

Effects of reduced genetic variation in elephant seals

The northern elephant seal almost became extinct in the late 1800's following harvesting by whalers and sealers for their blubber which contains oil. A small colony of between 20 and 100 individuals survived on Guadalupe Island off Baja California. From that small colony have come the approximately 160,000 elephant seals found on the Pacific coast today. That dramatic shrinking of the population resulted in a reduced genetic diversity among the survivors – a “genetic bottleneck.”

Genetic bottlenecks such as experienced by the northern elephant seal impact the species in two ways. More frequent inbreeding – breeding between two closely related animals – results in the more frequent occurrence of recessive traits that are often harmful. Also, the reduced range of genetic variation reduces the adaptability of the species to environmental change.

In a paper cited by Trupkiewicz, et al., Bonnell and Selander, in 1974, took blood samples from northern elephant seals representing 5 breeding colonies in California and Mexico. These samples were examined for protein variations which would reflect underlying genetic differences. A lack of polymorphism was found among 21 proteins examined meaning there was only one form of protein in all of the animals sampled, pointing to a lack of genetic variation in northern elephant seals.

Trupkiewicz et al. documents, in a limited way, the evidence that congenital defects occur in northern elephant seals at a higher rate than that reported in other surveys of marine mammals.

Eleven cases of congenital defects were identified through post mortem examinations in 210 (5%) juvenile northern elephant seals found stranded along the central California coast from Jan 1, 1988 to December 31, 1995. Seven animals had mild-moderate hydrocephalus (fluid buildup in the skull), two animals had severe cardiac abnormalities, one animal had a kidney defect, and one animal had a developmental pulmonary problem. A single case of an animal with multiple digits (toes) was observed in an animal that was rehabilitated and released.

Potential causes could be environmental toxins (including mercury and irradiation), hypovitaminosis (vitamin deficiency), viruses etc. However, no detailed toxicological or virus studies have been done on northern elephant seals. Lack of genetic diversity could be a cause as well, especially when you consider that harbor seals from California have a higher genetic diversity than elephant seals and the prevalence of congenital defects in harbor seals is much lower (<1% in animals stranded in the same geographic range and examined at post mortem).

Even though harbor seals and northern elephant seals are in the same family, phocidae or true seals, a more representative sample of data from the northern elephant seal population would help clarify whether the occurrence of congenital defects is caused

by toxins, irradiation, hypovitaminosis, viruses or by the reduced genetic diversity of northern elephant seals.

The data in this paper were from animals stranded away from rookeries. Elephant seal pups dying in rookeries have not been examined. Thus the true prevalence per 100 animals born may be lower/higher. In addition, the northern elephant seal population is estimated at 160,000 and thus these animals in this study presented at post mortem represent a small proportion of the total population meaning the level of congenital defects in the total population may be quite different from stranded animals. These data limitations raise the question of having a representative sample from which to draw conclusions about genetic diversity in northern elephant seals. The authors of this paper believe based on this preliminary data that more detailed studies are needed to determine the relative roles of infectious agents, contaminants, and genetics in causing congenital anomalies in northern elephant seals.

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1974 Bonnell, M., and Selander, R., Elephant seals: genetic variation and near extinction. *Science* 24 May 1974. 184(4139):908-909.

1997 Trupkiewicz, J.G., Gulland, F.M.D. and Lowenstine. L. J., Congenital defects in northern elephant seals stranded along the central California coast. *Journal of Wildlife Diseases*, 1997 33(2):220-225.