PLIOCENE AVIAN REMAINS FROM BAJA CALIFORNIA

By HILDEGARDE HOWARD
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PLIOCENE AVIAN REMAINS FROM BAJA CALIFORNIA

By HILDEGARDE HOWARD

ABSTRACT: Seven species are represented in an Early Pliocene avifauna from marine deposits in three canyons in the southeastern part of Cedros Island. Predominant is a new species of flightless auk, _Mancalla cedrosensis_, represented by four incomplete skeletons as well as disassociated elements. Other new species described are _Puffinus tedfordi_ and _Cerorhinca minor_. The primitive flamingo, _Megapaloelodus opsigonus_ Brodkorb, is tentatively identified. A shearwater, gannet, and murrelet (listed by genus only) complete the avifauna.

INTRODUCTION

In 1964 and 1965 the University of California, Riverside, in cooperation with the University of Baja California, Ensenada, collected vertebrate fossils on Cedros Island. Through the kindness of Dr. Richard Tedford, who headed the field work, the bird remains were presented to the Los Angeles County Museum of Natural History.

Tedford’s notes accompanying the collection indicate that the fossil-bearing marine deposits involved are “in the basal part of the northwesterly dipping Pliocene section as it crops out in deep canyons and ridges near the base of the escarpment which forms the high northern wall of Valle Blanca.” This prominent valley, he states, runs east and west, draining much of the southeast corner of Cedros Island, with its mouth opening at the sea about two miles south of the “cannery village.” The fossils were collected from marine sandstones that overlie unconformably the Tortuga Formation of Late Miocene (Temblor) age, and because of this relationship, they have been referred to the Almejas Formation of Mina (1957), whose type section occurs at Tortuga Bay on the nearby Viscaino Penninsula.

Dr. Frank Kilmr, of the Geology Department of Humboldt State College, California, who studied the invertebrate beds on Cedros Island, believes (personal communication) that the vertebrate-bearing sands may be Early to Middle Pliocene in age. Although these beds are so far not known to contain invertebrates, he notes that they rest on diatomaceous strata of probable Upper Middle Miocene (Luisian) age, and underlie coarsely clastic invertebrate-bearing beds of probable mid-Pliocene age.

With respect to the Miocene-Pliocene contact, most of the bird remains occurred in the lower 10-70 feet of the Pliocene deposits. They were taken from approximately 22 field collecting sites over a half-mile of strike in three canyons. From west to east the canyons were named by the field party:

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Arroyo Esqueletos, Arroyo Tiberon, and Arroyo Delphin. Los Angeles County Museum of Natural History (LACM) locality numbers have been assigned to the collecting sites within these canyons based, in general, on their depth within the section. These are as follows (from lowest to highest within each canyon or ridge, and including from one to five field numbers each): Arroyo Esqueletos, loc. nos. 65144, 65145, 65146, and 65147; Arroyo Tiberon, loc. nos. 65152, 65151, 65150; Arroyo Delphin, loc. nos. 65148, 65149; ridge between Arroyo Tiberon and Arroyo Delphin, loc. nos. 65154 and 65153.

AVIFAUNA

Predominant among the approximately 100 avian bones found are those of a heretofore undescribed species of the flightless auk, *Mancalla*. Other species (all extinct) represented in the collection by fragmentary elements are two shearwaters, a gannet, a flamingoid species of the extinct family Palaelodidae, an auklet, and a murrelet. The taxa represented are as follows:

- *Puffinus tedfordi*, n. sp.
- *Puffinus* sp.
- *Morus* sp.
- *?Megapalaeolodus opsigonus* Brodkorb
- *Cerorhinca minor*, n. sp.
- *Endomychura (?)* sp.
- *Mancalla cedrosensis*, n. sp.

ANALYSIS OF SPECIES

Order Procellariiformes
Family Procellariidae–Shearwaters

*Puffinus tedfordi*, new species

Figure 1, A, B, E, F

Holotype: Proximal end of left tarsometatarsus, LACM 15386. Collected by Whistler and Tedford, August, 1965.

Locality: LACM locality 65151, Arroyo Tiberon, approximately 70 feet above Miocene-Pliocene contact; north side of Valle Blanca, 1½ miles south of cannery village, southeast corner of Cedros Island, Baja California, Mexico.

Formation and Age: Almejas Formation; Early Pliocene.

Diagnosis: Resembling *Puffinus opisthomelas* in gradual merging of internal calcaneal ridge with internal edge of shaft, but shaft broader, and proximal end relatively narrower and more evenly flared; anteriorly both edges of...
shaft forming well-defined ridges, with external edge more extended anteriorly; internal face of shaft sloping laterally so as to be plainly visible in anterior view in proximal half of bone.

Paratype: Incomplete tarsometatarsus LACM 15387; same data as for holotype. Although both proximal and distal ends are incomplete in this specimen, the contact of the internal calcaneal ridge with the shaft and the anterior shaft ridges are preserved and conform in character with the holotype. The paratype is important in providing a measurement of length between the distal and proximal foramina, showing the specimen to be within the range of 13 tarsometatarsi of *P. opisthomelas* in this dimension, but 28 per cent broader of shaft than the maximum for that species. Without this dimension of length, the stoutness of the shaft would suggest considerably greater length of the element.

Measurements: Holotype, breadth of proximal end 6.8 mm; least breadth of shaft 3.3 mm; greatest depth of external side of shaft 4.0 mm; depth of internal side of shaft below internal calcaneal ridge 2.7 mm. Paratype, length between proximal and distal foramina 32.2 mm; breadth of shaft 3.0 mm; depth of external side of shaft 3.9 mm; depth of internal side of shaft 2.7 mm.

Comparison with Other Fossil Shearwaters: Only two other Pliocene shearwaters are known, both from California, *Puffinus kanakoffi* from San Diego and *P. felthami* from Corona del Mar. Tarsometatarsi of both are at hand. *P. tedfordi* resembles *P. kanakoffi* in the merging of the internal calcaneal ridge with the postero-internal edge of the shaft and approximates this species in length of the tarsometatarsus. It differs, however, in 20 per cent broader shaft, more evenly developed proximal end, and visibility of the internal side of the shaft in anterior view. *P. felthami* differs from *P. tedfordi* in having the internal calcaneal ridge slightly inset mediad from the internal edge of the shaft and the posterior surface of the shaft adjacent to the ridge swollen, not flat as in *P. tedfordi*. *P. felthami* is broader proximally than *P. tedfordi*, the shaft is deeper but narrower; no measurement of length is possible.

Three Miocene west-coast shearwaters in which the tarsometatarsus is identified are at hand (*P. diatomicus*, cast; and *P. calhouni* and *P. priscus*, original material). All have the calcaneal ridge inset and the swollen shaft adjacent as in *P. felthami*. To judge from the figured type tarsometatarsus of *P. arverensis* from the Miocene of France (Shufeldt, 1896, pl. 24, figs. 1, 2) this specimen is shorter and stockier even than in *P. tedfordi*, but the external side of the shaft is not as deep and the proximal end is more flared.

Other Miocene shearwaters are known only from the humerus. Using *P. opisthomelas* and *P. griseus* as points of reference for size, *P. micraulax* from Florida (as recorded by Brodkorb, 1966:161) would have been markedly smaller than *P. tedfordi*, whereas *P. mitchelli* and *P. inceptor* (both studied from casts) from California, and *P. conradi* (cast) from Maryland would have been larger. Lambrecht's (1933:273) reference to *P. aquitanicus* and *P. antiquus* from the Miocene of France suggests that these species also were larger than *P. tedfordi*. 
Puffinus sp.

Figure 1, C

A distal fragment of a humerus (LACM 15404) and a nearly complete ulna (LACM 15403) from the ridge between Arroyo Tiberon and Arroyo Delphin (LACM locality 65153) represent a larger species of shearwater than P. telfordi. Except for the fact that the humerus shows the marked lateral compression of the shaft characteristic of the subgenus Puffinus, no reliable diagnostic characters remain on this fragment. The few measurements that can be made in comparison with the type humerus of the California Pliocene P. felthami indicate close similarity in size. The fragment is too poor, however, to assign or describe.

The ulna is well preserved, with only a small section of the shaft incomplete. The proximal end is narrow relative to its depth through the olecranon as in members of the subgenus Puffinus. The brachial impression is long (13.5 mm) and deeply depressed adjacent to the prominence for the anterior articular ligament. The bone is slightly more slender than the ulna of P. griseus and markedly shorter, being about midway between this species and P. kanakoffi. As the ulna is not known in most of the previously described fossil shearwaters, it would be unwise to attempt assignment of the Cedros Island bone.

Measurements of ulna LACM 15403: Greatest length (with possibly a section of shaft missing) 86.7 mm; breadth across proximal cotylæ 7.8 mm; depth from cotylæ through olecranon 9.2 mm; breadth of distal trochlea 5.1 mm; depth of external crest of trochlea 6.9 mm; dimensions of middle of shaft 4.1 x 4.8 mm.

A very broad distal half of a tibiotarsus (LACM 15378) from Arroyo Tiberon (LACM locality 65151) exceeds even P. griseus in shaft breadth. It is doubtful that it is allied with the wing bones here discussed.

Order Pelecaniformes
Family Sulidae—Boobies and Gannets

Morus sp.

A distal end of a left humerus (LACM 15413) from Arroyo Delphin (LACM locality 65148) is crushed and broken in several important diagnostic areas. However, the long attachment of the anterior articular ligament and the positions of the attachments on the entepicondyle and ectepicondyle suggest alignment with the gannets (genus Morus) rather than with the boobies (genus Sula). The olecranal fossa, also, is seemingly less depressed than in Sula although the broken borders of the fossa may create a false visual impression of the area.

One portion of the specimen, fortunately preserved, is the well-developed entepicondylar area, which serves immediately to distinguish it from Sula humeralis from the San Diego Pliocene. S. humeralis is similar in size to the
Cedros Island bone, but is described (Miller and Bowman, 1958:10) as being underdeveloped in the entepicondylar area. Size alone separates the Cedros bone from west-coast Tertiary members of the genus Morus (larger than Morus vagabundus and smaller than Morus lompocanu). However, it closely approximates in breadth a humerus from the east coast referred to Morus loxostyla (Wetmore, 1926:467), a species known only from the Miocene. Assignment of the imperfect Cedros bone is inadvisable.

**Measurements:** Breadth of distal end 20.5 mm; length of attachment of anterior articular ligament 9.8 mm.

Order Ciconiiformes: Suborder Phoenicopteri–Flamingos
Family Palaelodidae–Primitive Flamingos
*Megapalaelodus opsigonus* Brodkorb

Figure 1, K, M, N

A distal end of a left tarsometatarsus (LACM 15423) and a fragment of the distal end of a tibiotarsus (LACM 15422), both from Arroyo Delphin locality 65148, 10 feet above the Miocene/Pliocene contact, are assigned to the family Palaelodidae. In the tarsometatarsus the palaelodid characters are seen in the shape and position of the internal and external trochlea as compared with the tarsometatarsus of *Phoenicopterus*, as follows: (1) internal trochlea arising from the shaft well in front of the posterior margin of the middle trochlea and rounding upward at the tip; (2) external trochlea also rounding upward posteriorly and its external lip more elevated than its internal lip. The contours of the tibiotarsus are badly worn, but the specimen is referred to the Palaelodidae on the basis of the following characters: (1) distal articular surface with low median ridge, and deep, pit-like depression on each side posterior to the condyles; (2) small, lateral papilla present above the external condyle anteriorly, but no large anterior intercondylar tubercle as in *Phoenicopterus*.

The family Palaelodidae is best known from the several species of the genus *Palaelodus* recorded from the Miocene of France and Germany. Previous records in North America are assigned to the genus *Megapalaelodus*, with two species: *M. connectens* Miller (genotype) and *M. opsigonus* Brodkorb. The former was described (A. Miller, 1944:86) on the basis of a large distal end of tarsometatarsus from the Miocene of South Dakota. Later, L. Miller (1950:70) referred a distal end of a tibiotarsus from the Miocene of California to the same species. *M. opsigonus* was described (Brodkorb, 1961:173) from a proximal end of a tarsometatarsus found in lower Pliocene deposits in Oregon.

Characters of the Cedros Island tarsometatarsus are as follows: internal trochlea well elevated above middle trochlea and posteriorly rotated toward the center of the shaft; proximo-distal dimension (height) 90 per cent of its antero-posterior depth; internal surface flat and bordered posteriorly by a
long, heavy ridge, deflected away from the shaft. External trochlea laterally compressed; proximo-distal dimension 89 per cent of its antero-posterior depth; external surface with deep depression near posterior tip. The specimen was compared with casts of the comparable portion of the tarsometatarsus of *Palaelodus ambiguus* and *Megapaloelodus connectens*, the types of their respective genera. Resemblance is closer to *P. ambiguus* in the elevation of the internal trochlea and the lateral compression of the external trochlea, but closer to *Megapaloelodus* in the relative height to depth of the internal and external condyles. The internal surface of the internal trochlea is flatter than in either of the other forms, but is furthest removed from *P. ambiguus*, in which this surface is deeply depressed. The degree of deflection of the posterior tip of the internal trochlea away from the shaft is, perhaps, closer to the condition in *Palaelodus* than in *Megapaloelodus* although this area in *M. connectens* is incomplete. Miller, however (1944:86), notes less abrupt deflection of this area as one of the characters distinguishing *M. connectens* from *Palaelodus*. The other character that he emphasizes concerns more pronounced development of the outer rim of the external trochlea. The angular measurement that he gives (formed with the axis of the shaft by a line from the inner to the outer rim of this trochlea) I have been unable to duplicate. Possibly, however, the greater inflation of this trochlea as compared with that of the Cedros specimen is a reflection of this character.

In breadth of the distal end, taken at right angles to the axis of the shaft, the Cedros tarsometatarsus is 10 per cent narrower than that of *M. connectens*, and 6 per cent broader than that of the largest species of *Palaelodus* (*P. goliath*). Compared with the proximal end of the tarsometatarsus that forms the type of *Megapaloelodus opsigenus*, the Cedros bone is approximately the same size. Both specimens measure 19.6 mm in breadth of their respective articular ends. There is some variation in relative breadth of articular ends of this element as noted in *Palaelodus* and *Phoenicopterus*. Milne-Edwards (1867-1871, 2:78) records the proximal ends of *P. gracilipes* and *P. ambiguus* as 2 mm broader than the distal, but shows the proximal end of *P. crassipes* to be 0.8 mm narrower than its distal end. In two modern tarsometatarsi of *Phoenicopterus ruber* the proximal ends are narrower than the distal; in another *P. ruber* and in a specimen of *P. antiquus* both ends are the same breadth.

The agreement in size between the Cedros tarsometatarsus and that of *M. opsigenus*, coupled with the fact that both come from deposits of early Pliocene age, strongly suggests that they are representative of the same species. The Cedros tarsometatarsus, therefore, is tentatively referred to *M. opsigenus*. The fact that the Cedros bone does not appear to agree with *Megapaloelodus* in the two characters particularly emphasized in Miller’s (1944:86) description of *M. connectens* is not considered a deterrent in view of the overall comparison with both *P. ambiguus* and *M. connectens*. Milne-Edwards notes considerable variability among the several species of *Palaeo-
dus, and similar variability may have existed in *Megapaloelodus*. Furthermore, there is also a possibility that *Megapaloelodus* itself is but another specific variant of *Palaelodus*.

The fragmentary distal portion of tibiotarsus from Cedros Island is commensurate in size with the tarsometatarsus, and is, therefore, also tentatively assigned to *P. opsiganus*. The only character of any possible importance below the family designation in this poorly preserved specimen is the large oval opening at the distal margin of the supratendinal bridge. The tibiotarsus referred to *M. connectens* is said to have a round, rather than an oval opening (L. Miller, 1950:70).

Measurements of tarsometatarsi of *Megapaloelodus* and *Palaelodus*

<table>
<thead>
<tr>
<th></th>
<th>Cedros Id.</th>
<th>LACM 15423</th>
<th><em>M. connectens</em></th>
<th><em>P. ambiguus</em></th>
<th><em>P. goliath</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Breadth of distal end at right angles to axis of shaft</td>
<td>19.6 mm</td>
<td>21.7 mm</td>
<td>12.0 mm</td>
<td>18.5 mm</td>
<td></td>
</tr>
<tr>
<td>Height of internal trochlea</td>
<td>12.8</td>
<td>12.2</td>
<td>6.8</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Depth of internal trochlea</td>
<td>14.2</td>
<td>14.2</td>
<td>8.9</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Height of external trochlea</td>
<td>12.0</td>
<td>12.1</td>
<td>6.0</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Depth of external trochlea</td>
<td>13.5</td>
<td>14.0</td>
<td>8.7</td>
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<td></td>
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</tbody>
</table>

Order Charadriiformes: Suborder Alcae
Family Alcidae, Subfamily Alcinae–Auks, etc.

Of eight small alcid bones, six show relationship to the group which includes the Rhinoceros Auklet and the Puffins. The three genera involved (*Cerorhinca, Lunda*, and *Fratercula*) so closely resemble each other in skeletal characters that the term “puffin” might properly be applied to all three. Similar characters are: humerus with long, hooked tip of internal tuberosity, deeply undercut head, and medially expanded pectoral attachment proximally; ulna with abrupt flare from shaft to internal cotyla, narrow notch between olecranon and tricipital attachment (viewed proximally), area anconally bordering attachment of anterior articular ligament uneven in profile as viewed from anconal side (more expanded proximally than distally), distally, carpal tuberosity long and prominently projected laterally; coracoid with long procoracoid and foramen very low; tarsometatarsus with broad, flat shaft. It is only by weighing a number of small details that the fossils are assigned to *Cerorhinca*. All elements are 25-30 per cent smaller than those of *Cerorhinca monocerata*, and the fossil species is described as new.
Cerorhinca minor, new species

Holotype: Proximal end of right humerus, LACM 15408, collected by Whistler and Jefferson, July, 1964.

Locality: LACM locality 65153, ridge between Arroyo Tiberon and Arroyo Delphin; 45-60 feet above Miocene-Pliocene contact; north side of Valle Blanca, 1½ miles south of cannery village; southeast corner of Cedros Island, Baja California, Mexico.

Formation and Age: Almejas Formation; Early Pliocene.

Diagnosis: Head smoothly rounded on lower margin; deep channel undercutting head and proximo-medial edge of pectoral attachment; internal edge of channel limiting medial extent of capital groove and aligned with median crest; pneumatic fossa more round than oval; approximately three-fourths the size of C. monocerata humerus.

Referred Specimens: Proximal half of ulna, LACM 15406 and incomplete tarsometatarsus, LACM 15407 from the type locality; incomplete right proximal end of humerus, LACM 15420 and upper end of coracoid, LACM 15421, from Arroyo Delphin (LACM locality 65148). Tentatively referred distal half of ulna, LACM 26572 from Arroyo Tiberon (LACM locality 65151).

Description of Referred Material: Humerus LACM 15420 is broken but resembles the type in all areas preserved. Proximal end of ulna with shorter, straighter, more blunt olecranon than in C. monocerata, attachment of anterior articular ligament shorter and broader, and internal side of shaft more rounded, resulting in less bladelike shaft; 72 per cent of size of C. monocerata in breadth of proximal end. Tentatively assigned distal half of ulna (LACM 26572) larger than proximal half in shaft breadth and approximately 82 per cent of the size of C. monocerata in depth through the external crest of the trochlea. Coracoid with straight upper border of long procoracoid as in Cerorhinca (Lunda and Fratercula with upcurved tip); triosseal canal broadly rounded (lacking keellike raised area slightly anterior of center found in Lunda and Fratercula); three-fourths the size of C. monocerata in breadth and further distinguished by less expanded head, less undercut by triosseal canal; the foramen was evidently low on the procoracoid as at least half the procoracoid is preserved and the foramen is not in evidence. Tarsometatarsus broken above the tibialis anticus tubercles and through the upper portion of the distal trochleae; shaft broad and flat and well depressed on anterior surface; resembling Cerorhinca in distinction to Lunda and Fratercula in less internal flare of troclear region and presence of small, slitlike depression separating base of internal trochlea from middle trochlea; approximately three-fourths the size of C. monocerata in breadth of shaft at upper level of distal foramen.

Measurements: Type humerus, breadth proximal end 10.5 mm; dimensions of shaft 3.0 x 4.2 mm. Ulna LACM 15406, breadth across proximal
cotyIae 5.0 mm; depth from internal cotylar to olecranon 5.5 mm; dimensions of shaft 2.3 x 3.3 mm. Ulna LACM 26572, depth external crest of distal trochlea 5.4 mm; dimensions of shaft 2.8 x 3.8 mm. Coracoid LACM 15421, length from below scapular facet to head 9.6 mm; breadth through troosal canal 2.9 mm; breadth of head 3.9 mm. Tarsometatarsus LACM 15407, least breadth of shaft 2.7 mm; depth of shaft 1.9 mm; breadth of shaft at upper level of distal foramen 4.2 mm; length from distal foramen to top of tibia ticus tubercles 12.8 mm.

Comparison with previously recorded fossil Cerorhinca: Cerorhinca dubia from the Miocene of Lompoc, California is known only from the leg bones. The tarsometatarsus (as recorded by Miller, 1925:116, and as examined on a cast of the type) is only 2 per cent shorter than that of C. monocerata, hence notably larger than that of C. minor. The only other Tertiary record of Cerorhinca is from the late Miocene of Laguna Hills, California. A proximal end of an ulna and a fragment of a humeral shaft were assigned only as Cerorhinca sp. (Howard, 1968:16). The ulna (LACM 18274) is 30 per cent larger than in C. minor.

?Endomychura sp.—Murrelet

Figure 1, I

The two remaining small alcid bones consist of a dorsal cap of a cranium (LACM 15426) from Arroyo Esqueletos (LACM locality 65144) and a proximal fragment of a humerus (LACM 26571) from Arroyo Tiberon (LACM locality 65151). Both are commensurate in size with the elements assigned to C. minor. However, they show closer relationship to the murrelets. On the cranium, the depressions above the orbits form evenly rounded, short arches, and the frontal area is well vaulted adjacent to them. This condition appears in both Endomychura and Synthliboramphus. The humerus is closer to that of Endomychura in the very shallow depression below the head (even shallower than in either E. craverii or E. hypoleuca). Neither specimen is sufficiently complete to permit of definite assignment.

Subfamily Mancallinae—Flightless "Auks"

Bones of the flightless auk, Mancalla, occurred at all LACM localities, and from approximately 5 feet (one bone) to approximately 120 feet (one bone) above the Miocene-Pliocene contact, with greatest concentration between 10-70 feet. Four incomplete skeletons and disassociated elements are represented, making a total of more than 80 bones.

Previously described species of this genus (see Howard, 1970, for review) have come from the Pliocene of California: Mancalla californiensis, M. diegense, and M. milleri. A possible ancestral form, Praemancalla lagunensis, is recorded from the late Miocene of California. The bones from Cedros Island are close in size to those of M. diegense, but structural peculiarities
serve to distinguish most of the elements. The Mexican form is, therefore, described as a distinct species.

**Mancalla cedrosensis**, new species

Figure 2, A-K and Figure 1, L

**Holotype:** Associated skeletal elements of one individual, LACM 15373, including essentially complete right scapula, coracid, humerus, ulna, femur, tibiotarsus, left ulna, radius, and carpometacarpus; also including distal ends of right radius, right carpometacarpus, and left tibiotarsus, extreme tip of proximal end of right tarsometatarsus, proximal three-fourths of left femur, and several fragmentary thoracic and cervical vertebrae. Collected by R. Tedford, 1965.

**Locality:** LACM locality 65147 (Tedford field no. 1296), east branch of Arroyo Esqueletos, approximately 70 feet above Miocene/Pliocene contact; 2 miles south of cannery village, southeast corner of Cedros Island, Baja California, Mexico.

**Formation and Age:** Almejas Formation, Early Pliocene.

**Referred Material:** Three associated skeletons: LACM 15425 from LACM locality 65144 (Arroyo Esqueletos, approximately 25 feet above Miocene/Pliocene contact) including proximal ends of left femur and tibiotarsus, distal end of right tibiotarsus, complete right tarsometatarsus, fragment of pelvis and vertebrae; LACM 23739, also from LACM locality 65144, including right and left femora, left tibiotarsus (distal end), and complete left tarsometatarsus; and LACM 15410 from LACM locality 65150 (Arroyo Tiberon, approximately 70 feet above Miocene/Pliocene contact) including right and left scapulae and coracoids, furcula, crushed sternum, and a carpometacarpus. Also unassociated elements from all localities, consisting of a rostrum, 2 scapulae, 1 coracoid, 10 humeri, 14 ulnae, 3 radii, 5 carpometacarpi, 1 femur, 4 tibiotarsi, 6 tarsometatarsi, and 3 vertebrae.

**Diagnosis:** Coracid relatively short and heavy (ratio of breadth below furcicular facet to length more than 12 per cent, ratio of length of coracid to length of humerus 59 per cent); tip of furcicular facet blunt but upturned. Humerus with internal contour from shaft through bicipital crest broadly and gradually curved; area below head, between pectoral attachment and pneumatic fossa oval and deeply depressed. Olecranon of ulna extending beyond shaft in ulnar contour. Length of process of metacarpal 1 of carpometacarpus more than 44 per cent of total length of bone. Femur with obturator ridge relatively short, straight in internal contour, and with well-marked depression internal to ridge. Tibiotarsus with distal internal ligamental prominence a distinct, rounded papilla below the level of the proximal edge of internal condyle; external ligamental prominence negligible. Tarsometatarsus (based on referred material) flared proximally and distally, shaft depressed anteriorly with bordering ridge sharply defined.
Comparisons: In all qualitative characters separating M. diegense and M. milleri from M. californiensis (Howard, 1970, Table I), M. cedrosensis is closer to M. diegense and M. milleri. In the characters that distinguish M. diegense from M. milleri (Howard, op. cit., Table IV), M. cedrosensis resembles M. diegense in the projecting anterior edge of the furcular facet of the coracoid and in the proximal flare of the tarsometatarsus, but the borders of the metatarsal shaft are more sharply defined. In the femur, the depth of the depression internal to the obturator ridge resembles the condition in M. milleri, but the ridge is shorter. In the tibiotarsus, the distal internal ligamental prominence is more prominent than in either M. diegense or M. milleri, but seemingly is closer to the latter in placement below the level of the proximal border of the condyle; the poor preservation of the San Diego specimens somewhat obscures the exact position of the prominence; the external ligamental prominence is negligible as in M. milleri.

M. cedrosensis is distinct from both M. diegense and M. milleri in the contour of the humerus from shaft to bicipital crest, being more broadly and gradually rounded even than in M. milleri; also distinct is the oval shape of the area of origin of the external head of the triceps below the humeral head; in both California species this area is broader and of generally angular contour at the junction of the head and pectoral attachment. Distinction is noted, also, in the ulna in which the olecranon is more prominently developed and extends slightly beyond the shaft in ulnar contour.

The type of M. cedrosensis provides, for the first time, an accurate guide to the proportionate dimensions of the skeleton in a species of Mancalla. It is 12-16 per cent longer than the average for M. milleri in all represented elements except the coracoid, and is 8 per cent longer in this element. It is essentially equal to the average of M. diegense in length of ulna, carpometacarpus, and femur, 5-7 per cent shorter in humerus, tibiotarsus and, probably, tarsometatarsus (this element is incomplete in the type), and 12 per cent shorter in the coracoid. Compared with the 59 per cent ratio of length of coracoid to length of humerus in the type of M. cedrosensis, the ratio in both M. diegense and M. milleri is 64 per cent, based on averages.

Compared with a specimen of present-day Uria aalge (LACM Bi480, which is of minimum size for the species in most elements), the type of M. cedrosensis shows greatest difference in 16 per cent longer coracoid and femur, but 13 per cent shorter humerus, 18 per cent shorter carpometacarpus and 53 per cent shorter ulna. The tibiotarsus is 2 per cent longer. The tarsometatarsus in the type is incomplete but estimating its length from the breadth of the proximal end, it was probably very nearly the same length as in U. aalge.

Figure 2. Skeletal elements from type specimen of Mancalla cedrosensis LACM 15373: A, D, tibiotarsus internal and anterior views; B, humerus; C, G, J, coracoid posterior, internal and anterior views; E, ulna; F, radius; H, scapula; I, carpometacarpus; K, femur. All figures slightly more than natural size.
These proportions differ somewhat from those computed for the San Diego *Mancalla* material (Miller and Howard, 1949:207) which, we now know, were based on two species (Howard, 1970). With unequal representation of the large and small species, these prior figures overemphasized the large size of the coracoid on one hand, and the small size of the humerus, carpometacarpus, and ulna on the other; the length of the femur was also underestimated.

**Measurements of Type, LACM 15373:** Coracoid, length (from head to sternal facet) 43.2 mm, breadth across furcular facet 7.3 mm, distance from below scapular facet to head 15.6 mm, least breadth of shaft below procoracoid 5.3 mm, breadth immediately below furcular facet 5.3 mm. Scapula, breadth across articular end 12.6 mm. Humerus, length from head to internal condyle 72.4 mm, breadth of proximal end 17.9 mm, breadth of distal end 7.2 mm, length from head to distal edge of deltoid crest 48.8 mm. Ulna, length from intercotylar ridge to internal condyle 29.5 mm, depth of proximal end through olecranon 9.5 mm, breadth across proximal cotylae 6.5 mm, breadth of shaft at middle 4.2 mm, depth of shaft 6.2 mm. Radius, greatest length 29.0 mm. Carpometacarpus, length to end of metacarpal II 35.8 mm, length of process of metacarpal I 16.0 mm (est.), Femur, greatest length 54.7 mm, depth through trochanter and obturator ridge 9.2 mm, greatest breadth of distal end 10.6 mm. Tibiotarsus, length from proximal articular surface to distal condyles 83.9 mm, breadth distal condyles 9.4 mm, depth distal condyles 8.8 mm. Tarsometatarsus, breadth of proximal end 10.2 mm.

**Summary and Conclusions**

The seven species represented in the Early Pliocene avifauna of Cedros Island are undoubtedly all extinct. Three, however, are represented by material that is unsatisfactory for assignment beyond the generic level. One is tentatively allocated to *Megapaloelodus opsigonus*, a primitive flamingo known only from the Early Pliocene of Oregon. Three are described as new: *Puffinus tedfordi*, *Cerorhinca minor*, and *Mancalla cedrosensis*. The genus *Puffinus* is well represented in the Tertiary of the west coast, with five Miocene and two Pliocene species previously recorded from California. *Cerorhinca* has only two previous fossil records, both from the Miocene of California. *C. minor* is the smallest known species of the genus. *Mancalla cedrosensis* adds a fourth species to those recorded for this genus of flightless auks; previous records are all from California, and presumably all Pliocene.

The avifauna of Cedros Island, although not nearly as abundantly represented as that of the somewhat later Pliocene of San Diego, California, is similar in the predominance of *Mancalla*. The absence of immature bones indicates that the area may have been a congregating site but not a nesting site for these flightless birds. This is thought to be true, also, of the San Diego site. The Cedros bones, however, are much better preserved than most of those from San Diego, suggesting that they were less subject to weathering.
Size Range (in mm) of *Mancalla cedrosensis*,
Compared with *M. diegense* and *M. milleri*

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<th></th>
<th><em>M. cedrosensis</em></th>
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and may have been deposited further offshore. In addition to *Mancalla*, other similarities of occurrence in the two avifaunas are shearwaters, sulids, and alcids although in no instance are the species the same. Grebes and loons, present at San Diego are lacking at Cedros. On the other hand, the Cedros primitive flamingo, *Megapaloeolodus*, represents a group that has not been noted at San Diego.
The Early Pliocene fauna of Juntura, Oregon (including fish, reptile, bird, and mammal) indicates a pond, lake or river community, not marine (Shotwell, 1963:15). The Megapaloelodus of this fauna is the only avian form similar to the avifauna of Cedros Island. Other Juntura birds include cormorant, goose, ducks, and coot.

The two bones from Cedros Island assigned to Puffinus sp. suggest a shearwater the size of P. fulhumi described from the Early Pliocene of Corona del Mar, California, but positive identification is impossible. The scant remains from Corona del Mar include but one other species, Mancalla californiensis.

In three of the other Pliocene marine localities in California, Mancalla is the only bird recorded: M. californiensis from the Third Street tunnel, Los Angeles; M. diegense from Humboldt County (age not confirmed), and Laguna Hills, Orange County. A fourth locality, in Monterey County, has a single record of a loon, Gavia concinna.

The addition of the Cedros avifauna to the fossil record brings to 19 the number of specifically assigned avian forms known from the marine Pliocene of the west coast.

ACKNOWLEDGMENTS

The generosity of Dr. Richard Tedford, now of the Department of Vertebrate Paleontology, American Museum of Natural History, in presenting the Cedros Island avian material to the Los Angeles County Museum of Natural History and in providing critical data pertaining thereto for this study, is gratefully acknowledged. The species Puffinus tedfordi is named in his honor.

My thanks are extended to Dr. Joel Cracraft for providing casts of Palaelodus and Megapaloelodus, and to him and to Drs. Frank Kilmer and Pierce Brodkorb for discussion and information provided. Posthumous recognition and appreciation go to Professor Loya Miller for reading and discussing the section on Mancalla a few weeks prior to his death.

Except for the Palaelodid specimens, comparative material examined, both Recent and fossil, was available at the Los Angeles County Museum of Natural History as original material or casts. I am continually grateful to the staff of that Museum for many courtesies and kindnesses.

Photographs are by Lawrence Reynolds.

RESUMEN

Siete especies se representan en una avifauna del Plioceno Temprano de depósitos marinos sobre Isla Cedros. Mayor número de huesos fósiles representan la especie nueva, Mancalla cedrosensis. Dos otras especies nuevas se describan, y el flamenco primitivo, Megapaloelodus opsigonous Brodkorb se identifica tentativamente. Tres especies se registran solamente por el género.
LITERATURE CITED


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