

# DISTRIBUTION AND PROVENANCE OF FOSSIL AVIFAUNA ON SAN MIGUEL ISLAND

DANIEL A. GUTHRIE

*Joint Science Program, Claremont McKenna, Scripps and Pitzer Colleges, Claremont, CA 91711  
dguthrie@jsd.claremont.edu*

**ABSTRACT**—The avian species abundance from 19 Pleistocene vertebrate sites on San Miguel Island include fauna from new sites not previously listed. The provenance of material at most sites was from nearby nesting colonies of seabirds. One site was a roost for barn owls, which included many small birds in their diet. Proximity to bald eagle bones and comparison to avian material from a recent eagle nest on San Miguel Island suggest that remains of most non-nesting marine birds found at some sites were brought there by eagles.

*Keywords: avifauna, bald eagles, California, Pleistocene, San Miguel Island*

## INTRODUCTION

To prevent loss of valuable faunal material to the forces of erosion, San Miguel Island has been surveyed periodically to salvage exposed bone from Pleistocene sediments. Collections were made in 1980, 84, 85, 88, 90, 94, 96, 98, and 2002. To date approximately 17,000 bones from 61 species have been recovered. All material has been catalogued and is in the collections of the Santa Barbara Museum of Natural History (Santa Barbara, CA; Appendix 1). The locality for each specimen was identified by a number (Fig. 1). Descriptions and maps of each locality are on file at the Santa Barbara Museum of Natural History and at the headquarters of Channel Islands National Park, Ventura, CA.

Exposed sediments containing fossil material occur along the north coast of San Miguel Island (Fig. 1). Most of these sediments were formed by erosion of sea cliffs washing material to lower levels toward the north shore of the island. In some areas, such as at localities 8, 14, 15, 17, 18, 19, narrow gullies have cut through these deposits, exposing nearly vertical sections of bone-bearing sediments. These fragile bones, including bird skulls, were deposited without breakage at these localities due in part to the nature of the sediments, which consist of fine grained soil and wind blown sand. The number of intact bones suggests that the distance of transport from the site of death to the site of deposition was not great.

At Simonton Cove, fossil material is found along the sides of several wide canyons (localities 6, 7, 16; Fig. 1). Although most material was deposited through erosion from higher levels, some complete skeletons have been recovered from this area suggesting these individuals may have burrowed into the sides of these canyons to nest. Presence of eggshell and of incompletely formed bones of immature birds further support this idea.

At Cuyler Harbor (locality 10; Fig. 1), sediments just above the east end of the beach were formed by erosion from higher levels which deposited a mixture of bone, snail shells and fragments of marine mollusk shells. There is a layer of tar sand in these deposits about 60 feet above sea level, which either indicates seepage from inland sources on San Miguel Island or deposition on the beach from offshore oil seeps. Although these deposits yielded many fossils in the 1980s, most of this area is currently inaccessible as it is covered by dunes and sand blown upward from Cuyler Beach.

Localities 4, 12, 21 and 22 (Fig. 1) are the only areas to produce fossils on the upper surface of the island. The bones in these localities were buried by sand blown inland from upwind beaches. At locality 12, although skeletal material is disarticulated, bones are concentrated in a small area. The presence of complete skulls and nearly complete eggshells indicates rapid *in situ* burial. Most of this site, which produced a rich collection of skeletal material in the 1980s, is now buried by

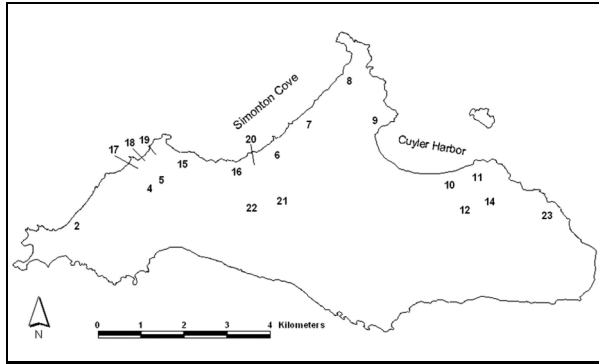


Figure 1. Pleistocene vertebrate fossil localities on San Miguel Island, CA.

shifting sand dunes. At localities 4, 21 and 22, bones are widely scattered and worn, indicating that these bones were either on the surface for an extended period before burial or were eroded out of the deposits well before collection. Additional comments on the geology of these sediments can be found in Johnson (1980) and Guthrie (1993).

Radiocarbon dating of bone from these deposits indicates ages varying between 12,000 and 40,000 BP (before present). The more recent dates were obtained from localities 4 and 12 on the upper terrace of the island, while older dates were obtained from lower strata at localities 7 and 10 (Guthrie 1992).

Material found on the surface along the sides of canyons and gullies may have fallen from higher levels or have been deposited at the site of discovery. Thus, bones occurring side by side in the deposits may have originally come from different layers and be of differing ages. However, the completeness of fragile skeletal elements indicates a short distance of transport for most of the material, and allows some interpretation about its provenance. There appear to be three main mechanisms by which avifaunal remains were incorporated into these deposits: from seabird colonies, by owls, and by bald eagles. Each of these will be discussed below.

### NESTING COLONIES

Four species are extremely well represented in the San Miguel Island deposits. These are an extinct flightless goose *Chendytes lawi* (1,836

bones), and three species of Alcidae; an extinct puffin (*Fratercula dowi*, 8,202 bones) and extant Cassin's auklet (*Ptychoramphus aleuticus*, 4,160 bones) and ancient murrelet (*Synthiboramphus antiquus*, 2,042 bones). Although none of these species currently nest on San Miguel, based on the abundance of these species in discrete areas (Appendix 1) and the presence of eggshells and undeveloped bones of immature individuals, it is believed that these four species once had nesting colonies on the island.

Bones and eggshell fragments of *C. lawi* were especially abundant at localities 10 and 12, and it is believed that these areas were once major nesting sites for this species. Extant species of geese build nests on the ground, often protected by grass and shrubs. Since *C. lawi* was flightless, its presence in these areas, which are connected to the ocean by a gradually sloping shoreline, seems reasonable. *Chendytes lawi* remains are scarce at other coastal localities on San Miguel Island, likely due to the cliffs separating upland from beach areas.

The three species of alcid usually construct burrows in soft soil. The presence of a few articulated skeletons and also of disarticulated skeletons (but with bones closely associated) appear to be from individuals that died in burrows. Nearly complete skeletons of *F. dowi* have been recovered from locality 7 as have egg shell remains. The area is rich in skeletal remains of this species, many of which were not fully developed, indicating they were young. Deposits at locality 10 and localities 17, 18, 19 consist almost entirely of material washed down from higher levels, as evidenced by the completely disarticulated nature of the skeletal material and some pre-depositional breakage of fragile elements such as skulls. However, the abundance of material from these locations, including many bones of immature individuals, indicates nearby nesting of *F. dowi*. Remains of the two smaller species of alcid, Cassin's auklet and ancient murrelet, were more abundant at localities 6, 15 and 16 than were remains of *F. dowi*, which is rare at the latter two localities. This suggests separation in nesting location between these species. The rarity of alcid remains at locality 12 indicates separation of nesting areas on the island between these species and *C. dowi*.

## BARN OWLS

Owls are often responsible for transporting skeletal material of small taxa to their roosting or nesting sites. At locality 20, a thin but rich layer of bones dated to 7,300 BP includes a few barn owl bones and extremely abundant remains of barn owl prey. The most common prey item at locality 20 is deer mouse (*Peromyscus maniculatus*), but ornate shrew (*Sorex ornatus*) alligator lizard (*Gerrhonotus multicarinatus*) and birds form significant components of the deposit. Although the avian material from this deposit has not been completely identified and tabulated, well represented species include Cassin's auklet, burrowing owl (*Athene cunicularia*) and many passerine species, including island residents (western meadowlark, *Sternella neglecta*; song sparrow, *Mesospiza melodia*; horned lark, *Eremophila alpestris*) and wintering species (white-crowned sparrow, *Zonotrichia leucophrys*).

At the Daisy Cave archeological site on the eastern end of San Miguel Island (just above locality 23), barn owl bones are found below ledges located above the entrance to this rock shelter along with numerous remains of species considered their prey. The extinct mouse *Peromyscus nesodytes* occurs frequently in the lower layers of this deposit, but disappeared about 8,000 BP (Guthrie 1980). At this time bones of *P. maniculatus* first appear in the deposits and remains of Xantus's murrelet (*Synthiboramphus hypoleucus*), Cassin's auklet and of passerine birds become increasingly common.

## BALD EAGLES

Recent analysis of the nest of a bald eagle from Ferrelo Point on San Miguel Island (Collins et al. 2004, 2005) revealed a wide range of marine birds in the diet of island eagles. Although bald eagles are often considered to prey predominately on fish, birds can account for a high proportion of their prey items in some areas (Buehler 2000). Eagles usually carry food items to the nest during breeding season or eat on nearby perch sites (Buehler 2000). Remains from the Ferrelo Point nest show that rhinoceros auklet (*Cerorhinca monocerata*) was the most common avian prey item, followed by

white-winged scoter (*Melanitta fusca*), Brandt's cormorant (*Phalacrocorax penicillatus*), sooty shearwater (*Puffinus griseus*) and Cassin's auklet (Collins et al. 2005). The frequency of these species mirrors their presence around San Miguel Island (Collins et al. 2005). Species poorly represented in material from this nest include shorebirds and gulls.

In an earlier paper (Guthrie 1993) I suggested that the bones of seabirds not nesting on the island but incorporated into the deposits probably were from beached carcasses that had been blown inland by the strong northwest winds. It now seems more likely that these remains were brought inland by bald eagles. Several remains of bald eagles were found in Pleistocene deposits on San Miguel Island (Appendix 1). A partially articulated skeleton of a bald eagle was found at locality 16 and 12 eagle bones were found at locality 7. A majority of the non-nesting marine birds found on San Miguel Island came from these localities. At locality 16, bones of marine birds were found concentrated very close to the bald eagle skeleton, suggesting that this was either a nest site or a perching site for eagles.

The only evidence of predation on bones from the eagle nest at Ferrelo Point is punctures in sterna of Brandt's cormorant, rhinoceros auklet, white-winged scoter and large gulls, the spacing and pattern of which correspond to the foot structure of bald eagle. Such puncture wounds could be from active predation, or from an eagle's attempt to stabilize a carcass while tearing feathers or meat from the bones. Larger sterna were found only rarely in the Pleistocene San Miguel Island deposits and there is, therefore, no direct evidence of eagle predation. However, similarity in composition between the avifauna from the Ferrelo Point nest (Collins et al. 2005) and that from Pleistocene deposits associated with eagle remains (locality 16; Appendix 1) is suggestive of eagle involvement in the formation of the assemblage.

The Pleistocene avifauna composition from localities with eagle remains was similar to that found in the Ferrelo Point nest in that both had high numbers of oceanic species (alcids, shearwaters, ducks) and low numbers of shorebirds. A major difference between the faunas is substitution of rhinoceros auklet in the modern fauna for Pleistocene *F. dowi*. However, these species are identical in size, and *F. dowi* is the probable

ancestor of the modern rhinoceros auklet (Guthrie et al. 2000). Other differences included the greater abundance of ancient murrelet in the Pleistocene deposits. Thus, it seems that eagles may have brought remains of oceanic species, especially the three species of alcids thought to nest on San Miguel Island, inland to eat, incorporating their remains in to the deposits. The suspicion that eagles fed on alcids at San Miguel Island in the past suggests that these species were incorporated into Pleistocene deposits by at least two different mechanisms. The presence of the three species of nesting alcids in small numbers at some sites may be an indication not of nesting but rather of scavenging and/or predation by raptorial birds.

The remains of red-tailed hawk (*Buteo jamaicensis*), crested caracara (*Polyborus plancus*) and peregrine falcon (*Falco peregrinus*) are also found more frequently at sites believed to have been frequented by bald eagles. This may be evidence of successful competition and predation by eagles on these species.

Bones of island fox (*Urocyon littoralis*) were very rare in the Ferrello Point nest (Collins et al. 2005). The few remains of island fox found in Pleistocene deposits on San Miguel Island come from localities where eagle remains occur frequently but whether this is due to predation or scavenging by eagles cannot be determined from the material.

## SUMMARY

Deposits on San Miguel Island have yielded more species of birds than any other coastal deposit in California (Jefferson 1991) and possibly from the Pacific rim. Due to burial by wind-blown sand and short distance of transport between site of death and site of deposition, this material is in an excellent state of preservation. Based on the frequency of occurrence in the deposits and the presence of bones of immature individuals and of eggshells, three species of alcid (*F. dowi*, Cassin's auklet and ancient murrelet) and an extinct goose (*C. lawi*) are believed to have once nested on San Miguel Island. Distribution of bones of these species in the deposits suggests some separation of nesting colonies. Predation and/or scavenging by bald eagles may account for the occurrence of

bones of the three alcids away from suspected nesting colonies. Bones of many other species of birds may also be present in the deposits because of bald eagle predation or scavenging.

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Appendix 1 . Tabulation of avian bones from sites on San Miguel Island, collected between 1980 and 2002.

Scientific name	Common Name	Locality number (see Fig. 1)																						total
		2	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	21	22	23				
Order Gaviiformes																								
<i>Gavia immer</i>	common loon	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2			
<i>Gavia pacifica</i>	Pacific loon	0	2	0	1	3	0	0	1	0	1	0	0	0	0	0	0	0	0	0	8			
Order Podicipediformes																								
<i>Aechmophorus</i> sp.	western/Clark's grebe	0	0	0	2	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	5			
<i>Podiceps nigricollis</i>	eared grebe	0	0	1	1	1	0	0	2	4	0	0	0	8	0	0	0	0	0	0	17			
<i>Podiceps auritus</i>	horned grebe	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2			
Order Procellariiformes																								
<i>Phoebastria albatrus</i>	short-tailed albatross	0	1	2	1	5	0	0	0	0	0	0	0	9	0	2	1	0	0	0	21			
<i>Fulmarus glacialis</i>	northern fulmar	0	4	0	1	4	0	1	1	0	0	0	1	4	0	1	0	0	0	1	18			
<i>Puffinus griseus</i>	sooty shearwater	0	9	1	5	20	1	0	0	0	0	0	0	8	0	1	0	0	0	5	50			
<i>Puffinus opisthomelas</i>	black-vented shearwater	0	4	0	8	5	0	0	2	0	0	2	2	2	0	1	0	0	0	0	24			
<i>Puffinus tenuirostris</i>	short-tailed shearwater	0	0	0	11	8	1	0	1	0	0	0	0	4	0	0	0	3	1	0	29			
<i>Oceanodroma furcata</i>	fork-tailed storm-petrel	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
<i>Oceanodroma homochroa</i>	ashy storm-petrel	0	0	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4			
Order Pelecaniformes																								
<i>Pelicanus occidentalis</i>	brown pelican	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8			
<i>Morus reyna</i>	extinct gannet	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0	0	5			
<i>Phalacrocorax penicillatus</i>	Brandt's cormorant	0	6	0	10	6	0	0	2	0	0	0	2	2	0	1	0	0	0	1	28			
<i>Phalacrocorax pelagicus</i>	pelagic cormorant	0	0	0	3	1	0	0	0	0	0	0	2	2	0	1	3	0	0	0	10			
Order Ciconiiformes																								
<i>Ardea herodias</i>	great blue heron	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3			
<i>Plegadis chihi</i>	white-faced ibis	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
<i>Gymnogyps californianus</i>	California condor	0	0	0	0	1	0	0	6	0	1	0	0	0	1	0	0	0	0	0	9			
Order Anseriformes																								
<i>Chen caerulescens</i>	snow goose	0	0	0	5	5	1	0	2	0	2	0	0	3	0	0	0	0	0	0	18			



Appendix 1 (Continued). Tabulation of avian bones from sites on San Miguel Island, collected between 1980 and 2002.

Scientific name	Common Name	Locality number (see Fig. 1)																	total			
		2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19		21	22	23
<i>Larus spp. (large)*</i>		0	3	0	0	0	3	0	0	0	0	1	0	0	3	0	0	0	0	0	0	10
<i>Rissa tridactyla</i>	black-legged kittiwake	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
<i>Uria aalge</i>	common murre	0	1	0	15	17	2	0	2	0	0	0	0	2	39	0	0	0	0	1	11	90
<i>Cepphus columba</i>	pigeon guillemot	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<i>Synthboramphus antiquus</i>	ancient murrelet	0	32	1	549	365	29	0	102	16	2	0	1	913	0	19	0	11	2	0	2042	
<i>S. hypoleucus</i>	Xantus's murrelet	0	1	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	4
<i>Phyboramphus aleuticus</i>	Cassin's auklet	1	149	7	1307	358	8	0	711	40	48	0	359	840	57	102	1	166	6	0	4160	
<i>Fratercula dowi</i>	extinct puffin	83	491	62	589	3372	110	0	1279	28	141	112	31	13	707	839	83	4	258	0	8202	
<i>Fratercula cirrhata</i>	tufted puffin	0	1	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4
Order Strigiformes																						
<i>Tyto alba</i>	barn owl	0	1	0	2	5	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0	12
<i>Athene cucularia</i>	burrowing owl	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	3
<i>Asio priscus</i>	extinct owl	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	3
Order Passeriformes																						
<i>Corvus corax</i>	common raven	0	0	0	0	6	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	9
<i>Melospiza melodia</i>	song sparrow	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
<i>Eremophila alpestris</i>	horned lark	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
<i>Zonotrichia leucophrys</i>	white-crowned sparrow	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
<i>Sturnella neglecta</i>	western meadowlark	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Totals		87	742	80	2569	4260	160	31	3155	143	810	126	419	2075	790	999	110	207	292	44	17099	

\* This category may include western, herring, and glaucous-winged gulls.