Hawk	<i>Accipiter cooperii</i>	x	x	x	x	RB
Northern Goshawk	<i>Accipiter gentilis</i>	x	x	x	x	RB
Bald Eagle	<i>Haliaeetus leucocephalus</i>			x		M
Common Black Hawk	<i>Buteogallus anthracinus</i>	x	x	x		MB
Solitary Eagle	<i>Buteogallus solitarius</i>	x	x			MB?
Harris's Hawk	<i>Parabuteo unicinctus</i>	x	x	x	x	RB
White-tailed Hawk	<i>Geranoaetus albicaudatus</i>	x				M
Grey Hawk	<i>Buteo plagiatus</i>	x	x	x		MB
Swainson's Hawk	<i>Buteo swainsoni</i>	x	x	x		MB
Zone-tailed Hawk	<i>Buteo albonotatus</i>	x	x	x		MB
Red-tailed Hawk	<i>Buteo jamaicensis</i>	x	x	x	x	RB
Sora	<i>Porzana carolina</i>			x	x	M
American Coot	<i>Fulica americana</i>	x	x	x	x	RB
Sandhill Crane	<i>Antigone canadensis</i>			x		M
Black-necked Stilt	<i>Himantopus mexicanus</i>	x		x		M
American Avocet	<i>Recurvirostra americana</i>	x		x		M
Killdeer	<i>Charadrius vociferus</i>	x	x	x	x	RB
Upland Sandpiper	<i>Bartramia longicauda</i>			x		M
Long-billed Curlew	<i>Numenius americanus</i>			x		M
Baird's Sandpiper	<i>Calidris bairdii</i>	x	x			M
Least Sandpiper	<i>Calidris minutilla</i>	x		x	x	M
Pectoral Sandpiper	<i>Calidris melanotos</i>	x		x		M
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>	x		x		M
Wilson's Snipe	<i>Gallinago delicata</i>			x	x	M
Wilson's Phalarope	<i>Phalaropus tricolor</i>	x		x		M
Spotted Sandpiper	<i>Actitis macularius</i>	x		x		M
Solitary Sandpiper	<i>Tringa solitaria</i>	x	x	x		M
Greater Yellowlegs	<i>Tringa melanoleuca</i>	x		x		M
Willet	<i>Tringa semipalmata</i>			x		M
Lesser Yellowlegs	<i>Tringa flavipes</i>			x		M
Bonaparte's Gull	<i>Chroicocephalus philadelphia</i>		x			M
Laughing Gull	<i>Leucophaeus atricilla</i>			x	x	M
Franklin's Gull	<i>Leucophaeus pipixcan</i>		x	x		M
Ring-billed Gull	<i>Larus delawarensis</i>	x	x	x		M
Forster's Tern	<i>Sterna forsteri</i>			x		M
Rock Pigeon	<i>Columba livia</i>	x		x	x	M
Band-tailed Pigeon	<i>Patagioenas fasciata</i>	x	x	x	x	RB
Eurasian Collared Dove	<i>Streptopelia decaocto</i>	x	x	x	x	RB
Inca Dove	<i>Columbina inca</i>	x	x	x	x	RB
Common Ground Dove	<i>Columbina passerina</i>	x	x	x	x	RB
White-tipped Dove	<i>Leptotila verreauxi</i>	x	x	x	x	RB
White-winged Dove	<i>Zenaida asiatica</i>	x	x	x	x	RB
Mourning Dove	<i>Zenaida macroura</i>	x	x	x	x	RB
Greater Roadrunner	<i>Geococcyx californianus</i>	x	x	x	x	RB
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	x	x	x		MB
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	x				M

English name	Scientific name	Spring	Summer	Autumn	Winter	Status
Barn Owl	<i>Tyto alba</i>	x	x	x	x	RB
Flammulated Owl	<i>Psilosops flammeolus</i>	x	x	x		MB
Western Screech Owl	<i>Megascops kennicottii</i>	x	x	x	x	RB
Eastern Screech Owl	<i>Megascops asio</i>	x	x	x	x	RB
Great Horned Owl	<i>Bubo virginianus</i>	x	x	x	x	RB
Northern Pygmy Owl	<i>Glaucidium gnoma</i>	x	x	x		MB
Elf Owl	<i>Micrathene whitneyi</i>	x	x	x		MB
Burrowing Owl	<i>Athene cucularia</i>	x	x	x	x	RB
Long-eared Owl	<i>Asio otus</i>	x		x	x	M
Short-eared Owl	<i>Asio flammeus</i>			x	x	M
Northern Saw-whet Owl	<i>Aegolius acadicus</i>	x	x	x		MB
Lesser Nighthawk	<i>Chordeiles acutipennis</i>	x	x	x		MB
Common Nighthawk	<i>Chordeiles minor</i>	x	x	x		MB
Common Pauraque	<i>Nyctidromus albigollis</i>	x	x			M
Common Poorwill	<i>Phalaenoptilus nuttallii</i>	x	x	x	x	RB
Mexican Whip-poor-will	<i>Antrostomus arizonae</i>	x	x	x		MB
White-throated Swift	<i>Aeronautes saxatalis</i>	x	x	x	x	RB
Rivoli's Hummingbird	<i>Eugenes fulgens</i>	x	x	x		MB
Blue-throated Hummingbird	<i>Lampornis clemenciae</i>	x	x	x		MB
Lucifer Hummingbird	<i>Calothorax lucifer</i>	x	x	x		MB
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	x		x		M
Black-chinned Hummingbird	<i>Archilochus alexandri</i>	x	x	x		MB
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	x	x	x		MB
Rufous Hummingbird	<i>Selasphorus rufus</i>		x	x		M
Calliope Hummingbird	<i>Selasphorus calliope</i>		x	x		M
Broad-billed Hummingbird	<i>Cynanthus latirostris</i>	x	x	x		MB
White-eared Hummingbird	<i>Hylocharis leucotis</i>	x	x			M
Belted Kingfisher	<i>Megasceryle alcyon</i>	x	x	x	x	RB
Green Kingfisher	<i>Chloroceryle americana</i>	x	x	x	x	RB
Acorn Woodpecker	<i>Melanerpes formicivorus</i>	x	x	x	x	RB
Golden-fronted Woodpecker	<i>Melanerpes aurifrons</i>	x	x	x	x	RB
Williamson's Sapsucker	<i>Sphyrapicus thyroideus</i>			x	x	M
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	x		x	x	M
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>			x	x	M
Ladder-backed Woodpecker	<i>Dryobates scalaris</i>	x	x	x	x	RB
Hairy Woodpecker	<i>Dryobates villosus</i>	x	x	x	x	RB
Ladder-backed × Hairy Woodpecker (hybrid)	<i>Dryobates scalaris</i> × <i>villosus</i>					R?
Northern Flicker	<i>Colaptes auratus</i>	x	x	x	x	RB
Crested Caracara	<i>Caracara cheriway</i>	x	x	x		M?
American Kestrel	<i>Falco sparverius</i>	x	x	x	x	RB
Merlin	<i>Falco columbarius</i>	x	x		x	M
Aplomado Falcon	<i>Falco femoralis</i>	x		x		M
Peregrine Falcon	<i>Falco peregrinus</i>	x	x	x	x	RB
Prairie Falcon	<i>Falco mexicanus</i>	x	x		x	M
Olive-sided Flycatcher	<i>Contopus cooperi</i>	x		x		M
Western Wood Pewee	<i>Contopus sordidulus</i>	x				M
Eastern Wood Pewee	<i>Contopus virens</i>	x				M
Willow Flycatcher	<i>Empidonax traillii</i>	x		x		M
Least Flycatcher	<i>Empidonax minimus</i>	x				M

English name	Scientific name	Spring	Summer	Autumn	Winter	Status
Hammond's Flycatcher	<i>Empidonax hammondii</i>	x		x		M
Grey Flycatcher	<i>Empidonax wrightii</i>	x		x	x	M
Dusky Flycatcher	<i>Empidonax oberholseri</i>	x				M
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>	x	x	x		MB
Black Phoebe	<i>Sayornis nigricans</i>	x	x	x	x	RB
Eastern Phoebe	<i>Sayornis phoebe</i>	x		x	x	M
Say's Phoebe	<i>Sayornis saya</i>	x	x	x	x	RB
Vermilion Flycatcher	<i>Pyrocephalus rubinus</i>	x	x	x		MB
Dusky-capped Flycatcher	<i>Myiarchus tuberculifer</i>	x	x			MB
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	x	x	x		MB
Couch's Kingbird	<i>Tyrannus couchii</i>		x			M
Cassin's Kingbird	<i>Tyrannus vociferans</i>	x	x	x		MB
Western Kingbird	<i>Tyrannus verticalis</i>	x	x	x		MB
Eastern Kingbird	<i>Tyrannus tyrannus</i>			x		M
Scissor-tailed Flycatcher	<i>Tyrannus forficatus</i>	x	x	x		M
Loggerhead Shrike	<i>Lanius ludovicianus</i>	x	x	x	x	RB
Black-capped Vireo	<i>Vireo atricapilla</i>	x	x	x		MB
Bell's Vireo	<i>Vireo bellii</i>	x	x	x		MB
Grey Vireo	<i>Vireo vicinior</i>	x	x	x	x	RB
Hutton's Vireo	<i>Vireo huttoni</i>	x	x	x	x	RB
Blue-headed Vireo	<i>Vireo solitarius</i>	x	x	x		M
Plumbeous Vireo	<i>Vireo plumbeus</i>	x	x			M
Warbling Vireo	<i>Vireo gilvus</i>	x				M
Red-eyed Vireo	<i>Vireo olivaceus</i>	x				M
Steller's Jay	<i>Cyanocitta stelleri</i>				x	M
Mexican Jay	<i>Aphelocoma wollweberi</i>	x	x	x	x	RB
Clark's Nutcracker	<i>Nucifraga columbiana</i>				x	M
American Crow	<i>Corvus brachyrhynchos</i>	x				H
Chihuahuan Raven	<i>Corvus cryptoleucus</i>	x	x	x	x	RB
Common Raven	<i>Corvus corax</i>	x	x	x	x	RB
Horned Lark	<i>Eremophila alpestris</i>			x		M
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	x	x	x	x	MB
Violet-green Swallow	<i>Tachycineta thalassina</i>	x	x	x		MB
Bank Swallow	<i>Riparia riparia</i>	x	x	x		MB
Barn Swallow	<i>Hirundo rustica</i>	x	x			MB
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	x	x	x		MB
Cave Swallow	<i>Petrochelidon fulva</i>	x	x	x		MB
Black-crested Titmouse	<i>Baeolophus atricristatus</i>	x	x	x	x	RB
Verdin	<i>Auriparus flaviceps</i>	x	x	x	x	RB
Bushtit	<i>Psaltiriparus minimus</i>	x	x	x	x	RB
Red-breasted Nuthatch	<i>Sitta canadensis</i>	x	x	x	x	HB
White-breasted Nuthatch	<i>Sitta carolinensis</i>	x	x	x	x	RB
Pygmy Nuthatch	<i>Sitta pygmaea</i>	x	x	x	x	RB
Brown Creeper	<i>Certhia americana</i>			x		M
Rock Wren	<i>Salpinctes obsoletus</i>	x	x	x	x	RB
Canyon Wren	<i>Catherpes mexicanus</i>	x	x	x	x	RB
House Wren	<i>Troglodytes aedon</i>	x		x	x	M
House Wren (Brown-throated)	<i>Troglodytes aedon</i> [brunneicollis group]	x	x	x	x	RB
Marsh Wren	<i>Cistothorus palustris</i>	x			x	M

English name	Scientific name	Spring	Summer	Autumn	Winter	Status
Carolina Wren	<i>Thryothorus ludovicianus</i>	x	x	x	x	RB
Bewick's Wren	<i>Thryomanes bewickii</i>	x	x	x	x	RB
Cactus Wren	<i>Campylorhynchus brunneicapillus</i>	x	x	x	x	RB
Blue-grey Gnatcatcher	<i>Poliophtila caerulea</i>	x	x	x	x	RB
Black-tailed Gnatcatcher	<i>Poliophtila melanura</i>	x	x	x	x	RB
Golden-crowned Kinglet	<i>Regulus satrapa</i>			x	x	M
Ruby-crowned Kinglet	<i>Regulus calendula</i>	x		x	x	M
Eastern Bluebird	<i>Sialia sialis</i>				x	M
Western Bluebird	<i>Sialia mexicana</i>	x		x	x	MB
Mountain Bluebird	<i>Sialia currucoides</i>			x	x	M
Townsend's Solitaire	<i>Myadestes townsendi</i>	x		x	x	M
Russet Nightingale-Thrush	<i>Catharus occidentalis</i>	x	x			MB?
Swainson's Thrush	<i>Catharus ustulatus</i>	x				M
Hermit Thrush	<i>Catharus guttatus</i>	x		x	x	M
American Robin	<i>Turdus migratorius</i>	x			x	M
Grey Catbird	<i>Dumetella carolinensis</i>			x		M
Curve-billed Thrasher	<i>Toxostoma curvirostre</i>	x	x	x	x	RB
Long-billed Thrasher	<i>Toxostoma longirostre</i>	x	x	x	x	RB
Crissal Thrasher	<i>Toxostoma crissale</i>	x	x	x	x	RB
Sage Thrasher	<i>Oreoscoptes montanus</i>	x		x	x	M
Northern Mockingbird	<i>Mimus polyglottos</i>	x	x	x	x	RB
European Starling	<i>Sturnus vulgaris</i>	x				M
American Pipit	<i>Anthus rubescens</i>	x		x	x	M
Cedar Waxwing	<i>Bombycilla cedrorum</i>	x		x	x	M
Phainopepla	<i>Phainopepla nitens</i>	x	x	x	x	RB
Olive Warbler	<i>Peucedramus taeniatus</i>	x	x	x	x	RB
Lapland Longspur	<i>Calcarius lapponicus</i>	x				M
Chestnut-collared Longspur	<i>Calcarius ornatus</i>	x				M
Louisiana Waterthrush	<i>Parkesia motacilla</i>	x				M
Black-and-white Warbler	<i>Mniotilta varia</i>	x		x		M
Orange-crowned Warbler	<i>Oreothlypis celata</i>	x		x	x	M
Colima Warbler	<i>Oreothlypis crissalis</i>	x	x	x		MB
Nashville Warbler	<i>Oreothlypis ruficapilla</i>	x		x		M
Virginia's Warbler	<i>Oreothlypis virginiae</i>	x		x		M
MacGillivray's Warbler	<i>Geothlypis tolmiei</i>	x		x		M
Common Yellowthroat	<i>Geothlypis trichas</i>	x	x	x	x	MB
American Redstart	<i>Setophaga ruticilla</i>	x		x		MB
Northern Parula	<i>Setophaga americana</i>	x				M
Magnolia Warbler	<i>Setophaga magnolia</i>	x				M
Yellow Warbler	<i>Setophaga petechia</i>	x		x		M
Black-throated Blue Warbler	<i>Setophaga caeruleascens</i>			x		M
Palm Warbler	<i>Setophaga palmarum</i>	x				M
Yellow-rumped Warbler	<i>Setophaga coronata</i>	x		x	x	M
Yellow-throated Warbler	<i>Setophaga dominica</i>	x				M
Black-throated Grey Warbler	<i>Setophaga nigrescens</i>	x		x		M
Townsend's Warbler	<i>Setophaga townsendi</i>	x		x		M
Golden-cheeked Warbler	<i>Setophaga chrysoparia</i>	x	x			M
Wilson's Warbler	<i>Cardellina pusilla</i>	x		x		M
Red-faced Warbler	<i>Cardellina rubrifrons</i>	x	x			MB?

English name	Scientific name	Spring	Summer	Autumn	Winter	Status
Painted Redstart	<i>Myioborus pictus</i>	x	x	x		MB
Slate-throated Redstart	<i>Myioborus miniatus</i>	x	x			MB
Cassin's Sparrow	<i>Peucaea cassinii</i>	x	x	x	x	MB
Grasshopper Sparrow	<i>Ammodramus saviannarum</i>	x				M
Baird's Sparrow	<i>Centronyx bairdii</i>	x				M
Chipping Sparrow	<i>Spizella passerina</i>	x	x	x	x	M
Clay-coloured Sparrow	<i>Spizella pallida</i>	x		x	x	M
Black-chinned Sparrow	<i>Spizella atrogularis</i>	x	x	x	x	RB
Field Sparrow	<i>Spizella pusilla</i>	x				M
Brewer's Sparrow	<i>Spizella breweri</i>	x		x	x	M
Black-throated Sparrow	<i>Amphispiza bilineata</i>	x	x	x	x	RB
Lark Sparrow	<i>Chondestes grammacus</i>	x	x	x	x	RB
Lark Bunting	<i>Calamospiza melanocorys</i>	x		x	x	M
Fox Sparrow	<i>Passerella iliaca</i>			x	x	M
Dark-eyed Junco	<i>Junco hyemalis</i>	x			x	M
Yellow-eyed Junco	<i>Junco phaeonotus</i>	x	x	x	x	RB
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	x		x	x	M
White-throated Sparrow	<i>Zonotrichia albicollis</i>	x			x	M
Vesper Sparrow	<i>Poocetes gramineus</i>	x		x	x	M
Savannah Sparrow	<i>Passerculus sandwichensis</i>	x		x	x	M
Song Sparrow	<i>Melospiza melodia</i>	x		x	x	M
Lincoln's Sparrow	<i>Melospiza lincolni</i>	x		x	x	M
Swamp Sparrow	<i>Melospiza georgiana</i>			x	x	M
Canyon Towhee	<i>Melospiza fusca</i>	x	x	x	x	RB
Rufous-crowned Sparrow	<i>Aimophila ruficeps</i>	x	x	x	x	RB
Green-tailed Towhee	<i>Pipilo chlorurus</i>	x		x	x	M
Spotted Towhee	<i>Pipilo maculatus</i>	x	x	x	x	M
Yellow-breasted Chat	<i>Icteria virens</i>	x	x	x		MB
Hepatic Tanager	<i>Piranga flava</i>	x	x	x		MB
Summer Tanager	<i>Piranga rubra</i>	x	x	x		MB
Scarlet Tanager	<i>Piranga olivacea</i>	x				M
Western Tanager	<i>Piranga ludoviciana</i>	x	x	x		MB
Flame-coloured Tanager	<i>Piranga bidentata</i>	x	x			M
Northern Cardinal	<i>Cardinalis cardinalis</i>	x	x	x	x	RB
Pyrrhuloxia	<i>Cardinalis sinuatus</i>	x	x	x	x	RB
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	x				M
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	x	x	x		MB
Blue Grosbeak	<i>Passerina caerulea</i>	x	x	x		MB
Lazuli Bunting	<i>Passerina amoena</i>		x			M
Indigo Bunting	<i>Passerina cyanea</i>	x	x	x		MB
Varied Bunting	<i>Passerina versicolor</i>	x	x	x		MB
Painted Bunting	<i>Passerina ciris</i>	x	x	x		MB
Dickcissel	<i>Spiza americana</i>	x		x		M
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	x	x	x		M
Western Meadowlark	<i>Sturnella neglecta</i>	x	x	x	x	RB
Eastern Meadowlark	<i>Sturnella magna</i>	x		x	x	M
Orchard Oriole	<i>Icterus spurius</i>	x	x	x		MB
Hooded Oriole	<i>Icterus cucullatus</i>	x	x	x		MB
Bullock's Oriole	<i>Icterus bullockiorum</i>	x	x			M

English name	Scientific name	Spring	Summer	Autumn	Winter	Status
Audubon's Oriole	<i>Icterus graduacauda</i>	x	x	x	x	RB
Scott's Oriole	<i>Icterus parisorum</i>	x	x	x		MB
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	x	x	x	x	RB
Bronzed Cowbird	<i>Molothrus aeneus</i>	x	x	x		MB
Brown-headed Cowbird	<i>Molothrus ater</i>	x	x	x		MB
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	x		x	x	M
Great-tailed Grackle	<i>Quiscalus mexicanus</i>	x	x			M
House Finch	<i>Haemorhous mexicanus</i>	x	x	x	x	RB
Cassin's Finch	<i>Haemorhous cassinii</i>			x	x	M
Pine Siskin	<i>Spinus pinus</i>	x		x	x	MB
Lesser Goldfinch	<i>Spinus psaltria</i>	x	x	x	x	RB
American Goldfinch	<i>Spinus tristis</i>	x		x	x	M
House Sparrow	<i>Passer domesticus</i>	x	x	x	x	RB

observed every year BRM conducted field work in 2003–13. All observations were made between 1,460 and 2,450 m elevation. The lowest vegetation association was in Cañón Juárez, characterised by scattered pines, juniper and oak. The highest observation was made near Campo Tres, in pine–oak–fir forest. The majority of observations were centred on pine–oak woodlands, and all were made in mid March–early May.

A specimen was collected in 1961 by A. Garza de Leon, former director of the Museo de las Aves in Saltillo, at Rancho las Margaritas, in the Serranías del Burro, adjacent to the Sierra del Carmen (Howell & Webb 1995). He shot it believing it to be a Turkey Vulture *Cathartes aura*. When he reached the downed bird, he was astounded to discover its true identity. The mounted specimen is in the Museo de las Aves collection, and was examined by Clark *et al.* (2006) for their primer on identification.

In 1993 and 1994, Elizabeth Spence de Sellers & BRM observed a pair of Solitary Eagles in the ‘Lobo Pasture’, Serranías del Burro, during bird surveys, including an observation of a pair hunting and one carrying an Eastern Fox Squirrel *Sciurus niger* in its talons. No nest could be located.

Based on these observations, Solitary Eagle might occasionally nest in the Sierra del Carmen, which would represent a significant range extension. In Mexico, the species is listed as Endangered, and the nearest population is in the Sierra Madre Mountains of Chihuahua far to the west (Howell & Webb 1995). There are also recent photo-documented records on eBird from Tamaulipas.

WHITE-TAILED HAWK *Geranoaetus albicaudatus*

On 15 June 2003, JEM observed many at the entrance to Santo Domingo Ranch on the east side of the Sierra del Carmen. In May 2010, one was observed by BRM and a group from US Fish & Wildlife Service, Big Bend National Park, and Rio Grande Joint Venture, flying low over grasslands in the Zacatosa area, near Rancho Los Pilares. It has also been documented on eBird in the vicinity of Múzquiz, as well as in Big Bend National Park and Black Gap Wildlife Management Area.

NORTHERN GOSHAWK *Accipiter gentilis*

R. Wauer documented a nest high in the pine–fir forest of the Sierra del Carmen (Wauer 1992). The species is a resident breeder at the highest elevations, in stands of tall, mature

pine–fir habitat with sheer cliffs bordering open areas, during spring to autumn. In winter the species moves downslope to the lower canyons, particularly the upper Cañón El Alamo, Cañón Fronteriza and Cañón Juárez, which support riparian pine–oak habitat. This is a very isolated population of the species, with the nearest populations in the Sierra Madre Occidental and parts of the south-west USA.

LAUGHING GULL *Leucophaeus atricilla*

Photographs were taken of this species on the landing strip at Los Pilares in 2001. Presa Don Martin near Sabinas, Amistad Lake at Del Rio, and Balmorhea Lake, in Texas, all have resident Laughing Gulls.

WHITE-TIPPED DOVE *Leptotila verreauxi*

Regularly recorded in lower canyons of the sierra, and we found nests in September 2004 and May 2007. Given the relative ease of detection (flushes at close range and calls regularly), it is unlikely to have been missed by Miller (1955). Instead, these new records are probably attributable to range expansion, both locally (McCormack *et al.* 2007) and regionally, possibly as a result of land-use changes (Hogan 1999).

WHITE-WINGED DOVE *Zenaida asiatica*

Seen just once by Miller (1955), we regularly observed it in low-elevation canyons like El Alamo. Like White-tipped Dove, it is probable that the species was indeed rare in the 1950s, and that its modern abundance in the region is a function of recent range expansion (Schwertner *et al.* 2002).

COMMON PAURAQUE *Nyctidromus albicollis*

Not documented on eBird much further west than Del Rio, Texas, the species was heard calling near Tanque Pilares one evening in early October 2001 by BRM *et al.*

RIVOLI'S HUMMINGBIRD *Eugenes fulgens*

Seen just once by Miller (1955), with a specimen collected by A. Starker Leopold housed at the Berkeley Museum of Vertebrate Zoology (MVZ 129681). We regularly observed it in mid- to high-elevation forests. There are now many eBird records in Big Bend National Park, where it has been known as a breeder for some years (Wauer 1996). On 8 May 2007 a nest was found above Campo Dos. The female was incubating or brooding. The nest was 7 m up in a 17 m-tall conifer, 3 m along a horizontal branch and 60 cm from its tip. At Casa San Isidro, where hummingbird feeders were installed, the species was a daily visitor during spring to early autumn. The surprisingly small number of observations by Miller is hard to explain.

APLOMADO FALCON *Falco femoralis*

Spring and autumn sightings in 2003–05 of a lone bird near Los Pilares. No photographs were taken. Perhaps a vagrant from west of the Sierra del Carmen in adjacent Chihuahua, where there is a breeding population (Moreno-Contreras *et al.* 2015). There are a few eBird records in Big Bend National Park.

EASTERN WOOD PEWEE *Contopus virens*

At least one in the evening of 28 April 2007 at Campo Uno before a heavy thunderstorm passed. At least one was present again the following morning. Identification was based on the vocalisation, which was clear, plaintive and less hoarse than that of Western Wood

Pewee *C. sordidulus*. The Sierra del Carmen is outside the known regular migration route of the species, although Howell & Webb (1995) mentioned it as a vagrant in adjacent Chihuahua.

DUSKY FLYCATCHER *Empidonax oberholseri*

Mist-netted in Cañón El Alamo on 22 April 2007. Identification confirmed mensurally. There are numerous records in Big Bend National Park on eBird.

DUSKY-CAPPED FLYCATCHER *Myiarchus tuberculifer*

First seen on 30 May 2007, when we observed a pair exploring cavities in various snags around Campo Uno. The species' unique vocalisations first alerted us to the birds' probable identity. We later confirmed the identification visually—they were much smaller than the common Ash-throated Flycatcher *M. cinerascens*, the undertail was all grey, and the belly was brighter yellow. Considered a very rare breeder in the Jeff Davis and Chisos Mountains of Texas, and it is probably a regular but rare breeder in the Sierra del Carmen as well. All of our observations relate to the same pair at Campo Uno.

BLACK-CAPPED VIREO *Vireo atricapilla*

Reported by Miller (1955) as fairly common in the lower Boquillas Canyon, where it was found primarily in catclaw *Senegalia greggii*-dominated areas of dense shrubs. Benson & Benson (1990) estimated $6,301 \pm 3,162$ breeding pairs in the region, and one of us previously documented a comparatively dense population breeding in the Sierra del Carmen (McKinney 1998). At the eastern end of the range, in Cañón Morteros, Black-capped Vireo was abundant in areas of scattered oaks, large boulders and stands of juniper. Singing males were territorial by early April, and several were mist-netted in 2002. They are also found at Cuesta Malena in a habitat comprising scattered oaks, Gregg ash *Fraxinus greggii* and boulders. To the east, in the Serranías del Burro in similar habitat, a large breeding population was documented in 1993–96 (McKinney 1987, McKinney & Sellers 1996).

CLARK'S NUTCRACKER *Nucifraga columbiana*

One was observed by S. Gibert Isern on the road to Campo Dos in 2003. There is also a single eBird record from the Chisos Mountains in Big Bend National Park.

RED-BREASTED NUTHATCH *Sitta canadensis*

Seen on Mesa Bonita and at Campo Tres, high in the mountains in pine–oak–fir forest. Observed in all seasons, but nesting not definitively documented. Three were seen in Ponderosa pine *Pinus ponderosa* at Campo Tres in July 2002. Not considered to be resident in the area, and is only an irregular winter visitor to northern Mexico (Howell & Webb 1995, Delgado-Fernández & Delgadillo-Nuño 2016), and a sporadic visitor in autumn to spring throughout the Trans-Pecos, including Big Bend National Park (Peterson & Zimmer 1998).

RUSSET NIGHTINGALE-THRUSH *Catharus occidentalis*

On 14 May 2007, at c.2,500 m, we heard a *Catharus* singing, but we assumed the song belonged to an odd migrant Hermit Thrush *C. guttatus*. The vegetation in the ravine comprised small deciduous shrubs (e.g., *Physocarpus monogynus*) with a coniferous canopy on the fairly steep, dry slopes above. We heard the same bird singing upon our return to the area on 31 May 2007, and again on 1 June 2007. On 3 June 2007 we returned at 08.05 h with the goal of observing the bird. It was difficult to see, but we noted that the upperparts were dull brown, the breast grey, it had an eye-ring, a bicoloured bill, and the vent was white or



Figure 2. The environs and possible nest of Russet Nightingale-Thrush *Catharus occidentalis*, Sierra del Carmen, Coahuila, Mexico, June 2007. Clockwise from left: an old nest from the side, with dense moss still largely intact, but most pale twigs / grass have fallen off (some still visible hanging from the nest); the steep slopes of the ravine in which the nest was sited; the same nest from above, showing the thickness of the moss cup and the carefully constructed lining of rootlets and conifer needles (Eliot T. Miller)

pale grey. The bird sang almost continuously until we left at 10.15 h. We returned on 7 June 2007 and were able to record two brief song bouts using a digital camera (<http://www.xeno-canto.org/357625>, <http://www.xeno-canto.org/357626>). A bandpass-filtered version has also been uploaded to Macaulay Library (ML85671051), where the identification was confirmed by reviewers. Near the singing bird, we noted the presence of at least four old nests that resembled those of other Central and South American *Catharus* and *Turdus* species (ETM, H. F. Greeney & V. Rohwer pers. obs.; Fig. 2). We departed the study site on 10 June 2007, and made no further observations of the bird. This site is c.425 km north of the nearest known population, near Monterrey, Nuevo León. While our evidence of breeding is far from conclusive, the large number of nightingale-thrush-like nests in the ravine, and extensive singing throughout the day for 24 days suggests at least a male advertising for a mate.

LAPLAND LONGSPUR *Calcarius lapponicus*

Rare visitor. Observed at the bird feeder at Casa San Isidro. The species has been documented across the Rio Grande in western Texas, in the northern portion of the Trans-Pecos, where it is considered accidental in winter (Peterson & Zimmer 1998).

GOLDEN-CHEEKED WARBLER *Setophaga chrysoparia*

Rare, sightings from Cañón Morteros area, where there is Ashe juniper *Juniperus ashei*, the species' preferred breeding habitat. A few eBird records exist for Big Bend National Park.

RED-FACED WARBLER *Cardellina rubrifrons*

Seen once, on 12–17 April 2006 (only a single checklist was kept for this period) just downstream of Campo Dos, at the entrance to El Moreno Canyon.

SLATE-THROATED REDSTART *Myioborus miniatus*

Like McCormack *et al.* (2005), who documented a breeding pair near Campo Dos, we found the species to be thinly distributed throughout the narrow drainage from Campo Dos to Campo Tres. Our observations were primarily in May–June.

FLAME-COLOURED TANAGER *Piranga bidentata*

Very rare. Documented just three times in the Sierra del Carmen. Photo-documented on eBird in the Chisos Mountains of Big Bend National Park. Common in the Sierra Santa Rosa, 100 km to the south-east (McCormack *et al.* 2007).

AUDUBON'S ORIOLE *Icterus graduacauda*

Not noted by Miller (1955b), but we found the species to be common throughout the lower western canyons. McCormack *et al.* (2007) also noted it as common in the Sierra Santa Rosa, 100 km to the south-east, and suggested that the failure of previous studies to locate the species in this area might reflect a recent increase in its abundance. While this could be true, there is a specimen from the Sierra del Carmen collected in 1940 at the Perot Museum of Nature and Science in Dallas (PMNS 001444), two specimens taken to the south-east near Sabinas, Coahuila, in 1910, housed at the Field Museum of Natural History, Chicago (FMNH 125181–182), and an audio-recording from the nearby Sierra Encantada in 1983 (Florida Museum Bioacoustic Archive UF Audio 7216). It therefore seems probable that the species has long been present in the region, but might have experienced a more recent increase in abundance. Audubon's Oriole is resident and its preferred habitat is the lower edge of pine-oak woodlands comprising pine, oak, juniper and yucca. It is also common to the east in the Serranías del Burro (Benson *et al.* 1989).

Discussion

The Sierra del Carmen possesses an interesting avifauna that combines species from several nearby biogeographic regions. Those characteristic of regions to the north and the high mountains of Mexico include Broad-tailed Hummingbird *Selasphorus platycercus*, Cordilleran Flycatcher *Empidonax occidentalis* and Flammulated Owl *Psilosops flammeolus*. Species primarily found further south include Montezuma Quail *Cyrtonyx montezumae*, Common Black Hawk, Solitary Eagle, White-tipped Dove, Rivoli's Hummingbird, Blue-throated Hummingbird *Lampornis clemenciae*, Dusky-capped Flycatcher, Russet Nightingale-Thrush, Olive Warbler *Peucedramus taeniatus*, Colima Warbler *Oreothlypis crissalis*, Painted Redstart *Myioborus pictus*, Slate-throated Redstart, Yellow-eyed Junco *Junco phaeonotus*, Varied Bunting *Passerina versicolor* and Audubon's Oriole. Finally, as noted by Miller (1955a,b), certain species are 'notably lacking'. We confirm the absence of any breeding evidence for chickadees *Poecile* spp., bluebirds *Sialia* spp. or Brown Creeper *Certhia americana*, and likewise corroborate his observation that some species expected to be common based on habitat are absent or almost so during the breeding season: Hairy Woodpecker *Dryobates villosus*, Steller's Jay *Cyanocitta stelleri*, Plumbeous Vireo *Vireo plumbeus* and Yellow-rumped Warbler *Setophaga coronata*.

Compared to sky islands north of the Sierra Madre Occidental like the Chiricahua Mountains, those north of the Sierra Madre Oriental, of which the Sierra del Carmen is one, are relatively depauperate in tropical bird species. McCormack *et al.* (2007) posed the

question whether the eastern sky islands truly lack such species, or whether the regional list might grow with additional exploration of this comparatively poorly known area. We conclude that while we have added a few southern taxa to the regional list, these isolated mountains are indeed less diverse in tropical species than their western counterpart sky islands. This begs the question of how these tropical species have come to be distributed in the area. Have they dispersed comparatively recently from further south, or are they perhaps relict populations from when more mesic vegetation dominated the region (Metcalf *et al.* 2000, McCormack *et al.* 2007)? Based on genetic evidence from Mexican Jay *Aphelocoma ultramarina*, many of these species may be relicts of populations that were previously more widespread during glacial maxima when forest was amply distributed (McCormack *et al.* 2008).

As a sky island, the Sierra del Carmen rises as a beacon of intact, forested landscape within an otherwise sparse corridor of suitable habitat for montane Middle American species shifting north along the Sierra Madre Oriental with climate change (Davis & Shaw 2001, Colwell *et al.* 2008). Moreover, it harbours a distinctive set of known (McCormack *et al.* 2008) and presumed genetically distinct populations of otherwise more southerly distributed species. Fortunately, the majority of the region is federally protected and carefully managed, much of it by the international company CEMEX. Rehabilitation efforts of past environmental injuries have been underway for many years, including removal of logging waste and the re-introduction of Bighorn Sheep *Ovis canadensis*, Pronghorn *Antilocapra americana* and Elk *Cervus canadensis*, and the long-term conservation outlook in the Sierra del Carmen appears promising (McKinney & Villalobos 2014).

Acknowledgements

We thank CEMEX for conserving and stewarding land in the Sierra del Carmen, Elena Berg, Erik Peñaloza and Jan Brotman for contributing their observations, and the anonymous reviewers whose input greatly improved this manuscript. We also appreciate the observations by Billy Pat McKinney (Manager El Carmen), Jonas Delgadillo, Feliciano Heredia Pineda and Santiago Gibert Isern who have conducted field work at El Carmen.

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