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Revisiting *Asio priscus*, the extinct eared owl of the California Channel Islands

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Abstract — *Asio priscus* was described on the basis of a single bone from upper Pleistocene (late Wisconsinan Glacial Episode) deposits of Santa Rosa Island, one of the Channel Islands in the Pacific Ocean off the coast of southwestern California. Several additional specimens referable to this extinct species have been recovered since the original description, including what appear to be several bones of one individual. The new specimens are described, and they substantiate the original description of the species as distinct from living eared owls. Wing bones associated with a leg bone suggest that *A. priscus* had smaller wings relative to its legs than does the similar-sized Short-eared Owl, *A. flammeus*, a condition not uncommon in island birds in comparison to mainland relatives.

Key words: *Asio priscus*, California, Channel Islands, eared owls, Pleistocene

Introduction

Hildegarde Howard (1964) described *Asio priscus* from upper Pleistocene (late Wisconsinan Glacial Episode) deposits of Santa Rosa Island, one of the Channel Islands in the Pacific Ocean off the coast of southwestern California. The holotypic, and only known, specimen at the time of description was a tibiotarsus collected between 1928 and 1931. Since the original description several additional specimens referable to this extinct species have been recovered from Santa Rosa Island and San Miguel Island, which lies ~6.0 km northwest of Santa Rosa Island (Fig. 1). The new specimens include several bones of what appears to be one individual that were collected together at one site. Some of these new specimens were mentioned, or listed in tables, by Guthrie (1980, 1998, 2005), although without osteological descriptions. Two fragmentary specimens referred to *A. flammeus* by Guthrie (1998) are referred herein to *A. priscus*. The purpose of this paper is to describe the new specimens for the record and comment on possible life history traits of *A. priscus*.

The living species of eared owls, *Asio flammeus* Pontoppidan, 1763, and *A. otus* Linnaeus, 1758, are listed as very rare visitors to the Northern Channel Islands, with the former being a transient fall visitor and the latter a summer visitor (Collins 2011). Two fossil specimens referable to *A. flammeus* are in collections from San Miguel Island stored at the SBMNH. Neither of the living species currently nests on the islands, and it is not known if they did so previously.

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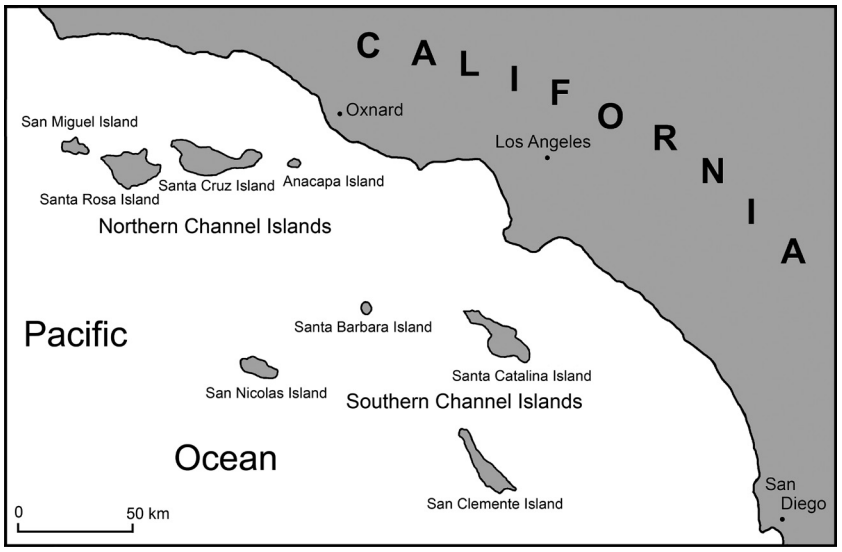

FIGURE 1. Map showing location of Channel Islands of California, USA.

Study area

The California Channels Islands comprise a group of eight continental islands in the Pacific Ocean off the coast of southwestern California (Fig. 1). The group is divided into the Southern Channel Islands and Northern Channel Islands, the latter comprising San Miguel Island, Santa Rosa Island, Santa Cruz Island, and Anacapa Island. Although today the nearest island to the mainland, Anacapa Island, is ~23 km distant, during the Pleistocene, when sea level was lowered by over 100 m (Miller *et al.* 2005), it would have been less than 10 km distant. Further, all four of the Northern Channel Islands were united during periods of low sea level during the Pleistocene, giving a single large island known as Santa Rosae Island. The current point of highest elevation (747 m) is found on Santa Cruz Island, and the topography of the four islands varies from steep, narrow canyons to broad plains representing ancient marine terraces.

Materials and Methods

The fossil specimens were compared with modern skeletons of *Asio flammeus* (n=11; 2♂, 4♀, 5?) and *A. otus* (n=13; 4♂, 5♀, 4?), as well as dozens of specimens of those two species from the upper Pleistocene Rancho La Brea asphalt deposits housed in the George C. Page Museum, a subsidiary of the Natural History Museum of Los Angeles County. Together, the two species of eared owls represent the third most common owls at Rancho La Brea, with a minimum number of individuals exceeding 175. Measurements were taken with digital calipers accurate to 0.01 mm, captured directly to computer, and rounded to nearest 0.1 mm. Some of the specimens are too fragmentary to provide meaningful measurements. Osteological terminology mostly follows Baumel & Witmer (1993) and Howard (1980).

Abbreviations: LACM, Natural History Museum of Los Angeles County; n, number; R, Range; RLB, Rancho La Brea; SBMNH, Santa Barbara Museum of Natural History; $\bar{x}$, mean.

Anatomical abbreviations used in the illustrations: am, Angulus medialis; Artic., Articularis; cb, Crus breve; Ccl, Crista cnemialis lateralis; ce, Condylus externis; cf, Crista fibularis; ci, Condylus internis; cl, Condylus lateralis of femur; cl, Crus longum; clh, Crista lateralis hypotarsi; cmh, Crista medialis hypotarsi; di, Depressio intercondylaris of Incisura intercondylaris; ei, Eminentia intercotylaris; ep, extension proximad of Condylus lateralis of tibiotarsus; Fac., Facies; fc, attachment for M. flexor carpi ulnaris; fe, Fac. externa of Crista articularis sternalis; fl, Fac. lateralis of Corpus coracoidei; fp, Fac. plantaris; iii, Os metacarpi III; iv, Os metacarpi IV; li, Linea intermuscularis; pa, Proc. acrocoracoideus; Proc., Processus; sf, Sulcus flexorius.; si, Sulcus inter-

condylaris; st, Sulcus tendinosus; ta, Tuberculum aponeurosis ventrale; tc, Tuberculum carpale; tf, Trochlea fibularis; ti, Tuberositas interna retinaculi extensori; tr, Tuberculum retinaculi m. fibularis [peronei]; um, distal attachment of Lig. ulnocarpo-metacarpale ventrale.

Systematic Paleontology

Order Strigiformes Wagler, 1830
Family Strigidae Leach, 1820
Genus *Asio* Brisson, 1760

Asio priscus Howard, 1964
(Figs 2–4)

Holotype: Right tibiotarsus, some portions of shaft and proximal end missing: LACM 106/4712. (Fig. 2).

Emended diagnosis: Similar to *Asio flammeus* and *A. otus* in general form and deep excavation of shaft anteroproximal to distal condyles. Howard (1964) noted the following diagnostic characters: 1) Crista fibularis flaring laterad distally; 2) Crista fibularis with broad longitudinal depression on anterior face medial to lateral edge, which gives a relatively narrow, convex Fac. anterior of shaft, in contrast to broadly convex Fac. anterior of shaft in *A. flammeus* and *A. otus*; 3) Linea intermuscularis extending proximad from proximal end of Crista fibularis slanting more abruptly posteriad from crest, in lateral view; 4) Crista cnemialis lateralis less excavated at its posterolateral edge; 5) Tuberositas interna retinaculi extensori prominent; 6) Condylus lateralis with posterior rim extending 5–15 percent more proximad relative to anterior rim than in modern species; 7) length greater. To those characters I add: 8) Crista cnemialis lateralis very broad at proximal end; 9) Fac. artic. lateralis of proximal end very prominent, more rounded; 10) Incisura tibialis of proximal end very narrow, with prominent ridge leading to it from Fac. artic. lateralis; 11) Depressio intercondylaris of Incisura intercondylaris much deeper; 12) Tuberculum retinaculi m. fibularis [peronei] longer and protruding more laterad; and 13) condyles broader.

Type locality: LACM(CIT) 106; Arlington Canyon, east of canyon mouth, Santa Rosa Island, Santa Barbara County, California, USA.

Type horizon and age: Tecolote Member of Santa Rosa Island Formation; upper Pleistocene (late Wisconsinan Glacial Episode).

Referred specimens: Santa Rosa Island: Presumed associated left coracoid, proximal right carpometacarpus, distal left and right ulnae, distal left femur, distal left radius, and right Os carpi ulnare, SBMNH 648; proximal left femur, SBMNH 420.

San Miguel Island: Distal end and shaft of left humerus, SBMNH 222; distal left femur, SBMHN 86; complete right tarsometatarsus, SBMNH 223. Distal end and shaft of left humerus (A.6431–6924) and distal end of right tibiotarsus (A.6431–6923), Archeology Collections, Anthropology Department, LACM.

Description: *Asio priscus* is closest in size to the Short-eared Owl, *A. flammeus*. The Long-eared Owl, *A. otus*, is generally a smaller, more slender bird, although the latter two species do overlap in size (Table 1). The characters noted above as diagnosing *A. priscus*, and below as differentiating it from other species, are based on limited fossil material and might not hold with a larger series of specimens.

Coracoid (Fig. 3E): Left, incomplete. Compared with *A. flammeus*: 1) Proc. acrocoracoideus not extending as far proximad, much narrower, and less robust; 2) Fac. artic. humeralis shorter and more rounded; 3) Cotyla scapularis more concave adjacent to Fac. artic. humeralis; 4) Angulus medialis longer and more pointed mediad, although broken and improperly glued back onto shaft; 5) Fac. lateralis of Corpus coracoidei flattened anterior to Angulus lateralis (tapers to thin edge in *A. flammeus*, but similarly flattened in *A. otus*). Similar in length to *A. otus*, but 1) more robust; 2) Proc. acrocoracoideus longer, less rounded; 3) Fac. artic. humeralis longer, broader; 4) Fac. externa of Crista artic. sternalis larger at medial end.

Humerus (Tab. 1): Proximal end missing, distal end and shaft abraded. Compared with *A. flammeus*: 1) Condylus dorsalis shorter anteroposteriorly, and more rounded, in dorsal view; 2) Condylus ventralis smaller; 3) Epicondylus ventralis small, not protruding as far ventrad, although more distinctly set off from shaft.

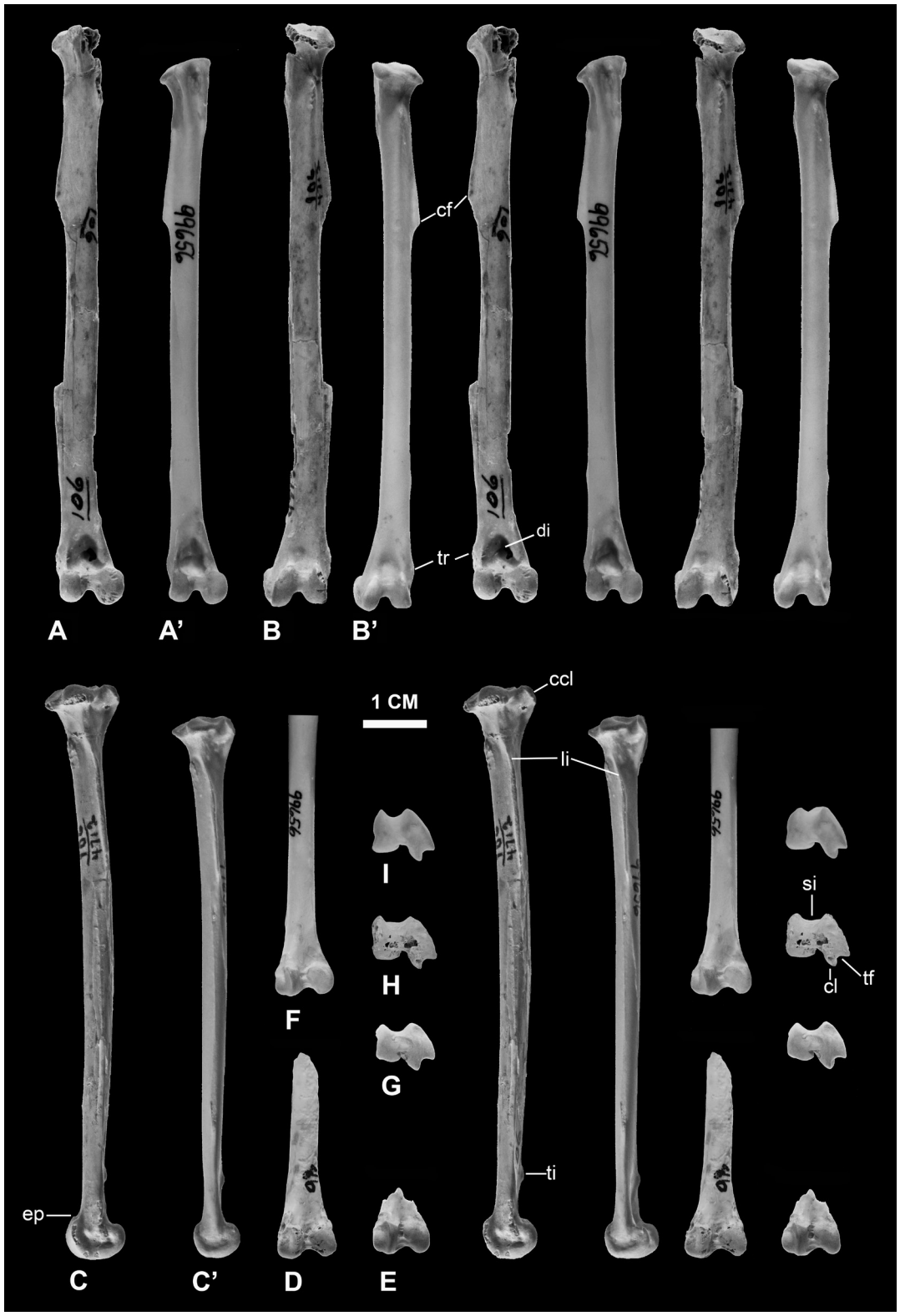

FIGURE 2. Stereopair photographs of holotypic right tibiotarsus of *Asio priscus* (LACM 106/4712, **A**–**C**), in comparison with that of *A. flammeus* (LACM 99656, **A'**–**C'**), in **A**, **A'**) anterior, **B**, **B'**) posterior, and **C**, **C'**) lateral views; and referred femora of *A. priscus* (SBMNH 86, **D**, **H**; SBMNH 648, **E**, **G**), in comparison with that of *A. flammeus* (LACM 99656, **F**, **I**) in **D**, **E**, **F**) posterior and **G**, **H**, **I**) distal views. Note the more robust shaft and condyles of the tibiotarsus of *A. priscus*.

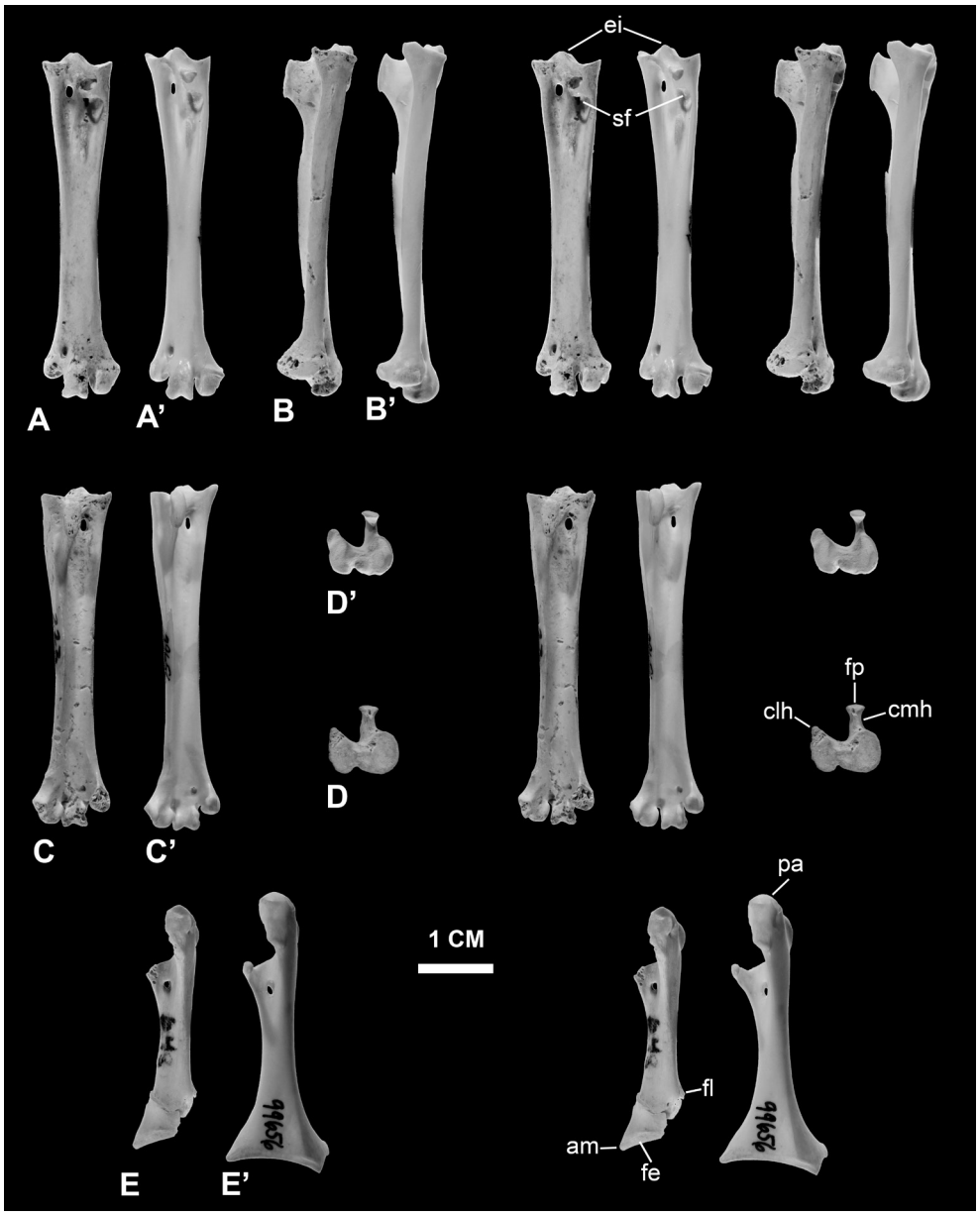

FIGURE 3. Stereopair photographs of right tarsometatarsus (SBMNH 223, **A–D**) referred to *A. priscus* in comparison with that of *A. flammeus* (LACM 99656, **A'–D'**) in **A**, **A'**) anterior, **B**, **B'**) lateral, **C**, **C'**) posterior, and **D**, **D'**) proximal views; and referred left coracoid (SBMNH 648, **E**), in comparison with that of *A. flammeu*s (LACM 99656, **E'**), in **E**, **E'**) ventral view.

Ulna (Fig. 4D, Tab. 1): Distal end, right and left associated bones, identical. Compared with *A. flammeus*: 1) Condylus externis longer, thinner in ventral view and with rim more rounded in lateral view; 2) Condylus internis ulnaris undercut anteriad, not extending as far distad; 3) Sulcus intercondylaris not as prominent in ventral view; 4) Tuberculum carpale not extending as far anteriad; 5) shaft less robust. Distinctions with *A. otus* similar.

Radius (Fig. 4C, Tab. 1): Distal end, right. Compared with *A. flammeus*: 1) Sulcus tendinosus prominent, well marked; 2) Tuberculum aponeurosis ventrale angular, forming a prominent spur; 3) Fac. artic. radiocarpale set off more abruptly from shaft; 3) attachment for Lig. radio-radiocarpale ventrale more prominent, elevated.

Os carpi ulnare (Fig. 4A, B): Right. Compared with *A. flammeus*: 1) length from tip of Crus breve to tip of Crus longum relatively

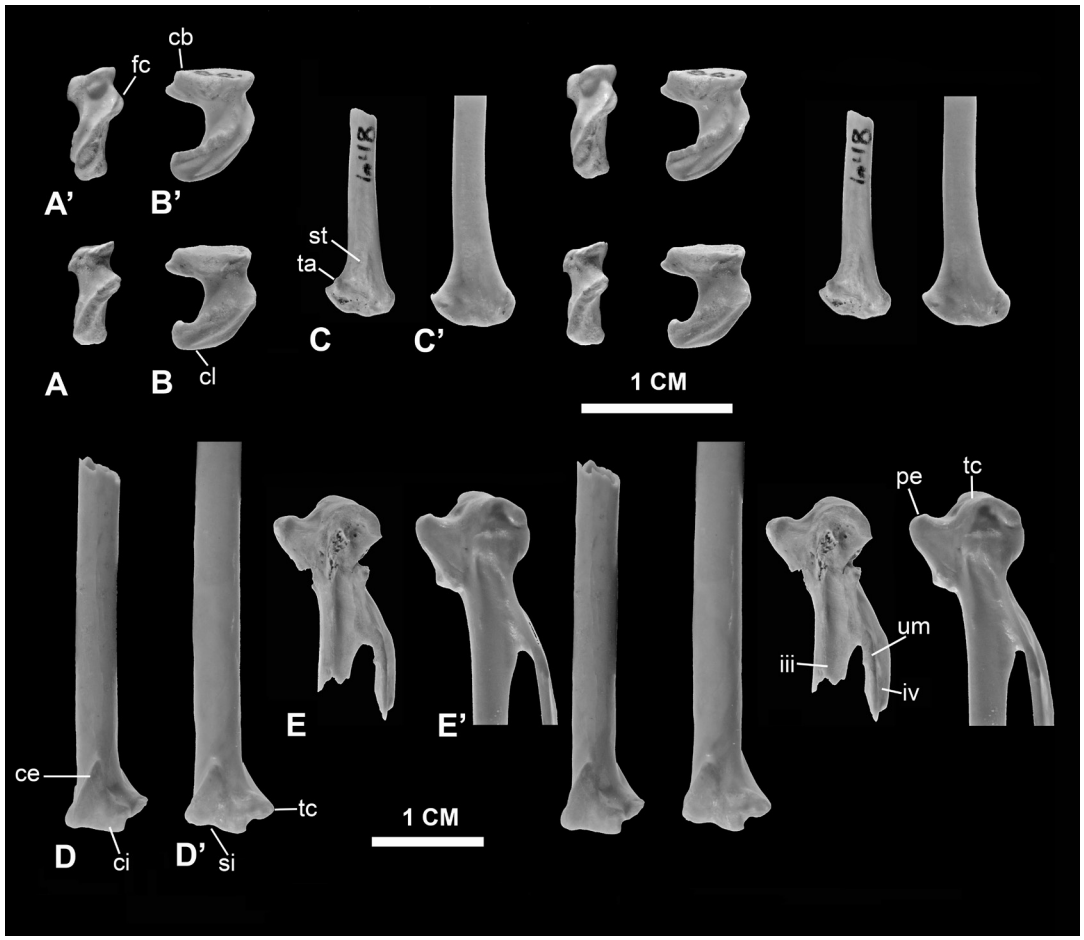

FIGURE 4. Stereopair photographs of referred specimens of *Asio priscus* in comparison with those of *A. flammeus*: right Os carpi ulnare (SBMNH 648, **A**, **B**; LACM 99656, **A'**, **B'**), in **A**, **A'**) posterior and **B**, **B'**) ventral views; distal right radius (SBMNH 648, **C**; LACM 87427, **C'**) in dorsal view; distal left ulna (SBMNH 648, **D**; LACM 99656, **D'**) in ventral view; and proximal right carpometacarpus (SBMNH 648, **E**; LACM 99656, **E'**) in ventral view. Scale bars equal 1 cm; long bar (x2.0) in reference to A and B only; short bar (x1.5).

shorter; overall smaller, less stout; 2) attachment for M. flexor carpi ulnaris not protruding as far dorsoproximad.

Carpometacarpus (Fig. 4E): Proximal end, right, broken. Compared with *A. flammeus*: 1) Trochlea carpalis does not lie as far proximal to Proc. extensorius; 2) Fac. artic. radiocarpalis does not extend as far proximad, giving less slope to Trochlea carpalis, in distal view; 3) Os metacarpale IV (minus) more separated from Os metacarpale III (majus) proximally, in dorsal view; 4) Os metacarpale IV (minus) narrows distal to proximal synostosis, but expands to comparable width seen in *A. flammeus* at distal attachment of Lig. ulnocarpo-metacarpale ventrale.

Femur (Tab. 1): Proximal end, left, abraded. Compared with *A. flammeus*: 1) Caput femoris larger, extending more proximad, and rotated more toward horizontal, in anterior view when held vertically; 2) Fac. artic. antitrochanterica not sloping as steeply relative to long axis of shaft, in anterior view when bone held vertically.

Distal ends, two left, one abraded, one unabraded. 1) Sulcus intercondylaris broader, flatter on bottom; 2) Trochlea fibularis broader, more open "U"-shape; 3) Condylus lateralis more in line with long axis of shaft proximodistally (*i.e.*, anteroproximal end does not turn as far laterad), in posterior view. The three femoral specimens appear to be more robust than those of *A. flammeus*, but they are too fragmentary to say definitively that they are.

Tarsometatarsus (Fig. 3A–D; Tab. 1):

Compared with *A. flammeus*: 1) Eminentia intercotylaris larger, probably more elevated, but abraded; 2) cotylae broader and more rounded, which agrees with broader condyles of tibiotarsus; 3) Crista medialis hypotarsi thicker, with medial side of base positioned more medially and with broad Fac. plantaris; 4) Crista lateralis hypotarsi (proximal surface missing, but posterior tip present) smaller, not extending as far posteriad; 5) shaft broader, more robust, with Sulcus flexorius broader; 6) trochleae (all broken at critical places) appear to be more robust and longer proximodistally; 7) Trochlea metatarsi III extends slightly farther distad relative to other two trochleae than in *A. flammeus*.

Discussion

The new specimens of *Asio priscu*s substantiate the original description of the species as distinct from the living Short-eared Owl, *A. flammeus*, and Long-eared Owl, *A. otus*. There are still too few specimens to make any definitive statements to characterize the species, but the greater length and robustness of the holotypic and referred tibiotarsi and the greater least shaft width of the tarsometatarsus suggest that *A. priscus* had longer and more robust legs than the similar-sized *A. flammeus*. The greater width of the Sulcus intercondylaris and the combined width of the condylus lateralis and trochlea fibularis of the femur are also indicative of a more robust, more powerful leg. These features might also be an indication of greater body mass, but a larger

TABLE 1. Measurements (mm) of holotypic tibiotarsus and referred tarsometatarsus, humerus, ulna, radius, and femur of *Asio priscus* and fossil (Rancho La Brea) and modern specimens of *A. flammeus* and *A. otus*.

	A. priscus (n=1(2))	***A. flammeus*** (n=11)		**RLB *A. flammeus*** (n=10)		***A. otus*** (n=13)		**RLB *A. otus*** (n=5)	
	R	R	$\bar{x}$	R	$\bar{x}$	R	$\bar{x}$	R	$\bar{x}$
Tibiotarsus									
length	90.4	76.1–86.8	81.9	78.0–86.7	81.8	74.8–81.5	77.1	72.9–78.7	76.5
fibular crest width	6.5	4.5–6.3	5.5	5.3–5.7	5.5	4.3–5.3	4.9	4.6–5.2	4.8
least shaft width	4.9	3.5–4.6	4.1	4.0–4.3	4.2	3.2–3.9	3.8	3.5–4.1	3.9
distal width	10.1	8.8–9.4	9.1	8.2–9.8	9.1	7.9–9.1	8.5	7.9–8.7	8.2
Tarsometatarsus									
length	46.4	41.6–47.3	44.6	42.2–46.3	44.8	35.6–44.0	40.6	37.9–43.7	40.4
proximal width	9.4	8.2–9.2	8.7	8.6–9.4	8.9	7.7–8.8	8.3	7.4–8.5	8
least shaft width	5.1	4.3–4.7	4.5	4.3–4.9	4.6	3.6–4.4	4.2	3.8–4.4	4.2
distal width	10.6	9.8–10.7	10.2	10.0–10.8	10.4	8.4–10.2	9.4	8.8–10.1	9.3
Humerus									
least shaft width	5.9	5.3–6.0	5.7	5.3–5.9	5.6	4.8–5.4	5.1	4.8–5.5	5.1
distal width	13.0	12.5–14.4	13.7	12.8–14.2	13.4	11.6–13.4	12.4	11.6–12.4	12.0
Ulna									
depth through tub. carpale	7.2	7.0–8.1	7.7			6.5–7.6	7.0		
depth shaft. prox. to cond.externa	3.8	3.7–4.3	4.0			3.3–4.2	3.7		
Radius									
distal width	6.4	6.4–7.7	7.0			5.7–7.0	6.2		
Femur									
distal width	9.5–10.3	8.7–10.2	9.6			8.4–9.6	9.0		
least shaft width	4.5	3.8–4.4	4.2			3.7–4.1	3.9		

sample is required before that can be determined.

Note that all of the measurements of the holotypic tibiotarsus of *A. priscus* exceed the range of those of *A. flammeus* (Table 1), whereas the measurements of the tarsometatarsus fall within the range of those of *A. flammeus*, except for shaft width. Limited measurements of the referred tibiotarsus (not included in table) are identical to the holotype. There was very little difference recorded in the mean measurements of modern *A. flammeus* and *A. otus* and a sample of specimens of these species from the upper Pleistocene Rancho La Brea asphalt deposits selected for their completeness, although the range of measurements of the modern forms often exceeded those of the fossil forms.

Also, wing bones presumed to be associated with a distal femur suggest that *A. priscus* had smaller wings relative to its legs than does *A. flammeus*. This possibility is also suggested by the partial humerus, whose measurements fall within the range of those of *A. flammeus*. Such changes in relative proportions of wings and legs are not uncommon in island birds relative to mainland relatives, especially the lengthening of the legs (Grant, 1965a, 1965b, 1966). For owls in general, this condition was noted by Louchart (2005), and Campbell & Bocheński (2010) suggested that the extinct La Brea Owl, *Oraristrix brea* (Howard, 1933) might well have responded evolutionarily to isolation in southwestern California as if that geographic region were an island.

The alternative to viewing *Asio priscus* as having followed the allometric trends of many island birds in reducing wing size relative to leg size would be that there were two extinct species of *Asio* on Santa Rosae Island, one represented in collections only by leg elements and the other only by elements of the pectoral girdle. That is considered unlikely, especially given the presumed association of wing and leg bones.

The paleofauna of the Channel Islands is quite rich, with many species of reptiles, birds, and mammals reported. For example, according to Guthrie (2005), a total of ~17,000 specimens from 61 species of birds were recovered from San Miguel Island alone from 1980 to 2002. In addition to *Asio priscus*, there were three additional extinct species of birds: *Morus reyanus* Howard, 1936; *Chendytes lawi* Miller, 1925; and *Fratercula dowi* Guthrie, Thomas & Kennedy, 2000. Various extinct mammals have also been recorded from the Channel Islands, including *Mammuthus exilis* Stock and Furlong, 1928 (a dwarf mammoth), *M. columbi* Falconer, 1857 (the Columbian mammoth), *Desmodus stocki* Jones, 1958 (a vampire bat), and, of special interest to the strigid avifauna, two species of mice: *Peromyscus nesodytes* Wilson, 1936 (the "giant" deer mouse) and *Microtus miguelensis* Guthrie, 1998 (a vole). For more information on the paleofaunas, geological deposits, and excavations on the Northern Channel Islands, see Guthrie (1992, 1993, 1998, 2005).

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