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North Pacific climate influences pup sex in northern elephant seals

For decades ecologists have asked why there are different numbers of males vs. females in animal populations. This difference is called the sex ratio, and it can have important effects on demography and evolution.

Evolutionary theory predicts that parents should invest in offspring in ways that enhance their own lifetime reproductive success. Lifetime reproductive success is not measured simply by how many children are produced, but how many grandchildren are produced. This is because grandchildren are a more effective measure of how much genetic material was successfully distributed by a mother's investment strategy in her offspring. In mammals, studies of parental adjustment of offspring sex ratio focus on differences in the expected future reproductive success of male vs. female children. For example, in the harem-based mating system of northern elephant seals, females usually produce 1 pup per year during the average breeding lifespan of 3-6 years, but alpha males of a large harem can sire up to 60 pups in one year. The genetic payoff in grandchildren is therefore ten times greater for the mother who invested in a son who becomes alpha versus the mother who invested in a daughter. The odds of a son achieving alpha status, however, are 1 in 1000, so the safe bet for a decent number of grandchildren is to invest in daughters.

The trick is whether a mother can 'game the system' by improving the odds of her son becoming an alpha-male harem master. One possible advantage to a mother would be if she could give her son a head start during a good year so he has a size advantage when fighting for dominance. This is called the Trivers-Willard Hypothesis, named after the biologists who first proposed this strategy.

Because elephant seals forage in different habitats according to their sex, another strategy for mothers would be to invest in a son during a bad year, so the mother wouldn't have to compete with her son for food resources. This is called the Resource Competition Hypothesis. For northern elephant seals, good and bad years are determined in large part by ocean climate and productivity related to El Niño and the Southern Oscillation.

In a paper published in the *Journal of Mammalogy*, we examined data from 31 years for a population of northern elephant seals on the Farallon Islands, California to test how offspring sex ratio is related to ocean climate and productivity that affect the condition of reproductive females. Our results show that more male pups were produced during years of reduced or dispersed prey resources for gestating females in the North Pacific Ocean. These results are consistent with the Resource Competition Model for adjustments of offspring sex ratio.

Main Points

- More male elephant seal pups were born during warm water years in the North Pacific Ocean.
- Global warming is predicted to warm the North Pacific. This could result in an overabundance of males that may adversely affect this and other similarly regulated mammal populations.

Paper Citation

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