New Information on the Prehistoric Fauna of San Miguel Island, California

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Abstract – The geology and fauna of the terrestrial late Pleistocene deposits on San Miguel Island is described. These deposits date 12,020-40,000 B.P. New records for San Miguel from these deposits include: pacific rattlesnake, crested caracara, an extinct species of owl, and new species of extinct puffin *Fratercula* and vole (*Microtus*). The remains of nesting colonies of two species of alcids and the extinct flightless goose (*Chendytes*) also were discovered. Faunal discoveries resulting from new work at SMI - 261, the Daisy Cave archeological site, also are listed. This material provides the earliest date for human occupation on San Miguel at 10,700 B.P. The time and causes of extinction of the various elements of the San Miguel fauna are discussed and evidence for decrease in size of small mammals on San Miguel during the last 9,000 years is presented.

Introduction

The 1978 California Islands Symposium (Power 1980) contained two papers on faunal discoveries from Daisy Cave, an archeological site at the eastern end of San Miguel Island. These papers (Guthrie 1980; Walker 1980) reported the past existence on San Miguel of now extinct species of vampire bat, flightless goose, and giant mouse as well as the first records of extant ornate shrew and spotted skunk. A report in 1980 that bones, including what looked like snake vertebrae, had been observed weathering out of sandstone below the earliest archeological sites on San Miguel indicated that more might be learned of the prehistory of this island and prompted the author to begin a survey of late Pleistocene deposits on the island. This reconnaissance, conducted during the summers of 1984 and 1985, was designed to examine the whole of San Miguel Island for fossil bearing deposits of late Pleistocene age as well as to reexamine Daisy Cave with a view to obtaining better stratigraphic information about the age of the material already recovered from that site. The following paper consists of two parts. The first will describe the geology of the late Pleistocene deposits on San Miguel Island and summarize information on the faunal material from them. The second section will present the results of the reopening of Daisy Cave. There follows a general discussion of the current state of knowledge of the prehistoric fauna of San Miguel Island.

Part I. Late Pleistocene Deposits

In his geology of San Miguel Island, Bremner (1933) indicated that the basement of the island is composed of volcanics and consolidated marine sediments of Eocene and Miocene age, most of which are covered with a layer of Quaternary unconsolidated sediments. Over much of the surface of San Miguel Island these Quaternary sediments are covered with well developed vegetation and a considerable thickness of soil. However, on the northwest facing slopes of the island there are several pockets where aeolian erosion has uncovered sands of late Pleistocene age. These areas were surveyed during the summers of 1984 and 1985 and surface collections were made wherever vertebrate remains were discovered. In addition, some sieving was done in the more unconsolidated sands to recover smaller members of the fauna. The locations of the fossiliferous areas are shown in Figure 1. More detailed information on fossil localities is on file at Channel Islands National Park headquarters.

The late Pleistocene deposits on San Miguel Island consist of beach sand blown inland and mixed with soil eroded from the top of the island. Approximately 90,000 B.P. (before present) sea level was higher than today and wave cut terraces were formed in the Eocene sediments on the northwest face of the island (Fairbridge 1961; Fig. 2A). Sea level then receded and a period of deposition began. During this time sand was blown from the beaches onto the island, covering the Eocene wave cut shelf and eventually most of the island. Some of these sands, as they blew up over the island, were deposited at a fairly steep angle. In general, deposition occurred at times when vegetation impeded the movement of sand. A well developed soil layer caps much of these late Pleistocene deposits on San Miguel (Fig. 2B) and can be taken as a marker for the end of Pleistocene deposition.

At times when the island was denuded of vegetation by fire or overgrazing by elephants (Johnston 1980), erosion occurred. During these periods, some material, eroded out of the older deposits, was mixed on the surface with newly deposited material of more recent age. The result is that at many localities bones of different ages are found side by side. The Pleistocene bone, however, is harder than the recent material and can be easily identified.

Figure 2C shows the current profiles at three sites on the island and the location of the remnant late Pleistocene deposits in relation to current shoreline and past depositional conditions. At the Mammoth Locality (Loc. V-1 and V-3) the shoreline consists of Eocene material. Inland a few feet is the base of a cliff of late Pleistocene sand which is topped by a hard layer of caliche and soil. These extend inland to the base of an Eocene hill. Mammoth bones have been found just beneath the caliche layer. At the Airport Locality (V-4) The late Pleistocene sediments are exposed in a blowout at the top of a long slope upward from the sea.

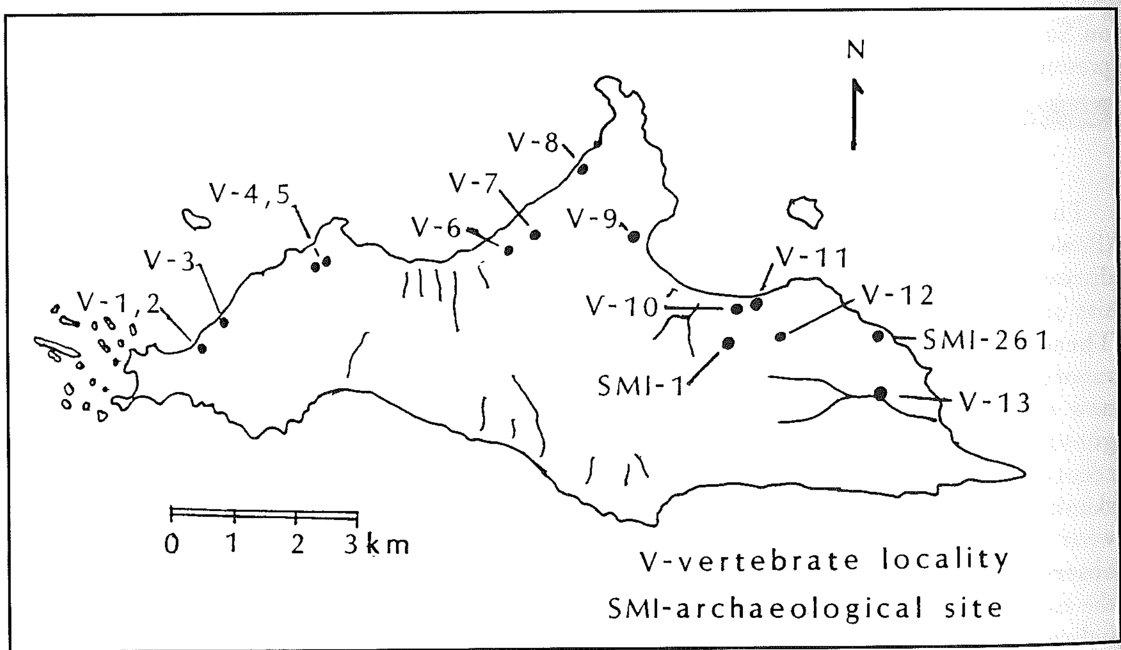

Figure 1. Location of vertebrate fossil localities and archeological sites on San Miguel Island.

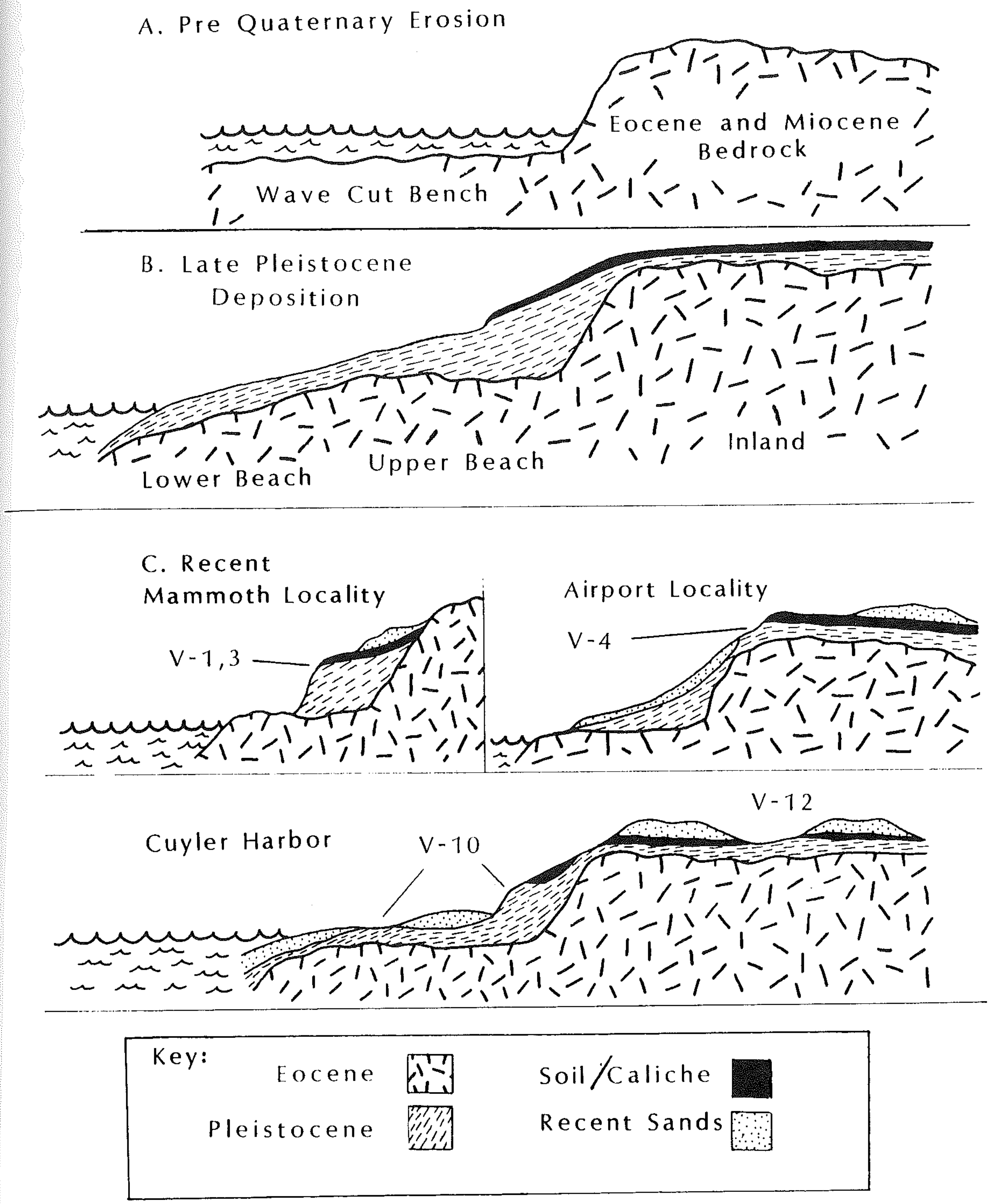

Figure 2. Depositional profiles of late Pleistocene deposits on San Miguel Island (See text for explanation).

A caliche and soil layer lie just above this blowout while the slope below the blowout is covered with newly deposited sand and soil. At Cuyler Harbor the late Pleistocene deposits are mostly covered by recent sand, but small outcrops occur on the lower beach as well as on the hills behind the beach (V-10). Above Cuyler Harbor on the upper part of the island are drifts of recent sand overlying an extensive shelf of caliche. In a few places, such as at Locality V-12, blowouts have eroded through the caliche and exposed fossiliferous upper Pleistocene sands.

Judged by their contained fauna (Table 1), the late Pleistocene deposits on San Miguel Island seem to contain two depositional facies, differentiated by their distance from the beach. Both facies contain mouse bones, and remains of the land snail (*Helminthoglypta ayresiana*). Presence of these species is taken as an indication of the presence of vegetation at the time of deposition. One facies, represented at Locality V-12 and some layers at locality V-10, contains almost exclusively skeletal remains of the extinct flightless goose (*Chendytes lawi*) as well as numerous fragments of eggshell assigned to this species. Deposits of this type are believed to have formed inland from the coastal cliffs, on the upper surface of the island. Presence of eggshell indicates that this area was once a *Chendytes* nesting area.

A second facies is represented at localities V-4, V-7 and V-10. This facies contains numerous bones of two species of alcid; Cassin's auklet (*Ptychoramphus aleuticus)* and an undescribed species of auklet (*Fratercula* sp. nov.) closely related to Rhinoceros auklet. Also present are eggshells assignable to these two alcid species and whole skeletons of these species that appear from their positions to have died in burrows. It appears that these deposits were formed just seaward of coastal cliffs and contain material that has fallen into this area from the cliffs in which these species of alcids nested.

This facies also contains a few bones of raptors and of other marine birds. The raptors undoubtedly also nested on the sea cliffs and may have brought to their nests prey organisms including marine birds. However, the marine birds also may have been deposited by wind transport. If the beach were nearby at the time of deposition one would expect to find bones of birds that, having been washed up on the beach, dried and mummified and then were blown inland until they caught in vegetation and were buried. This process can be observed today on coastal beaches where dead birds, as they dry, are moved by wind and high tide into the upper beach zone. This zone, however, lacks marine shells and skeletons of marine mammals, both of which are too heavy for wind transport. Further evidence for the closeness of this facies to the beach is found at Locality V-10, where a layer of tar sand occurs in the deposit. This tar sand was deposited about 34,000 B.P. when oil from an offshore oil seep washed up on the beach.

At several localities on San Miguel the uppermost level of the late Pleistocene deposits is capped by a soil layer which in some areas has been solidified into a layer of caliche. The geology of caliche has been discussed by Johnson (1967) but is not well understood. No fossils have been found in these caliche deposits except at locality V-1 and V-3 where a few bird bones and bones of dwarf mammoth have been discovered.

Radiocarbon dates from the late Pleistocene localities are shown in Table 2. All dates are from about 12,000 B.P. or from between 25,000-35,000 B.P. These dates represent periods when sea levels were near present levels. Presence in the deposits of marine species, taken as an indication of a nearby beach is, therefore, expected. No fossil material has been obtained for the period between 12,000 and 25,000 B.P. During this time sea levels were lower than today and the shoreline of San Miguel was up to 5 km away from the present island shoreline (Vedder & Howell 1980). It is unlikely that deposition would have occurred so far inland from the sand source on the beach during this period.

Table 1. Fauna from late Pleistocene deposits on San Miguel Island[1]. Numbers indicate identifiable bones from each locality.

	Vertebrate Fossil Locality Number								
Species	2	4	5	6	7	8	10	11	12
Reptiles									
**Crotalus viridis*	-	12	-	-	3	-	2	-	-
Elgaria multicarinata	-	-	-	-	1	-	2	-	-
Aves									
Aechmophorus sp.	-	-	-	-	1	-	-	-	-
Ardea herodias	-	4	-	-	-	-	-	-	-
+*Asio* cf. *priscus*	-	-	-	-	-	-	1	-	-
Branta canadensis	-	-	-	1	1	-	-	-	-
Buteo jamaicensis	-	1	-	-	4	-	1	-	-
Cepphus columba	-	-	-	-	1	-	-	-	-
Chen caerulescens	-	-	-	-	4	1	1	-	-
+*Chendytes lawi*	1	3	1	2	4	-1096	16	400	
Charadrius sp.	-	-	-	-	-	-	1	-	-
Corvus corax	-	-	-	-	2	-	4	-	-
Diomedea albatrus	-	1	1	3	1	-	-	-	-
Eremophila alpestris	-	-	-	-	-	-	1	-	-
Falco sparverius	-	-	-	-	1	-	-	-	-
+*Fratercula* sp. nov.	105	237	-	-	1696	60	980	26	-
Fulmarus glacialis	-	1	-	-	3	-	-	-	-
Gavia arctica	-	1	-	-	3	-	1	-	-
**Gymnogyps californianus*	-	-	-	-	-	-	6	-	-
**Haliaeetus leucocephalus*	-	-	-	-	7	-	2	-	-
Larus californicus	-	-	-	-	2	-	-	2	-
Larus sp.	-	1	-	-	-	-	-	-	-
Melanitta perspicillata	-	-	-	-	-	-	1	-	-
Melanitta fusca	-	-	-	-	1	-	1	-	-
Mergus serrator	-	-	-	-	-	-	1	-	-
Melospiza melodia	-	-	-	-	1	-	-	-	-
Oceanodroma homochroa	-	-	-	-	1	-	-	-	-
Passerine sp.	-	-	-	-	2	-	-	-	-
Pelecanus occidentalis	-	12	-	-	-	-	-	-	-
Phalacrocorax penicillatus	-	4	-	1	1	-	-	-	-
Phalacrocorax pelagicus	-	-	-	2	1	-	-	-	-
Plegadis chihi	-	-	-	-	1	-	-	-	-
Podiceps nigricollis	-	-	1	-	1	-	1	-	-
**Polyborus plancus*	-	1	-	2	4	-	-	-	-
Ptychoramphus aleuticus	-	69	10	124	107	5	612	24	-
Puffinus griseus	-	6	1	-	8	-	-	-	-
Puffinus opisthomelas	-	2	-	-	1	-	1	-	-
Rissa tridactyla	-	1	-	-	-	-	-	-	-
Synthliboramphus antiquus	-	16	-	33	152	16	83	6	-
**Synthliboramphus hypoleucus*	-	-	-	-	1	-	1	-	-
Tyto alba	-	-	-	-	1	-	-	-	-
Uria aalge	-	-	-	4	4	1	-	1	-
Zonotrichia leucophrys	-	-	-	-	1	-	-	-	-
Mammalia									
Enhydra lutris	-	-	-	-	1	-	1	1	1
+*Mammuthus exilis*	14#	-	-	-	-	-	-	-	-
+*Microtus* sp. nov.	-	-	-	-	-	-	1	-	-
+*Peromyscus nesodytes*	P	P	P	P	P	P	P	P	P
Urocyon littoralis	-	-	-	-	1	-	1	1	-

[1] Several additional species are known from Daisy Cave but not from other deposits on the island.

* Living species extirpated from San Miguel Island.

+ extinct

P present; numbers not calculated

all specimens from localities V-1 and V-3.

Although the late Pleistocene deposits on San Miguel are over 30 m thick and represent a considerable time period the fauna within these deposits is rather uniform. Except for the facies differences noted above, no changes in composition of the fauna or evolutionary development have been detected within the deposits. Therefore, the whole deposit is treated here as a single faunal zone.

A. Fauna

1. Reptiles: Jaw fragments from two localities have been identified as southern alligator lizard (*Elgaria multicarinata*, formerly in the genus *Gerrhonotus*), thus establishing this indigenous species as present on San Miguel in late Pleistocene time. Totally unexpected is the recovery of vertebrae of the southern pacific rattlesnake (*Crotalus viridis* cf. *helleri*) from localities V-4, V-7 and V-10. Given the total absence of any other mainland species from these deposits and the multiple finds, it seems highly unlikely that these remains floated to the island from the mainland. Rattlesnakes currently are found on other near shore islands, including Santa Catalina, Los Coronados and islands in the Gulf of California, an indication that they are good colonizers by sweepstakes routes.

2. Birds: As the avifauna recovered from the late Pleistocene deposits is being described in detail elsewhere the following account is of a general nature. Species recovered are listed in Table 1. By and large, the avifauna reflects the current breeding populations of sea birds on San Miguel (Guthrie 1980) or what might be expected as beached birds (information available from Point Reyes Bird Observatory). A few species, however, deserve special comment.

Snow and Canada geese, California condor and short-tailed albatross, although not regular visitors to San Miguel today, were common near San Miguel before 1900. The presence of white-faced ibis is unexpected. It may have been a vagrant.

The remains of the extinct flightless goose (*Chendytes lawi*) are extremely common at locality V-12 and in some layers at locality V-10. At both sites all skeletal elements are preserved although disarticulated and scattered. Also present are numerous eggshell fragments of a thickness and curvature expected for the eggs of a large goose. These sites are therefore believed to have once supported a nesting colony of *Chendytes*.

By far the most numerous species present in the late Pleistocene deposits on San Miguel Island are Cassin's auklet and an, as yet undescribed, species of puffin (*Fratercula* sp nov). This latter species is similar to living rhinoceros auklet in nearly all skeletal respects

Table 2. Radiocarbon dates from San Miguel Island.

Sample No	Locality	Depth	Level	Age (B.P.)	Material Dated
Beta 14659	V-12	surface	-	12,020 ± 270	*Chendytes lawi*
AA 1319	V-10	surface	C	32,143 ± 787	*C. lawi*
AA 1320	V-4	surface	A	11,890 ± 95	*Fratercula* sp.
AA 1818	V-7	surface	A	25,160 ± 380	*Fratercula* sp.
AA 1819	V-7	surface	C	>38,000	*Fratercula* sp.
Beta 15619	SMI-261	25 cm	A	2,990 ± 90	*Haliotis rufescens*
Beta 15620	SMI-261	44 cm	C	5,940 ± 110	*H. cracherodii*
Beta 15621	SMI-261	55 cm	E	8,030 ± 100	*H. cracherodii*
Beta 15622	SMI-261	75 cm	E	8,270 ± 120	*H. cracherodii*
Beta 15623	SMI-261	80 cm	F	8,470 ± 120	*Mytilus californicus*
Beta 14660	SMI-261	110 cm	G	10,700 ± 90	*H. cracherodii*

All dates corrected for O^{12}/O^{13} ratios
Beta = Beta Analytic, Coral Gables, FL
AA = University of Arizona, Laboratory of Isotopic Geochemistry, Tucson, AZ

except for bill size, the bill being intermediate between rhinoceros auklet and tufted puffin in thickness. Eggshell fragments that seem referable to both these species also are present in the deposits. Further evidence of these species nesting on San Miguel is the recovery of complete skeletons cemented in consolidated sand harder than the surrounding sediments. These are thought to be casts of burrows. Today Cassin's auklets nest on islets just offshore from San Miguel Island but not on the island proper. The southernmost nesting colony of rhinoceros auklet today is the Farallon Islands, although nesting of a small colony is suspected near Point Arguello (Sowls *et al.* 1980). Although eggshell remains definitely identified as ancient murrelet have not been recovered, this species also is well represented in the deposits and also once may have nested on San Miguel.

The few passerine bones collected on San Miguel all belong to species that currently nest on the island or are common winter visitors. The remainder of the terrestrial avifauna consists of raptoral and scavenger species. All except for two of these are known from the island today or in the recent past. The few bones of caracara recovered seem referable to the modern species of crested caracara (*Polyborus plancus*) as do bones of caracara previously recovered from Santa Rosa Island. These latter remains were thought to be between 10,000 and 30,000 years B.P. and were referred by Howard (1968) to the mainland Rancho La Brea species *P. pretulosus*. Caracaras are present today in southern Baja California, Mexico and a well-marked endemic subspecies recently became extinct on Guadalupe Island 270 km off the coast of Mexico. The presence of a caracara on San Miguel Island, therefore, is not unexpected.

A femur of an owl from locality V-10 barely is distinguishable from that of the modern short-eared owl (*Asio flammeus*) but, considering its age, is tentatively assigned to (*A. priscus*) a late Pleistocene species described from Santa Rosa Island on the basis of a tibiotarsus by Howard (1964).

3. Mammals: Five species of mammals (Table 1) have been recovered from the late Pleistocene deposits on San Miguel Island. The bones of California sea otter and island fox are too few in number to tell us anything other than that both were present during this period. The excellent specimens of the extinct dwarf mammoth (*Mammuthus exilis*) that have been recovered at localities V-1 and V-3 are being described elsewhere. They were found in a caliche sand in which few other fossil remains were present. An attempt to date fragments of mammoth bone proved unsuccessful due to the leaching of organic material out of the bone during the formation of the caliche deposit. However, these remains were just below a thick layer of caliche and soil that appear from stratigraphic considerations to be similar to that found elsewhere on the island and dated about 12,000 B.P.

Bones of the extinct giant island mouse (*Peromyscus nesodytes*) were recovered from almost every locality. This species is believed to be descended from *P. anyapahensis*, an older and smaller form from Anacapa Island. Mean measurements for maximum length of lower molar row for samples from several localities on San Miguel are presented in Table 3, along with the mean values for the type sample of *P. nesodytes* from Santa Rosa Island and the Anacapa sample of the ancestral *P. anyapahensis.* The date of the Santa Rosa sample, which has a slightly larger mean size than the San Miguel samples, is not precisely known. The Anacapa species is thought to date from about 35,000 B.P. (Lipps 1964), but this date is based on a correlation of the wave cut bench on Anacapa with a dated bench on Santa Rosa Island. These benches were considered to be 90,000 B.P. by other authors (Fairbridge 1961). This latter date makes more sense considering the large size of *P. nesodytes* at 35,000 B.P.

Totally unexpected was the recovery from the late Pleistocene beach exposures at Cuyler Harbor of a fragment of right mandible referable to the genus *Microtus.* The only tooth preserved is the first lower molar, which measures 4.22 mm in length, compared to a mean measurement of 3.0 mm for this tooth in populations of *M. californicus* from the southern California coastal region. This specimen, which will be more thoroughly described elsewhere, appears to represent a hitherto unknown species of giant island vole. Members of the genus *Microtus* have colonized many islands off both coasts of the United States.

Extensive collecting and examination of the late Pleistocene deposits discussed here by both myself and archaeologists has failed to uncover any evidence of human activity, supporting the belief that these deposits were formed prior to human occupation of the island.

Part II. Daisy Cave

Daisy Cave is an archeological site at the eastern end of San Miguel Island. The site was excavated by Charles Rozaire for the Los Angeles County Museum of Natural History between 1964 and 1968 (Rozaire 1976). An analysis of the fauna from this site (Guthrie 1980; Walker 1980) left several questions unanswered. The single specimen of shrew reported by Walker (1980) might have been captured on the mainland by an owl that subsequently roosted at the cave. The exact stratigraphic location of the extinct vampire bat (*Desmodus stocki*) and and extinct flightless goose (*Chendytes*) reported by Guthrie (1980) and of the extinct giant mouse (*Peromyscus nesodytes*) reported by Walker (1980) were not known precisely nor were any dates reported for the site.

In order to gain more precise information on the fauna of the site as well as to resolve some archeological questions, the site was reopened by Pandora Snethkamp of the University of California, Santa Barbara, and the author in 1985. Two column samples were obtained from sections of the walls of Rozaire's excavation that showed no signs of disturbance. The complete columns were collected by both soil and depth levels and transported back to the mainland for analysis. In addition, radiocarbon dates were run on shell samples from these columns. A detailed report on this new excavation and archeology of the site will be published elsewhere. New findings about the fauna from this site are presented here.

Table 3. Measurements of fossil *Peromyscus* from the northern Channel Islands.

	Alveolar length of mandibular molar row			
Sample/Locality	*n*	$\bar{x}$	SD	Age (B.P.)
Peromyscus nesodytes				
SMI V-10C	19	5.79	0.15	32,143 ± 787
SMI V-7A	25	5.69	0.16	25,160 ± 380
SMI V-12	10	5.82	0.21	12,020 ± 270
SMI 261, level G	25	5.87	0.20	10,700 ± 90
Santa Rosa Isl.*	7	5.95	0.16	?
Peromyscus anyapahensis				
Anacapa Isl.*	7	5.51	0.14	90,000 ?

*Walker (1980)

Table 2 shows the dates obtained on shell remains from these different levels within the Daisy Cave excavation. Letters represent units of uniform soil conditions. No dates were obtained on levels B and D which are thin layers nearly devoid of shells and other cultural material. These layers represent periods when the site was unoccupied. Levels below G lack shell material and any other indication of human activity. The oldest date obtained, 10,700 ± 90 B.P., is based on shell material from the lowest human occupational level at the site.

A. Fauna

The remains of reptiles recovered during our recent work at the site have not been analyzed in detail and can only be reported on in general terms. Remains of southern alligator lizard are present at every level in the site, presumably brought in by owls. Also present in level E (8,000 B.P.) are vertebrae referable to the gopher snake (*Pituophis melanoleucus*). This species is found today on Santa Cruz Island but has not been reported previously from any of the other northern Channel Islands.

The avian material adds little to the previous analysis of birds from the site (Guthrie 1980).

Table 4. Measurements of length of lower molars in *Sorex ornatus*.

Sample	Measurement of lower molars			Average Age
	n	$\bar{x}$	SD	(B.P.)
Recent, Santa Barbara Co.	22	3.38	0.10	0
SMI 261, levels 100-300	12	3.51	0.06	1000
SMI 261, levels 500-700	12	3.55	0.07	6500
SMI 261, levels 900-1300	3	3.67	0.05	9000

The bones of *Chendytes* previously reported from Daisy Cave were found at all levels within the site and also from all levels of SMI-1, a midden locality on the upper surface of the island, indicating that *Chendytes* survived on the island for some time after the onset of human occupation. However, none of the *Chendytes* material from Daisy Cave shows any sign of cooking or being worked.

Our 1985 excavations recovered additional remains of an extinct vampire bat (*Desmodus stocki*). All these remains were recovered below the 10,700 B.P. level as apparently were the earlier known specimens. My earlier view (Guthrie 1980) that these remains dated no more than 5,000 B.P. was incorrect. Bones of the ornate shrew (*Sorex ornatus*) were recovered at every level in the column samples from Daisy Cave, a clear indication of the value of sieving archeological sites with fine mesh screens. Mean measurements for the length of the lower molars of island samples and mainland individuals are presented in Table 4. As with the few ornate shrews from Santa Catalina (Collins & Martin, 1985), the San Miguel Island individuals are larger in size than the mainland population. However, when the island sample is subdivided into levels (Table 4) it appears that the San Miguel shrews were undergoing a decrease in size during the last 9,000 years. The new material from Daisy Cave also shows that the ornate shrew was a member of the San Miguel fauna for over 9,000 years and became extinct only recently.

The rodents from Daisy Cave were studied by Walker (1980). He felt that the arrival of the deer mouse (*Peromyscus maniculatus*) on San Miguel occurred after the arrival of man and that *P. nesodytes* may have survived on the island until 2,000 B.P. However, his material came from an area that had been disturbed by grave robbers resulting in mixing of materials between levels. Counts of the numbers of upper incisors referable to these two species from each level of one of our undisturbed column samples appear in Table 5. The mice were probably brought to the cave by owls, as the column was taken directly under a ledge at the entrance of the cave and directly adjacent to sections of Rozaire's excavation that contained bones of barn owls. Some of the variation in numbers of rodents between levels may be an indication of the presence or absence of owls at the site. This probably accounts for lack of rodents from early levels. However, the absence of remains of *P. nesodytes* from the site after 8,000 B.P. seems a clear indication of extinction. Owls were active at the site at this time, as evidenced by the remains of *P. maniculatus*, and would have preyed on the larger mouse species had it been available.

Table 5. Information on rodents *(Peromyscus)* from column sample D5, SMI-261 (Daisy Cave).

Depth (cm)	Level	Number of upper incisors *man*	*nes*
0	A	3	-
23	A	7	-
25	A	19	-
40	B	10	-
44	C	36	-
51	D	21	-
55	E	21	-
65	E	17	1
75	E	47	1
80	F	44	4
87	F	28	5
98	F	2	3
110	G	2	30
117	H	-	22
125	H	-	1
133	I	-	1
135	J	-	-

man = Peromyscus maniculatus
nes = P. nesodytes

The first occurrence of *Peromyscus maniculatus* at Daisy Cave coincides with the first evidence of human activity at the site. The small numbers of *P. maniculatus* from the lower levels of Daisy Cave may be due to preference by owls for the larger mouse species that was on the island at that time. The pattern of relative numbers of the two species of *Peromyscus* strongly suggests that interspecific competition caused the extinction of *P. nesodytes.*

As expected with small island mammals, the San Miguel Island deer mouse has a larger body size than populations of this species from the nearby mainland. Unexpectedly, the earliest sample of *P. maniculatus* from Daisy Cave has a lower molar alveolar length of 4.13 ± 0.09. This is larger in size than the living island mice, where this measurement is 3.83 ± 0.12.

Discussion

This project was undertaken with the hope of gaining a better understanding of the impact of human arrival on San Miguel Island on the island fauna. The earliest evidence of human occupation on San Miguel is found at Daisy Cave, where the lowest cultural material is dated at 10,700 B.P. Absence of any evidence of human activity at an active *Chendytes* nesting colony dated at 12,020 B.P. or in other deposits of this age suggests that humans arrived on San Miguel subsequent to this date.

The earliest record of *Peromyscus maniculatus* on San Miguel occurs at the same level as the first evidence of human occupation, suggesting accidental human transport of this species to the island by man. Human settlers were probably involved, directly or indirectly, in the extinction of at least three species on San Miguel. The extinction of *P. nesodytes* was probably due to human introduction of deer mice to San Miguel. Humans were probably also responsible for the extinction of the flightless goose (*Chendytes lawi*) but this extinction also seems to have occurred well after the time of human arrival. Shrews lived on San Miguel until fairly recently and may not have become extinct until the introduction of sheep and agriculture to the island in the early 1800's.

Species of an alcid, owl, bat, vole and dwarf mammoth, all now extinct, were present on San Miguel before 11,000 B.P. as were living species of rattlesnake and caracara. It is highly unlikely that the vole was present on the island after about 11,000 B.P. Voles are a preferred food of barn owls in most habitats and if the vole were present on San Miguel its bones should appear in the Daisy Cave deposits. Similarly, absence of bones of vampire bats and the new species of alcid in Daisy Cave after about 11,000 B.P. probably indicates the extinction of these species. All of these findings suggest that a major period of extinction occurred on San Miguel at about the time of human arrival on the island. However, there is no direct evidence that humans were responsible for these extinctions nor that they were present on San Miguel before these species became extinct. The caliche and soil layers dating about 12,000 B.P. suggest that climatic changes and perhaps changes in sea level also were occurring at this time. It may be that these extinctions were due to climatic changes and that these changes were also the reason why humans migrated to San Miguel. More material from deposits between 10,000 and 12,000 B.P. would be most welcome. Such deposits may exist in the sterile layers below the cultural levels at Daisy Cave.

The phenomenon of gigantism on islands has been noted by many authors. Foster (1964) rejected the hypothesis that island giants were relics of once widely distributed larger forms. Instead, he felt that island giants must have developed *in situ.* More recently, Lomolino (1985) reiterated the widely held belief that ecological release from competition and possibly selection for larger immigrants were the factors responsible for size increases by mammals on islands. Due to the lack of a sufficiently dense fossil record, however, nearly all studies of animal size on islands make no reference to size changes through time on either the islands in question or on the nearby mainland.

The late Pleistocene deposits on San Miguel provide one of the few cases where size changes of island animals can be followed through a period of time. This record shows that *Sorex ornatus* and *Peromyscus maniculatus* significantly decreased in size on the island during the last 9,000 years. The existence of large-sized populations of both these species in late Pleistocene Rancho La Brean deposits on the California mainland supports the view that the island populations are relics of once widely distributed large-sized species.

That both mainland and island populations of these two species decrease in size during the last 9,000 years suggests that climatic factors, perhaps moderating temperatures after the last ice age, are responsible. Due to the cold California current which bathes San Miguel, island temperatures have not warmed as much as mainland conditions during this period and this may explain the smaller decrease in size of the island populations of these two species.

Conclusions

A late Pleistocene fauna from San Miguel Island is described from deposits dating from 11,000 - 12,020 and 25,000 - 40,000 B.P. Island fox and southern alligator lizard, two modern inhabitants of San Miguel have been recovered as well as several species not previously recorded on the island. These include the gopher snake, pacific rattlesnake, crested caracara, undescribed species of puffin and *Microtus* and an extinct owl. New material from Daisy Cave shows that *Desmodus stocki*, an extinct vampire bat, lived on San Miguel Island 11,000 B.P. while ornate shrews were present on the island from 10,000 B.P. until very recently. The first record of human activity on San Miguel Island occurs at the Daisy Cave site at 10,700 B.P. Although there is no evidence that humans were responsible, dwarf mammoth, rattlesnake, vole and vampire bat died out at this time or slightly earlier. *Chendytes lawi*, *Sorex ornatus* and *Peromyscus nesodytes* died out more recently. The sizeable breeding population of *Chendytes* on San Miguel was probably killed by humans while *P. nesodytes* in all likelihood died out 8,000 B.P. due to competition with *P. maniculatus*, a species probably accidentally introduced to the island by humans.

Acknowledgments

This study would not have been possible without the financial support of a W.M. Keck Foundation grant to the Joint Science Department of the Claremont Colleges and the generous aid of the many personnel of the Channel Islands National Park. Gregory Pregill of the San Diego Natural History Museum identified the reptiles and Phil Walker of the University of California, Santa Barbara provided much useful information on rodents. Paul Collins and the staff at the Santa Barbara Natural History Museum also provided much valuable support. Thanks also to Phil Walker and Kimball Garrett of the Los Angeles County Museum for critically reading the manuscript and offering many helpful suggestions for its improvement.

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