# The Biology, Ecology, Taxonomy, and Conservation of *Neophoca cinerea*

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**Abstract:**

*Neophoca cinerea,* commonly known as the Australian Sea Lion, is an endangered species that resides between the Page Islands in South Australia and the Houtman Albrohols in Western Australia (Seal Conservation Society, 2011). They are part of the family Otariidae and the subfamily Otariinae (Berta et al. 29 2015). The Australian Sea lion possesses a wide range of unique breeding and interactive behaviors that fascinate researchers and attract many tourists. *Neophoca cinerea* are protected by the National Australian Government, as a means to conserve their population, as humans pose as a great threat to their existence (Marine Bio Conservation Society, 2013). This papers aims to provide knowledge about the biology, ecology, taxonomy, human impact, and conservation of the endangered *Neophoca cinerea.*

**Introduction**:

The *Neophoca cinerea*, is a species that is endemic to Australia. It is one of the most endangered species of pinnipeds, with a remaining population of about 10,000 to 12,000 individuals (Seal Conservation Society, 2011). The generic name, *Neophoca* is Greek, and means "new seal". The species name of *cinerea* is the Greek word for "asch-colored". The Australian naturalist François Peron originally used the species name of *allbicolus,* or "white necked" as a means to describe the Australian Sea Lion that he observed in 1817 (Ling, 1992).

**Anatomy and Biology:**

The *Neophoca cinerea* and the *Phocarctos* genus, which includes the *Phocarctos hookeri* species, common name the New Zealand Sea Lion, are often

confused when comparing animals of the same size and sex. There are various anatomical characteristics of the *Neophoca* genus that allows for identification. One is that there is an absence of a postorbital process from the zygomatic arch in the skull. Another anatomical characteristic that helps to identify *Neophoca cinerea* is that their dental arrangement is different from the *Phocarctos* and they have a total of 34 teeth.

The skeleton of *Neophoca cinerea* is essentially identical to that of other Otariidae. In *Neophoca cinerea,* along with most other sea lions, there is an absence of a cylindrical prolongation in their tympanic bulla. In mature males, on average, their condylobasal lengths are approximately 304 millimeters, and their mastoid width is about 165 millimeters. In mature females, on average, the cylindrical prolongation of their tympanic bulla is about 243 millimeters in length, and their mastoid is 129 milimeters respectively. Males possess a well-developed sagittal crest, as well as developing an ossiculum mastoideum as a traction epiphysis to the triangular mastoid process. The aforementioned is common among the skulls of Otariidae.

The heart and circulatory system of *Neophoca,* which is present in all otariids, are more similar to other mammals than that of phocids. *Neophoca cinerea* differ from phocids in that their hepatic sinus develops later, while phocids are born already possessing a well-developed hepatic sinus. *Neophoca cinerea* do not have a pericardial rete and a stellate plexus. Their renal veins are that of a typical mammal, while their extradural vein is not visibly enlarged. In *Neophoca cinerea,* the external jugular vein drains the head, which is common to mammalians. They have erythrocytes that are large in volume and have hemoglobin concentrations that are much greater than those of the *Zalophus* individuals (includes individuals such as Galapagos sea lion and California sea lion). The concentration of 17 metabolites, electrolytes, and enzymes in the plasma of *Neophoca cinerea* is similar to other pinnipeds. The average concentration of glucose in the plasma of *Neophoca cinerea* is about half of the average concentration in *Zalophus.*

*Neophoca cinerea* have a small intestine that is measured at about 20 meters in length, while their large intestine is measured at about 1.2 meters in length. The

ratio of small intestine to large intestine is 17:1 in *Neophoca cinerea.* Ratios of small intestine to large intestine vary in different species, which may be related to different diving and resting behaviors associated with different levels of gastrointestinal motility. The passage of waste may be restricted by the pyloric torus through the pyloric canal. Indigestible items, which include squid beaks and the exoskeletons of crustaceans, remain in the pyloric antrum. Easily passable waste passes quickly to the pylorus through the gastroduodenal junction, then along the intestine. Items, such as Barium Sulfate, which is present in fish, appears in the duodenum about 12 minutes after a meal, and reaches the large intestine within 2 hours, while the items in the colon could remain for as long as 28 hours.

On average, *Neophoca cinerea* take about 13.6 breaths per minute, while resting on land, when they are young, and as adults, they take about 3 to 5 breathes per minute. The range of breaths that adult *Neophoca cinerea* take while swimming leisurely in the water is about one breath every 17 seconds. Adult males, however, vary more in breathing patterns than females.

*Neophoca cinerea* are extremely skilled and strong swimmers. They perform strokes that are wide sweeping, with their fore-flippers, in order to propel themselves forward rapidly. Their hind flippers do not contribute as much to propulsion and rather function in balance and as rudders. *Neophoca cinerea* are able to swim at speeds that are so fast that they leave the water completely in shallow arcs. They constantly swim up and down in a “porpoise- like" manner to gain speed. As a result of their great size, large male *Neophoca cinerea* are more sluggish and clumsy on land, but can easily outswim females and young males in the water (Ling, 1992).

**Appearance:**

The profile view of the face of *Neophoca* is less round, sharper, and its muzzle is longer than that of the *Phocarctos*. Male *Neophoca cinerea* have a much larger head than female, and juvenile *Neophoca cinerea* (Ling, 1992). Males also have a brown coat color and mane-like yellow patches on their neck and the top of their

head. *Neophoca cinerea* females have a silver gray coat color on their back and a cream colored coat on their front.

Adult Male *Neophoca cinerea* weigh about 250 to 300 kilograms and are about 2 to 2.5 meters in length. Adult females weigh about 61 to 104 kilograms and are about 1.3 to 1.8 meters in length (Marine Bio Conservation Society, 2013). *Neophoca cinerea* pups are about 60 to 70 centimeters in length and weigh about 6.5 to 8 kilograms when they are born. They are also born with a temporary chocolate brown coat, which soon is lost and replaced with an adult coat at about 8 to 10 weeks of age (Hoglund, 2003).

**Systematics, and Evolution:**

*Neophoca cinerea* are from the order of Carnivora and the suborder of Pinnipedia. They are more specifically in the family of otariidae, which includes sea lions, eared seals, and fur seals (Berta et al. 29 2015). Sea lions are from the subfamily Otariinae. Based on morphological data, the family Otariidae, arose from the Enaliarctidae, who used to reside in temperate waters of the Northern Pacific Ocean over 22 million years ago. Even older ancestors of otariids include ancestral ursids. Recently, however, important anatomical evidence, as well as molecular data, support that all pinnipeds are monophyletic and the Enaliartidae had a sister-group relationship with the Otariidae.

10 to 12 million years ago, the *Pithanotario starri,* the earliest known otariid, existed. While otariids originally moved into the southern hemisphere about 5 million years ago, sea lions moved into the Southern hemisphere about 3 million years ago. Sea lions are the most recently evolved otariids. There is a lack of known fossil record history of Southern Hemisphere otariids. All of the found material has come from the middle Pleistocene era (Ling, 1992).

**Distribution:**

As previously mentioned, the *Neophoca cinerea,* is endemic to Australia. It is the only endemic pinniped to Australia. The distribution range of *Neophoca cinerea* rages from the Houtman Abrolhos Islands in Western Australia to The Pages, just

east of Kangaroo Island in South Australia. Some *Neophoca cinerea* have been found more northwest in Shark Bay, Western Australia (Australian Government; Department of the Environment, 2016). Some have also been found more southeast in Beachport, South Australia. The distribution of *Neophoca cineera* used to extend to Eastern Bass Strait, Northwestern Tazmania, and The Furneaux Group of Islands.

*Neophoca cinerea* colonies usually reside on off shore Islands, but sometimes travel to a few mainland sites. It is unknown if the mainland sites are used as breeding areas or resting sites. One known status, of a mainland site, is Point Labatt in South Australia, which is the most famous and largest site for *Neophoca cinerea* breeding (Ling, 1992).

**Reproduction and Breeding:**

*Neophoca cinerea* live between 12 to 24 years on average with a maximum life span of 24.1 years. Females reach sexual maturity at about 3 to 6 years of age, while males also reach sexual maturity at around 3 to 6 years of age (Hoglund, 2003). *Neophoca cinerea* are polygynous species.

Males find and secure a territory for breeding where they defend it against other males. They perform ritualized posturing and engage in aggressive confrontation with the other males near their territory (Hoglund, 2003). Males will make a clicking sound to vocalize that they have established their territory. Males will often also lie down on their stomach and stare at each other as a method of territory defense. Although these aggressive confrontations are common on land, they rarely continued in the water (Ling, 1992). In order to obtain food, the male will occasionally leave his territory for a few hours at a time. If another male overtakes his territory during this feeding period, the males will aggressively battle in order to control the territory. The *Neophoca cinerea* males will allow multiple females on their breeding territory. If a female leaves the site of the territory, the male will aggressively bring her back and make her stay on his territory, even if the male has to trespass onto another males territory to retrieve the female. Male herding of females is a behavior that is uncommon in other sea lions (Hoglund,

2003). A male will defend his territory for four to five days, then will move to establish another territory if no females arrive (Ling, 1992).

Males have been observed to kill sea lion pups, however, not their own pups. This notion of territorial defense in males is believed to possibly be an indirect mechanism of paternal care for their young. Evidence has been found, that cooperative care is present among *Neophoca cinerea* females, in which they care for pups that do not belong to them (Hoglund, 2003).

*Neophoca cinerea* have an asynchronous breeding cycle of about 17.5 months (Australian Government; Department of the Environment, 2016). The breeding cycle does not occur annually, which was originally believed to be affected by environmental factors. Now it is believed to be affected by an unknown factor rather than environmental conditions. In any colony of *Neophoca cinerea,* births can occur during a reproduction period that spans from 4 to 6 months.

Males copulate with a group of 4 to 5 females simultaneously in their breeding territory. After about 6 days following giving birth, females enter a state of estrous and are mated by the male at this time (Hoglund, 2003). The period of estrous is preceded by courtship, which involves the extension of the vibrissae and a vocal clicking made by the male, while the female will engage in gentle biting and neck rubbing with the male (Ling, 1992).

It is common for pinnipeds to experience a 3-month delay in implantation, which is then followed by an 8 to 9 month period of placentation. *Neophoca cinerea* experience a longer interbirth interval, which is different than that of the average pinniped. It is believed by some speculators that *Neophoca cinerea* experience a delay in implantation of blastocyst, which is about 10 to 11 months. This implantation period is longer than that of the average pinniped, however, the length of pregnancy of *Neophoca cinerea* is the same as the average pinniped. Other speculation, says that implantation in *Neophoca cinerea* is the same length as a typical pinniped (around 5 to 6 months), and an abnormally long placentation is present (longer than one year) (Hoglund, 2003).

**Parental and Unique Behaviors:**

*Neophoca cinerea* are usually weaned off of nursing, at 15 to 18 months, just prior to the birth of subsequent offspring, although females have been observed to nurse pups of many different ages at the same time. Two days prior to giving birth, female *Neophoca cinerea* perch and create a natal site on shore. The female will remain at the natal site until approximately 10 days after birth when she returns to the water for food. The female then returns to land every few days in order to nurse her offspring, where she remains with her pups for about 33 hours at a time. The pups are born altricial at birth, and at 3 months are able to follow their mother on land and into the water (Hoglund, 2003). The female *Neophoca cinerea* use vocal and scent communication in order to locate and identify their young. Females that return from the sea for their young, vocalize a high-pitched "moo", while the pups respond with a high-pitched "squawk" (Ling, 1992). Pups often form small groups as they mature, and begin to swim in shallow waters before leaving the shore and traveling into the ocean with their mother.

Some female *Neophoca cinerea* have been observed to be aggressive to pups other than their own, while others have been reported caring for groups of pups other than their own. Paternal care for *Neophoca cinerea* pups is not present, although by protecting their breeding territories the fathers are believed to possibly be protecting their offspring from other male *Neophoca cinerea.*

As previously mentioned, *Neophoca cinerea* display fostering behavior, which is atypical for pinnipeds. Females, at their own expense, protect and nurse other pups that are not their own. If the mother of the other pups was killed, some *Neophoca cinerea* females will even adopt the other pups as their own. It has been observed in the Seal Bay region that some females have even participated in babysitting behaviors. The babysitting behaviors include, protecting a group of pups even if they are not her own pups. If the female exhausts while displaying babysitting behaviors, she will leave and another female *Neophoca cinerea* will take her place. Although there have been many observations of this altruistic behavior, their have been some observations of female *Neophoca cinerea* displaying agnostic behavior towards pups that are not their own. It has also been found that female *Neophoca cinerea* familial relationships will affect their behaviors towards pups.

As aforementioned, males do not protect their pups and will often kill pups. They are often observed being extremely aggressive towards pups and biting or shaking them to death. Male *Neophoca cinerea* often sexually harass groups of females and behave playfully with other males. A unique behavior that *Neophoca cinerea* have is the swallowing of gastroliths. They are believed to exhibit this behavior in order to balance their weight while diving for meals (Hoglund, 2003).

**Ecology:**

There is a lack of information available on the diet of *Neophoca cinerea* (Marine Bio Conservation Society, 2013). It is known however, that their major source of food consists of blue-throated wrasse, and octopus. It has been found that they also often eat squid, cuttlefish and other small fishes (whiting, rays, and small sharks). *Neophoca cinerea* primarily focus on shallow water benthic organisms and dive no greater than 37 meters in depth for food. Some sources suggest that they even occasionally prey on penguins as well (Hoglund, 2003). It has been found that female *Neophoca cinerea* feed in relatively shallow waters near the shore, more specifically about 20 to 30 kilometer off shore. Females, however, will also feed in deeper off shore waters as well (Australian Government; Department of the Environment, 2016). When *Neophoca cinerea* catch prey, it is often times grabbed by their mouth and tossed in the air to separate the cuttlebone or shaken vigorously from side to side as a means to break it up (Ling, 1992). *Neophoca cinerea* is considered to most likely have a role in the ecosystem as a regulator on fish and penguin population (Hoglund, 2003).

Sharks pose as a dangerous predator to *Neophoca cinerea.* Great white sharks in particular prey on them. The region in which *Neophoca cinerea* range includes many sharks, such as *Carcharodon carcharias,* who have been observed to attack *Neophoca cinerea* and leave them with large scars and wounds. An important breeding site for *Neophoca cinerea*, Dangerous Reef, is an area, in which *Carcharodon carcharias* are plentiful.

Another otariid, *Arctocephalus forsteri,* commonly know as the New Zealand fur seal, which shares a similar geographic range does not pose as a competitor for space with the *Neophoca cinerea,* however some believe that they do compete for some resources*. Arctocephalus forsteri* resides on rocky headlands where *Neophoca cinerea* occasionally haulout among them, although there is little to no interaction between the two species. The New Zealand fur seals are very rarely seen on sandy beaches or rocky areas among *Neophoca cinerea*, who tend to be present in these types of locations for resting and breeding.

*Neophoca cinerea* are agile individuals who often scale steep slopes to have resting sites in caves and overhangs. Occasionally, they travel inland for great distances. *Neophoca cinerea* do not typically migrate and are considered to be a sedentary species that spends the majority of its life in close proximity to its birth site. The longest recorded movement was of a tagged young male *Neophoca cinerea* who traveled at least 250 kilometers by sea from Seal Bay to Port Vincent, where it was found dead, most likely killed by a propeller of a boat. Other *Neophoca cinerea* have been observed to travel 20 to 40 kilometers to other areas of Kangaroo Island. Weak large old *Neophoca cinerea* males haulout to beaches near Adelaide, which is about 100 kilometers from the nearest breeding sites by sea. Upon completion of breeding, or as a result of other disturbances, *Neophoca cinerea* disperse and colonize other areas from the current site (Ling, 1992).

**Human Threat and Conservation:**

Humans historically have posed as a huge threat to the *Neophoca cinerea,* associated with seal lion hunting and overharvest through sealing activities. In the 18$^{th}$ and 19$^{th}$ century *Neophoca cinerea* were exploited for their hide and oil. These activities were discontinued in the 1920s; however, the population of *Neophoca cinerea* has not been able to recover to pre-exploitation levels. Presently, humans still pose as the largest threat to the *Neophoca cinerea*. One of the main threats to *Neophoca cinerea* is the entanglement in fishing nets such as shark nets and crayfish pots in particular. Some are concerned by the placement of fish farms near

*Neophoca cinerea* haulouts and feeding areas because it has been found that the shooting of *Neophoca cinerea* has occurred as a means to protect the fish. The extent to which this occurs is unknown, and this act is highly illegal. Populations are vulnerable to human disturbance especially during the time of breeding.

The *Neophoca cinerea* is now listed as Rare under South Australia Legislation. Since 1964, it has received full legal protection. In Western Australia it has received Special Protected Species Status as well as being protected under legislation since 1892. Since 1975, *Neophoca cinerea* have been protected under national Australian legislation. Small colonies are currently under protection in South Australia, by the Great Australian Bight Marine Park since 1996, when it was created by the South Australian Government, and further developed by the Australian National Government in 1998.

Recently, evidence has been found that the *Neophoca cinerea* population has leveled off, but still possibly on the decline. Recent research has also portrayed unexplained signification fluctuations in the mortality rate of pups. This may be endangering the whole species of *Neophoca cinerea.* One example of this is in the 1999 breeding season at the Dangerous Reef colony in South Australia, where the pup mortality rate was at a record high of 41 percent for the colony. This has caused for concern due to the fact that the population may be decreasing as a result. It is believed that aggressive behaviors of adult male *Neophoca cinerea* against pups were the cause of this high mortality rate. Lack of food and other factors may have contributed to this increased mortality rate, however, definite causes remain unknown (Marine Bio Conservation Society, 2013).

*Neophoca cinerea,* are economically valuable in South Australia and preservation of the population has been made a high priority. *Neophoca cinerea* attract tens of thousands of tourists per year to Seal Bay on Kangaroo Island (Hoglund, 2003). Measures to protect the population include monitoring the population, as well as regulation of *Neophoca cinerea* colony visitors. This includes the banning of outsider entry into nursery and breeding grounds. A marine reserve at Seal Bay and Kangaroo Island has been established in order to regulate the

activity of vessels off shore, in addition to restrictions inland (Australian Government; Department of the Environment, 2016).

**Conclusion:**

The unique biology, ecology, and distribution of the *Neophoca cinerea* make it extremely fascinating, important to the ecosystem, and valuable to the Australian economy. Although there have been measures put in place to protect this significant species, it is still endangered and major precautions will be needed to be taken in order to protect them. This is especially true for incidents that result in *Neophoca cinerea* death that could be avoided. If these precautions and regulation are unable to protect the species, there could be consequences for both the ecosystem as well as humans.

**References:**

1) Australian Government; Department of the Environment. (2016). Neophoca cinerea in Species Profile and Threats Database. Retrieved from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=22

2) Berta, A., Sumich, J. L., & Kovacs, K. M. (2015). *Marine mammals: Evolutionary biology* (3rd ed.). San Diego: Academic Press, Pp. 35-58

3) Hoglund, K., & Animal Diversity Web. (2003). Neophoca cinerea (Australian sea lion). Retrieved from http://animaldiversity.org/accounts/Neophoca_cinerea/

4) Ling, J. K. (1992). Neophoca cinerea. *Mammalian Species,* (392), Pp. 1-7. doi:10.2307/3504081

5) Marine Bio Conservation Society (2013). Australian Sea Lions, Neophoca cinerea. Retrieved October, 3, 2016 from World Wide Web: http://marinebio.org/species.asp?id=267

6) Seal Conservation Society. (2011). Australian Sea Lion. Retrieved from Retrieved October, 3, 2016 from World Wide Web: http://www.pinnipeds.org/seal-information/species-information-pages/sea-lions-and-fur-seals/australian-sea-lion