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Neophoca cinerea.

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Neophoca Gray, 1866

Neophoca Gray, 1866:231. Type species *Arctocephalus lobatus* Gray.

CONTEXT AND CONTENT. Order Carnivora, Family Otariidae. The family contains the extant genera *Arctocephalus*, *Callorhinus*, *Eumetopias*, *Otaria*, *Neophoca*, *Phocarctos*, and *Zalophus*. The genus *Neophoca* contains one extant species, *N. cinerea*.

Neophoca cinerea (Péron, 1816)

Australian Sea Lion

Otaria cinerea Péron, 1816:54. No extant type specimen. Type locality Île Decrès (=Kangaroo Island, South Australia).

Otaria albicollis Péron, 1816:118. No extant type specimen. Île Eugene (=St. Peter Island, Nuyts Archipelago, South Australia: males of *O. cinerea* described as a separate species).

Arctocephalus lobatus Gray 1828:1. Lectotype with no locality.

Otaria australis Quoy and Gaimard 1830:93. Type locality "King Georges Sound, Western Australia" (Marlow and King, 1974: p. 127).

Arctocephalus williamsi McCoy, 1877:7. Type locality Queenscliff, Victoria.

Arctocephalus forsteri: Wood Jones, 1922:193, not *Otaria forsteri* Lesson, 1828.

CONTENT AND CONTEXT. Context as noted in generic summary above. *N. cinerea* (Fig. 1) is monotypic (King, 1960).

DIAGNOSIS. A postorbital process is absent from the zygomatic arch of *Neophoca* (Figs. 2, 3), but present in *Phocarctos* (King, 1960). *Neophoca* has 5/5 cheek teeth, *Phocarctos* 6/5, and the palate is flatter in *Neophoca* than in *Phocarctos*. The dental formula for *Neophoca* is 3/2, 1/1, 5/5, total 34 (Wood Jones, 1925). The geographical ranges of *Neophoca* and *Phocarctos* do not overlap, but animals of the same size and sex could be mistaken for one another. The profile of the face of *Neophoca* is sharper and less rounded than in *Phocarctos* and the muzzle appears longer. *Neophoca* males are a rich chocolate-brown in color. From the nape of the neck to the shoulders, the hair is slightly longer and coarser, and from the level of the eyes to the upper region of the shoulders, the color is a pale creamy-white. The muzzle is dark. *Phocarctos* males are dark gray to black in color with a mane of coarser, longer hair on the neck and chest, making them appear much heavier around the shoulders than *Neophoca*. Females and younger males of *Neophoca* are silvery-gray dorsally and cream ventrally; those of *Phocarctos* vary from buff to creamy-gray with darker coloration around the muzzle and flippers (Gaskin, 1972). Adult *Neophoca* males weigh slightly less (300–410 kg) than *Phocarctos* males (318–410 kg). Adult females of *Neophoca*, weigh much less (61–104.5 kg) than those of *Phocarctos* (136–230 kg; Crawley and Cameron, 1972; Walker and Ling, 1981).

GENERAL CHARACTERS. *Neophoca cinerea* shows marked sexual dimorphism (Figs. 1–3). A near-term (1 October) pregnant female weighed 104 kg and 14 lactating females averaged 73.9 kg (range, 63.0–81.6 kg; Walker and Ling, 1980). Two males reared in captivity and believed to have been aged 14–15 and 15–16 years weighed 215 and 188 kg, respectively, at death. Their standard lengths were 198 and 187 cm, respectively (unpublished data). Females ranged from 132 to 181 cm (mean, 148 cm) in length. Mass and dimensions presented in previous literature are too large (Walker and Ling, 1980, 1981). The creamy-white mane becomes increasingly conspicuous with age in adult males. The neck of adult males is massive and obscure, but slimmer and more pronounced in females and young males. The head is much more massive (King, 1960) and the canine teeth larger in adult males than females (32 and 13 mm beyond the gum level and 17 and 11 mm in diameter at gum level, respectively; unpublished data). There is a marked reduction in size of the digits on the manus, from the strong first digit to the vestigial fifth, and the claws on all five also are greatly reduced to about 12 mm or less. On the pes, the digits are well developed; digits 1 and 5 extend up to 40 mm beyond digits 2–4, but bear smaller claws (12 and 22 mm, respectively) than the middle three digits whose claws measure up to 56 mm long. The palmar and plantar sides of the flippers respectively are hairless; on the dorsal surface fur reaches to the bases of the claws. Claws on pes digits 2, 3, and 4 are used for grooming (unpublished data; Wood Jones, 1925).

DISTRIBUTION. *Neophoca cinerea* is the only endemic pinniped in Australia and its current range extends from Houtman Abrolhos in Western Australia (28°51′S, 114°03′E) to The Pages just east of Kangaroo Island, South Australia (35°46′S, 138°18′E; Fig. 4). Until recently, stragglers have been reported as far west and north as Shark Bay, Western Australia (25°51′S, 114°05′E) and east and south only as far as Beachport, South Australia (37°29′S, 140°00′E). The species formerly extended to eastern Bass Strait, the Furneaux Group of Islands, and northwestern Tasmania (Walker and Ling, 1981). Scheffer (1958) gave the distribution of *Neophoca* as extending as far north as Port Stephens on the east coast of New South Wales (32°42′S, 151°59′E), but this record and one at Western Port, Victoria (38°22′S, 145°32′E) were based on Sivertsen's (1954) mistaken identifications of skulls from these two localities which proved to be *Arctocephalus pusillus* (Marlow and King, 1974). However, on 22 December 1989 and 9–11 March 1990, different male Australian sea lions hauled out on Birdie Beach (33°26′S, 150°54′E) and in Woolongong Harbor (34°26′S, 150°54′E) New South Wales, respectively. These are believed to be the first authenticated sightings on Australia's east coast (Fulton, 1990). Colonies mainly are found on offshore islands, but Australian sea lions haul out at several mainland sites, the status of which as breeding or just resting areas is not known, apart from the largest and best known one at Point Labatt, South Australia (33°09′S, 134°16′E) where breeding takes place (Lee, 1987). *Neophoca* occurs in the eastern one-half of the Great Australian Bight on D'Entrecasteaux Reef (32°00′S, 131°55′E; Ling and Walker, 1977; Robinson and Dennis, 1988) and a few have been seen swimming and hauled out at the base of the cliffs about 30 km east of the South Australia-Western Australia border (unpublished data).

FIG. 1. Photograph of *Neophoca cinerea* showing adult male and adult female with young at Dangerous Reef, South Australia, 8 December 1976.

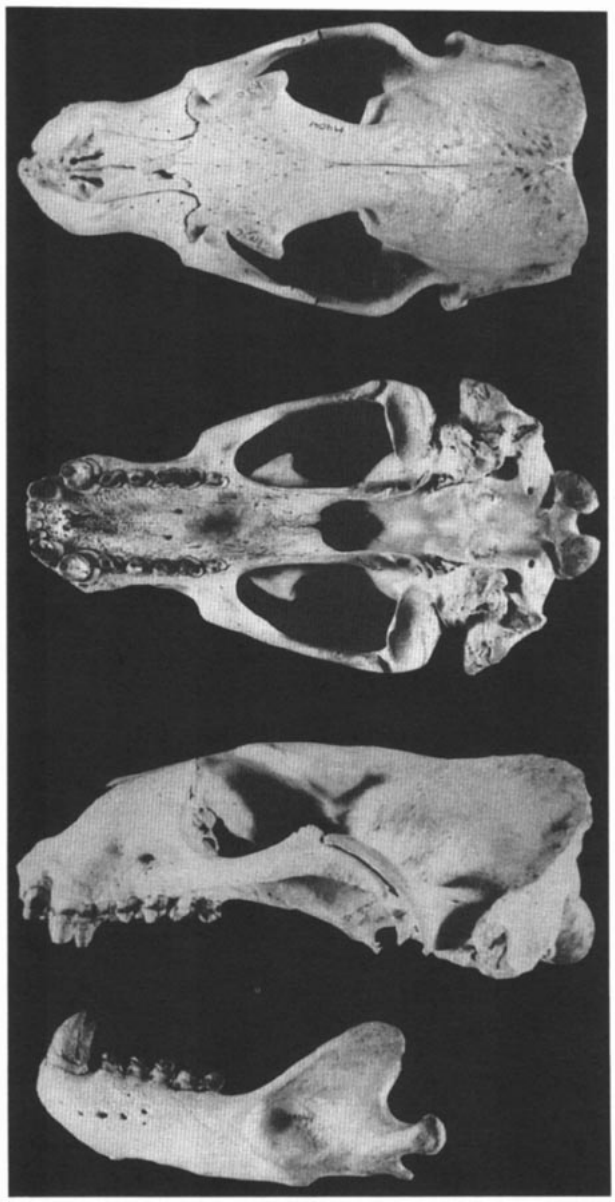

FIG. 2. Dorsal, ventral, and lateral views of cranium, and lateral view of lower jaw of a male *Neophoca cinerea* from Seal Bay, Kangaroo Island, South Australia; South Australian Museum M9041; condylobasal length, 297 mm.

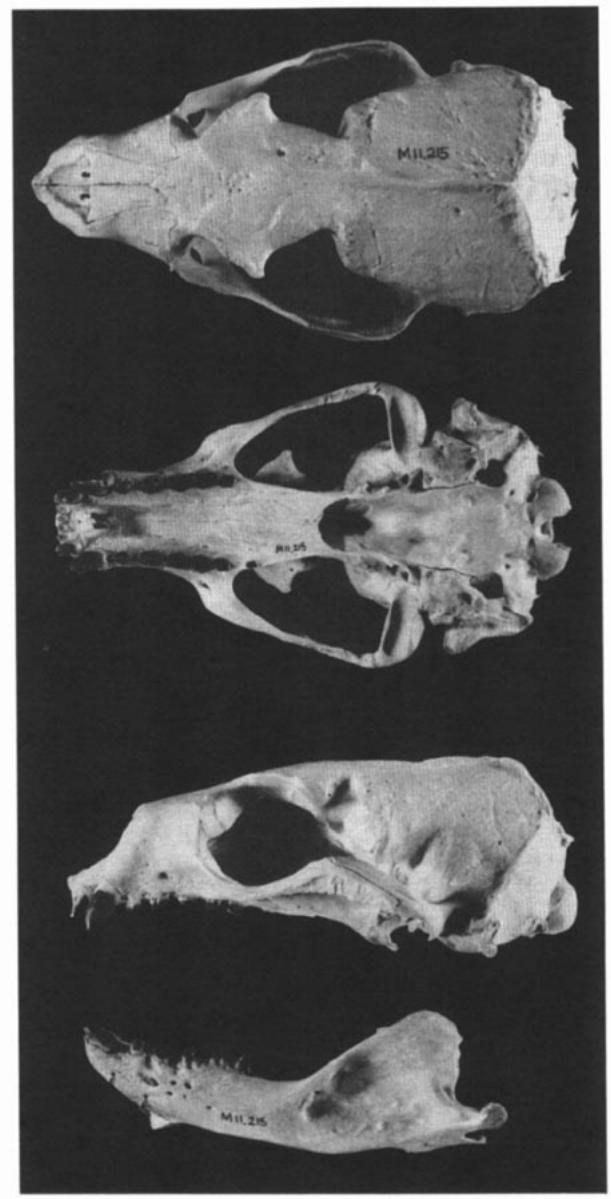

FIG. 3. Dorsal, ventral, and lateral views of cranium, and lateral view of lower jaw of a female *Neophoca cinerea* from Parsons Beach, South Australia; South Australian Museum M11215; condylobasal length, 245 mm.

FOSSIL RECORD. Until recently, otariids were thought to have arisen from the Enaliarctidae in temperate waters of the northern Pacific Ocean more than 22 mya from ursine ancestors (Barnes, 1979; Mitchell and Tedford, 1973; Repenning and Tedford, 1977). However, Berta et al. (1989) and Wyss (1989) have produced convincing anatomical evidence, supported by molecular biology studies (Árnason and Widegren, 1986), that the Pinnipedia share a monophyletic origin, with the Enaliarctidae having a sister-group relationship with the Otariidae. The earliest known otariid, *Pithanotaria starri*, is 10–12 million years old and otariids invaded the Southern Hemisphere by 5 mya. However, the sea lions, the most recent development of the otariids, appear to have spread to the Southern Hemisphere less than 3 mya and dispersed only into the south-western Atlantic from the southern Pacific (Repenning, 1976). Little is known of the fossil history of otariids in the Southern Hemisphere, and all of the material examined so far is of middle Pleistocene to historic age (King, 1983*a*; Repenning and Tedford, 1977). A fossil skull, originally described as *Arctocephalus williamsi* by McCoy (1877), was recovered from Pennington Aeolianite at Queenscliff, Port Phillip Bay, Victoria, but Marlow and King (1974) believe that it is *Neophoca*. Its age from uranium/thorium dating is 90,000–100,000 years (Gill and Collins, 1986). King (1983*b*) described a species of middle Pleistocene sea lion, *Neophoca palatina*, from Ohope, New Zealand.

FORM AND FUNCTION. Scheffer (1964), when referring to hair patterns in *Neophoca*, actually was dealing with *Phocarctos* whose skin and hair have been described (Orr et al., 1983), but have yet to be compared with the integument of its Australian counterpart *Neophoca*. Young are born with a dark grayish to rich chocolate-brown fur that has a bluish cast to it when wet. There is a paler crown and darker mask across the face. This coat is replaced by an adult-type pelage at 8–10 weeks of age, the process taking several weeks to complete. Thereafter, an annual molt takes place in August-September; shedding starts in the mid-dorsal area and spreads anteriorly (Marlow, 1975). Molting also may occur at other times of the year (Walker and Ling, 1981). Females and young males are pale brown to smoky-gray dorsally and creamy-yellow ventrally, but older males assume a more uniform darker color over the body and a creamy-white mane develops over the shoulders, neck, and back of the head (Fig. 1). The neck and chest region become scarred in older territorial males through fighting with con-

specifics. There may be other scars from wounds inflicted by sharks (probably white pointer, *Carcharodon carcharias*; Marlow, 1975), or entanglement, particularly by the neck, in nylon fishing nets, which cut deeply into the flesh (Robinson and Dennis, 1988). There are two superciliary vibrissae (eyebrows) and 44–48 mystacial vibrissae (whiskers) arranged in 7–11 rows; they are smooth (that is, not 'beaded' as in many phocids), round in cross-section, and creamy-gray in color. The longest measure up to 18 cm in length from the skin surface to the slightly abraded tip, and are up to 1.5 mm in diameter at the base (unpublished data). The usual number of mammary teats is four (King, 1983*a*).

The skeleton, apart from the skull, is basically the same as in other Otariidae. Skulls of male *Neophoca* (Fig. 2) have wider mastoid and supraorbital processes and shorter nasals than *Phocarctos*. The entire interorbital region is very wide in the former. A cylindrical prolongation of the tympanic bulla is absent in *Neophoca* and all other sea lions except *Phocarctos*. The postorbital process of the zygomatic is almost non-existent in *Neophoca*, particularly in females (King, 1960). Mean condylobasal lengths are about 304 mm for adult males and 243 mm for adult females (King, 1960; Sivertsen, 1954; Wood Jones, 1925). Mean mastoid width is 165 and 129 mm for adult males and females, respectively. The sagittal crest is strongly developed in males (Wood Jones, 1925). An ossiculum mastoideum develops as a traction epiphysis to the triangular mastoid process that is characteristic of the otariid skull (Cave and King, 1964). There is generally a greater degree of fusion of the lacrimal bone to the maxilla and frontal in *Neophoca* than in *Phocarctos*; hence, it tends to appear more as a discrete bone (King, 1971).

The otariid heart and circulatory system, exemplified by *Neophoca* (and *Phocarctos*) are more similar to those of other mammals than of phocids. The hepatic sinus develops later in *Neophoca*, but is well developed at birth in phocids. A stellate plexus and pericardial rete are absent. The extradural vein is not noticeably enlarged and the renal veins also are typically mammalian. The head is drained in typical mammalian fashion by the external jugular vein (King, 1977). Erythrocytes are large in volume (96–112 μm^3) and packed-cell volumes and haemoglobin concentrations are much greater than those of *Zalophus* (Needham et al., 1980). Plasma concentrations of 17 metabolites, electrolytes, and enzymes in *Neophoca* have similar values to those in other pinnipeds. However, mean concentrations of plasma glucose are 4.3 mM/l, about one-half those reported for *Zalophus* (Cargill et al., 1979).

The small intestine is about 20 m long and the large intestine only about 1.2 m (Richardson and Gales, 1987). Most fecal deposits consist of particles with a diameter <1.2 mm; however, orally administered marker pellets (approximate diameter 1 or 3 mm) were generally found in fecal deposits containing, principally, coarse particles; that is, of diameter >1.2 mm. About one-half of the marker pellets stayed in the tract for >6 days. Their passage may be restricted through the pyloric canal by a pyloric torus. Indigestible items such as squid beaks and crustacean exoskeletons are retained in the pyloric antrum (Richardson and Gales, 1987). The easily ground portion of a meal passes rapidly to the pylorus, through the gastroduodenal junction and along the intestine. Barium sulphate in fish shows up in the duodenum 12 min after ingestion and reaches the large intestine within 2 h. However, the contents of the colon remain for 28 h (Needham, 1981). In *Neophoca*, the ratio of the small intestine to the large is about 17:1, compared with 2:1 in *Ommatophoca*, 36:1 in *Eumetopias jubatus*, and 42:1 in *Mirounga leonina*. Although the relatively long small intestine in most pinnipeds is still an enigma, the differences may be related to different diving and resting behaviors linked with different levels of gastrointestinal motility (Richardson and Gales, 1987). Stones up to 5 cm in diameter often occur in stomachs and may prevent large pieces of food from reaching the pyloric orifice (Needham, 1985).

Read et al. (1982) described and treated surgically a prolapsed vagina believed to have been caused by pressure of a gravid uterus down through the pelvic canal. *Neophoca* young take an average of 13.6 breaths/min and adults 3–5 when resting on land. The respiratory cycle is a short exhalation followed by a short inhalation; then a longer period of apnea up to 12 s. While cruising leisurely in the water, adult males breathe on average every 17 s (range, 11–48 s) and females breathe at the same average rate, but the range (10–34 s) is smaller (Marlow, 1975).

ONTOGENY AND REPRODUCTION. At North Fisherman Island, Western Australia (30°08′S, 114°57′E), near the western extremity of *Neophoca*'s distribution, parturition seems to peak about mid-year, although births can extend throughout the year (Ling, 1980). Other evidence suggests an 18-month interval between births. R. E. Johnstone (in litt.) saw newborn there in May–June 1973 and not again until late November 1974. Ling and Walker (1979) saw young at the Purdie Islets, South Australia (32°16′S, 133°14′E) in late October 1977 and then not again in the same area until late February 1979. According to Marlow (1968, 1975), parturition at Dangerous Reef, South Australia (34°49′S, 136°12′E) extends from mid-October to mid-December. A 4–7-day post-partum estrus occurs. Stirling (1972*a*) observed newborn young at the South Neptune Islands, South Australia (35°20′S, 136°07′E) in October. Ling and Walker (1978) produced some evidence of an approximately 18-month interval between parturition dates for *Neophoca* at Seal Bay on Kangaroo Island, South Australia (36°00′S, 137°20′E). They suggested that this could come about through a variable time of either mating or implantation; assuming there is a free blastocyst stage, and fetal development after implantation is approximately 7–8 months as in other pinnipeds (Riedman, 1990). Delayed implantation in *Neophoca*, has not been reported in the literature, but post-partum mating has (Marlow, 1968, 1975). Ling (1986), describing twin fetuses aborted on 23 January at Kangaroo Island, estimated their post-implantation ages to be 13 weeks which means that, assuming a typical pinniped gestation period, they would have been born in about mid-June when the next breeding season took place. This indicates there is a pre-implantation period of about 8–9 months. However, Stirling (1972*a*) found a dead young only a few days old that had been born in June, about 4 months early, suggesting that development had commenced immediately after fertilization. Marlow (1968) reported a number of stillbirths in July at Dangerous Reef, some 3 months before the commencement of the breeding season. Newborn are 62–68 cm long and weigh 6.4–7.9 kg; males are heavier on average than females. The birth weight is doubled at 2–4 months of age (Walker and Ling, 1981).

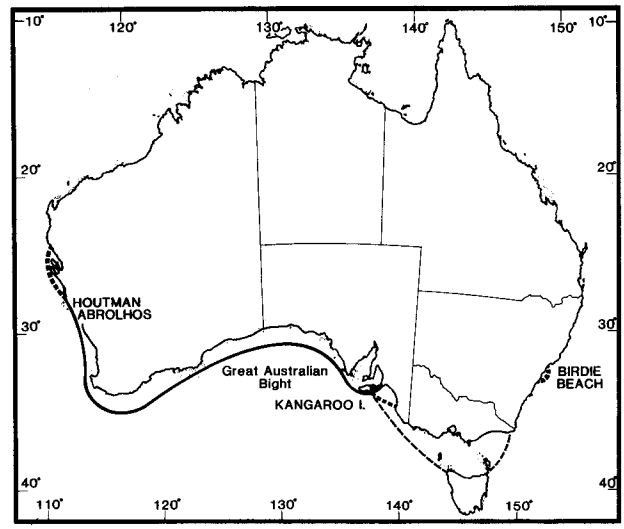

FIG. 4. Map showing past and present distribution of *Neophoca cinerea* and type locality (dot). Unbroken line depicts known present distribution; thin broken line depicts extent of former range; thick broken line depicts current seasonal stragglers.

Up to 14 days of age, young stay close to their mothers with which they maintain much physical contact, after which the females go to sea for the first time since coming ashore to give birth. At this age too, the young may enter shallow rock pools and play with each other amongst the rocks. Later on, they begin to swim and play in the larger rock pools and along the open shoreline. Females later call their pups into the sea and accompany them until after the post-natal molt is completed and the young are able to fend for themselves in the water (Marlow, 1975; Walker and Ling, 1981). Marlow (1972) recorded three cases of females attempting to abduct young that were not their own. The abducting females appeared to have lost their own offspring.

Suckling many begin <1 h post-partum, but usually starts about 2 h from parturition, still before the placenta is passed. When young are older, females return to feed them every 1–2 days, and

suckling bouts last about 1 h. Lactation lasts for at least a year, based on marked animals observed at Dangerous Reef (Marlow, 1975). At Seal Bay, females have been observed suckling young up to 75% of their own size and believed to be up to 18 months old (Ling and Walker, 1977). Stirling (1972*a*) thought some young still being suckled were as old as 2 years. Because the lactation period is so long in *Neophoca*, females may produce milk continuously once they begin to bear young. If two young of different ages accompany an adult female, only the smaller one is suckled (Marlow, 1975).

Stirling (1972*a*) examined teeth from 25 males and 2 females collected at the South Neptunes (35°20′S, 136°07′E) and 13 males and 7 females from West Bay (on the southwestern corner of Kangaroo Island; 35°54′S, 136°32′E). There was a preponderance of animals aged 7 years or more; the oldest were >12 years, compared with 14–16 years of the two captive males referred to above. Two tagged females were found dead in May 1988 at Kangaroo Island, where they had been marked 11 years previously. Death appeared to have been from natural causes (unpublished data).

Neophoca females may be capable of breeding at 3 years of age to compensate for their short life expectancy (Stirling, 1972*a*). Fully developed harem males may be >6 years old, based on being able to identify age categories up to that age (Marlow, 1975).

ECOLOGY. Sixty-eight island and three mainland haul-out sites have been identified in South Australia. Of these, 38 contained more than 10 individuals when inspected (Robinson and Dennis, 1988). The geographic range of *Neophoca* includes that of *Carcharodon carcharias* and other species of sharks. Australian sea lions often haul out bearing large wounds apparently resulting from attacks by sharks. Dangerous Reef, an important breeding site of Australian sea lions, also is notable for its large numbers of *C. carcharias* (Marlow, 1975).

Scheffer (1958) estimated the total population of *N. cinerea* at 2,000–10,000. However, Abbott (1979) estimated the Western Australian population to be only about 700 and Ling and Walker (1977) obtained a combined total of 2,300 from 36 haul-out sites, including all of the major areas, in South Australia. Allowing for those animals missed or at sea, they placed the South Australian population at about 3,000 and the Australian total at 4,000–5,000. Robinson and Dennis (1988) put it at 3,500, based on much more extensive censuses; but recent estimates put populations in Western Australia and South Australia at 3,100 and 6,900, respectively (Gales, in litt.). No data exist on pristine populations, but Gilbert (1843; cited by Abbott, 1979:377) described "very thickly inhabited" islands of Houtman Abrolhos. Cumpston (1974:117, 120, 122, respectively) mentioned 600, 1,000, and 400 "hair seal" skins among three cargoes each of several thousand fur seal pelts landed at eastern Australian ports in the early 19th century. Even allowing for their low commercial value, Australian sea lions may not have been numerous around the southern Australian coast before sealing began (Ling and Walker, 1977). Abbott (1979) believes that *Neophoca* has retained its former distribution in Western Australia but was more abundant in earlier times.

Discontinuous census data exist for the Seal Bay (Kangaroo Island) colony since 1963 (Robinson and Dennis, 1988). Up to 1973, numbers were about 200, fluctuating from 50 to 290. The size of this colony has more than doubled in the last decade and fluctuates around 400, with up to 170 births occurring in a season (Ling and Walker, 1976), accounting for almost 30% of the South Australian population (Ling and Walker, 1979). However, in May 1987 there were 1,130 Australian sea lions on The Pages, east of Kangaroo Island, and at the same time 400 were counted at Seal Bay (Robinson and Dennis, 1988). A mortality rate of 36% over a 5-month period since being tagged (that is, up to about 6 months of age) tentatively has been estimated at Seal Bay. Deaths are caused by crushing, drowning, and unknown disease, and probably starvation and predation (Ling and Walker, 1976). Overt aggression by conspecifics was the main cause of death of young *Neophoca* at Dangerous Reef; larger animals of both sexes being responsible (Marlow, 1975). Drowning and strangulation in monofilament fishing nets causes mortality in older Australian sea lions after they have become entangled as juveniles (Robinson and Dennis, 1988).

At Kangaroo Island, the number of adult females is three to four times the number of adult males and the number of subadults is about 1.5 times the number of adult females (Ling and Walker, 1979). Marlow (1968, 1975) stated that harems contained from one to four females per male.

While there are insufficient data to analyze population trends in detail, there is nothing to suggest any significant change in numbers over the past decade. There certainly is evidence, however, of considerable mobility between major haul-out sites, which accounts for the large fluctuations in numbers at these localities (Robinson and Dennis, 1988). *Neophoca* occupies a moderate environment compared with most other pinnipeds and its life history and population structure may reflect this (Ling and Walker, 1977).

Neophoca does not compete for space with the other otariid, the New Zealand fur seal (*Arctocephalus forsteri*), which occurs over much of the same geographic range. *A. forsteri* exclusively occupies rocky headlands where a few individual Australian sea lions may haul out occasionally among them. There is little or no interaction between the two forms (Ling and Walker, 1976). New Zealand fur seals are rarely, if ever, seen on sandy beaches or even rocky areas among Australian sea lions, which tend to rest on sandy beaches and use rocky platforms or shingle beaches for breeding (Ling and Walker, 1976, 1977; Marlow, 1975). *Neophoca* is agile and capable of scaling steep slopes to rest in caves and overhangs on the way up or lie out at the top, high above the beach. They sometimes move considerable distances inland (Wood Jones, 1925). Post-breeding dispersion takes place and severe disturbance at colonies results in their abandonment for several years during which other areas are colonized. *Neophoca* is not known to migrate. The longest recorded movement of a tagged Australian sea lion, a young male, was at least 250 km by sea from Seal Bay to Port Vincent (34°46′S, 137°52′E), where it was found dead (apparently killed by a boat's propeller; Walker and Ling, 1981). Others have dispersed 20–40 km to other parts of Kangaroo Island. Large old males sometimes haul out in a weakened state onto beaches near Adelaide (and presumably elsewhere) about 100 km by sea from the nearest breeding sites. Hence *Neophoca* may be regarded as a fairly sedentary, non-migratory species that probably spends much of its life close to its birth site (King, 1983*a*; Wood Jones, 1925).

Squid beaks have been commonly associated with mummified carcasses and skeletons, which suggests that squids form part of the diet (Marlow, 1975). Australian sea lions have been observed catching and ingesting cuttlefish (*Sepia*; Cockerham, 1985; West, 1986). The prey is held by the fore-flippers and torn apart and swallowed; after a while the "cuttlebone" is expelled. West (1986) saw the same animal eat two cuttlefish within 1 h and a third 3 h later after resting on land for 2 h. After eating cuttlefish, the feces appears black. Prey usually is grabbed in the mouth and either tossed in the air to separate the cuttlebone or shaken vigorously from side to side to break it up. *Neophoca* also has been known to feed on Australian salmon, *Arripis trutta* (Storr, 1965). Fishermen also have reported that *Neophoca* takes whiting (*Silliganodes*), school shark (*Galeorhinus*), and gummy shark (*Mustelus*) from nets. Australian sea lions appear to attack these sharks and eat the livers (Robinson and Dennis, 1988; Walker and Ling, 1981), which contain a high concentration of vitamin A. The liver of *Neophoca* also carries a high level of vitamin A that is toxic to humans (Cleland and Southcott, 1969; Southcott, 1982).

Ectoparasites recorded from *Neophoca* are the louse *Antarctophthirus microchir* (King, 1983*a*; Marlow, 1975) and the mite *Halarachne* (*Orthohalarachne*) *attenuata*, which has been found on the palate of dead young (Marlow, 1975) and, along with *O. diminuata*, in the nasal passages of adults (Nicholson and Fanning, 1981). Endoparasites include the cestode *Diphyllobothrium arctocephalinum* (Johnston, 1937), the trematode *Mesostephanus neophocae* (Dubois and Angel, 1976), the nematodes *Contracaecum osculatum* (Johnston, 1937; Johnston and Mawson, 1941), and an undescribed species of *Parafilaroides* from the lungs (Nicholson and Fanning, 1981), and the acanthocephalan *Corynosoma australe* (Johnston, 1937; Johnston and Best, 1942).

Australian sea lions are of considerable indirect economic value in South Australia (Stirling, 1972*b*), and management of this resource has taken a high priority. Measures include monitoring the population and control of visitors to Australian sea lion colonies, including the prohibition of entry to breeding and nursery areas. At Seal Bay, Kangaroo Island, in addition to restrictions inland, a marine reserve also has been established that limits the activity of vessels offshore (Anonymous, 1987; Robinson and Dennis, 1988).

Young *Neophoca* and adult females have been captured, measured, weighed, tagged, and released at a number of sites in South

Australia (Ling and Walker, 1976, 1977, 1979). Adults are caught in hoop nets; the young are caught in hoop nets or by hand and held and weighed in sacks (Ling, 1977), and the females in pig nets. Monel metal and plastic "Allflex" cattle ear-tags, of various colors are applied to the trailing edge of the fore-flippers (Ling and Waliker, 1976, 1977).

There have been three recent births in the Adelaide Zoo (King, 1988). Haynes-Lovel (1988) has described the conditions under which Australian sea lions recently introduced into Taronga Zoo (Sydney), will be kept, including a sophisticated filtration system and chlorination plant, a wave generation unit, "natural" haul-out areas, a large viewing window for the public, and narrated underwater feeding demonstrations. Australian sea lions have also been behaviorally conditioned to submit themselves to various captive management procedures, such as weighing, measuring, clinical examination and data collection (Steele, 1988). *Neophoca* also are kept successfully in captivity at Ocean Park in Hong Kong, Kamogawa Sea World in Japan (Anonymous, 1979*a*, 1979*b*), and Atlantis Marine Park, Western Australia.

BEHAVIOR. *Neophoca* is more aggressive than *Phocarctos* and this aggression plays a major role in mortality and the survival of the species. Behavioral differences are attributed to differences in habitat and to innate behavior patterns. *Neophoca* males establish territories on rocky substrates such as gullies, platforms, or boulder beaches, where natural features mark territorial boundaries. These are defended by posturing, vocalizing a guttural clicking noise, and by fighting. Males may sometimes simply lie down on their bellies and eye each other. Aggression rarely continues in the water. Territories are defended for 4–5 days after which, if no females have arrived, the males move off and try to establish a territory elsewhere. Because of the protracted nature of the breeding season, parturient females arrive singly and in pairs a few days before giving birth and join others or select a secluded spot that may or may not be within a dominant male's territory. The males herd the females within their territories to prevent escape. Mating takes place about a week postpartum. It is preceded by courtship involving extension of the vibrissae and clicking by the male and gentle biting and head- and neck-rubbing by the female (Marlow, 1975).

Parturition is preceded by a general restlessness of the female, which may persist for >1 h. The amniotic sac then appears and the female raises herself up on her fore- and hind flippers, straining visibly. These activities continue and intensify until the sac ruptures and its contents are voided. The head or hind flippers of the young then appear (25% of births are head presentations) and the final act of parturition is a series of violent swings of the hind quarters, which expel the young and break the umbilical cord. The female immediately turns round and smells her offspring, which soon begins to vocalize (Marlow, 1975).

Females normally guard their young carefully, but the young are vulnerable to attack by other Australian sea lions when their mothers are engaged in copulation and the young are not tucked away in some crevice. Young straying too close to another female or a male are likely to be grabbed roughly and tossed high into the air to land many meters away; sometimes sustaining serious, or even fatal injuries (Marlow, 1975).

Recognition between females and offspring depends on sound and smell. Females returning from the sea emit a high-pitched "moo" and the young respond with a higher-pitched sound more like a squawk. Males emit guttural threats and growls as well as high-pitched barking during agonistic disputes (Stirling, 1972*a*). Young Australian sea lions engage in a great deal of play on land and in shallow rock pools; fighting, swimming, diving, and chasing each other with much vocalization. Females may push their young under the water and the young sometimes ride piggyback on their mothers (Walker and Ling, 1981).

Neophoca is a powerful and skillful swimmer. It uses wide-sweeping strokes of its fore-flippers for rapid propulsion, while the hind flippers act mainly as rudders and for balance. Australian sea lions are extremely manouverable and can swim at high speeds sometimes leaving the water altogether in shallow arcs and "porpoising" to gain greater speed. While the large males are rather ponderous on land, they can easily outswim the females and younger males in the water (Marlow, 1975).

Rapid terrestrial locomotion consists of an ungainly gallop, with front and hind flippers moving in unison, but the gallop is never sustained for more than about 10 m. Even the slow waddle from the beach to the water is punctuated by several rests (Marlow, 1975).

During the non-breeding season particularly, Australian sea lions spend long periods resting on land either on the beach or among sand dunes, which, at Seal Bay on Kangaroo Island, are covered with a thick growth of salt bush (*Atriplex cinerea*), under which they may shelter on hot days. Another favorite resting site, particularly for adult males, are large banks of seaweed in the intertidal zone. Males tend to lie about separately, but females exhibit a moderate degree of thigmotaxis and actively seek out another body to lie against amid an almost constant shuffling, wriggling, and squirming (Ling and Walker, 1979).

REMARKS. Other common names used mainly in the past include hair seal (particularly in Australia), white-capped or white-necked hair seal, and counsellor seal. The generic name *Neophoca* means new seal in Greek, and the specific epithet *cinerea* means ash-colored.

Péron (1816) based his description of the species on either females or immature males (or both) that he saw at Kangaroo Island. Later he saw some adult males at St. Peter Island, Nuyts Archipelago, which he thought to be a different species and to which he gave the specific name *albicollis* (white-necked). Quoy and Gaimard (1830) noted that the seals in King Georges Sound, Western Australia, had short hair without underfur and were therefore different from the seals they had previously seen at Westernport, Victoria (=*Arctocephalus pusillus doriferus*). They called the seals at King Georges Sound *Otaria australis* (=*Neophoca*). Bonnemains et al. (1988) published, for the first time, Lesueur's original watercolor drawing of *Neophoca* based on observations at Kangaroo Island in 1802. Ray and Ling (1981) published another early painting (attributed to George French Angas) of *Neophoca*, based on field sketches (also reproduced) made in May 1844 at Rivoli Bay, South Australia (37°29'S, 140°02'E).

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