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# CALIFORNIA SEA LION

## SCIENTIFIC CLASSIFICATION

### Order: Carnivora (Rice, 1998)

### Sub-order: Pinnipedia

- Means “feather” or “fin footed.” (in reference to the shape of their flippers)

Pinnipeds are characterized by large body size; presence of fur, blubber or both; fusiform bodies; ability to move around on land or ice; delayed implantation and superior diving abilities (Reynolds *et al.*, 1999).

### Family: Otariidae

Includes sea lions and fur seals
Characterized by ability to rotate the pelvis to bring the hind flippers under the body to permit walking or running on land, small external pinnae, and large pectoral flippers for propulsion in the water and sexual dimorphism and polygynous breeding (Reynolds *et al.*, 1999).

### Sub Family: Otariinae

Sea Lions. (Sub Family Arctocephalinae includes the Fur Seals) (Reynolds *et al.*, 1999; Rice, 1998).

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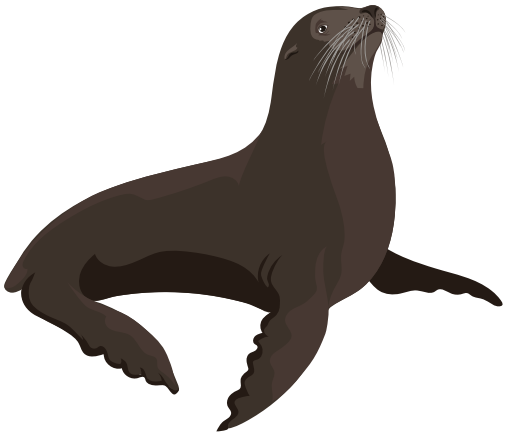
### Genus: Zalophus
Genus refers to the large sagittal crest on the skull of an adult male (Reeves *et. al.*, 1992).

### Species: californianus
Indicating their range. The other species in the Genus Zalophus are *Z. wollebaeki* (Galapagos) and *Z. japonicus* (Japan, (Extinct)) (Rice, 1998).



## FOSSIL RECORD
All pinnipeds evolved from a common carnivore ancestor approximately 25 million years ago and diverged into the current families 15 million years ago (10 million years later). Their carnivore ancestor has not been identified yet, but may have been bear- or otter-like (Boness and Bowen, 1996).

## DISTRIBUTION
Prince William Sound in Alaska to Chiapas, Mexico. However, the main breeding grounds are the Channel Islands in California and islands off the Pacific coast of Baja in Mexico as well as in the Gulf of California. Males migrate more than the females (Heath and Perrin, 2009).

## HABITAT
California sea lions living in temperate and tropical climates inhabit a variety of substrates on islands and along the mainland. These include cobblestone and sandy beaches, sloping rock outcroppings and rock platforms, emergent offshore tidal rocks, rocky shorelines with large boulders and rubble, sandbars and mudflats, sheltered crevices and sea-caves, and tide pools. California sea lions can also be found on man-made structures like piers, jetties, offshore buoys and oil platforms (Reidman, 1990).

California Sea Lions breed on sandy beaches and rocky areas on remote islands. These habitats range from temperate to tropical regions (Heath and Perrin, 2009).

## POPULATION
Total for species in 2012 is estimated at 296,750 (Caretta, *et.al.*, 2013)

## DIET
The animals hunt a wide variety of prey. In Southern California: market squid (*Loligo opalescens*), northern anchovy (*Engraulis mordax*), Pacific whiting (*Merluccius planipes*), rockfish (*Sebastes sp.*), jack mackerel (*Trachurus symmetricus*), Pacific mackerel (*Scomber japonicas*) and blacksmith (*Chromis punctipinnis*) (Heath and Perrin, 2009; Lowry et al., 1986; Lowry and Carretta, 1999). Myctophids, sardines (*Sardinops caeruleus*), cutlass fish (*Trichiurus nitens*), octopus (*Octopus sp.*), cusk eels (*Aulopus bajacali*), anchoveta (*Cetengraulis mysticetus*), grunts (*Haemulopsis sp.*), squids (*Loliolopsis diomedeae*) and various bass (*Pronotogrammus eos*, *Pronotogrammus multifasciatus*, and *Hemanthias sp.*) in the Gulf of California (Heath and Perrin, 2009; Garcia-Rodriguez and Aurioles-Gamboa, 2003; Mellink and Romera-Saavedra, 2005). Known prey species consumed by the California sea lion include: Pacific lamprey (*Entosphenus tridentatus*), Pacific herring (*Clupea harengus pallasi*), northern anchovy (*Engraulis mordax*), salmon (*Oncorhynchus sp.*), plainfin midshipman (Porichthys notatus), Pacific hake (Merluccius productus), Pacific tomcod (*Microgadus proximus*), jacksmelt (*Antherinopsis californiensis*), white croaker (*Genyonemus lineatus*), jack mackerel (*Trachurus symmetricus*), rockfish (*Sebastes sp.*), rex sole (*Glyptocephalus zachiris*) , slender sole (*Lyopsetta exilis*), English sole (*Parophrys ventulus*), and squid (*Loligo opalescens*), (Best 1963); (Antonelis and Fiscus, 1980)

Based on records of adult California sea lions at SeaWorld, 5–8 percent of their body weight (15-40 pounds) is eaten in a day (SeaWorld, Inc.). http://seaworld.org/en/animal-info/animal-infobooks/california-sea-lion

## MIGRATION
During the breeding season (May–July), almost the entire population is found south of 340 Latitude (National Marine Fisheries Service, 1978). Beginning in mid-July, a portion of the male population migrates northward. (Antonelis and Fiscus, 1980).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## ANATOMY AND PHYSIOLOGY

### Coat

Newborn sea lions are dark brown to black until they molt to a tawny brown (4–6 months of age). Females remain this color. Male coats darken as they age. Males also range in color from light brown to black. The fur of California sea lions appears darker when wet (Heath and Perrin, 2009).

### Flippers

The species is characterized by relatively short hind flippers and by foreflippers that have hair on the dorsal surface from the insertion of the limb down to the first or second digit (Antonelis and Fiscus, 1980).

California sea lions use an up and down sweeping motion with their front flippers to propel themselves through the water (Feldkamp, 1987 and Godfrey, 1985). The foreflippers resemble the front limbs of terrestrial, land mammals but are adapted for swimming (English 1976a and English 1976b). Sea lions use their rear flippers for steering and maneuverability when swimming. Both sets of flippers are used for locomotion on land. (Godfrey, 1985)

California sea lions groom by scratching with their rear flippers, rubbing their bodies with their front flippers and rubbing on rocks or other sea lions. Sometimes they rub down their vibrissae just after coming out of the water (Peterson and Bartholomew, 1967). The animals have three claws or nails on their flippers that they use to scratch their bodies (Peterson and Bartholomew, 1967).

### Head

Males have an obvious sagittal crest that distinguishes them from females. It first appears on the skull of five-year-old males (Schusterman and Gentry, 1971). The hair on the forehead is much lighter than the rest of the body (Reeves et. al., 2002). The sagittal crest is usually topped with white fur (Heath and Perrin, 2009).

### Pinnae

California sea lions have reduced (small) pinnae or ear flaps over each ear (Holt and Schusterman, 2007).


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## Vibrissae
California sea lions have 38 vibrissae (whiskers) on either side of their face, (Dehnhardt and Ducker, 1996. These vibrissae are attached to muscles. Each one is supplied with nerves (Stephens *et al*., 1973). Sea lions use their sensitive vibrissae to explore objects in their environment. Vibrissae can be used to sense vibrations as well as give the sea lion information about objects (size and shape) through active touch (Dehnhardt and Ducker, 1996).

## Size Difference
California sea lions are highly sexually dimorphic, meaning males and females differ in size, color and weight. (Heath and Perrin, 2009)

### Maximum Adult Male Length in the Wild
Male California sea lions can reach a maximum length of seven feet, 10 inches (2.4m) (Reeves *et. al*., 2002) (Heath and Perrin, 2009).

### Average Adult Male Weight in the Wild
Males weigh, on average, 770 pounds (350kg) (Heath and Perrin, 2009).

### Maximum Adult Male Weight in the Wild
Male California sea lions can reach a maximum weight of 858 pounds (390kg) (Reeves *et. al*., 2002).

### Maximum Adult Female Length in the Wild
Females can reach a maximum length of six feet and seven inches (2m) (Reeves *et. al*., 2002).

### Average Adult Female Weight in the Wild
Females generally weigh close to 220 pounds (100kg) (Heath and Perrin, 2009).

### Maximum Adult Female Weight in the Wild
Female California sea lions can reach a maximum weight of 242 pounds (110kg) (Reeves *et. al*., 2002).

# SENSORY SYSTEMS

## Hearing
When underwater, sea lions have a hearing range of approximately 100 Hz to 35 kHz with best sensitivity between 1 and 20 kHz (Schusterman *et al*., 1972; Mulsow *et al*., 2011).

When out of the water, sea lions hear in a range of approximately 100 Hz to 30 kHz. Their peak out of water hearing range is in the region of 10–20 kHz (Reichmuth *et al*., 2013).

## Vision
California sea lions can see underwater about as well as they do on land. When out of the water, their vision is quite sharp under moderate illumination, but poor under low illumination (Schusterman, 1981).

## Color Vision
Research suggests that California sea lions have dichromatic color vision, a form of color blindness. They appear to be able to discriminate colors in the blue-green part of the color spectrum, which could be a physiological adaptation to their aquatic coastal habitat (Griebel and Schmid, 1992).

## Tapetum Lucidem
California sea lions have one of the most highly developed tapeta among mammals. This ability enhances vision in dim light by reflection of light passing through the retina back into the photoreceptor outer segments (Miller *et al*., 2010). (This is likened to cat's eyes, which glow at night when light is shined on them).

## Smell (Olfaction)
California sea lions have a sense of smell used in a variety of social situations on land, which is important in mating. (Yu *et al*., 2010). Smell also plays a significant role in mother-pup recognition. (Schusterman *et al*., 1992).

## Taste (Gustation)
California sea lions have a sense of taste. Their ability to detect sour flavor is about the same as humans. They also sense salty and bitter flavors, though with lower sensitivity than humans. They cannot detect the sweet flavor of sugars (Friedl *et al*., 1990).


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### Touch
Sea lions often group together on land in tightly clumped groups. Sometimes they are even seen piled on top of each other (this type of behavior is referred to thigmotaxic behavior) (Riedman, 1990). Also, See Vibrissae

## SWIMMING, DIVING AND THERMOREGULATION

### Swimming
Reported swimming speed for California Sea Lions was observed at 2.7 to 3.5 m/s (about 6 - 8mph). (Feldkamp, 1987).

### Diving
California sea lions are relatively shallow and short-duration divers (Feldkamp *et al.*, 1989).

#### Average Dive Duration
The average dive time for California sea lions is 1.5-2.8 minutes (Feldkamp *et al.*, 1989).

#### Maximum Dive Duration (and Breath Hold)
Dives can last for a maximum of about 10 minutes (Feldkamp *et al.*, 1989).

#### Average Dive Depth
California sea lions dive, on average, to depths of 66 feet (20m) to 164 feet (50m) (Feldkamp et al., 1989).

#### Maximum Dive Depth
They can dive to a maximum of about 900 feet (274m) (Feldkamp et al., 1989).

### Thermoregulation
Sea lions are equipped with thick blubber layers that insulate them and allow them to maintain their body temperature in the water. To cool off, sea lions may enter the water or wet their bodies and then cool through evaporation.

Sea lions also employ a variety of postures for thermoregulation. When the weather is cool and they are in the shade, sea lions may lie with their flippers tucked under their bodies, reducing the amount of their body surface area exposed to the cold. When they need to cool off, they may raise one flipper in the air or go into the water with a flipper raised. Their furless flippers allow sea lions to have a great deal of surface area through which to give off excess heat (Odell, 1974). Although equipped with sweat glands, sea lions do not sweat in response to high temperatures. Instead, they use postures to cool off and increase blood flow to their extremities (Whittow *et al.*, 1972).

## BEHAVIOR
### Social Behavior
Play behavior is common among pinnipeds, especially between juveniles. Play behaviors include body surfing, rough-and-tumble play while swimming, romping, wrestling, twisting and grabbing at one another with their mouths. Sometimes, young California sea lions will chase, taunt and bite at the flippers of scuba divers. Sea lion pups also play with their prey, tossing it and then catching it. They have also been seen making toys out of objects like kelp and rocks (Reidman, 1990).

California sea lions are intelligent and adaptable animals. They can recognize individuals through sight, sound and scent. They are gregarious, but the only obvious social bond exists between mothers and pups (Heath and Perrin, 2009).

California sea lions can be found living near elephant seals, harbor seals and Steller sea lions (Peterson and Bartholomew, 1967).

### Vocalizations
California sea lions are one of the most vocal pinnipeds. They use various sounds primarily to repel or attract other sea lions by identifying the caller's species, sex, age and location. This can also be used to identify certain individuals (Schusterman *et al.*, 1992). Males bark incessantly during the breeding season (Peterson and Bartholomew, 1967). See also, maternal behavior.

### Posture
Males engage in territorial boundary displays using stereotypical postures. They might stare directly at another animal, open their mouth, shake their head or fall prostrate on the ground (Schuesterman and Gentry, 1971).


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### Sleep
Sea lions are seen sleeping on land in various positions, usually on the tummy with all four flippers tucked under them. They also sleep on their sides and have been seen sleeping or resting on their foreflippers with their nose in the air, comfortably balanced (Peterson and Bartholomew, 1967).

## REPRODUCTION AND MATERNAL CARE
### Mating Season
Male and female California sea lions arrive at onshore breeding sites to mate and give birth from May to August, though the majority of births occur in June. Males are most territorial in June and July. Sea lions tend to return to the same breeding sites year after year (Peterson and Bartholomew, 1967).

### Birth
Pregnant females give birth to a single pup a few days after coming ashore throughout May and June (Heath and Perrin, 2009). As with other pinniped species, female sea lions usually give birth to one pup per year (Boness and Bowen, 1996). The greatest numbers of pups are born the first week of June, generally on land in rocky areas (Odell, 1975).

Sixty-three percent of pups are born head-first, but pups have also been born successfully tail-first and in other positions. The average length of labor, delivery and then passage of the placenta is 91 minutes (Odell, 1975).

The umbilical cord breaks during delivery (Peterson and Bartholomew, 1967; Odell, 1975).

### Weight at Birth
At birth, pups weigh 13–20 pounds (6-9kg) (Heath and Perrin, 2009).

### Mating
Females come into estrus, or heat, about two weeks after giving birth and can again become pregnant (Peterson and Bartholomew, 1967). Mating usually occurs 15-30 days after giving birth (Odell, 1975). Females signal they are receptive by lying prone on the ground and rubbing on the male. Courtship usually lasts a few minutes, but can last an hour or longer. The female terminates mating by biting the neck of the male and pulling free. Females only engage in one mating session. Mating can occur on land or in shallow or deep water. (Peterson and Bartholomew, 1967), but 60 percent of mating occurs in the water (Odell, 1975).

### Gestation
Since mating occurs 15–30 days after pupping, and pups are born predominantly in May and June, it would appear that sea lions carry their pups (gestation) for just under a year. However, California sea lions exhibit delayed implantation. Although the egg is fertilized, it does not implant and began developing until mid-October and sea lions actually produce a new pup in about seven to eight months (Odell, 1975. Greig *et al.*, 2007).

### Male Territorial Behavior
Males establish territories along the coast where the females are congregated. Boundaries are not well defined but territories can also include ocean waters. Females can move freely through the territories, but males will defend their territories against rival males. The ratio of males to females in the breeding area averages 1:14. Younger males or males who are pushed out of the breeding site congregate on separate beaches. Males maintain territories for an average of 27 days (Odell, 1975).

Males on established territories bark incessantly (Peterson and Bartholomew, 1967). Studies have shown these vocalizations have different meanings depending on the rate of barking. Some barks indicate impending aggression when an intruder approaches a territory. Other barks act as an advertisement for breeding purposes (Schusterman, 1977). When an intruding male crosses the boundary of the territory, a fight occurs. Usually, one male physically shoves the other out of the territory. Sometimes biting occurs. These fights rarely lead to severe injury because the animals' well-padded chest and neck protect them from most of the bites (Peterson and Bartholomew, 1967).

### Migration after Breeding
After the breeding season, some males migrate north as far as Alaska. Females generally remain within 90 miles (150 km) of the breeding rookeries (Greig *et al.*, 2007).

### Maternal Care
California sea lion pups nurse from their mothers 15 to 30 minutes after birth (Schusterman *et al.*, 1992). Females stay at


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the rookery and nurse their pups for the first eight days after the pup is born, then, they go out to sea to forage for food. Foraging trips last an average of 2.5 days and then nursing bouts last about 1.4 days (Oftedal *et al.*, 1987). When females return to the busy rookery, they locate their pups with what is called a "pup attraction call". This call is established shortly after birth when the mother and pup call to one another and the pup imprints on its mother's distinct call. Once reunited, mother and pup sniff one another and use scent to recognize each other (Schusterman *et al.*, 1992). At about three months of age, the pup begins to follow its mother on foraging trips (Schusterman *et al.*, 1992).

While females look for secluded spots to whelp, they form groups with their pups. The females are gregarious and sometimes aggressive with one another. Females guard their pups and threaten intruders that get too close (Peterson and Bartholomew, 1967).

### Daily Nursing Duration

Once its mother begins foraging for food, a sea lion pup will usually nurse, on average, every third day. On those days, pups suckle for about 10 minutes every 2.4 hours for a total of 1.8 hours per day. This nursing averages out to 0.6 hours per day (Oftedal *et al.*, 1987; Boness and Bowen, 1996).

### Nursing Period

Nursing lasts just under a year, generally six to 11 months (Oftedal *et al.*, 1987; Greig *et al.*, 2007).

### Milk Composition

California sea lion milk is 22 to 44 percent fat (Oftedal *et al.*, 1987).

## LONGEVITY AND MORTALITY

The median life expectancy of juvenile California sea lions born in North American zoological parks and aquariums is two to three times longer, depending on gender, than the life expectancy of juvenile sea lions in the wild.

Current scientific data show that the median life span for a male California sea lion in the wild is 7.7 years. For a female in the wild, the median life span is 11.5 years. (Hernandez-Camacho, et al, 2008) The median life expectancy of a one-year-old California sea lion born in a zoological park or aquarium is 23.5 years.

## PREDATORS AND NATURAL THREATS

In the wild, sea lions can face starvation, infection, predation by sharks and killer whales, toxic phytoplankton blooms and human impacts (Heath and Perrin, 2009). During a ten year survey of live California sea lion strandings, multiple causes were determined. Malnutrition was the cause of the highest percentage of stranding. Parasites and climate change due to El Niño events were often associated with the cause of the malnutrition. The disease leptospirosis was the second most common cause of the strandings. The third most common cause was trauma, predominately caused by humans shooting the animals. Entanglement in marine debris, shark bites and propeller wounds were also factors. Other causes of sea lion stranding and mortality include peritonitis, abscesses, pneumonia, pleuritis, septicemias, cystitis, central nervous system infections, other various diseases/infection, renal failure, prolapsed uterus, congenital defects, domoic acid toxicity and cancer (Greig *et al.*, 2005).

## CONSERVATION

### Domoic Acid

Certain algae produce toxins. One, domoic acid, is produced by the diatom (algae), *Pseudo-nitzschia*, and is fast becoming problematic for California sea lions. Domoic acid is water soluble and concentrates in organisms when they eat the algae. Sardines and anchovies, two common prey for sea lions, can be contaminated with this toxin.

Typically, this toxin is found at low levels. However, when conditions are right, harmful algae blooms can occur with more frequency and in larger areas. In addition, there is currently better reporting and monitoring of the blooms and a better understanding of and research into domoic acid effects on organisms in the food web. Human impacts—such as global climate change, pollution, overfishing and transport of contaminated seafood—may aggravate the problems.

In 1998, 400 sea lions stranded along the central California coast and testing indicated that all had been exposed to domoic acid. Domoic acid interferes with the animals' normal neurological functioning. Symptoms include loss of appetite, seizures, periods of lethargy, vomiting, muscle twitching, head weaving, ataxia and abnormal behavior (Goldstein *et al.*, 2007 and Van Dolah, 2000).

If a stranded sea lion has had limited exposure to domoic acid, the animal can be rehabilitated and released back into the wild. However, if a sea lion has long-term exposure causing brain damage, they are not good candidates for release as they will likely not survive (Denise Greig, personal communication, 3/3/2012).

### Marine Debris

California sea lions can become entangled in a whole host of marine debris. Entanglement and ingestion of fishing line is a significant problem for the animals. In addition, rubber bands, plastic packing straps and fishing nets and hooks all can contribute to injury and death if the animals ingest or are entangled in these objects (Raum-Suryan *et al.*, 2009).


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## Competition for Resources

In 2008, NOAA Fisheries Service authorized three states; Idaho, Washington and Oregon to "permanently remove" sea lions eating endangered salmon and trout that congregate at the Bonneville Dam on their way to spawning areas in the Columbia River. "Permanent removal" meant euthanizing the large adult males or permanently placing them in a zoological park or aquarium. NOAA authorized the states to remove up to 93 sea lions per year until 2016. The agency authorized the removal of the animals after various non-lethal deterrent efforts (i.e. firecrackers, rubber bullets, boat chasing) failed. (NOAA, 2014)

Between 2008 and 2010, 40 California sea lions were removed (30 lethal removals and 10 relocations; Carretta *et al.* 2013). In 2011, no California sea lions were euthanized at Bonneville Dam (Stansell *et al.* 2011). In 2012, Oregon and Washington's request for lethal removal authority of California sea lions under Section 120 of the Marine Mammal Protection Act was granted. The authorization allows the states to remove up to 93 California sea lions a year. In 2012, one California sea lion was relocated and 11 were euthanized (Stansell *et al.* 2012). The states removed four California sea lions in 2013 (Stansell *et al.* 2013).

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