Northern fur seal before and after harvesting: calibration results of mathematical models according to observation data (on the example of Tyuleniy island herd)

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Following many years of managed harvest, the population size of Northern fur seal on Tyuleniy Island as well as that in other North Pacific islands have decreased, particularly the number of newborn pups, which dropped by half and then almost stabilized at this low level. Although the harvest was significantly limited and then banned eventually, the birth rates have never recovered.

To estimate intrapopulation parameters and model the population dynamics we use mathematical modeling, numerical simulations and multivariate statistical technique.

Then we analyzed the harem structure and birth rate dynamics of the population. A connection between the birth rate and harvest intensity has identified, which allows the classification of all observation data on several intervals of different population dynamics according to the changes in harvest intensity. Using a matrix population model for both part of the population, we analyzed the population growth rate associated with changes in both birth and survival rates considering the stochastic effects. Sufficient convincing evidence of the hypothesis that the harvest was selective one was obtained. The most productive bulls were taken from the population, which resulted in essential changes of the population age structure and vast decrease of growth rate, even against the background of a slight increase in survival rates of almost all age groups. Further increase in the population of the northern fur seal, if it happens, will not be quick. To accelerate the population growth, the number of bulls with high reproductive success should be increased.