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Short Note

Rehabilitation and Movement of a Blind California Sea Lion from the Southern Gulf of California to the Western Baja California Peninsula, Mexico

Fernando R. Elorriaga-Verplancken,[1] Patricia Meneses,[2]
Abraham Cárdenas-Llerenas,[2] Wayne Phillips,[2] Abel de la Torre,[2] Abel Reyes,[2]
Xochitl Yin Hernández,[3] Hiram Rosales-Nanduca,[4] Irma González-López,[5]
Roberto Robles-Hernández,[3] María José Amador-Capitanachi,[1]
and Julieta Sandoval-Sierra[1]

[1]*Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas (CICIMAR-IPN), Avenida IPN, s/n, Colonia Playa Palo de Santa Rita, Apartado Postal 592, La Paz, Baja California Sur, México*
E-mail: felorriaga@ipn.mx
[2]*Dolphin Adventure, Nuevo Vallarta, Nayarit, México*
[3]*Procuraduría Federal de Protección al Ambiente (PROFEPA), Delegaciones Jalisco y Baja California Sur, México*
[4]*Departamento de Ingeniería en Pesquerías (current affiliation) & Departamento Académico de Ciencias Marinas y Costeras, Universidad Autónoma de Baja California Sur, La Paz, Baja California Sur, México*
[5]*Comisión Nacional de Áreas Naturales Protegidas (CONANP; Parque Nacional Zona Marina del Archipiélago Espíritu Santo), La Paz, Baja California Sur, México*

Pinnipeds have prominent, highly sensitive mystacial vibrissae that serve important functions in the detection and analysis of objects and water movements, as well as in self-orientation and social interactions (Hanke et al., 2000; Dehnhardt et al., 2001). This includes a significant role in the perception of prey (Schusterman et al., 2000). Studies of California sea lions (*Zalophus californianus*) (Gläser et al., 2011) and harbor seals (*Phoca vitulina*) (Dehnhardt et al., 2001) have demonstrated that their vibrissae detect hydrodynamic trails produced by potential prey; these trails remain for several minutes (Hanke et al., 2000), providing information on prey size, speed, and direction of movement (Blickhan et al., 1992). Pinniped vibrissae are extremely sensitive because they are highly innervated with myelinated fibers that end in three distinct terminations with nerve bundles entering at the base of the follicles (surrounded by blood sinuses) and then branching into smaller nerve bundles that pass through the connective tissue (Stephens et al., 1973; Ginter et al., 2010; Mcgovern et al., 2015). Some pinniped species, such as the Baltic ringed seal (*Phoca hispida*), have ten times more nerve fibers in their vibrissae than their terrestrial counterparts (Hyvärinen, 1989).

The sensory capacity of vibrissae is important during the foraging trips undertaken by California sea lions; some individuals perform dives up to a depth of 480 m (Schreer & Kovacs, 1997), where light is either limited or absent. This could be or has been related to sporadic records of blind California sea lions (Elorriaga-Verplancken, unpub. data), harbor seals (Newby et al., 1970), and ringed seals (Hyvärinen, 1989) in apparent good body condition in their natural environment. Additionally, the diving capacity of California sea lions is influenced by sexual dimorphism. There are marked differences in body mass and, therefore, differences in oxygen storing capabilities between males and females; thus, males of this species are potentially able to dive to greater depths than their female counterparts. These inter-sexual differences in diving and oxygen storage have a key role regarding foraging variation within the species (Weise & Costa, 2007), which include large migratory movements by males (Mate, 1975; Elorriaga-Verplancken et al., 2018).

The higher growth and dispersal rates of males, relative to females, lead to increased possibility of physical weakening, nutritional stress, or death by infections or diseases (Clinton & Le Boeuf, 1993), resulting occasionally in the stranding of live or dead individuals. Herein, we describe the rescue, rehabilitation, and release of a blind subadult male California sea lion (CSL005), measuring 2.01 m total length, which was found stranded on Mayto Beach (20.290° N, 105.629° W) (Figure 1) in Cabo Corrientes, Jalisco, Mexico, on 2 February 2017. The Procuraduría Federal de Protección al

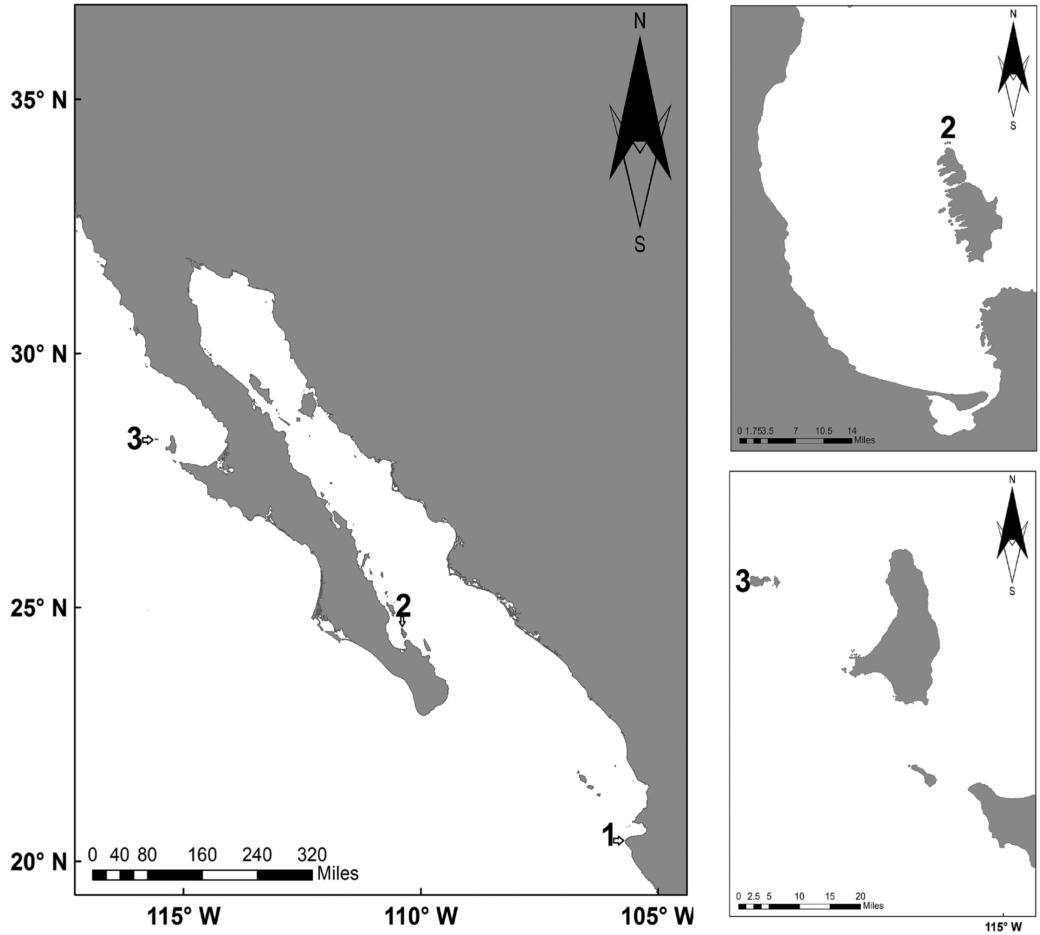

Figure 1. Localities related to our record: (1) Stranding site of the subadult California sea lion (*Zalophus californianus*) (CSL005) (Cabo Corrientes, Jalisco), (2) release site (Los Islotes, Bahía de La Paz), and (3) final record (San Benito Archipelago)

Ambiente (PROFEPA; Federal Attorney's Office for Environmental Protection) of Jalisco and the Red de Atención a Mamíferos Marinos en las Costas del Estado de Jalisco (Marine Mammal Stranding Networks for the Coasts of Jalisco State) responded to the report of the stranded animal (hereafter referred to as CSL005). The individual was transported to Dolphin Adventure (Nuevo Vallarta, Nayarit, Mexico), a dolphinarium, for medical care.

The individual was lethargic and displayed poor body condition (101 kg) for its age (5 to 6 y); the ribs and spine were visible (Figure 2), but there were no apparent fractures. Importantly, CSL005 presented bilateral corneal edema. Photographs were taken of the eyes, and fecal, gastric, and blood samples were collected to determine CSL005's health status. Following ophthalmic assessment, it was determined that CSL005 presented corneal opacity due to edema as well as bilateral cataracts. Both eyes had traumatic perforations with a certain degree of corneal and lenticular dystrophy. The left eye presented a posterior synechia and pupil dilation with retinal exposure without reacting to light; meanwhile, the right eye had cataracts and severe damage to the cornea (Figure 3), including likely retinal detachment. Blood tests confirmed a degree of hemoconcentration and dehydration, and suggested possible occult anemia due mainly to low caloric intake. There was no evidence of infection.

Once feeding was induced, CSL005 showed a significant gradual improvement and began to gain body mass; the last recorded weight was 175 kg (10 May 2017), an increase of 74 kg (mean of 0.69 kg/d) from the initial weight. Marked improvement was achieved via a daily intake of up to 11 kg

Figure 2. Subadult California sea lion (CSL005) stranded in Cabo Corrientes, Jalisco, 2 February 2017

Figure 3. External appearance of the visual condition of CSL005

of herring and capelin. In addition, these assessments and diagnoses were confirmed by specialists from independent institutions: Dr. Martin Haulena of the Vancouver Aquarium in Vancouver, British Columbia, Canada, and Dr. Carmen Colitz of All Animal Eye Care in Jupiter, Florida, USA.

Based on previous exposed cases that involved blind pinnipeds in good body condition, in conjunction with the high sensitivity of pinniped vibrissae, after 106 d of observation and rehabilitation, CSL005 was released on 20 May 2017. The release effort was coordinated by the Comisión Nacional de Áreas Naturales Protegidas (CONANP; National Commission of Natural Protected Areas), the Parque Nacional Zona Marina del Archipiélago Espíritu Santo (Espíritu Santo Archipelago National Marine Park), and the corresponding PROFEPA offices in Jalisco and Baja California Sur, Mexico. The individual was marked using a plastic tag (Number 005) and released at Los Islotes (24.598° N, 110.401° W) (see Figure 1), a colony with approximately 500 California sea lions located in the southern Gulf of California, Mexico (Adame et al., 2017b). This particular colony was chosen because it is one of this species' few reproductive colonies that currently presents a positive growth trend (+15% between 2004 and 2016; Adame et al., 2017a) in the Gulf of California. This positive growth trend has been linked to the probable high availability of resources in the region (Szteren et al., 2006), increasing CSL005's chances of survival.

On 12 July 2017 (53 d after release), CSL005 was observed on a pebble beach (28.302° N, 115.577° W) (Figure 1) of West Island during a field expedition to the San Benito Archipelago in the Mexican Pacific. Its body condition was good, with an apparent weight equal to or higher than the final weight recorded prior to release (Figure 4). The individual's ribs and spine were not apparent upon visual inspection, and CSL005 remained alert during our approach. Photographs were taken approximately 5 m from the individual, which was unable to visualize our presence given its blindness.

Although CSL005 was released in the southern portion of the Gulf of California in May, the presence of this California sea lion on the San Benito Archipelago appeared to follow the natural behavior proposed for this species' migrating subadult males. These individuals initially arrive in the southern part of the Gulf of California in the fall and abandon the area in the spring (April-May)

Figure 4. Final record: CSL005 resighted at the San Benito Archipelago, 12 July 2017

(Aurioles-Gamboa et al., 1983; Elorriaga-Verplancken et al., 2018). Thus, the movement of this individual towards the Mexican Pacific (i.e., western Baja California) coincides with previous migratory observations of this species under normal conditions.

This record highlights the importance of vibrissae as sensitive structures. This feature may have been fundamental in permitting this blind California sea lion to present a good body condition nearly two months after its release. Moreover, CSL005 was found approximately 1,500 km away from the point of release, assuming it followed a coastal route, which would be consistent with the displacements described for males of this species along the coast of California (Weise et al., 2006).

Other researchers have suggested that blind sea lions that survive in the wild may do so by modifying their diet to feed on benthic prey inhabiting the ocean bottom, with their vibrissae serving as their main strategy for detecting prey (Thomas & Kastelein, 1990). In conjunction with their apparent ability to detect hydrodynamic trails in the water column (Gläser et al., 2011), vibrissae sensitivity appears to be essential to the survival of blind pinnipeds. The importance of vibrissae in the absence of light also has been demonstrated experimentally by artificially covering the eyes of California sea lions and harbor seals in captivity. In those studies, the animals successfully detected objects of different size using their vibrissae (Dehnhardt, 1994; Grant et al., 2013). Moreover, a more detailed previous study evidenced that vibrissae detect vibrations at low frequencies (< 500 Hz). After testing frequencies ranging from 10 to 1,000 Hz, the main response (best sensitivity) of a harbor seal took place between 20 and 250 Hz (Murphy et al., 2015). As mentioned before, if pinniped species use their vibrissae to perceive and follow hydrodynamic trails (Hanke et al., 2000; Dehnhardt et al., 2001), a high sensitivity within these frequencies would be important to detect these relevant signals in the absence of light (Murphy et al., 2015).

Aside from the animal's blindness, no other cause could be identified to explain the stranding of CSL005 in Cabo Corrientes. It is possible that the availability of resources in the area was not sufficient to maintain an individual with these characteristics, making its stranding with a poor body condition an eventuality. Moreover, the individual's release in an area of high resource availability, which is apparently sufficient to support a large number of subadult individuals (Aurioles-Gamboa et al., 1983; Elorriaga-Verplancken et al., 2018), may have been essential to CSL005's ability to both survive and thrive. Additionally, it is impossible to totally discard that the rescue occurred relatively soon after the onset of blindness and before the individual was able to adapt to it.

Nearly two months could be insufficient to conclude, based on this event, the overall potential success of releasing blind sea lions. An extended period of sightings (or a formal monitoring program) and a larger sample of this type of individual would consolidate a much stronger conclusion in this regard. However, this record sets one precedent for blind individuals of this and other pinniped species that may be candidates for release into the wild following adequate observation and rehabilitation over a significant period to rule out other factors that may put the individual at risk upon release into the wild.

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