



Re-examining Habitat Segregation and Foraging Effort of Northern Fur Seals After 15 Years of Decline

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Background

- The Pribilof Islands (AK, Fig. 1) is home to the largest breeding colony of northern fur seals in the US.
- This population has shown an overall pattern of decline since the mid-1950's (Fig. 2, Towell *et al.* 2012), although rates vary between St. Paul Island (SP) and St. George Island (SG).
- During a brief period of stability (1995/1996), a previous study found that fur seals segregate foraging habitat between and within islands (Robson *et al.* 2004).
- This foraging habitat segregation may have been a mechanism to reduce intraspecific competition at these large breeding colonies (> 950,000 fur seals in 1996).
- By 2010, the Pribilof Islands fur seal population had declined to ~ 560,000 fur seals.
- Due to the continued decline in the fur seal population, we hypothesized that the segregation of foraging habitat may be relaxed and foraging effort reduced as fewer fur seals use the foraging areas.

Objective

Re-examine northern fur seal foraging habitat segregation and foraging effort after a significant decline in the population.

Results

Island comparisons in 2010

- Foraging habitat segregation was found between islands, with less than 8% of foraging trips from SP fur seal occurring in the SG fur seal foraging area (Fig. 4).
- Fur seals from SG travelled further (maximum distance) during longer duration foraging trips (Table 1).

Rookery comparisons in 2010

- Foraging trip durations, distances travelled, and foraging ranges did not differ between rookeries on SG (Table 2, Fig. 5 top).
- On SP, fur seals from the Southwest rookeries had significantly longer duration foraging trips (Table 2) and travelled greater distances to forage (total and maximum, Table 2, Fig. 5 bottom).

Interannual comparisons 1995/96 and 2010

- The overall patterns of island-wide habitat use and segregation were similar between studies (Figs 4-6).
- On SG, no reduction in foraging effort was found as fur seals travelled further in 2010 and trip duration did not change (Table 3).
- On SP, there was a trend for reduced foraging trip durations but fur seals travelled similar distances to forage and used a larger overall foraging range (Table 3).

Conclusions

- Our hypothesis that a potential reduction in competition (due to fewer fur seals) would lead to reduced foraging effort or habitat segregation was not supported.
- This indicates that fur seals are expending similar effort to acquire sufficient prey and suggests a change in fur seal carrying capacity has occurred.
- Changes to carrying capacity can result from a reduction in prey availability (e.g. Boyd *et al.* 1994; Costa 2008) or increased competition with other predators (Barlow *et al.* 2002; Ainley *et al.* 2006).
- Due to the continued foraging habitat segregation within and between islands, managers must recognize that natural and anthropogenic disturbances may have differential impacts on fur seals based on breeding location.

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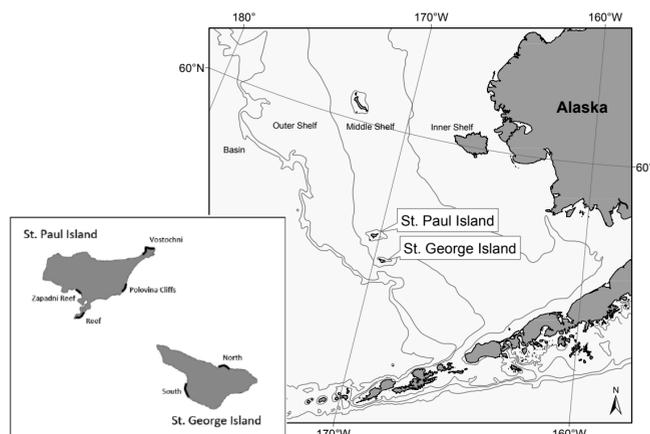


Figure 1. Northern fur seal foraging behavior was examined at St. George Island and St. Paul Island, Alaska, USA. Lines denote depth contours of the Bering Sea shelf and basin (50, 100, 200, and 1000 m) and the respective hydrographic domains are noted (inner shelf, middle shelf, outer shelf, and basin). Inset: Schematic of study rookery locations on St. Paul and St. George Islands denoted by thick black lines along the shoreline.

Methods

- Adult female fur seals (N = 27) were equipped with GPS tracking instruments (Fig. 3) to measure foraging behavior from August to October in 2010.
- Deployments were distributed among 4 rookeries on SP and 2 rookeries on SG (Fig. 1).
- Trip durations, movement patterns (maximum distance, total distance, transit rate), and foraging habitat (95% fixed kernel home range) were compared between islands and rookeries in 2010 and between studies (1995/1996 and 2010).
- Rookeries were grouped by natal areas for comparison to the 1995/1996 study ("Southwest" - Reef and Zapadni Reef, "Northeast" - Polovina Cliffs and Vostochni).

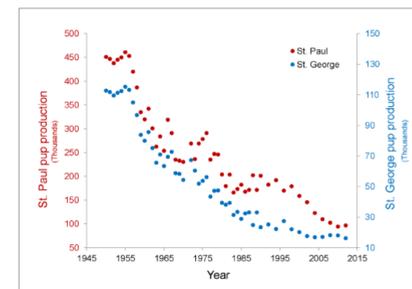


Figure 2. Northern fur seal pup production on St. Paul and St. George Islands. The average number of pups born over the past three censuses is multiplied by a correction factor of 4.47 to estimate the total stock for the Pribilof Islands.



Figure 3. A female northern fur seal equipped with tracking instruments.

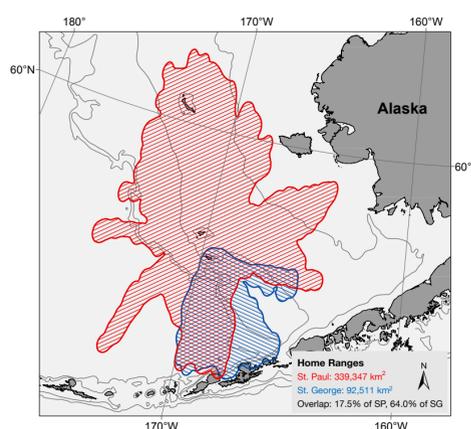


Figure 4. Home ranges for northern fur seals from St. Paul (red) and St. George Islands (blue). A total of 129 foraging trips were recorded over 45.2 ± 0.7 days of tracking. Only 7 foraging trips (< 8%) from SP fur seals occurred in the SG foraging area.

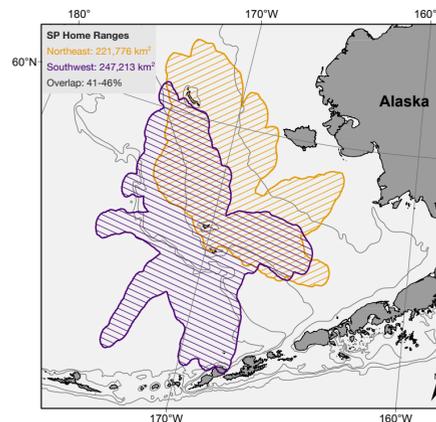
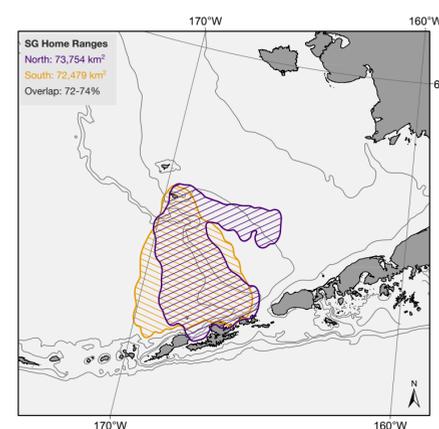


Figure 5. Home ranges of northern fur seals from two rookeries on St. George Island (North and South) and two rookery complexes on St. Paul Island (Northeast and Southwest).

Table 1. Comparison of movement patterns of northern fur seals between islands in 2010 (mean ± SE). Significant differences denoted by * ($P < 0.05$) and # ($P = 0.06$).

	St. George Island	St. Paul Island
Trip durations (d)	8.7 ± 0.3*	7.0 ± 0.2*
Total distance travelled (km)	709.2 ± 20.0	593.8 ± 26.1
Maximum distance (km)	285.3 ± 6.6*	34.3 ± 11.5*
Transit rate (km h ⁻¹)	3.4 ± 0.1	3.5 ± 0.1

Table 2. Comparison of movement patterns of northern fur seals between rookeries on St. Paul and St. George Islands in 2010. * denotes significant differences between rookeries on an island ($P < 0.05$).

	St. George Island		St. Paul Island	
	North	South	Northeast	Southwest
Trip durations (d)	8.9 ± 0.4	8.5 ± 0.4	6.3 ± 0.4*	8.0 ± 0.2*
Total distance travelled (km)	712.3 ± 25.5	705.7 ± 32.3	534.9 ± 37.3*	682.1 ± 28.8*
Maximum distance (km)	282.2 ± 9.5	288.7 ± 9.3	206.5 ± 15.8*	275.9 ± 13.7*

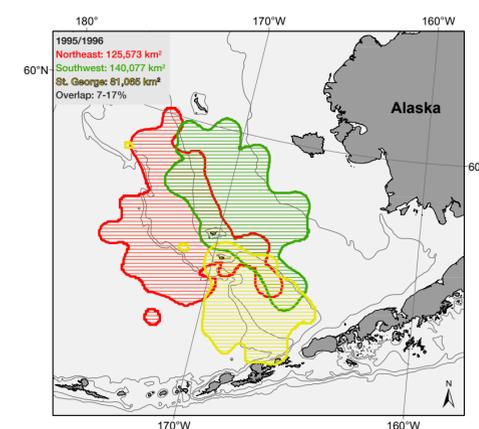


Figure 6. Northern fur seal foraging ranges identified in 1995/1996 by Robson *et al.* 2004. St. Paul fur seals were grouped by rookery complexes (Northeast and Southwest).

Table 3. Comparison of movement patterns and foraging range of northern fur seals between the 1995/1996 study and the present study (2010). Significant differences denoted by * ($P < 0.05$) and # denotes a significant trend ($P = 0.07$).

	1995/1996		2010	
	St. George	St. Paul	St. George	St. Paul
Trip durations (d)	8.0 ± 0.3	8.4 ± 0.3*	8.7 ± 0.3	7.0 ± 0.2*
Maximum distance (km)	242.1 ± 11.0*	247.4 ± 9.5	285.3 ± 6.6*	234.3 ± 11.5
Foraging range (km ²)				
Total	81,065	237,515	92,511	339,347
NE		125,573		212,776
SW		140,077		247,213