

AVIAN FOSSILS FROM THE MARINE PLEISTOCENE OF SOUTHERN CALIFORNIA

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Recent discoveries of fossil birds in the Upper Pleistocene deposits near Newport Bay, California, have suggested the advisability of reviewing the entire marine avifauna of southern California of that age. Pertinent fossil material in the collections of the Los Angeles County Museum has been supplemented by specimens from the University of California, the California Institute of Technology, and the collection of Dr. Loye Miller. The courtesy of these loans is gratefully acknowledged. Loans of modern comparative material were obtained through the kindness of Dr. Alexander Wetmore and Dr. Miller.

I wish to take this opportunity to thank Mr. George Kanakoff, invertebrate paleontologist in charge of the Los Angeles County Museum's excavations at Newport Bay, for the attention he has devoted to the collecting of the avian fossils, and Mr. Fred Feltham for his generous aid in this field project, as well as for several specimens which he personally collected.

Including the Newport site, eight Upper Pleistocene occurrences of marine birds have been reported from southern California, as follows:

- Newport Bay
- Santa Rosa Island (Howard, 1944)
- Bixby Slough (Howard, 1944)
- San Pedro, Second and Orizaba Streets (Howard, 1944)
- Playa del Rey (Howard, 1936)
- Santa Monica (Miller, 1925)
- San Pedro, lumber yard (Miller, 1914, 1930)

The combined collections of avian fossils from these localities total 190 specimens, of which 100 are newly recorded at this time. Forty-eight of the 100 are from the Newport Bay site, and 52 are from the previously recorded localities at San Pedro (lumber yard), Santa Monica, and Playa del Rey.

NEWPORT BAY

The bird-bearing Upper Pleistocene deposits of the Newport area occur in a dry canyon and higher adjacent gullies of the mesas on the east side of the upper end of Newport Bay. At this locality the Pleistocene sand lies unconformably over Pliocene siltstone. The Los Angeles County Museum's first excavations in the area were carried on intermittently through 1940, 1941 and 1942. In this time only invertebrates were recovered (Willett, 1944, 1948). In 1946 and 1947 more intensive work resulted in the recovery of both bird and mammal remains in addition to shells. Most of the bird bones were found in a short gully which joins the main canyon from the west about 15 feet above the bottom of the dry creek bed. A few were taken from the east bank of the main canyon. The bones are petrified. Most of them are broken and the condyles are slightly abraded. The matrix is a coarse, soft sandstone.

Forty-one of the 48 bird bones found are specifically identifiable and are assigned to sixteen different species. Only one, the large diving duck, *Chendytes lawi*, can be said to be abundant. Sixteen specimens represent this curious bird. Four bones of the Sooty Shearwater (*Puffinus griseus*) were found; no other species is represented by more than three specimens.

A list of the identified specimens follows. Pertinent information concerning the individual species is included in the general discussion of all materials now at hand.

- Gavia arctica*? Incomplete humerus, L. A. Mus. no. 2017.
Gavia immer. Incomplete carpometacarpus, no. 2032; shaft of humerus (unnumbered, tentative).
Aechmophorus occidentalis. Fragment of left ramus of lower mandible, L. A. Mus. no. 2023.
Diomedea albatrus. Two distal ends of tibiotarsi, nos. 2016 and 2054; 1 incomplete humerus, no. 2055.
Puffinus griseus. Distal end of tibiotarsus, no. 2028; coracoid, no. 2044. Fragments of tibiotarsus and carpometacarpus, nos. 2049 and 2045 (tentative).
Puffinus opisthomelas? Wing phalanx (unnumbered).
Fulmarus glacialis. Humerus, no. 2019; ulna, no. 2046; proximal end radius, no. 2047.
Phalacrocorax penicillatus. Proximal half of ulna, no. 2018.
Moris reykana. Proximal end of tarsometatarsus, no. 2052; radius, no. 2043; fragment of shaft of humerus, no. 2052A (tentative).
Branta canadensis? Distal fragment of carpometacarpus, no. 2020.
Anser albifrons? Fragment of tibiotarsus, no. 2022.
Aythya valisineria? Shaft of ulna (unnumbered).
Melanitta deglandi? Shaft of femur, no. 2024.
Chendytes lawi. Coracoid, no. 2042; humerus, no. 2030; 4 femora, nos. 2015, 2027, 2031, 2057; 1 tibiotarsus, no. 2015; 2 tarsometatarsi, nos. 2026, 2050; 3 pedal phalanges, no. 2025; 3 vertebrae, no. 2056; fragment of pelvis, no. 2055.
Stercorarius sp. Humerus, no. 2029.
Larus sp. Fragmentary coracoid, no. 2051.

PREVIOUSLY RECORDED LOCALITIES

The material available for this study includes practically all of the recorded avian bones from the Upper Pleistocene marine deposits of southern California. These have been carefully reviewed and a few changes made in identifications.

The 52 additional specimens, previously unrecorded, represent for the most part material collected since the first reports on the localities concerned. Abbreviations used to designate the collections in which the specimens occur are as follows: University of California Museum of Paleontology (U.C.); California Institute of Technology Department of Vertebrate Paleontology (C.I.T.); the Loye Miller collection at the University of California at Los Angeles (Miller); and the Los Angeles County Museum (L.A.M.).

List of previously unrecorded specimens from San Pedro (lumber yard),
Santa Monica, and Playa del Rey

- Gavia immer*? Ulna, U. C. "Lot 24," San Pedro.
 †*Gavia arctica*. Scapula, Miller, San Pedro.
Aechmophorus occidentalis. 2 tibiotarsi, U. C. no. 21093 and Miller, both San Pedro.
Colymbus auritus? Carpometacarpus, U. C. no. 21095, San Pedro.
 **Colymbus nigricollis*. Coracoid, Miller, San Pedro.
Diomedea albatrus? Ulna, U. C. "Lot 19," San Pedro.
Puffinus opisthomelas. Scapula, Miller, San Pedro.
Puffinus griseus. Humerus, C.I.T., San Pedro.
Phalacrocorax penicillatus. Coracoid, Miller, San Pedro.
Branta canadensis? Radius, L.A.M. no. 683, San Pedro.
Branta nigricans? Tarsometatarsus, U.C., San Pedro.
 **Mareca americana*. Ulna, U.C. no. 21094, San Pedro.
Anas carolinensis? Ulna and humerus, Miller; ulna, U.C. "Lot 10"; all San Pedro.
 **Bucephala albeola*. Femur, U.C. 21088, San Pedro.
 †*Melanitta deglandi*. Humerus, Miller; coracoid, U.C. "Lot 22"; both San Pedro.
Melanitta perspicillata. Tarsometatarsus, U.C., San Pedro.
Chendytes lawi. 4 femora, U.C. nos. 21091, 21089, L.A.M. no. 2014, and Miller; partial pelvis with sacrum, Miller; 2 fragments sacrum, U.C. no. 21092; 2 pedal phalanges, U.C. and C.I.T.; 3 tibiotarsi, Miller and L.A.M. no. 2010; 1 vertebra, U.C.; all from San Pedro. 1 femur, Miller, Santa Monica; 3 vertebrae, 1 femur, 1 fibula, L.A.M. nos. 989, 2013, and 999, Playa del Rey.

- Duck, sp. Tibiotarsus, U.C. "Lot 28"; carpometacarpus and humerus, Miller; all from San Pedro.
- Fulica americana*. Carpometacarpus, L.A.M. no. 684 (tentative); 2 humeri, U.C. no. 21100 (one uncatalogued); all from San Pedro.
- **Limosa fedoa*? Fragment of tarsometatarsus, U.C. no. 21094, San Pedro.
- **Ptychoramphus aleuticus*. Carpometacarpus, U.C. "Lot 28," San Pedro.
- Alcidae, sp. (possibly *Synthliboramphus*). Humerus, San Pedro; ulna, Santa Monica. Both Miller.
- Lophortyx californica*. Femur and coracoid, Miller, San Pedro.
- **Falco sparverius*. Tibiotarsus, Miller, San Pedro.

* New record for locality named.

† New record for southern California Pleistocene.

DISCUSSION

Gavia arctica and *Gavia immer*.—Of the two specimens here assigned to *Gavia arctica*, the one from Newport is too worn for more than a tentative identification; the scapula from San Pedro, however, is in good condition and is clearly distinguishable from *G. stellata* by the greater flare of the acromion and the flatter coracoidal articulation.

The carpometacarpus from Newport which is assigned to *Gavia immer* is in a good state of preservation and is so nearly identical with modern specimens available that I feel justified in making the allocation. The tentatively listed specimens, from Newport and San Pedro, are incomplete.

It is unfortunate that the difficulty in exactly determining the specific identity of fossil specimens has resulted in the omission of the genus *Gavia* as a member of the Pleistocene avifauna in the check-list of fossil birds of North America. Previous records have listed a large form from San Pedro and Playa del Rey, presumably *Gavia immer*, and a smaller one from San Pedro, listed as *Gavia* sp. (Miller, 1914:37). The latter record was based on an incomplete femur longer and more slender than specimens of *Gavia arctica* or *G. stellata* then available for comparison. This fossil femur is now at hand (U.C. no. 21057). In the series of modern skeletons of *G. arctica* at the Los Angeles County Museum, there are femora even longer than this fossil, and one which is more slender. I believe, therefore, that the San Pedro specimen is assignable to *Gavia arctica*.

Aechmophorus occidentalis.—The lower mandible from Newport coincides closely with comparable Recent specimens of the modern Western Grebe except for slightly larger size. The larger dimension is in keeping with the character of the Pleistocene representation of *Aechmophorus* noted at Fossil Lake, Oregon (Howard, 1946:148). The distal fragment of tibiotarsus from San Pedro is in good condition, and measurements of the condylar area are above the average for the modern grebe (breadth, 10.7 mm.; depth of external condyle, 11.5 mm.). The proximal fragment cannot be accurately measured but does not appear to be large.

Among previously recorded specimens of *Aechmophorus* from San Pedro (Miller, 1930:117), a nearly complete humerus shows a breadth of distal end of 12.2 mm. which is well above the average for the modern Western Grebe (11.0 mm.). It also exceeds the average of the series of humeri from Fossil Lake, Oregon (11.2 mm.). Of two femora of *Aechmophorus* recorded from Playa del Rey (Howard, 1936:211), one, with distal end intact, exceeds both modern and Fossil Lake series in depth and breadth of shaft. In the other specimen the shaft is broader than in the modern series, but the measurement of depth of shaft falls within the modern range, although above the average. Two fragmentary specimens, a humerus from San Pedro, and a sternum from Playa del Rey, cannot be measured.

Of the eight specimens of Western Grebe available from the Pleistocene marine deposits of southern California, five are now found to exceed the average of comparable elements of Recent birds (2 from San Pedro, 2 from Playa del Rey, and 1 from New-

port Bay). It is strongly indicated, therefore, that in the Pleistocene the Western Grebe was larger all along the coast than it is today. The trinomial distinction accorded the Oregon representation (*Aechmophorus occidentalis lucasi*) might appropriately be applied to the California specimens as well.

Colymbus auritus and *Colymbus nigricollis*.—The carpometacarpus from San Pedro tentatively assigned to the Horned Grebe resembles *Colymbus* but is too large for *C. nigricollis* and too small for *C. parvus*. Measurements fall within the range of those taken on a series of modern specimens of *C. auritus*. However, they do not agree with any one specimen available, appearing rather stockier in proportions.

The coracoid from San Pedro assigned to *Colymbus nigricollis* is a fraction of a millimeter smaller than the minimum modern specimen available. It should be noted that the series of small grebe coracoids from Fossil Lake, Oregon, also contains specimens of lesser size than the modern specimens. With the small series of both modern and fossil grebe bones now at hand, it would be unwise to state that the Pleistocene Eared Grebe averaged smaller than the living bird, although the possibility should be kept in mind as more fossils become available.

Diomedea albatrus.—Albatross remains have been reported before from the Upper Pleistocene of California: at San Pedro, *Diomedea* near *nigripes* (Miller, 1914:34) and *Diomedea* sp. (Miller, 1930:117); and at Playa del Rey, *Diomedea albatrus* (Howard, 1936:212). These specimens have been examined in the course of this study; the larger one from San Pedro, reported as *Diomedea* sp., is an incomplete tarsometatarsus which is larger in distal dimension than any available specimens of *D. albatrus* but appears to agree with that measurement on skins of *Diomedea immutabilis*. Further study should be made of this specimen when skeletons of the latter species are available.

The bones here recorded from Newport agree in all particulars with specimens from the kitchen middens of California which have been identified as *Diomedea albatrus*. The distal end of an ulna from San Pedro agrees in shaft size with this kitchen middens material; no available comparative specimen of ulna has the distal end intact.

Fulmarus glacialis.—In the available series of 14 humeri of the Recent Pacific Fulmar (half of which were kindly measured by Dr. Loye Miller in his collection), the range in length is from 98.7 mm. to 110.2 mm., with an average of 103.4 mm. The fossil humerus from Newport is about 3 mm. smaller than the minimum of this modern series, measuring in greatest linear dimension 95.4 mm. Otherwise it is identical with the modern bones. The ulna falls within the size range of modern specimens. The radius is too fragmentary to measure.

There is one other Pleistocene record of the Fulmar, from the lumber yard locality of San Pedro (Miller, 1914:35). The specimen, a carpometacarpus, is not available at this time, so no determination of its size can be made.

Phalacrocorax penicillatus and *Phalacrocorax auritus*.—The specimens here recorded from Newport and San Pedro provide the first conclusive evidence of the occurrence of *P. penicillatus* in the Pleistocene, although it has been tentatively recorded from the San Pedro deposits on the basis of a femur (Miller, 1914:35) and a tarsometatarsus (Miller, 1930:117). Examination of these San Pedro specimens now indicates that the tarsometatarsus can be definitely assigned to *P. penicillatus*, being distinguished from *P. auritus* in the greater flatness across the distal end. The femur, however, lacks the excavation below the head anteriorly which is characteristic of *penicillatus* and should be assigned to *P. auritus*.

An incomplete tarsometatarsus with distal end intact from Santa Monica, formerly assigned to *P. auritus* (Miller, 1925:147), is now thought to belong to *P. penicillatus* by reason of its flatness across the anterior surface, and abrupt, short middle trochlea.

The ulna and coracoid herein assigned to *P. penicillatus* are distinguished from *P. auritus* as follows: ulna, greater extent of impression of brachialis anticus muscle and nature of tricipital and bicipital attachments; coracoid, intermuscular line situated farther from the medial border.

Moris reykana.—Three specimens from Newport are assignable to the Sulidae. The tarsometatarsus is allocated to *Moris* in distinction to *Sula* on the basis of the presence of three separate calcaneal ridges in the hypotarsus, very small proximal foramina, and less pneumaticity of the element as a whole. The specimen exhibits about the same size relationship to comparable specimens of *Moris bassana* as is true of the coracoid described as *Moris reykana* (Howard, 1936:213) from the Playa del Rey locality about 40 miles to the north. For this reason I have assigned the tarsometatarsus to the extinct species.

The radius resembles *Moris* in its stoutness just below the head and in the depression of the bicipital attachment. Like the tarsometatarsus, the radius is slightly smaller than in *M. bassana*, and is assigned to *M. reykana*. Although it is likely that the humerus belongs with the other bones, it is too fragmentary to attempt a definite allocation.

Histrionicus histrionicus?—A distal end of a humerus (U.C. no. 21096 from San Pedro was originally assigned to *Anas carolinensis* (Miller, 1914:35), but proves on comparison with additional modern material to be that of a nyrocine duck indistinguishable from the Harlequin.

Spatula clypeata.—A tibiotarsus and coracoid (U.C. no. 29032) from San Pedro, now referred to the Shoveller, were previously assigned to *Anas cyanoptera* with the remark that they appeared too stout for the comparative material than available (Miller, 1914:36).

Melanitta deglandi and *Melanitta perspicillata*.—The shaft of a femur from Newport, tentatively assigned to *M. deglandi*, resembles comparable Recent specimens of that species but is slightly larger (breadth of shaft, 5.3 mm.; depth of shaft, 6.7 mm.; *M. deglandi*, breadth, 4.4-5.0 mm.; depth, 5.7-6.4 mm.). The bone is too slender to belong to the large diving duck *Chendytes*.

A poorly preserved proximal end of a humerus previously assigned to *Melanitta perspicillata* (Miller, 1930:117) is now referred to *M. deglandi* on the basis of its large size. The humerus newly listed from San Pedro (a distal end) shows the same state of preservation and possibly represents the other half of this same bone.

Chendytes lawi.—In addition to the specimens of *Chendytes* from known Pleistocene strata, three fragments of leg bones were found in an Indian site at Malaga Cove (Southwest Museum Coll. no. 1011; E. C. Walker ms.). These appear to have been carried to the site by human hands, presumably from nearby fossil beds. Dr. Loye Miller has in his collection seven well preserved specimens (1 tarsometatarsus, 2 femora, 3 tibiotarsi, 1 fragment of sacrum) from an unknown locality. They were brought to him many years ago with a collection of kitchen midden bones from San Nicolas Island, but as no similar material has ever been found on San Nicolas, it is believed that the fossil bones were taken elsewhere and secondarily associated with the island material. The bones are well petrified in distinction to the typical kitchen midden preservation noted in other specimens.

The occurrence of *Chendytes* at Newport was previously recorded (Howard, 1947:76) in connection with two degenerate wing elements which point conclusively to the flightlessness of the bird and to its dependence on the pelvic limbs for swimming. Unfortunately no additional specimens of wing elements have come to light since.

Previous reports on *Chendytes* have discussed the femur, tibiotarsus, and tarsometatarsus at some length (Miller, 1925; 1930:117). The pelvis and the pedal phalanges

now available merit some description. The shape of the centrum of the anteriormost synsacral vertebra closely resembles that of the mergansers in its diminished dorsoventral depth. In the scoters and in the geese the centrum is as deep or deeper than it is wide. The steep slope of the sides of the ilia also resembles the condition in the mergansers, as well as in the geese. The ilia are united at the midline at least in the area just anterior to the acetabulae. They are broken away beyond this point so that the condition cannot be observed. The line of union appears to be narrow, not broad as in the geese. Openings between the ilia and the spines of the synsacral vertebrae noted in the mergansers and scoters are lacking in *Chendytes*; in this character the fossil bird resembles the geese. The phalanges are similar to those of the scoters except for much larger size.

With the large number of specimens of *Chendytes* now available the general characteristics of the bird have become more evident. The degenerate nature of the available wing elements contrasts markedly with the condition noted in such flightless swimmers as the penguins, Great Auk, or the Pliocene *Mancalla*. These birds though unable to use the wings in the air, used them for under-water progression. *Chendytes* is likened, rather, to the flightless cormorant of the Galapagos Islands, *Nannopterum harrisi*, in which the swimming power is in the legs. In body size *Chendytes* appears to have been close to *Nannopterum* (breadth of pelvis: *Nannopterum* 40 mm., *Chendytes* 37 mm.?). The length of the tarsometatarsus, also, is similar in the two birds. The femur and tibiotarsus, however, are longer in *Chendytes*, and the coracoid and humerus are markedly shorter.

Measurements of *Chendytes* and *Nannopterum*

	<i>Chendytes</i>	<i>Nannopterum</i>
Length of tarsometatarsus	63- 66 mm.	64.5 mm.
Length of tibiotarsus	134 mm.	120.0 mm.
Length of femur	67- 73 mm.	58.0 mm.
Length of coracoid	48- 50? mm.	56.0 mm.
Length of humerus	70? mm.	89.5 mm.

Relative to the length of the humerus, the average length of the femur in *Chendytes* is 100 per cent, in *Nannopterum* 64 per cent, in a flying cormorant 37 per cent, and in the scoters 50 per cent.

Stercorarius sp.—The jaeger humerus from Newport is in two pieces with one point of contact preserved. Its length of 125.6 mm. exceeds that of the average for *Stercorarius pomarinus* by 12.5 mm., but falls short of the type of *S. shufeldti* from Fossil Lake, Oregon, by 13.5 mm. Probably the specimen is not as nearly intermediate between the two species as these figures would suggest. Compared with a maximum humerus of *S. pomarinus* the difference is but 6.5 mm. Possibly the fossil represents an ancestral form of *pomarinus* which attained greater size than its living descendants. However, in view of the fact that the bone is considerably broken away at the points where distinguishing characters might be present, it is thought wise to allocate it generically only.

Larus sp.—The gull coracoid from Newport appears to belong to a bird of about the size of *Larus glaucescens*, although it is more slender than available modern specimens of that species. Comparison with a cast of the type of *Larus robustus* from Fossil Lake shows the two bones to be nearly equal in length, but the Oregon specimen appears more robust. Unfortunately the breakage of the proximal end and the general erosion of the Newport specimen have destroyed any distinctive characters it may have had.

Although possibly of no significance, it is worthy of comment that at Newport, as at Fossil Lake, there occurs a humerus ascribed to a large jaeger and a coracoid ascribed to a large gull. In both instances the generic allocation of the humeri to *Stercorarius* and the coracoids to *Larus* seems entirely justified. But as there is considerable simi-

larity in the coracoids of the two genera, the parallel occurrence at the two localities should be borne in mind as Pleistocene studies of birds advance.

SURVEY OF PLEISTOCENE MARINE AVIFAUNA

By way of summary of present information, the accompanying table lists all avian species known from Upper Pleistocene marine localities in southern California. The number of specimens now available is indicated both by locality and in totals for each species.

Compared with well over a hundred different kinds of birds which can be found along our shores today, the 38 forms listed from the Pleistocene seem pitifully few. We can, however, observe general trends of occurrence in this small sample available as fossils. Certain families, such as the loons, grebes, shearwaters, and ducks, may be considered abundant. The albatrosses, cormorants, and alcids may be called fairly common. These are all occurrences that could be expected, coinciding as they do with present conditions.

In contrast, however, there is a complete, or nearly complete absence of pelicans, gulls, and waders. Of the latter group, many different forms are known to have lived around inland lakes and ponds of this region in the Pleistocene by evidence presented from the Rancho La Brea and McKittrick deposits. Possibly none of the marine deposits so far encountered has represented the particular type of shore environment suitable for these shallow-water birds.

The rarity of the gulls and the total absence of the pelicans is remarkable. Gulls occurred in good numbers in the Fossil Lake deposits of Oregon with at least 3 species determinable. Can it be that the northern location of breeding areas of the majority of gulls today is reminiscent of a restricted northerly distribution of this family in the Pleistocene? Possibly the warmer climate which the southern coast is believed to have enjoyed at that time has some bearing on this matter.

Regarding the pelicans, Dr. Loye Miller has voiced the thought in oral discussion that owing to their great pneumaticity the bones of pelicans were too fragile to preserve well in spite of their large size. However, the White Pelican has appeared in two inland fossil deposits, and quantities of Brown Pelican bones, not greatly fragmented, are found in Indian kitchen middens of Recent age along our shores. The only alternative to Dr. Miller's theory appears to be the assumption that these birds were not part of the coastal scene in the Pleistocene.

The dominant marine bird of the Pleistocene here was apparently the flightless diver, *Chendytes*. Its abundant fossil representation relative to that of other species suggests its presence in numbers reminiscent of the Great Auk of northern waters and more recent time. There is as yet no record of the species elsewhere than in southern California.

Though the San Pedro deposits have yielded more specimens than any of the other localities, comparisons are possible between this assemblage and those from Newport Bay and Playa del Rey. It is first of all notable that *Chendytes* was a more dominant member of the avifauna at the last-named localities than at San Pedro. Although the actual number of specimens of *Chendytes* from San Pedro slightly exceeds that from Newport or Playa del Rey, proportionate abundance is much greater at the latter localities (48 per cent of the total number of specimens at Playa del Rey, 39 per cent at Newport, and only 21 per cent at San Pedro). Furthermore, careful search through all available material from San Pedro fails to reveal any specimens of the fragile wing elements. In the Newport deposit a humerus and coracoid were found; at Playa del Rey a coracoid.

Other differences in the deposits seem to be associated with environmental conditions. The birds found at Newport and at Playa del Rey suggest a more strictly marine

List of Avian Species Now Known from Upper Pleistocene Marine Deposits in Southern California

	LSP	OSP	PDR	SM	BS	SRI	NB	Total specimens
<i>Gavia immer</i>	2?		1?				2	5
<i>Gavia arctica</i>	2						1?	3
<i>Colymbus auritus?</i>	1							1
<i>Colymbus nigricollis</i>	1							1
<i>Aechmophorus occidentalis</i>	4		3				1	8
<i>Diomedea nigripes?</i>	1							1
<i>Diomedea albatrus</i>	1?		2				3	6
<i>Diomedea</i> sp.	1							1
<i>Puffinus opisthomelas</i>	2		2				1?	5
<i>Puffinus griseus</i>	2		1				4	7
<i>Fulmarus glacialis</i>	1						3	4
<i>Phalacrocorax auritus</i>	1			1				2
<i>Phalacrocorax penicillatus</i>	2			1			1	4
* <i>Moris reykana</i>			2				3	5
<i>Branta canadensis</i>	2					5	1?	8
<i>Branta nigricans?</i>	1							1
<i>Anser albifrons</i>	1						1?	2
<i>Anas platyrhynchos</i>	7					1?		8
<i>Anas carolinensis</i>	4					1		5
<i>Mareca americana</i>	1							1
Teal, sp.	1							1
Duck, sp.	3		1				1	5
<i>Histrionicus histrionicus?</i>	1							1
<i>Bucephala albeola</i>	1							1
<i>Spatula clypeata</i>	2							2
<i>Melanitta deglandi</i>	3						1?	4
<i>Melanitta perspicillata</i>	4							4
* <i>Chendytes lawi</i>	19		13	2	1		16	51
<i>Fulica americana</i>	2 (3?)							3
<i>Limosa fedoa?</i>	1							1
* <i>Stercorarius</i> sp.							1	1
<i>Larus glaucescens</i>	1						1?	2
<i>Synthliboramphus antiquus</i>	1 (2?)			1?				3
<i>Ptychoramphus aleuticus</i>	1							1
<i>Uria aalge</i>			1					1
<i>Cathartes aura</i>	1							1
<i>Haliaeetus leucocephalus</i>	1							1
<i>Lophortyx californica</i>	5	1						6
<i>Falco sparverius</i>	1							1
<i>Sturnella neglecta</i>	1							1
<i>Corvus corax</i>			1					1
Totals identifiable	88	1	27	5	1	7	41	170
Misc. unidentifiable	7		6				7	20
GRAND TOTALS	95	1	33	5	1	7	48	190

LSP, Lumber Yard, San Pedro; OSP, Second and Orizaba, San Pedro; PDR, Playa del Rey; SM, Santa Monica; BS, Bixby Slough; SRI, Santa Rosa Island; NB, Newport Bay.

influence than do those from San Pedro. Ten per cent of the specimens from San Pedro represent land birds (five species). No land birds have been found at Newport, and only one bone (of a raven) at Playa del Rey. Strictly oceanic birds comprise but 12.5 per cent of the San Pedro avifauna, compared with 37 per cent for Newport and 30 per cent

for Playa del Rey. The two alcids recorded from San Pedro which are absent at Newport are represented by only one or two specimens. As the total number of avian bones collected at San Pedro is more than twice that so far taken at the Newport locality, the absence of these less abundant species from the smaller collection is probably not significant. On the other hand, the occurrence of two species at Newport which do not appear in the San Pedro beds is noteworthy. One of these is the large extinct gannet which was described originally from Playa del Rey where two bones were found. At Newport there are two, possibly three specimens assignable to this bird. The other species is the large (presumably extinct) jaeger recorded here as *Stercorarius* sp. Both gannet and jaeger belong to groups of birds usually found off shore.

Although the possibility of an age difference between the Newport and Playa del Rey deposits and those of San Pedro should not be overlooked, it seems more likely that environmental factors may explain the occurrence of the gannet and the jaeger. As previously pointed out (Howard, 1936:211), the Playa del Rey deposits were probably laid down under 10 to 15 fathoms of water, which would indicate an offshore deposit. Of the "lumber yard" collections, Woodring (1946:95) says "It is inferred that this material was deposited in shallow current-swept marine water. That of the fresh-water and land animals except birds, were probably derived from the mainland and represent presumably drift carcasses stranded on the shore of an island formed by the Palos Verdes Hills during Palos Verdes time."

Mr. George Kanakoff has kindly furnished me with a tentative survey of the invertebrates of the Newport locality which indicates even less incidence of deep water forms and greater abundance of estuarine types than in the San Pedro deposits. The suggestion is therefore offered that the similarity of the Newport and Playa del Rey avifaunae as contrasted with that of the San Pedro area may in some way be associated with the occurrence of the latter locality on the leeward side of the island of Palos Verdes, whereas the other two areas were on the open coast.

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