MAMMALIAN SPECIES No. 700, pp. 1–5, 3 figs.

Arctocephalus townsendi.

By Rebecca L. Belcher and Thomas E. Lee, Jr.

Published 5 July 2002 by the American Society of Mammalogists

Arctocephalus Geoffroy Saint-Hilaire and F. Cuvier, 1826

Phoca: Schreber, 1775:pl. 85. Type species *Phoca pusilla* (part, not *Phoca* Linnaeus, 1758:37).

Otaria: Desmarest, 1817:590. Type species *Phoca coxii* (part, not *Otaria* Péron, 1816:37).

Arctocephalé F. Cuvier, 1824:205. Part, vernacular, unavailable name.

Arctocephalus É. Geoffroy Saint-Hilaire and F. Cuvier, 1826:554. Type species *Phoca pusilla* Schreber by subsequent designation of the International Commission on Zoological Nomenclature.

Halarctus Gill, 1866:7. Type species *Arctocephalus delalandi* Gray (= *Phoca pusilla* Schreber) by original designation.

Arctophoca Peters, 1866:276. Type species *Otaria philippii* Peters by monotypy.

Euotaria Gray, 1866:236. Type species *Arctocephalus nigrescens* Gray (= *Phoca australis* Zimmerman, 1783) by monotypy.

Gysophoca Gray, 1866:236. Type species *Arctocephalus cinereus* Gray (= *Otaria forsteri* Lesson, 1828) by monotypy.

CONTEXT AND CONTENT. Order Carnivora, suborder Pinnipedia, family Otariidae, subfamily Arctocephalinae, genus *Arctocephalus*. The synonymy follows Gardner and Robbins (1998). A key to the 8 species (Wozencraft 1993) of the genus *Arctocephalus* follows:

1 Occurs in northern hemisphere ..... *A. townsendi*
Occurs in southern hemisphere 2
2 Occurs in waters off Australia and New Zealand 3
Does not occur in waters off Australia and New Zealand 4
3 >200 cm in total length ..... *A. pusillus*
<200 cm in total length ..... *A. forsteri*
4 Progressive reduction posteriorly in crown size of postcanine teeth ..... *A. gazella*
No progressive reduction posteriorly in crown size of postcanine teeth 5
5 Conspicuous yellowish chest, with a topknot or tuft of fur on forehead ..... *A. tropicalis*
No conspicuous yellowish chest, with a topknot or tuft of fur on forehead 6
6 Occurs in waters of continental South America ..... *A. australis*
Not in waters of continental South America, but near offshore islands 7
7 Occurs in waters of Galapagos Islands ..... *A. galapagoensis*
Occurs in waters of Islas Juan Fernánadez ..... *A. philippii*

Arctocephalus townsendi Merriam, 1897

Guadalupe Fur Seal

Arctocephalus townsendi Merriam, 1897:175. Type locality "Guadalupe Island, off Lower California. Collected on the beach on west side of Guadalupe" [Mexico].

Arctophoca townsendi Sivertsen, 1954:42. Based on *Arctocephalus townsendi* Merriam.

Arctocephalus philippii King, 1954:326. Based on *Arctocephalus townsendi* Merriam.

CONTEXT AND CONTENT. Context as for genus. *A. townsendi* is monotypic.

DIAGNOSIS. *Arctocephalus townsendi* is the only member of the genus *Arctocephalus* in the northern hemisphere. *A. townsendi* is distinguished from *A. pusillus* and *A. galapagoensis* by size. Males, measured from nose to tail, are 273 cm for *A. pusillus*, 180 cm for *A. townsendi*, and 154 cm for *A. galapagoensis* (Bonner 1994). Skull of *A. townsendi* is low above the orbits, so forehead is flat, rather than convex as in *A. philippii* (Repenning et al. 1971). *A. pusillus*, *A. forsteri*, *A. australis*, and *A. tropicalis* all have accessory cusps on postcanine teeth, whereas *A. townsendi* has almost none. *A. gazella* has the smallest postcanine teeth of any in the genus, with progressive reduction posteriorly in size of crowns (Repenning et al. 1971). *A. townsendi* is separated from *Callorhinus ursinus*, northern fur seal, by a more elongated muzzle, lower forehead, and slope of anterodorsal aspect of skull (Bartholomew 1950). Facial angle of *A. townsendi* always exceeds 125°, whereas facial angle of *C. ursinus* is always <125°. Fur of front flipper extends past wrist in *A. townsendi* but ends abruptly at wrist in *C. ursinus* (Bonner 1994; Peterson et al. 1968; Repenning et al. 1971).

GENERAL CHARACTERS. *Arctocephalus townsendi* (Fig. 1) is a medium-sized otariid and is sexually dimorphic (Wickens and York 1997). Males average 180 cm, length from nose to tail, with a body mass of 160–170 kg (Bonner 1994); length from nose to tail of territorial males is 190–245 cm (Gallo-Reynoso and Figueroa-Carranza 1996). Females average 120 cm, length from nose to tail, with a body mass of 40–50 kg (Bonner 1994). Other scientists have recorded average measurements of *A. townsendi* (Gallo-Reynoso and Figueroa-Carranza 1996; Wickens and York 1997).

FIG. 1. An immature male *Arctocephalus townsendi* from Guadalupe Island, Mexico. Photograph by Phillip Colla.

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of a male *Arctocephalus townsendi* from San Mateo County, California (MVZ 191003). Greatest length of skull is 176 mm. Specimen courtesy of Jim Patton and Yuri Leite, University of California, Berkeley, Museum of Vertebrate Zoology. Photographs by Steve Butman.

Body measurements (in cm) of an adult male carcass were: dorsal length, 181.6; ventral length, 160.0; girth of head around eyes, 35.0; girth at neck behind ears, 64.8; girth at shoulder, 113.0; girth at axillae within lateral flippers, 118.0; girth at tip of lateral flippers, 98.0; girth of lateral flipper at shoulder, 31.8; girth at base of tail, 52.1; length of lateral flippers, 52.1; length of rear flippers, 40.0; length of tail, 6.3; and length of exposed scratching claw, 3.2 (Townsend 1931).

Arctocephalus townsendi has a narrow skull and zygomatic arch, a long narrow rostrum, broad maxillae roots, triangular postorbital processes, and smooth, rounded tympanic bulla. Interorbital breadth is 10–12% of length of skull (Hall 1981). Muzzle or snout is long and pointed (Orr 1989), generally 30% of total length of skull (Fig. 2). Condylobasal length in males is 235.0–256.0 mm and in females is 197.0–217.0 mm. Zygomatic breadth is 130.0–140.0 mm in males and 107.0–118.0 mm in females, and interorbital constriction is 26.0–30.7 mm in males and 21.5–22.0 mm in females (Hall 1981). Additional measurements (in mm) taken on 1 complete adult male skull include: greatest basal length, 248.0; basal length from gnathion to basion, 233.0; basilar length of Hensel from basion to incisors, 223.0; palatine length from gnathion to postpalatal notch, 120.0; postpalatal length from postpalatal notch to basion, 113.0; least interorbital width from anterior to supraorbital processes, 24.0, and from posterior to supraorbital processes, 21.0; width of supraorbital processes, 47.0; greatest nasal length, 38.0; anterior width of nasals, 27.0; width of rostrum, 46.0; and width of mastoid, 119.0. Braincase was measured at frontal–parietal suture as 81.0 mm; greatest length of ramus was 172.0 mm. Jaw measurements (in mm) were: lateral series of teeth from canine to last molar, 88.0; distance between canines, 20.5; distance between 3rd pair of molariform teeth, 23.0; and width of zygomatic root of maxilla, 18.0 (Townsend 1931). Measurements (in mm) from a skull of unknown sex were: greatest basal length, 256.0; basal length, 243.0; basilar length of Hensel, 233.0; length of palatine, 120.0; postpalatal length, 125.0; zygomatic breadth, 151.0; lateral series of teeth, 88.0; distance between canines, 22.5; distance between 3rd pair of molariform teeth, 22.5; and width of zygomatic root of maxilla, 21.0 (Merriam 1897).

Dental formula is i 3/2, c 1/1, p 4/4, m 2/1, total 36 (Hall 1981). Dentition is nearly homodont; first 2 upper incisors possess a transverse groove (Bonner 1994). Cheek teeth lack accessory cusps and are widely spaced. Canines are large and recurved with a cone shape (Nowak 1991). A diastema occurs between P4 and M5 (Repenning et al. 1971). Upper cheek teeth have simple high-pointed cusps and minimal development of cingula. In most specimens a minute anterior accessory cusp occurs on cingulum of each lower postcanine tooth (Repenning et al. 1971).

General color of *A. townsendi* is dusky black, with ventrum a lighter shade than dorsum. Shoulders and head are gray; nose is black with brown-red hair around eyes (Townsend 1931). In adult males, outer guard hairs are white-tipped. Pelage color is affected by dryness, dirt, and fading (Bonner 1994) and tends to possess an overall "grizzled" appearance (Peterson et al. 1968).

Arctocephalus townsendi (Townsend 1931) has small, cartilaginous pinnae (Nowak 1991) that measure 3.2 cm in length. Front flippers of *A. townsendi* are cartilaginous and elongated to greater than one-fourth of total length of body. Terminal flaps of hind flippers are equal in length (Peterson et al. 1968). Front flippers have 5 clawed fingers, whereas claws are absent on the 1st and 5th toes of the hind flippers. Cartilaginous webbing extends past the claws (Allen 1979).

DISTRIBUTION. *Arctocephalus townsendi* occurred northward to the Gulf of the Farallones in California and southward to the Revillagigedo Islands, Mexico (Fig. 3), before its reduction in numbers in the 19th century by fur traders (Aurioles-Gamboa et al. 1999; Starks 1922). Currently, *A. townsendi* is most commonly found on the island of Guadalupe, Mexico (29°00′N, 118°15′W), 250 km off the coast of Baja California (Aurioles-Gamboa et al. 1999). *A. townsendi* has been observed on San Miguel, San Clemente, Santa Barbara, and San Nicolas Islands (Channel Islands) off the coast of southern California since 1969 (Melin and DeLong 1999; Seagars 1984; Stewart 1981; Stewart et al. 1987). In 1992 and 1993, an adult male established a territory on San Miguel Island (Melin and DeLong 1999). Sightings and strandings have occurred in Monterey Bay (36°30′N, 121°50′W) in 1977 and 1992 and once in Princeton Harbor (37°30′N, 122°29′W) in 1984 (Feldman and Parrott 1996; Hanni et al. 1997; Webber and Roletto 1987). Several sightings occurred in the southeastern regions of the Farallon Islands (37°42′N, 123°00′W) from 1988 through 1995 (Hanni et al. 1997). Three males were seen during a census from Piedras Blancas, San Luis Obispo County, California (Bonnot et al. 1938). The northernmost record for *A. townsendi* is a stranding in California at Blind Beach, Sonoma County (38°26′10″N, 123°07′15″W) on 4 July 1988.

From 1981 to 1997, sightings from south of the Guadalupe Islands included Isla Lobos, Gulf of California (29°55′N, 114°28′W), Bahia de Bacochibampo Guaymas (27°56′N, 111°07′W), and Los Islotes in Bahia de La Paz, Gulf of California (24°35′N, 110°23′W—Aurioles-Gamboa et al. 1999). The southernmost record was a female stranded in Puerto Guerrero near Zihuatanejo, state of Guerrero, Mexico (17°39′N, 101°34′W), on 28 April 1997.

Guadalupe Island is the only recorded breeding ground for *A. townsendi* (Melin and DeLong 1999). However, an incipient breeding colony may have been established at Isla Benito del Este, Baja California, Mexico, as 9 *A. townsendi* pups were observed among a *Zalophus californianus* population in August 1997. The *A. townsendi* pups were too young to have traveled the 266-km distance from Guadalupe Island. Territorial males were present, another indication that it was a breeding colony (Maravilla-Chavez and Lowry 1999). In June through September of 1997, a female and pup were spotted on San Miguel Island, California, indicating reproduction

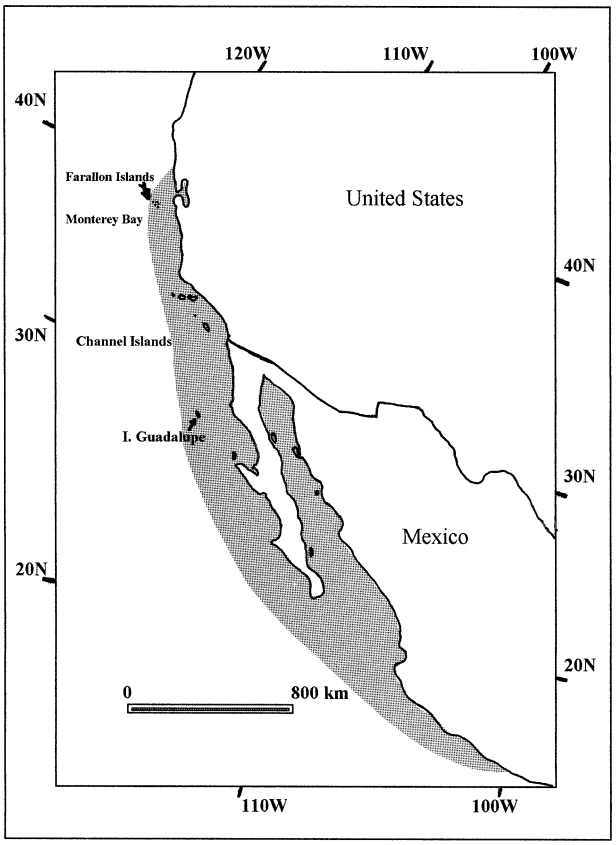

FIG. 3. Geographic distribution of *Arctocephalus townsendi* based on Aurioles-Gambo et al. (1999), Bonnot et al. (1938), Hanni et al. (1997), Melin and Delong (1999), Seagars (1984), Stewart (1981), and Stewart et al. (1987).

occurred in the Channel Islands, 590 km north-northeast of Guadalupe Island (Melin and DeLong 1999).

FOSSIL RECORD. Subfossils are known from the Emeryville shellmound from the Late Holocene period of San Francisco Bay (Broughton 1999). Archeological excavations within the historic range indicate that *A. townsendi* was once more common on Isla Socorro of the Revillagigedo Archipelago, Mexico, and San Miguel Island and Monterey Bay, California (Hubbs 1956; Lyon 1937; Repenning et al. 1971; Townsend 1924; Walker and Craig 1979).

FORM AND FUNCTION. Females have 2 pairs of abdominal nipples (Bonner 1994). Milk is rich, ca. 50% fat, leading to rapid pup growth (Nowak and Paradiso 1983). A female, whose body weight dropped to 20 kg, suffered from severe malnutrition (Aurioles-Gamboa et al. 1999). Males have testes contained in a scrotum (Bonner 1994) and a well-developed baculum (Nowak 1991).

Arctocephalus townsendi relies on a thick underfur layer of fine hair covered by outer guard hairs that are angled for thermoregulation. Hairs are coated by oily secretions produced from sebaceous glands, giving hairs the ability to trap air bubbles within the pelage to form an additional layer of insulation (Feldman and Parrott 1996).

The flippers serve as the primary means of locomotion. Fore and hind flippers are used on land for doglike locomotion (Nowak and Paradiso 1983).

ONTOGENY AND REPRODUCTION. *Arctocephalus townsendi* is polygamous (Bernardi et al. 1998). A single territorial male maintains ca. 6 females in his harem (Wickens and York 1997). Breeding occurs near or in caves of isolated areas after the male marks his territory (Orr 1989). *A. townsendi* males have been observed to average 76% of their time resting and fasting while on breeding grounds (Boness 1984; Pierson 1978). A single offspring is produced between 15 June and 22 July; the median pupping date is 21 June (Wickens and York 1997). Mating occurs postpartum. Implantation probably occurs ca. 4 months after mating (Reynolds and Rommel 1999). Pups nurse for 9–11 months (Wickens and York 1997). Their dark natal coat will eventually become interspersed with guard hairs. Pups shed the natal coat toward the end of their 1st summer (Nowak and Paradiso 1983). The yearling coat is tinged silver (Bonner 1994). During lactation, nursing females fast for an average of 5.03 days but up to 12 days (Gallo-Reynoso and Figueroa-Carranza 1996).

ECOLOGY. *Arctocephalus townsendi* favors shores with abundant large rock and lava blocks often at the base of large cliffs. They inhabit caves and recesses, which provide protection and cooler temperatures, especially during the warm breeding season. *A. townsendi* generally segregates from other pinniped species (Peterson et al. 1968) and exhibits strong site tenacity (Nowak 1991).

Contents of feces and gastrointestinal tracts, from several individuals stranded off the coast of northern California near Farollon Island, included 81 beaks of squids (38 *Loligo opalescens* and 3 *Gonatopsis*) in 1 individual and 34 beaks of squids (*Onychoteuthis borealojaponica*) in a 2nd individual. The gastrointestinal tract of a 3rd individual contained 30 teleost otoliths representing *Cithariichthys sordidus*, *Lampanyctus*, *Protomyctophum*, and *Scopelogadus*, indicating a diet including cephalopods and bony fish (Hanni et al. 1997). Crustaceans are also a component of the diet of *A. townsendi* (Nowak 1991).

A stranded female from Puerto Guerrero with severe malnutrition, body mass 20 kg, total length 114 cm, was fed ojotón (*Trachurops crumenophtalmus*) daily for 60 days. Daily average intake was 3.04 ± 1.53 (*SD*) kg, with an average growth rate of 250 g per day (Aurioles-Gamboa et al. 1999).

During histological or postmortem examinations 9 stranded *A. townsendi* exhibited the following disorders: decreased pancreatic zymogen granules, septicemia, adrenal atrophy, bacterial pneumonia, verminous pneumonia, umbilical hernia, gastric nematodiasis, enteritis, hepatitis, pulmonary vascular thrombosis, renal hemorrhage, liver necrosis, and emaciation (Hanni et al. 1997). The single live stranded animal was emaciated.

A cookiecutter shark (*Isistius brasiliensis*) wound occurred on a male *A. townsendi* (Gallo-Reynoso and Figueroa-Carranza 1992). Killer whales prey upon Guadalupe fur seals (Allen 1979).

BEHAVIOR. Several vocalizations of *A. townsendi* are characterized. Males are most often observed barking when occupying territory (Peterson et al. 1968). Their bark is a throaty, muffled sound with almost the tone of a steamboat whistle (Bartholomew 1950). When disturbed by humans, males will roar with a pitch lower than that of pups. Male bulls in neighboring territories utter harsh, threatening puffs at each other. Spectrograms of male calls show a high-frequency shadow after each sound. Females emit prolonged bawls when interacting with pups. Spectrograms of female calls show a pulsing or chopping call when near pups. Pups bark when moving or playing, give off a high-pitch roar as a warning or defense against humans, much like that of males, and cough when threatening other animals or when crowded. Spectrograms of the roars of a young male show progressively more structure and clear harmonics throughout each call, and the calls appear to rise in pitch (Peterson et al. 1968). While standing still or moving slowly, *A. townsendi* keeps up a distinctive call that starts as a deep, hoarse growl and ascends the musical scale to end in a querulous rasping tenor note (Bartholomew 1950).

Over 18 days, a captive young female averaged 3.8 h/day grooming, more than twice as often when wet (62 events) than dry (28 events); grooming constituted 5–28% of its daily activity. Also, the departure of a *Z. californianus* pen mate was followed by an increased grooming rate, increased grooming duration, and decreased grooming frequency (Feldman and Parrott 1996).

Both male and female *A. townsendi* defend territories from other pinnipeds. A male observed in 1992 through 1993 at San Miguel Island (34°01′N, 120°26′W) displayed territorial behavior toward *Z. californianus* females and pups. Similarly, a female *A. townsendi* with her pup on San Miguel Island in 1997 defended a territory from *Z. californianus* females, which caused her pup to become isolated from and act aggressively toward *Z. californianus* pups (Melin and DeLong 1999).

Characteristically *A. townsendi* position themselves vertically, head-down, in shoal water, while the exposed hind flippers wave

slowly in the air. Once in the water, the Guadalupe fur seal stays close to shore and rarely protrudes its head from the water. Juveniles on Guadalupe Island played in tide pools, lunging at each other's flippers, barking, and chasing (Peterson et al. 1968).

Arctocephalus townsendi is diurnal and nocturnal, relying primarily on vision because of poorly developed sense of smell and hearing (Nowak and Paradiso 1983). The species is shallow diving (Gallo-Reynoso and Figueroa-Carranza 1992).

GENETICS. *Arctocephalus townsendi* has 2n = 36 (Bonner 1994; Repenning et al. 1971). Polymerase chain reaction was used on a 350-bp region of the D-loop, noted as the mitochondrial control region (Bernardi et al. 1998). Seven mitochondrial DNA haplotypes from 25 individual *A. townsendi* from Guadalupe Island clustered into 4 clades using a 320-bp portion of the D-loop (Bernardi et al. 1998). DNA fingerprinting identified 56 characters among 29 profiles of the species. DNA fingerprints had moderate genetic variation and high genetic diversity compared to other bottleneck species. The unique character frequency in *A. townsendi* is 0.14. *A. townsendi* has probably undergone 2 population bottlenecks, over the last 100 years, caused by extensive hunting in the 19th century (Bernardi et al. 1998).

CONSERVATION STATUS. *Arctocephalus townsendi* is listed as threatened under the U.S. Endangered Species Act and as depleted under the U.S. Marine Mammal Protection Act as of 31 December 1994 (Reynolds and Rommel 1999). It is also classified as Vulnerable by the International Union for Conservation of Nature and Natural Resources Red List (Wickens and York 1997). *A. townsendi* and the Island of Guadalupe are currently protected under Mexican law (Bonner 1994).

Throughout the 19th century, fur seal hunters placed tremendous population pressures on *A. townsendi*. Commercial fur harvesting occurred from 1834–1894 (Wickens and York 1997), during which time ca. 5,575 fur seals were taken, between 1876 and 1892 (Townsend 1924, 1931). The population on Guadalupe Island was almost exterminated by commercial sealing (Hubbs 1956; Townsend 1899). No sightings of this species are known from 1892 (Thoburn 1899) until 1926, when 35–60 were reported by 2 fishermen (Huey 1930; Townsend 1931; Wedgeforth 1928). One of the fishermen returned in 1928 and killed most of the herd (Hubbs 1956). No more sightings were recorded for an additional 26 years until 1954, when 14 were sighted (Hubbs 1956). The original population may have numbered 20,000–200,000 animals (Hamilton 1951; Hubbs 1979; Maravilla-Chavez and Lowry 1999; Scheffer 1958). Three males were spotted off the coast of central California (Bonnot et al. 1938) and a single male at San Nicolas Island in 1949 (Bartholomew 1950), which caused the further exploration of Guadalupe Island (Hubbs 1956). Since 1954, the population has been increasing at a rate of 13.7% per annum (Maravilla-Chavez and Lowry 1999) with an annual pup (<1 year old) production of 2,205 for the entire population as of 1992 (Wickens and York 1997). The Guadalupe Island population has been irregularly censused since 1954 and numbered 7,408 in 1993 (Berdegué 1956, 1957a, 1957b; Bernardi et al. 1998; Fleischer 1987; Gallo-Reynoso 1994; Hanni et al. 1997; Hubbs 1956; Lluch Belda et al. 1964; Rice et al. 1965).

REMARKS. *Arctocephalus* comes from the Greek *arktos* meaning bear and *kephale* meaning head (King 1964). Merriam (1897) named the species after Charles Townsend, who discovered 4 adult males on Guadalupe Island. *A. townsendi* has been considered conspecific with *A. philippii* (King 1954, 1964; Scheffer 1958). *A. townsendi* has also been placed in the genus *Arctophoca* with *Arctophoca philippii* (Sivertsen 1953, 1954). We thank Sebastian Luhay and an anonymous reviewer for reviewing earlier drafts of this manuscript and Phillip Colla for photographing the fur seal.

LITERATURE CITED

Allen, T. B. 1979. Wild animals of North America. National Geographic Society, Washington, D.C.

Aurioles-Gamboa, D., C. J. Hernández-Camacho, and E. Rodriguez-Krebs. 1999. Notes on the southernmost records of the Guadalupe fur seal, *Arctocephalus townsendi*, in Mexico. Marine Mammal Science 15:581–583.

Bartholomew, G. A. 1950. A male Guadalupe fur seal on San Nicolas Island, California. Journal of Mammalogy 31:175–180.

Berdegué, A. J. 1956. La foca fina, el elefante marino y la ballena gris en Baja California, y el problema de su canservación. Ediciones Institución Méxicano Recursos Naturales Renovables 14:1–38.

Berdegué, A. J. 1957a. La Isla de Guadalupe, México. Contribución al conocimiento de sus recursos naturales renovables. Secretaría de Marina, Dirección General de Pesca e Industrias Conexas, Mexico.

Berdegué, A. J. 1957b. Redescubrimiento de la foca fina (*Arctocephalus townsendi* Merriam) en la Isla de Guadalupe, México; con notas acerca de la biología de otros pinnépedos en las aguas. Reverva Sociedad Méxicano Historia Naturales 18: 173–198.

Bernardi, G., S. R. Fain, J. P. Gallo-Reynoso, A. L. Figueroa-Carranza, and B. J. Le Boeuf. 1998. Genetic variability in Guadalupe fur seals. Journal of Heredity 89:301–305.

Boness, D. J. 1984. Activity budget of male gray seals, *Halichoerus grypus*. Journal of Mammalogy 65:291–297.

Bonner, N. 1994. Seals and sea lions of the world. Facts on File, Inc., New York.

Bonnot, P., G. H. Clark, and S. R. Hatton. 1938. California sea lion census for 1938. California Fish and Game 24:415–419.

Broughton, J. M. 1999. Resource depression and intensification during the late Holocene, San Francisco Bay: evidence from the Emeryville shellmound vertebrate fauna. University of California Press, Berkeley.

Cuvier, F. 1824. De quelques espèces de *Phoques* et des groupes génériques entre lesquels elles se partagent. Mémoires du Muséum d'Histoire Naturelle 11:174–214.

Desmarest, A. G. 1817. Phoque, *Phoca* Linnaeus, Cuvier, Geoffroy; *Otaria*, Péron. Genre de mammiferes, de l'ordre des carnassiers et de la famille des amphibies. Nouveau dictionnaire d'histoire naturelle, appliquée aux arts, à l'agriculture, à l'économie rurale et domestique, à la médecine, etc. New edition. Deterville, Paris, France 25:544–604

Feldman, H. N., and K. M. Parrott. 1996. Grooming in a captive Guadalupe fur seal. Marine Mammal Science 12:147–153.

Fleischer, L. A. 1987. Guadalupe fur seal, *Arctocephalus townsendi*. Pp. 43–48 in Status, biology, and ecology of fur seals (J. P. Croxall and R. L. Gentry, eds.). National Oceanic and Atmospheric Association, Technical Report, National Marine Fisheries Service 51:1–212.

Gallo-Reynoso, J. P. 1994. Factors affecting the population status of the Guadalupe fur seal, *Arctocephalus townsendi* (Merriam, 1897), at Isla de Guadalupe, Baja California, Mexico. Ph.D. dissertation, University of California, Santa Cruz, 199 pp.

Gallo-Reynoso, J. P., and A. L. Figueroa-Carranza. 1992. A cookiecutter shark wound on a Guadalupe fur seal male. Marine Mammal Science 8:428–430.

Gallo-Reynoso, J. P., and A. L. Figueroa-Carranza. 1996. Size and weight of Guadalupe fur seals. Marine Mammal Science 12:318–321.

Gardner, A. L., and C. B. Robbins. 1998. Generic names of northern and southern fur seals (Mammalia: Oteriidae). Marine Mammal Science 14:544–551.

Geoffroy Saint-Hilaire, É., and F. Cuvier. 1826. Phoque. Dictionnaie des Sciences Naturelles dan lequel on traite méthodiquement des différens ètres de la nature, considérés soit en eux-mèmes, d'après l'état actuel de nos connoissances, soit relativement, à l'utillité qu'en pruvent retires la médecine, l'agriculture, le commerce et les arts (F. Cuvier, ed.). F. G. Levrault, Strasberg; Le Normant, Paris, France 39:540–559.

Gill, T. 1866. Prodome of a monograph of the pinnipedes. Proceedings Essex Institute, Salem Communications 5:7–13.

Gray, J. E. 1866. Notes on the skulls of sea bears and sea lions (Otariidae) in the British Museum. Annals and Magazine of Natural History 18:228–237.

Hall, E. R. 1981. The mammals of North America. Second edition. John Wiley and Sons, New York 2:601–1181 + *90*.

Hamilton, A. 1951. Is the Guadalupe fur seal returning? Natural History 60:90–96.

Hanni, K. D., D. J. Long, R. E. Jones, P. Pyle, and L. E. Morgan. 1997. Sightings and strandings of Guadalupe fur seals in Central and Northern California, 1988–1995. Journal of Mammalogy 78:684–690.

HUBBS, C. L. 1956. Back from oblivion. Guadalupe fur seal still a living species. Pacific Discovery California Academy of Sciences 9:14–21.

HUBBS, C. L. 1979. Guadalupe fur seal. Pp. 24–27 in Mammals in the seas. Pinniped species summaries and report on sirenians. FAO Fisheries Series no. 5. Food and Agriculture Organization of the United Nations, Rome, Italy.

HUEY, L. M. 1930. Past and present status of the northern fur seal with a note on the Guadalupe fur seal. Journal of Mammalogy 11:188–194.

KING, J. E. 1954. The otariid seals of the Pacific Coast of America. Bulletin of the British Museum of Natural History Zoology 2:311–337.

KING, J. E. 1964. Seals of the world. The British Museum (Natural History), London, United Kingdom.

LESSON, R.-P. 1828. Phoque. Pp. 400–426 in Dictionaire classique d'histoire naturelle (J. G. B. M. Bory de Saint-Vincent, ed.). Rey et Gravier, Paris, France.

LINNAEUS, C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis synonymis, locis. Regum animale. Class 1, Mammalia. Tenth edition. Laurentii Salvii, Stockholm, Sweden 1: 1–824.

LLUCH BELDA, D., L. IRVING, AND M. PILSON. 1964. Censo de la foca fina de Guadalupe (*Arctocephalus townsendi*) para 1964. Institución Nacional Investigación Biológico-Pesqueras, México, Publication no. 10.

LYON, G. M. 1937. Pinnipeds and a sea otter from the Piont Mugu shell mound of California. University of California Publication, Biological Sciences 1:133–168.

MARAVILLA-CHAVEZ, M. O., AND M. S. LOWRY. 1999. Incipient breeding colony of Guadalupe fur seals at Isla Benito del Este, Baja California, Mexico. Marine Mammal Science 15:239–241.

MELIN, S. R., AND R. L. DELONG. 1999. Observations of a Guadalupe fur seal (*Arctocephalus townsendi*) female and pup at San Miguel Island, California. Marine Mammal Science 15: 885–888.

MERRIAM, C. H. 1897. A new fur-seal or sea-bear (*Arctocephalus townsendi*) from Guadalupe Island, off Lower California. Proceedings of the Biological Society of Washington 11:175–178.

NOWAK, R. M. 1991. Walker's mammals of the world. Fifth edition. The Johns Hopkins University Press, Baltimore, Maryland 2:643–1629.

NOWAK, R. M., AND J. L. PARADISO. 1983. Walker's mammals of the world. Fourth edition. The Johns Hopkins University Press, Baltimore, Maryland 2:569–1362.

ORR, R. T. 1989. Marine mammals of California. University of California Press, Berkeley.

PÉRON, F. M. 1816. Voyage de découvertes aux terres australes, exécuté sur les Corvettes le Géographe, le Naturaliste, et la Goëlette le Casuarina, pendent les années 1800, 1801, 1802, 1803 et 1804. l'Imprimerie Royal, Paris, France 2:1–471.

PETERS, W. 1866. Uber die Ohrenrobben (Seelöwen and Seebären), *Otaria*, insbesondere über die in den Sammlungen zu Berlin befindlichen Arten. Monatsberichte der Königlichen Preussischen Akademie des Wissenschaften zu Berlin 1866: 261–281.

PETERSON, R. S., C. L. HUBBS, R. L. GENTRY, AND R. L. DELONG. 1968. The Guadalupe fur seal: habitat, behavior, population size and field identification. Journal of Mammalogy 49:665–675.

PIERSON, M. O. 1978. A study of the population dynamics and breeding behavior of the Guadalupe fur seal *Arctocephalus townsendi*. Ph.D. dissertation, University of California, Santa Cruz, 110 pp.

REPENNING, C. A., R. S. PETERSON, AND C. L. HUBBS. 1971. Contributions of the Systematics of the Southern Fur Seals, with Particular Reference to the Juan Fernandez and Guadalupe species. Pp. 1–34 in Antarctic Pinnipedia (W. H. Burt, ed.). Antarctic Research Series 18:1–226.

REYNOLDS, J. E., III, AND S. A. ROMMEL. 1999. Biology of marine mammals. Smithsonian Institution Press, Washington, D.C.

RICE, D. W., K. W. KENYON, AND D. LLUCH BELDA. 1965. Pinniped populations at islas Guadalupe, San Benito, and cedos, baja California, in 1965. Transactions of the San Diego Society of Natural History 14:73–84.

SCHEFFER, V. B. 1958. Seals, sea lions and walruses: a review of the Pinnipedia. Stanford University Press, California.

SCHREBER, J. C. D. VON. 1775. Die Säugethiere in Abbildungen nach der Natur, mit Bsechrebungen. Wolfgang Walther, Erlangen 2:223–230.

SEAGARS, D. J. 1984. The Guadalupe fur seal: a status review. National Marine Fisheries Service, Southwest Region. Administrative Report, SWR-84-6, 29 pp.

SIVERTSEN, E. 1953. A new species of sea-lion, *Zalophus wollebaeki*, from the Galapagos Islands. Det Kongelige Norske Videnskabers Selskabs Forhandlinger 26:1–3.

SIVERTSEN, E. 1954. A survey of the eared seals (family Otariidae) with remarks on the Antarctic seals collected by M/K Norvegia in 1928–1929. Det Norske Videnskaps-Akademi i Oslo. Scientific results of the Norwegian Antarctic Expedition 1927–1928, 36:1–76.

STARKS, E. C. 1922. Records of the capture of fur seals on land in California. California Fish and Game 8:155–160.

STEWART, B. S. 1981. The Guadalupe fur seal (*Arctocephalus townsendi*) on San Nicholas Island, California. Bulletin of the Southern California Academy of Sciences 80:134–136.

STEWART, B. S., P. K. YOCHEM, R. L. DELONG, AND G. A. ANTONELIS, JR. 1987. Interactions between Guadalupe fur seals at San Nicholas and San Miguel Islands, California. Pp. 103–106 in Status, biology, and ecology of fur seals (J. P. Croxall and R. L. Gentry, eds.). National Oceanic and Atmospheric Association, Technical Report, National Marine Fisheries Service 51:1–212.

THOBURN, W. W. 1899. Report on an expedition in search of the fur seal of Guadalupe Island, lower California, June 1897. Pp. 275–283 in The fur seal and fur seal islands of the north Pacific ocean, report of fur-seal investigations: 1896–1897 (D. S. Jordan, ed.). U.S. Government Printing Office, Washington, D.C.

TOWNSEND, C. H. 1899. Pelagic Sealing with Notes on the Fur Seals of Guadalupe, the Galapagos, and Lobos islands. Pp. 265–274 in The fur seal and fur seal islands of the north Pacific Ocean, report of fur-seal investigations: 1896–1897 (D. S. Jordan, ed.). U.S. Government Printing Office, Washington, D.C.

TOWNSEND, C. H. 1924. The northern elephant seal and the Guadalupe fur seal. Natural History 24:567–577.

TOWNSEND, C. H. 1931. The fur seal of the California Islands. Zoologica 9:443–457.

WALKER, P. L., AND S. CRAIG. 1979. Archaeological evidence concerning the prehistoric occurrence of sea mammals at Point Bennett, San Miguel Island. California Fish and Game 65:50–54.

WEBBER, M. A., AND J. ROLETTO. 1987. Two recent occurrences of the Guadalupe fur seal *Arctocephalus townsendi* in central California. Bulletin of the Southern California Academy of Sciences 86:159–163.

WEDGEFORTH, H. M. 1928. The Guadalupe fur seal (*Arctocephalus townsendi*). Zoonooz, San Diego Zoological Society 3: 4–9.

WICKENS, P. A., AND A. E. YORK. 1997. Comparative population dynamics of fur seals. Marine Mammal Science 13:241–292.

WOZENCRAFT, W. C. 1993. Order Carnivora. Pp. 279–348 in Mammal species of the world: a taxonomic and geographic reference. Second edition (D. E. Wilson and D. M. Reeder, eds.). Smithsonian Institution Press, Washington, D.C.

ZIMMERMAN, E. A. W. 1783. Geographische Geschichte des Menschen, und der allgemein verbreiteten vierfüssigen Thiere, nebst einer hieher gehörigen zoologischen Weltkarte. Zweiter Band. Enthält ein vollständiges Vereichniss aller bekannten Quadrupeden. Weygandschen Buchhandlung, Leipzig, Germany.

Associate editors for this account were ELAINE ANDERSON and LUI MARINELLI. Editor was VIRGINIA HAYSSEN.

R. L. BELCHER AND T. E. LEE, JR., DEPARTMENT OF BIOLOGY, ABILENE CHRISTIAN UNIVERSITY, BOX 27868, ABILENE, TEXAS 79699.