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MEMORANDUM FOR: The Record

FROM: Rod Towell and Rolf Ream

SUBJECT: 2019 northern fur seal pup production estimate on Bogoslof Island, Alaska.

Bogoslof Island has been shaped by volcanic activity since the late 1700's. The first recorded sighting of northern fur seals, *Callorhinus ursinus*, on Bogoslof occurred in 1976 and the first evidence of fur seal breeding was noted in 1980 when 2 pups were observed. A land count in 1991 yielded 413 live pups. Bogoslof erupted in 1992 creating a new dome on the northeast side of the island, and 898 pups were counted (890 live, 8 dead) a year later, in 1993. Due to continued growth of the fur seal population on Bogoslof Island, mark-recapture methodology has been used to estimate pup production since 1997. After a period of no volcanic activity, Bogoslof experienced a series of substantial eruptions from December 2016 through August of 2017, expanding the land mass of the island to almost 3 times its prior size. The last estimate of pup production to occur before this recent volcanic activity was conducted during 2015, when 27,750 pups were born. In 2019 scientists and collaborators returned to Bogoslof to assess northern fur seal pup production and possible impacts from the recent volcanic activity.

Numbers of northern fur seal pups were estimated using a mark-recapture method, shear-sampling, on Bogoslof Island (Figure 1) during August 12 to 16, 2019. For the 2019 estimate, the island was divided into 2 rookeries, instead of 4 or 5 as had been done from 2005 to 2015 (Figure 2). The recent volcanic activity changed the terrain and size of the island dramatically, as well as the distribution of fur seals on the island. Previously, fur seals were distributed almost continuously around the island. In 2019 there were two delineated breeding areas, the smaller being on the north end of the island and the larger on the south end.

We estimated that 36,015 (SE = 1,098, Table 1) pups were born on Bogoslof Island in 2019. Dead pups were counted on all breeding areas of Bogoslof Island resulting in an observed pup mortality rate of 3.0%. The 2019 pup production estimate for Bogoslof Island is 29.8% greater than the estimate in 2015 (Figure 3). Since the first pups were observed on Bogoslof Island in 1980, pup production has increased at an annual rate of 30.0% (SE = 2.41) but has slowed to an annual rate of 9.2% (SE = 0.91) since 1997. These growth rates are in contrast to the Pribilof Islands, where a significant decline in pup production began in 1998 and continued at a rate of 3.4% per year through 2018.



Figure 1. – Bogoslof Island, August 2019. South side rookery is on the left (light blue shading), North side rookery area on the right (light orange shading). (photo by Josh London)

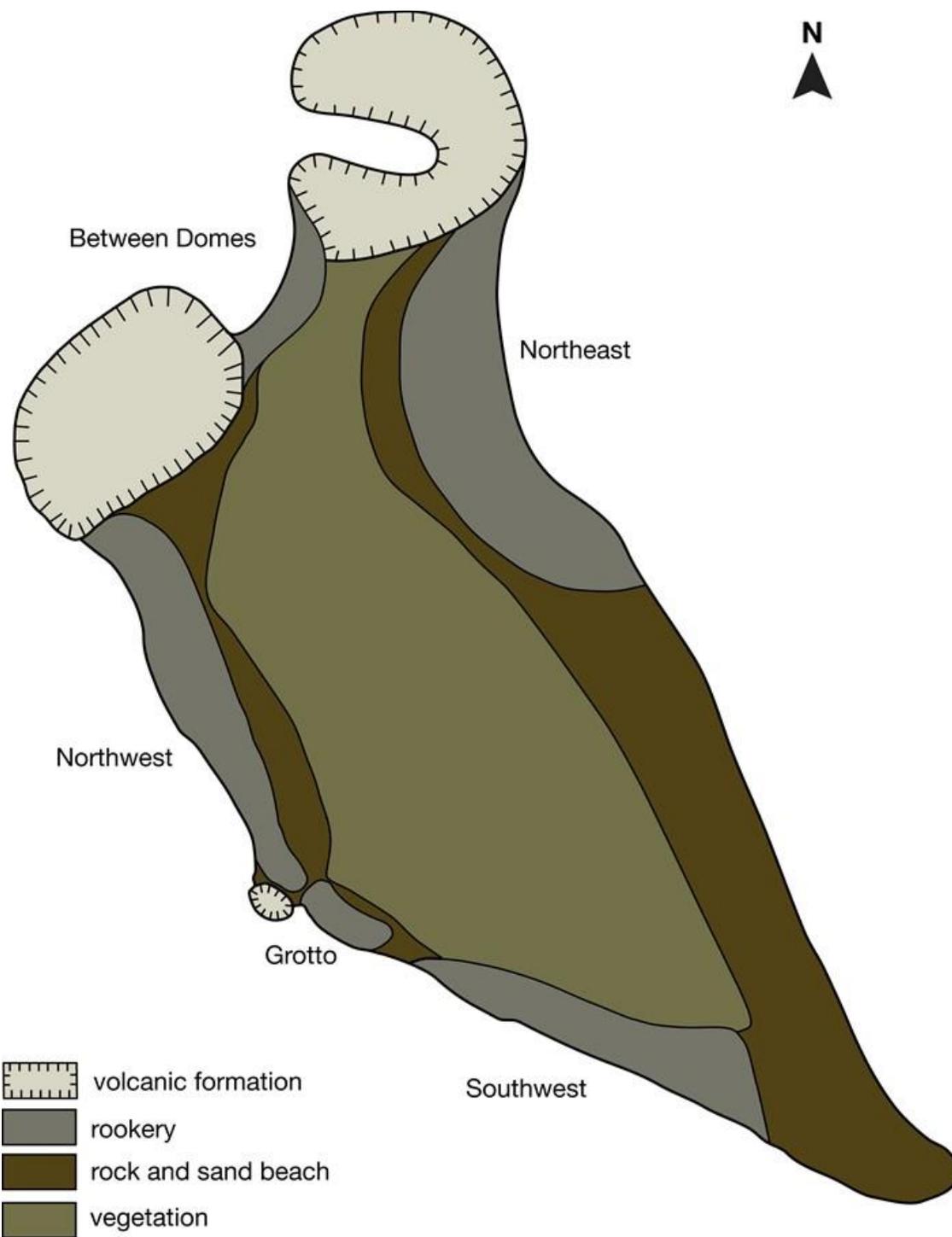


Figure 2. – Rookery areas of Bogoslof Island prior to the 2016-17 eruptions. Grotto rookery area was merged into Northwest in 2015.

Table 1: Numbers of northern fur seal, *Callorhinus ursinus*, pups born on Bogoslof Island, Alaska during 2019 by rookery area. Estimates are shown for the numbers alive at the time of shearing and the estimated total number of pups born.

Rookery	Live	Dead	Born	SE	Mortality
North	2,879	34	2,913	128.0	1.17
South	32,058	1044	33,102	1090.5	3.15
Total	34,937	1,078	36,015	1,098.0	2.99

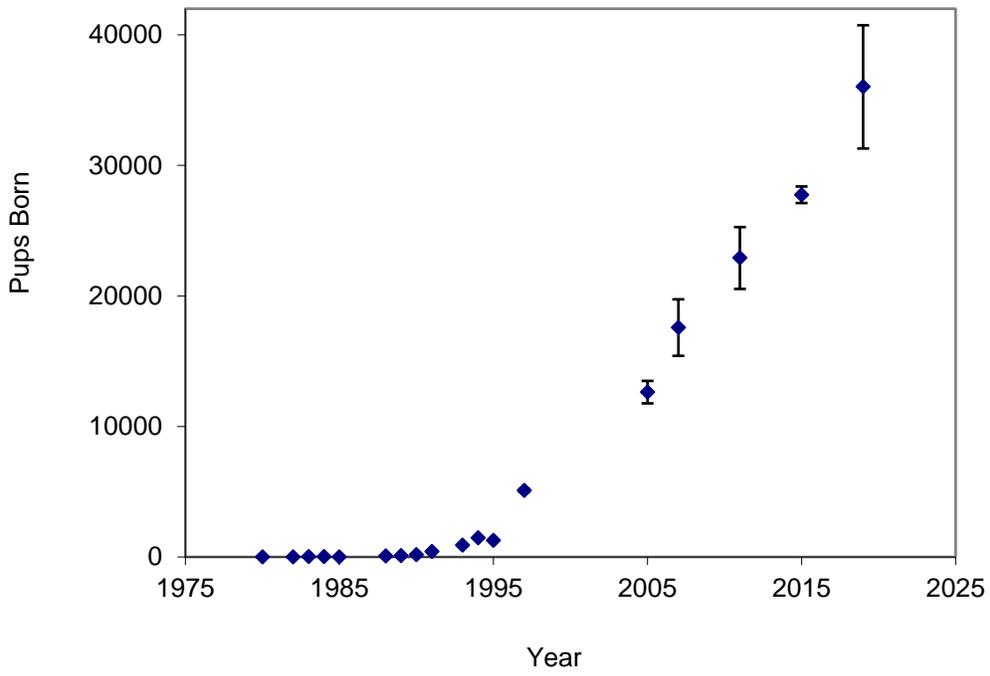


Figure 3. – Northern fur seal pups born on Bogoslof Island 1980-2019. Error bars are approximate 95% confidence intervals.