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Eumetopias jubatus.

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Eumetopias Gill, 1866

Eumetopias Gill 1866:7, 11. Type species *Arctocephalus monteriensis* Gray.

CONTEXT AND CONTENT. Order Carnivora, Family Otariidae, Subfamily Otariinae. The family contains the extant genera *Arctocephalus, Callorhinus, Eumetopias, Neophoca, Otaria, Phocarctos,* and *Zalophus.* The genus *Eumetopias* includes one species, *E. jubatus,* treated below.

Eumetopias jubatus (Schreber, 1776)

Steller Sea Lion

Leo marinus Steller, 1751:360. No type specimen; based on description from Commander Islands; preLinnaeus, 1758.

Phoca jubata Schreber, 1776:300, pl. 83b. Type locality "northern part of the Pacific Ocean," USSR Commander Islands, Bering Island. Description based on Steller's notes (Scheffer, 1958).

Otaria stellerii Lesson, 1828:420. A renaming of *Phoca jubata* Schreber.

Arctocephalus monteriensis Gray, 1859:358, 360, pl. 72. Type locality, Monterey, California. (Based on a skull of *Eumetopias* and a skin of *Callorhinus.*)

CONTENT AND CONTEXT. Context as above. The species *E. jubatus* is not divided into subspecies (Scheffer, 1958).

DIAGNOSIS. In *E. jubatus* there is a conspicuous diastema between the upper fourth and fifth postcanines; in males this constitutes 5-8% of the condylobasal length (King, 1954; Scheffer, 1958). Dental formula for permanent teeth is i 3/2, c 1/1, postcanine 5/5, total 34 (Spalding, 1966); for deciduous teeth it is i 3/2, c 1/1, postcanine 3/3, total 26 (Scheffer, 1967). After 4 years of age the baculum develops subapical lateral swellings found in no other pinniped genus (Morejohn, 1975). *E. jubatus* has a double alveolar capillary supply, as in the cetacea, unique among pinnipeds (Simpson and Gardner, 1972).

The distribution of *E. jubatus* and *Zalophus californianus* overlap from California to British Columbia and occasionally they are mistaken for one another (Schusterman, 1981). *E. jubatus* is lighter in color and larger than *Z. californianus.* Adults of *E. jubatus* weigh three times as much as adults of *Z. californianus.* Adult females of *Eumetopias* are as large as adult males of *Zalophus* and at least four times larger than adult females of *Zalophus* (Schusterman, 1981). Postcanine teeth of *Zalophus* are evenly spaced, thus lack the characteristic diastema found in *Eumetopias.* The head of *E. jubatus* is bearlike with a short straight nose, not upturned as in *Otaria*; the profile in adult males from forehead to snout is concave (Itoo et al., 1977; King, 1954). Underwater, *E. jubatus* appears white, whereas *Z. californianus* appears darker (Gentry and Withrow, 1978).

GENERAL CHARACTERS. *Eumetopias jubatus* (Fig. 1) is the largest otariid and shows marked sexual dimorphism (King, 1954, 1983). Standard length of males is up to 325 cm and females up to 291 cm; mass of males is up to 1,120 kg and females to 350 kg (Fiscus, 1961; King, 1983; Loughlin and Nelson, 1986; Rass et al., 1955). Girth and other body measurements were provided by Fiscus (1961).

Males and females are light buff to reddish brown and slightly darker on the chest and abdomen but females are lighter in color; naked parts of the skin are black (King, 1954). Pelage color varies with age and is lighter when recently molted; wet animals usually appear darker than dry ones, and subadults may appear silver to light brown when wet (King, 1954; Mate, 1973). Pups are dark brown to black until 4 to 6 months old when they molt to a lighter brown; and to the lighter color of the adult by the end of their second year (King, 1983). Adult vibrissae are up to 50 cm long and white or brownish black (King, 1954). Adult males have long, coarse hair on the chest, shoulders, and back of the neck; the chest and neck are massive and muscular. The neck is narrow and slim in young males and adult females; when the upper part of the body is seen out of the water this characteristic clearly separates them from adult males (Itoo et al., 1977).

DISTRIBUTION. The geographic range (Fig. 2) extends around the North Pacific Ocean rim from northern Hokkaido, Japan, through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering Sea, southern coast of Alaska, and south to the Channel Islands off California (Loughlin et al., 1984). The centers of abundance and distribution are the Gulf of Alaska and Aleutian Islands, respectively. Rookeries (breeding colonies) are dispersed from Chernyye Brat'ya Ostrova (46°N) in the central Kuril Islands to San Miguel Island, California (34°N); most large rookeries are in the Gulf of Alaska and Aleutian Islands (Kenyon and Rice, 1961; Calkins and Pitcher, 1983; Loughlin et al., 1984). The number of pups born at San Miguel Island has declined to only a few animals and its status as a rookery is now questionable. Seal Rocks in Prince William Sound represent the northern-most (60°09'N) rookery (Loughlin et al., 1984). Steller sea lions are not known to migrate, per se, but disperse widely during the postbreeding season and may occur near ice or northern islands in the Bering Sea during fall and winter; in the southeastern part of the range adult males move north then return to the rookeries in early spring (Kenyon and Rice, 1961; Mate, 1973).

FOSSIL RECORD. Otariids probably arose from the Enaliarctidae in temperate waters of the North Pacific Ocean (Barnes, 1979; Repenning and Tedford, 1977). The Enaliarctidae evolved more than 22 million years ago (mya) from ursine ancestors (Mitchell and Tedford, 1973), and the earliest known otariid, *Pithanotaria starri,* is between 10 and 12 million years old (Repenning, 1976). The earliest known large otariid with most cheek teeth single rooted is from the upper Onma formation in Japan during the Pliocene about 2 mya (Kaseno, 1951; Repenning, 1976). The remains consist of a right mandible and four detached teeth and are assigned

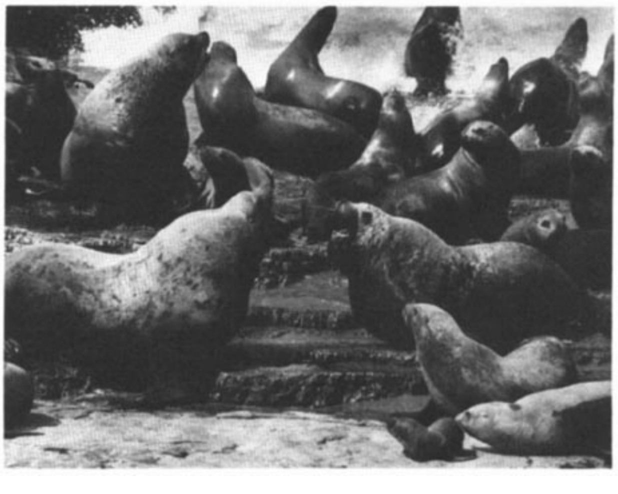

FIG. 1. Photograph of *Eumetopias jubatus* showing females, a pup (foreground), and a boundary display between two territorial males. Note the sexual dimorphism between the larger male and smaller females. Photograph by Roger Gentry.

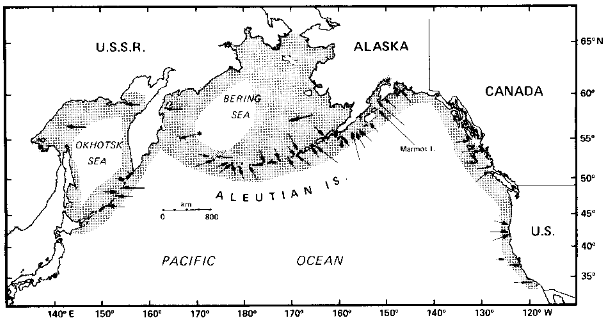

FIG. 2. Map depicting suggested world distribution (shaded area) and rookeries (arrows) of *Eumetopias jubatus*; type locality is shown by an asterisk. Marmot Island, the largest rookery in the world, is also shown. Modified from Loughlin et al., 1984.

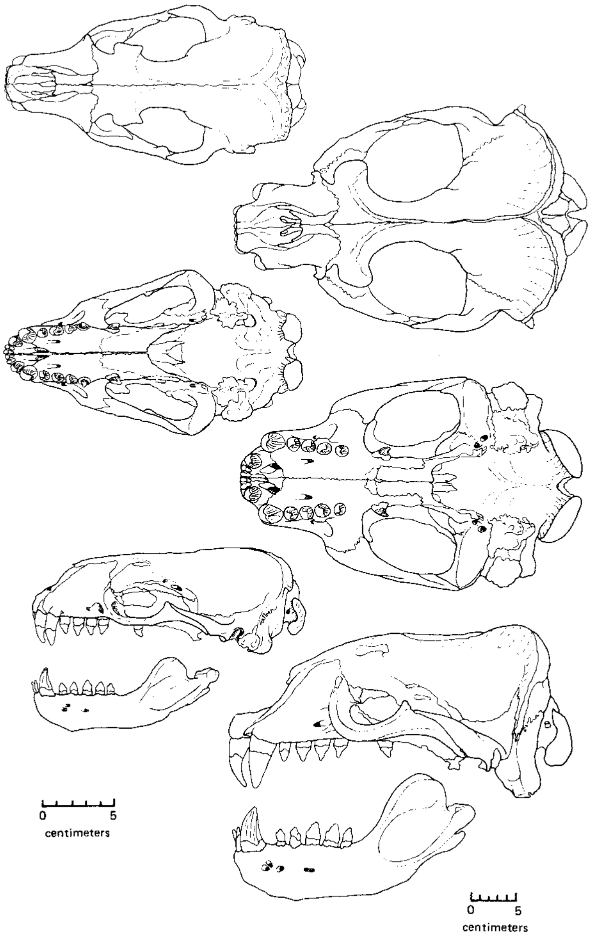

FIG. 3. Dorsal view, ventral view, and lateral view of skull and lateral view of the lower jaw of a 271.8 cm male (right) and a 246.4 cm female (left) *Eumetopias jubatus*. The condylobasal length of the male skull is 36.2 cm and the female 30.0 cm. Drawings by Cathy Short.

to the extant genus *Eumetopias*, probably a species different from *E. jubatus* (Mitchell, 1968). A single femur, about 3 to 4 million years old, found in California may have been from a similar ancient sea lion (Repenning, 1976). Packard (1947) reported a fossil radius of *Eumetopias* sp. from Cape Blanco, Oregon. Leffler (1964) reported a fossil otariid tooth from the same area that was about the same size as $P\underline{4}$ of *Eumetopias* but resembled teeth of *Zalophus*. A skull, teeth, vertebrae, and other parts of a postcranial skeleton of *E. jubatus* were recovered in California from Pleistocene deposits (Kellogg, 1922; Kohl; 1974).

Lyon (1941) and True (1909) suggested the Miocene fossil *Pontolis magnus* was ancestral to *E. jubatus*, but Mitchell (1968) argued that *P. magnus* was too specialized to be considered as such. Mitchell (1968) stated that *E. sinanoensis* is a junior synonym of *Allodesmus kernensis* from the Miocene. Mitchell (1968) also proposed a new genus *Oriensarctos* to receive the species *E. watasei* from the upper Pliocene in Japan. *Eumetopias* (?) *kishidai* in Japan was released to synonomy under *Zalophus californianus* (Mitchell, 1968).

FORM AND FUNCTION. The epidermis has defined layers typical of most mammals; it is light colored and only slightly pigmented, the typical otariid condition (Scheffer, 1964; Sokolov, 1959). The dermis is thickest on the flanks and consists of a dense network of collagenic fibers and numerous elastin fibers; fatty cells occur near the sudoriparous glands; sebaceous glands are abundant (Sokolov, 1959). Abdominal blubber is 11 to 39 mm thick (Ling, 1974). Hair bundles consist of one guard hair with one to three underhairs; the hairs are oriented at 45° to the surface (Sokolov, 1959). Hair bundles are regularly spaced (Scheffer, 1964), and in the fetus are in a straight line (Belkin, 1964). The birth pelage has a wavy pattern (Scheffer, 1962). Guard hairs are lanceolate with a variable medullary layer and are long (to 31 mm); underhairs have no medullary layer (Sokolov, 1959). Basal diameter of the hair increases with age (Scheffer, 1964). The cuticle is nonringed and the cuticle cells are irregular and winding (Sokolov, 1959). Like most pinnipeds, the arrector muscle is absent (Sokolov, 1959).

Number of mammary teats ranges from two to six but most commonly is four; one pair is anterior to the umbilicus, and the other pair is posterior and closer to it. (Gentry, 1970; King, 1983). When not in use the teats are retracted beneath the body surface. Milk of *E. jubatus* contains about 62% water, 21% fat, 33% solids, 11% proteins, 3% albumin, 8% casein, 1% ash, and has a pH of 6.3 (Poulter et al., 1965). The milk contains no lactose; lactose may be toxic to sea lions causing cataracts (Hubbard and Poulter, 1968).

The adult skull (Fig. 3) is robust and shows sexual dimorphism in size with males largest (Fiscus, 1961). Mean condylobasal length for males is about 398 mm and mastoid width 232 mm and about 327 mm and 158 mm, respectively, for females (Scheffer, 1958). Numerous skull measurements were provided by Allen (1880) and Fiscus (1961). The quadrate supraorbital process is anteriorly placed; the posterior end of the palate is contracted and truncate; distance from the palatal notch to the incisors is less than 55% condylobasal length; the palate is slightly concave, and the concavity usually is not more than 10 mm in depth (King, 1954; Scheffer, 1958). The pterygoid process is short and the temporal process is absent (Scheffer, 1958). The lacrimal bone is present but difficult to distinguish as a discrete bone because of its degree of fusion with the maxilla and frontal, especially in adults (King, 1971). The basioccipital-basisphenoidal suture closes at about 4 years of age, and the sagittal crest is strongly developed in males (Fiscus, 1961).

Upper postcanine 5 is double rooted, with the crown directed backward, and does not occlude with lower postcanine 5; all other postcanines are single rooted, slant somewhat forward, and have irregularly conical, pointed crowns (Allen, 1880; Orr and Poulter, 1967). The diagnostic diastema between upper postcanines 4 and 5 may be caused by rapid growth and extension of the skull (Chiasson, 1957) rather than by suppression of the fifth and sixth postcanines, as proposed by Allen (1880). The pulp cavity in females is well filled by dentin deposition by 11 or 12 years of age and almost completely closed by 15 or 16 years of age; male teeth fill somewhat slower (Fiscus, 1961). Annual growth layers exist in the dentin and cementum with dark layers corresponding to winter and light layers to summer (Fiscus, 1961).

Vertebral formula is 7 C, 15 T, 5 L, 3 S, and 10 to 12 Ca, total 40 to 42 (King, 1983). As with most otariids, *E. jubatus* has strong transverse and neural spines on the cervicals, large neural spines on the thoracic, and small transverse spines on the lumbar vertebrae; zygapophyses are closely set. Caudal vertebrae are small, cylindrical, and without strong processes (King, 1983). The sternum is in 8 to 9 pieces and the manubrium has a long bony extension; the scapula has a well-developed spine; the clavicle is absent (King, 1983). Ten of 15 ribs articulate with the sternum (Allen, 1880). The pelvis is well developed and pubic bones are not ankylosed (Allen, 1880). The first and second digits of the fore flipper and the first and fifth digits of the hind flipper are longest (Allen, 1880).

There are no descriptions of the muscular and circulatory systems for *E. jubatus*; however the excellent accounts of the anatomy of *Otaria byronia* by Murie (1872, 1874) incorrectly have been cited as descriptions for *E. jubatus.*

Pinnipeds generally are classified as microsomatic with olfactory lobes and nerves reduced (Scheffer, 1958). The mucous lining of the middle ear cavity is thick, tough, and possesses a rich supply of veins. This complex network of venous channels and sinuses is capable of filling and reducing air space within the middle ear and perhaps is an adaptation to diving (Kooyman and Andersen, 1969).

The lungs have many lobes; the left is divided by an incomplete septum into apical and diaphragmatic lobes; the cardiac lobe is absent (Sokolov et al., 1968). The right lung has typical lobulate structure of apical, cardiac, diaphragmatic, and postcardiac. Each lobe has many fissures, thus many auxillary lobes. The trachea is massive with large diameter (229.3 mm), thick walls and 20 to 30 broad rings (Sokolov et al., 1968). The trachea is rather short compared to the length of the neck, ending in the chest not beyond the second or third rib. The rings are incomplete with slightly parted tips (Sokolov et al., 1968).

The longest small intestine among pinnipeds is found in *E. jubatus* (Harrison et al., 1977). Otherwise, the digestive system is typical for the family with length and weight measurements for different components provided by Engle (1926), King (1983), and Slepstov (1950).

Average testis mass ranges from 86 to 92 g for animals 6 to 15 years old (Thorsteinson and Lensink, 1962). The distal end of the baculum is expanded into a roughly circular disc, with a keel ventral to the apex and a midventral keel in subadults (Morejohn, 1975). Average baculum mass ranges from 32.6 to 41.7 g for 6 to 17 year old animals (Thorsteinson and Lensink, 1962). The overall length of the baculum is 192 mm for a 20-year-old male and 67 mm for a 1 year old; the baculum grows throughout life (Fiscus, 1961; Morejohn, 1975). Female reproductive anatomy is typical of the family (King, 1983).

ONTOGENY AND REPRODUCTION. Males exhibit seasonal spermatogenesis, with active sperm found between late April and early August (Pitcher and Calkins, 1981). Mating occurs between late May and early July throughout the range (Gentry, 1970; Pitcher and Calkins, 1981). All females age 6 years and over ovulate, and 87% of those between ages 8 to 20 years become pregnant. Implantation occurs in late September through early October after a delay of 3 to 4 months (Pitcher and Calkins, 1981). Gestation period is about 354 days. Premature births occur as early as February, with viable births occurring from late May through early July (Pitcher and Calkins, 1981). Mating and pupping occur on land in areas defended by adult territorial males (Belkin, 1966). Sex ratios at birth are close to parity (Gentry, 1970). Birth rates are 60 to 75% throughout the range (Belkin, 1966; Gentry, 1970; Withrow, 1982). Pupping peaks in the second to third week of June (Withrow, 1982). There is a diurnal cycle in pupping, with the peak in the morning and the rate at night 50% that of daytime (Sandegren, 1970).

Twinning is rare. Newborn pups are about 1-m long, weigh 16 to 23 kg, and have a thick, dark-brown coat that is molted to lighter brown after 6 months; male and female pups 6 to 10 weeks old weigh about 40 kg (Belkin, 1966; Scheffer, 1945). Yearlings average 179 cm, indicating growth of about 77 cm in the first year (Mathisen et al., 1962). Growth is rapid during the first 2 years (Fiscus, 1961; Spalding, 1964*b*), body mass may double in the first 7 weeks (Scheffer, 1945) and body length may increase up to 80 cm during the first year (Mathisen et al., 1962). Body length by 3 years of age may double the length at birth (Spalding, 1964*b*; Calkins and Pitcher, 1983). Pups are capable of swimming at birth (Gentry and Withrow, 1978). Swimming by pups occurs in three phases: a terrestrial phase (first 2 weeks after birth); a littoral phase (weeks 3 and 4); and a pelagic phase (weeks 5 and 6; Sandegren, 1970). Most pups are weaned in their first year, although some are not weaned until their second year or later (Pitcher and Calkins, 1981).

Females reach sexual maturity between 3 and 8 years of age (Perlov, 1971; Pitcher and Calkins, 1981), and may breed into their early 20's (Mathisen et al., 1962). Males reach sexual maturity between ages 3 and 7 years and physical maturity by age 10 (Perlov, 1971; Pitcher and Calkins, 1981). Testis mass increases through year 9 (Thorsteinson and Lensink, 1962). Males begin to develop secondary sexual characteristics (massive muscular neck, thick pelage, and sagittal crest) at 4 years of age (Fiscus, 1961; Pitcher and Calkins, 1981). Males holding territories may range between 5 and 19 years of age (Mathisen et al., 1962) with 90% between 9 and 13 years of age (Thorsteinson and Lensink, 1962). Adult females are monoestrous (Gentry, 1970) and most breed annually (Pitcher and Calkins, 1981). Females may live to 30 years and males to about 15 (Pitcher and Calkins, 1981).

ECOLOGY. Fifty-one rookeries have been identified (Loughlin et al., 1984); the number of haul-out sites is greater. Estimates of the world population for *E. jubatus* during the late 1970's range from 245,000 to 290,000 animals, but declines in the Kuril Islands, Aleutian Islands, western Gulf of Alaska, British Columbia, and California likely reduced the overall population (Bigg, 1985; Braham et al., 1980; Loughlin et al., 1984).

While feeding at sea, *E. jubatus* frequently are seen near shore and out to continental slope waters; in the Gulf of Alaska they commonly occur near the 200-m depth contour (Kajimura and Loughlin, in press). Some individuals enter rivers in pursuit of prey (Jameson and Kenyon, 1977). They have been caught on fishing lines at depths of 183 m (Fiscus and Baines, 1966; Kenyon, 1952). During the breeding season females remain on land during the day and feed principally at night, whereas territorial males remain on land and fast throughout the breeding season (Gentry, 1970; Spalding, 1964*a*). Group feeding by *E. jubatus* (Fiscus and Baines, 1966) may aid in controlling the movement of large schools of fish and squid thereby facilitating their exploitation (Schusterman, 1981).

Eumetopias jubatus is an opportunistic predator, feeding primarily on fish and cephalopods, with prey varying by area, season, and water depth (Fiscus and Baines, 1966; Pitcher, 1981). Most food, including fish up to 2 kg, is swallowed whole within 10 to 20 s of capture (Jameson and Kenyon, 1977; Mathisen et al., 1962); large prey is consumed at the surface and reduced to small pieces by violent shaking (Spalding, 1964*a*). Fishes eaten include (in alphabetical order): capelin, *Mallotus villosus*; greenlings, Hexagrammidae; herring, *Clupea harengus*; lamprey, *Entosphenus tridentatus*; Pacific cod, *Gadus macrocephalus*; rockfish, *Sebastes* sp., salmon, *Oncorhynchus* sp.; sand lance, *Ammodytes* sp.; sculpins, Cottidae; smooth lumpsucker, *Aptocyclus ventricosus*; walleye pollock, *Theragra chalcogramma*; Pacific whiting, *Merluccius productus*, and an assortment of other round and flat fish. Cephalopods are a major proportion of the diet in the Gulf of Alaska and include *Octopus* sp. and squid, especially Gonatidae; shelled mollusks and crustaceans also are eaten (Fiscus and Baines, 1966; Itoo et al., 1977; Jameson and Kenyon, 1977; Jones, 1981; Panina, 1966; Pitcher, 1981; Spalding, 1964*a*). Consumption of walleye pollock by *E. jubatus* appears to have increased between 1958–60 and 1975–80 perhaps because of an increase in the abundance of pollock (Pitcher, 1981). Gravel and stones (to 12 cm in diameter and to 2 kg) often are found in stomachs of *E. jubatus*; the purpose of the rocks is unknown but they may be used as a vermicide against parasites or to prevent hunger pangs (Fiscus and Baines, 1966; Spalding, 1964*a*).

The diet of *E. jubatus* and *Phoca vitulina* in the Gulf of Alaska is similar but competition for food may be ameliorated by differences in their distribution, diving capabilities, a more diverse diet by harbor seals, and consumption of larger prey by sea lions (Pitcher, 1981).

Eumetopias jubatus males have been known to prey on *P. vitulina*, *C. ursinus* pups, *P. hispida*, and possibly *Enhydra lutris* (Gentry and Johnson, 1981; Pitcher and Fay, 1982). Predation on fur seal pups is only a supplementary part of the diet, and constitutes a small fraction of fur seal mortality (Gentry and Johnson, 1981).

Food requirements for *E. jubatus* are estimated at 2 to 6% of body mass per day (Mate and Gentry, 1979). Stomach contents have ranged to 23 kg (Itoo et al., 1977). Fiscus and Baines (1966) reported one stomach to contain food amounting to 9.4% of total body mass.

Age of *E. jubatus* and cadmium levels are significantly correlated, with the highest cadmium content in the kidneys (Hamanaka et al., 1982). Cadmium concentration in *Eumetopias* was lower than in other pinnipeds. Zinc concentration was more uniform among tissues than cadmium (Hamanaka et al., 1982). Effects of these heavy metals on sea lions are unknown (Mate and Gentry, 1979).

Hyponatremia, a low-blood-sodium disorder, has been observed in a captive Steller sea lion that became anorectic and extremely weak (Geraci, 1981). Lesions found in mandibles of prehistoric *Eumetopias* remains from Aleut middens suggest that younger and possibly weakened or old sea lions were preferentially captured by Aleuts (Bjotvedt and Turner, 1977). North American blastomycosis, a chronic granulomatous and suppurative mycotic infection caused by *Blastomyces dermatitidis*, was found in *E. jubatus* (Williamson et al., 1959). Antibodies to San Miguel sea lion virus (SMSV) were found in serum from one *E. jubatus* on St. Paul Island (Akers et al., 1974).

Parasites of *E. jubatus* include intestinal cestodes: *Adenocephalus pacificus, Anophryocephalus ochotensis, Diphyllobothrium pacificum, D. glaciale, Diplogonoporus fasciatus, D. tetrapterus, Pyramicocephalus phocarum*; trematodes, e.g., *Pricetrema zalophi*, in the intestine and bile duct of the liver; nematodes in the stomach, intestine and lungs: *Anisakis simplex, A. tridentata, A. similis, Contracaecum osculatum, Parafilaroides nanus, P. prolificus, Parafilaroides* sp., *Phocanema* (*Porrocaecum = Terranova*) *decipiens*; *Uncinaria hamiltoni*; acanthocephalans in the intestine: *Bolbosoma bobrovi, Corynosoma strumosum, C. villosum*; acarinan mites in the nasopharynx and lungs: *Orthohalarachne attenuata, O. diminuata, O. zalophi*; and an anopluran skin louse, *Antarctophthirius microchir* (Dailey and Brownell, 1972; Dailey and Hill, 1970). A serious infection of nematodes causes ulcers that may lead to massive stomach bleeding and death, and verminous pneumonia from larval nematodes may be lethal (King, 1983). On rookeries, pups often are seen with massive infestations of lice, but older animals are seldom infested (Dailey and Brownell, 1972).

Pup mortality includes drowning, starvation caused by separation from the mother or competition with an older sibling, crushing by larger animals, disease, predation, and biting by females other than the mother (Edie, 1977; Orr and Poulter, 1967). Pup mortality is about 10% at most rookeries (Gentry, 1970; Sandegren, 1970). Mortality in the Gulf of Alaska for animals through age 3 is 53% for females and 74% for males. Annual mortality for females decreases to 10% at age 7, and is stable through age 11. Annual mortality in males decreases to 12% at age 5, then may increase (Calkins and Pitcher, 1983). Loughlin et al. (1983) reported 90% of the marine mammals taken in other than U.S. commerical fishing from 1978 to 1981 in the North Pacific and Bering Sea were Steller sea lions, and 70% of these drowned. Female sea lions incidentally drowned in Shelikof Strait, Alaska, averaged 6.8 years of age and males 4.8 years of age (Loughlin and Nelson, 1986). Other sources of mortality include gunshot, parasites, bacterial infections, and predation by sharks *Lamna ditrops*, killer whales, *Orcinus orca*, and brown bears, *Ursus arctos* (Belkin, 1966; Orr and Poulter, 1967; Stroud, 1978).

BEHAVIOR. *Eumetopias jubatus* is gregarious and polygynous, and uses traditional rookeries and haul-out sites, usually located on remote islands. Both sexes haul out on land less frequently in winter and are not concentrated at rookery sites. Mate (1973) noted that males competing for rest sites exhibited behaviors similar to boundary displays observed during the breeding season; however, these displays were less frequent and less violent than during the breeding season.

Adult breeding animals and some subadults occupy rookeries during the breeding season. Nonbreeding males, most subadults, and transient females may be at separate haul-out sites. Rookeries and haul-out sites are generally characterized by: (1) minimal disturbance, (2) access to the sea, and (3) local abundance of food (Mate, 1973).

Eumetopias jubatus uses three types of territories—aquatic, semiaquatic, and terrestrial. Males with semiaquatic territories are the most successful in maintaining them (Sandegren, 1970). Territorial boundaries follow natural features such as cracks, faults, or ridges in rocks (Gentry, 1970). Some territories are stable for as long as 60 days (Gentry, 1970).

Rookery populations are low in early morning and high in late afternoon resulting from a movement of females to and from the sea to feed (numbers in some locations are affected by tide and weather; Sandegren, 1970; Withrow, 1982). A similar pattern was observed at haul-out sites in the nonbreeding season (Sullivan, 1980).

Copulation generally occurs only in territories (Gisiner, 1985). Once acquired, a male may occupy a territory for up to seven consecutive breeding seasons, with copulatory success increasing through the third year (Gisiner, 1985). Territories are established in early May, with boundaries delineated through ritualized threat displays toward neighbors and encroaching males. Displays are more common than fights (Gentry, 1970). Neighbors appear to habituate, and the number and duration of displays decreases over time (Gentry, 1970). There is an inverse relationship between the distance between males and the number of displays (Gentry, 1970).

Parturient females arrive at the rookery about 3 days prepartum (Gentry, 1970). Commonly used pupping sites are of gentle slope, above high-tide level, protected from storm waves, and away from territory boundaries. Females frequently return to the same pupping site in successive years (Edie, 1977; Gentry, 1970).

Births require 16 to 30 min after the amnion bursts (Gentry, 1970; Sandegren, 1970) and are evenly divided between caudal and cephalic presentations (Gentry, 1970; Sandegren, 1970). Females stimulate inactive newborn pups by lifting and dropping, nipping, flipper slapping, or nuzzling. Females move their pup into position for suckling that begins about 3 min postpartum (Gentry, 1970). Pups suckle an average of 230 min during a mean of 12 daily nursing periods; after several weeks nursing periods decline to 3 to 4 per day (Sandegren, 1970). Females first go to sea about 9 days postpartum but not until the female/pup recognition is established (Sandegren, 1970). Most feeding trips are less than 1 day in length (Gentry, 1970; Sandegren, 1970). Females return to sea at intervals of 1 to 3 days thereafter. (Gentry, 1970; Sandegren, 1970). Females with pups spent 63% of their time on land, whereas those without pups spent 47% (Gentry, 1970). Reunion of female and pup is by vocalization and olfaction (Ono, 1972). Females reject foreign pups that attempt to nurse (Belkin, 1966).

Female aggressiveness peaks at parturition and lasts from 3 to 10 days postpartum (Sandegren, 1970) and is caused by conflicts over pups and rest sites (Gentry, 1970), or by returning females searching for pups (Ono, 1972). Females may bite and toss pups of other females, and threaten subadults and adult males. Aggressive behaviors include vocalizations, open-mouth threats, crossed-mouthed threats, pushing, biting, and nose touching (Calloway, 1972).

Female rest sites have direct access to water for thermoregulation, but are out of the splash zone. Females with pups usually select rest sites more protected than those selected by females without pups (Edie, 1977). Most (80%) females with pups at the Cape St. James rookery mated within 10 m of where they gave birth (Edie, 1977).

Males initiate most copulations (Gisiner, 1985), and mount and dismount until the female becomes passive and pelvic thrusting can begin. Initial pelvic thrusting is irregular, then becomes more regular, more intense, and more frequent upon achieving intromission. Females signal the end of the mating by vigorous protests and by biting the male. Copulations average 16 min (Gentry, 1970; Sandegren, 1970). There are more mounts than copulations, with most of the multiple mounts occurring early in the mating period (Gentry, 1970).

Females mate 11 to 14 days postpartum (Gentry, 1970; Sandegren, 1970). Eighty-five percent of females copulate only once; the remainder copulate twice within a 4-day period (Gentry, 1970).

Both males and females preface movements with vocal displays (Gentry, 1970). Territorial male sounds are usually low frequency, with amplitude modulation varying with the type call; vocalizations signal threats toward other males, courting of females, or are comfort signals (Poulter, 1968). Females vocalize less, at a higher frequency, and use less amplitude modulation than males. Pups have a bleating cry like sheep, and their voice deepens as they age (Poulter, 1968). Adult underwater sounds are like their in-air signals. Poulter and Del Carlo (1971) suggested underwater sounds of adults are used for locating food; however, Schusterman et al. (1970) indicated that these sounds probably have a social function and are not used for foraging.

The motor components in pup social play are similar to adult male agonistic behavior and are separable into male sexual/female appeasement, dominance/submissive, and fighting/boundary defense bouts (Gentry, 1974). Adultlike behavior was evident by 2 weeks of age; sex, age, terrain, and play partner were determinants of motor components (Gentry, 1974). Farentinos (1971) found that all age and sex groups, except territorial males, played.

At substrate temperatures of 10–15°C, *E. jubatus* exhibit thermoregulatory behavior by staying dry, covering their flippers, and exposing a minimum of body surface to the air; at 20–30°C they expose their flippers and become wet (Gentry, 1973). Flippers are used for thermoregulation by evaporative cooling and by conduction and convection. Males usually wet their rear flippers first, perhaps to cool the testis and enhance spermatogenesis. Other thermoregulatory measures include use of shade, urohydrosis, and drinking of salt water by males (Gentry, 1981).

Grooming is performed by bending the head and neck backward, and scratching with the claws of the hind flipper (Steller, 1751). Animals also rub themselves on rocks and on other animals.

In swimming, the fore flippers are used for movement, whereas the hind flippers may be used for braking and turning. Walking is performed with the hind feet turned forward, with the animal balancing on the tarsal region and fore flippers (Tarasoff, 1972).

GENETICS. *Eumetopias jubatus* has 30 metacentric or submetacentric chromosomes and 4 acrocentric chromosomes; the X chromosome is submetacentric and the Y is acrocentric (2n=36; Hsu and Benirschke, 1974). Autosome no. 5 has a secondary constriction. The fundamental number is 68 (Fay et al., 1967). Four of 32 loci studied by Lidicker et al. (1981) exhibited rare alleles (maximum percentage 1.6). A fifth was truly polymorphic with two alleles in approximately equal proportions. Average individual heterozygosity was 0.018. Gentry (1970) estimated albinism to occur as 1 birth in 2,000.

REMARKS. Other common names include northern sea lion, sea beasts (Steller), seevitchie (Aleut), and sivuch or sea wolf (Russian). In Greek *Eumetopias* means having a well-developed, broad forehead; in Latin *jubatus* means having a mane, as in the male. The spelling of *jubatus* rather than *jubata* follows a rule "in International Trust for Zoological Nomenclature (1964:31): a noun of variable gender . . . is to be treated as masculine . . . ." (Rice, 1977:3).

Small numbers of *Eumetopias* are taken for human consumption and animal food in Alaska, Japan, and possibly the Soviet Union; a few are taken by natives in the Bering Sea for traditional arts and crafts (Mate and Gentry, 1979). *Eumetopias* products formerly used by Aleuts include: skins for boat coverings, intestines and other body parts for clothing and boots; stomach walls for oil pouches; and fat for fuel (Allen, 1880; Elliott, 1882). The vibrissae were sold to the Chinese for ceremonial purposes, including cleaners for opium pipes (Elliott, 1882). Economic utilization of *E. jubatus* was often proposed as a means to control their numbers because of presumed predation by sea lions on salmon, *Oncorhynchus* sp., and other fishery stocks (Thorsteinson et al., 1961). A small number are taken annually for public display and scientific purposes (Mate and Gentry, 1979). However, *E. jubatus* has not been popularized in captivity; is rarely seen in oceanariums, zoos, and circuses; and is seldom trained to perform tricks (Schusterman, 1981). Harassment occurs to varying amounts from sport and commercial fishing boats, divers, photographers, and tourists, which has unknown consequences (Mate and Gentry, 1979). Owing to the extensive literature on *E. jubatus*, references in this account often were limited to recent publications in which earlier works were cited.

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