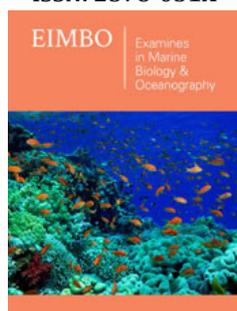


# Presence of Pinnipeds From South America in The Mexican Pacific, A Consequence of Climate Change

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## Abstract

Environmental changes caused by climate change have affected the distribution and feeding behavior of different species, including marine mammals such as pinnipeds, as an example there were reports of pinniped sightings on Mexican beaches, the original distribution and feeding areas are on the coasts of South America. These reports are becoming more and more frequent, and their possible causes are related with climatic anomalies such as El Niño-Southern Oscillation or La Niña event and the distribution of their potential prey.

**Keywords:** Climate change; Pinnipeds; Mexico

## Introduction

The United Nations Framework Convention on Climate Change (UNFCCC), in its article 1, defines climate change as “climate change attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that adds to the natural variability of the climate observed during comparable periods of time”. Thus, the UNFCCC differentiates between climate change attributable to human activities that alter atmospheric composition and climate change attributable to natural causes [1]. The evolutionary record from previous climate perturbations indicates that marine mammals are highly vulnerable but also remarkably adaptable to Climatic Change (CC) in coastal ecosystems [2]. Pinnipeds are unique marine mammals because they spend much of their life at the sea, but they require land or ice to give birth. Consequently, one of the effect of the CC impact their distribution and abundance through direct pathways, such as loss or gain of terrestrial [2].

Studies have been conducted focused on the conservation of pinnipeds, and how CC affects them [3]. In Mid-latitude species such as Galapagos fur seal (*Arctocephalus galapagoensis*) or Guadalupe fur seal (*Arctocephalus philippii townsendi*) are affected by warm oceanographic anomalies, like North Pacific marine heatwave termed “The Blob” or the 2015-2016 El Niño-Southern Oscillation (ENSO) [4,5]. These warm water anomalies impact primary productivity, and hence prey availability across the trophic web, including for pinnipeds and other top predators [6,3,7], many times declining their populations [8-10].

Another documented effect is the change in distribution sites, as the northward shift in long-term distribution of the northern elephant seal (*Mirounga angustirostris*) from Mexico this has been explained as a probable consequence of the ocean warming [11,12]. CC has become a major concern, since the increment of the sea surface temperature result in a nutritional stress [13], and a disruption of the northern elephant seal’s ability to thermoregulate while on land [14]. In the case of the Southern Elephant Seal (SES; *Mirounga leonina*), effects of global CC are not well known, although there may be an impact on foraging areas. Over the last decades ocean warming and the reduction of ice extents in certain areas of Antarctica [15]; affect life cycle, distribution, and abundance of key species like krill (*Euphausia superba*), important for the food web of the Southern Ocean ecosystem [16,17].

Pinniped species with distribution in South America have been observed more frequently in waters of the Mexican Pacific, as for the Galapagos fur Seal, reported in 2016 on the beaches of Michoacán, Páez et al. [18] hypothesized that the presence of the species could be related to anomalous temperatures recorded in the Pacific Ocean during the ENSO (2015-2016).

This cause presence of tropical pinnipeds outside of their potential foraging or reproductive áreas are primarily associated with oceanographic anomalies like ENSO [19,20]. Previously, Auriolos Gamboa et al. [21] reported two juveniles of Galapagos fur seal on the beaches of Chiapas and Guerrero during 1998, which coincides with a very intense ENSO 1997-1998.

During 2013, Zurita et al. [22] reported a sighting of *Arctocephalus australis* on the beaches of Oaxaca in Mexico, this species inhabits the continental margins of the Pacific and Atlantic coasts of South America, from southern Brazil to the Paracas peninsula of southern Peru [23]. The presence of this species in the Mexican Tropical Pacific could be related to an anomalous sea surface temperature during that period, which were related to La Niña conditions (cold temperatures) that are opposite of those observed for El Niño (warm phase). Zurita et al. [22] hypothesized that these anomalous cold conditions in 2013 allowed an unusual dispersion by this fur seal toward Mexican coasts. On the other hand, during the last two years, Mexican organizations have reported SES on Mexican beaches. The species presents virtually circumpolar distribution in the South. The reported have been in different beaches of Oaxaca, Chiapas, Baja California Sur and Nayarit in Mexico, which seem to be from the same individual, but the case is rare in the area. However, for this species it has already been reported in areas of Brazil, Ecuador and Central America [24-28].

According to Verplancken et al. [29], the diet could be a possible factor that has altered dispersal patterns of SES or other species. Additionally, other long-term phenomena have been recorded regarding ocean warming and the global shaolin of hypoxic oxygen minimum zones and their relationships with the range expansion of the jumbo squid (*Dosidicus gigas*) from the Humboldt Current Ecosystem into the northeastern Pacific [30,31]. It must consider that the described species have a behaviour of moving to remote feeding places. Therefore, there is no doubt that we will continue seeing more frequent records of southern pinniped species moving to the northern areas of their distribution, which could be related to changes in the environment and the presence of potential prey.

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