

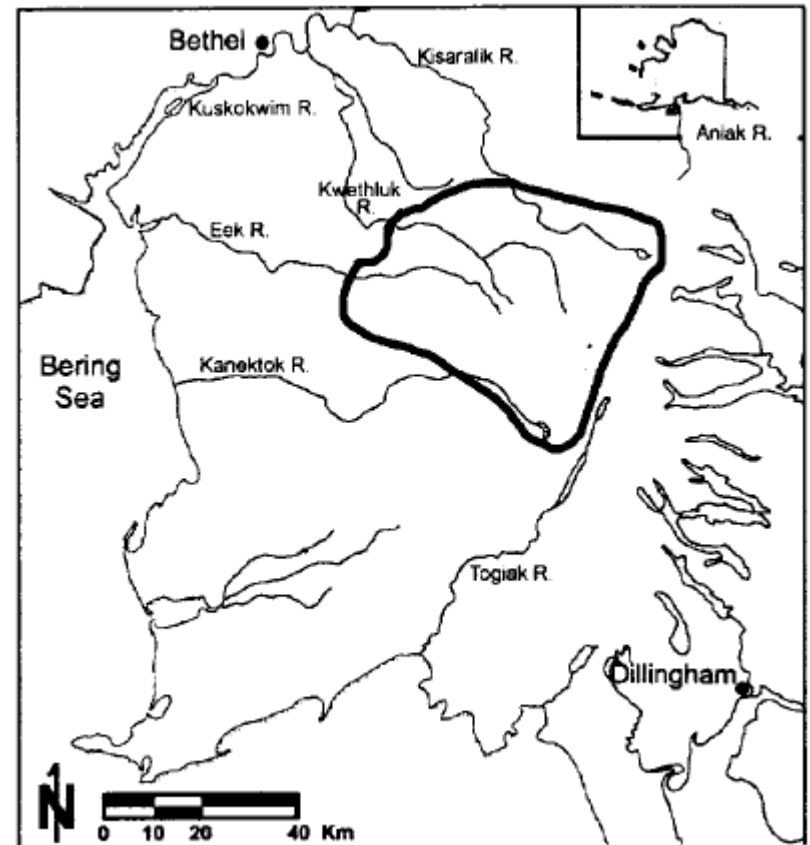
Wolf and brown bear predation on Togiak Refuge moose

- Bear status
- Wolf status
- Predation on moose and caribou by bears and wolves

Togiak Refuge brown bear home range and survival study, 1993-2003

- 40 adult female brown bears radiocollared
- Bears located close to salmon streams from 16 July–15 August, coinciding with salmon availability.
- Home ranges averaged 356 km² (93-623)
- Population rate of increase varied .963-1.047, suggesting stability

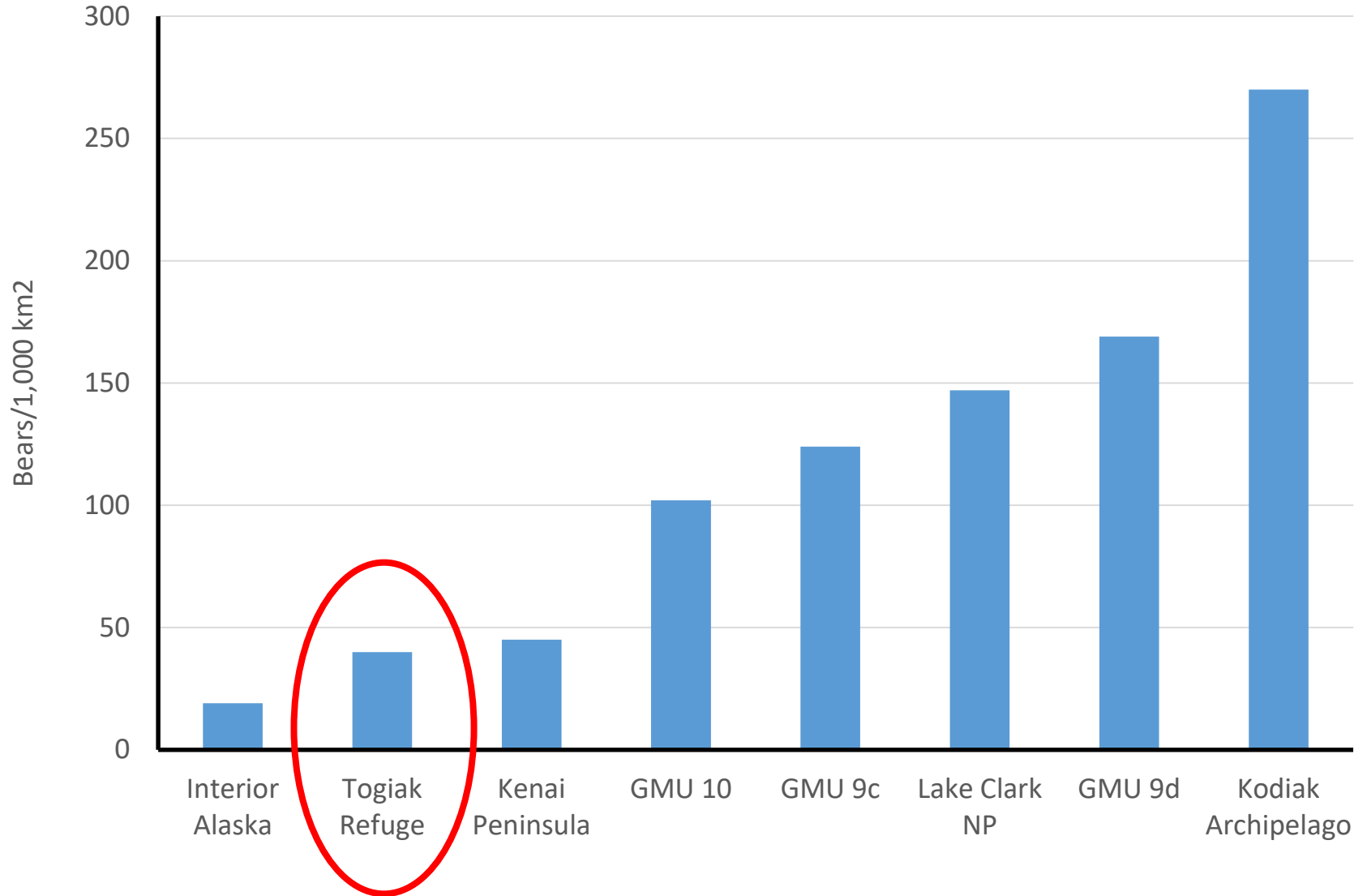
Ursus 16(2):181–189 (2005)
Ursus 17(1):16–29 (2006)



Togiak Refuge Brown Bear Population Estimate

- Performed in 2003 – 2004
- 969 aerial transects flown
- 197 Bear groups seen (330 bears)
- Population density: 40.4 total bears/1000 km² (95% CI: 31—55)
- **Total bears: 855** (95% CI: 665 – 1,154)

Bear Population Density



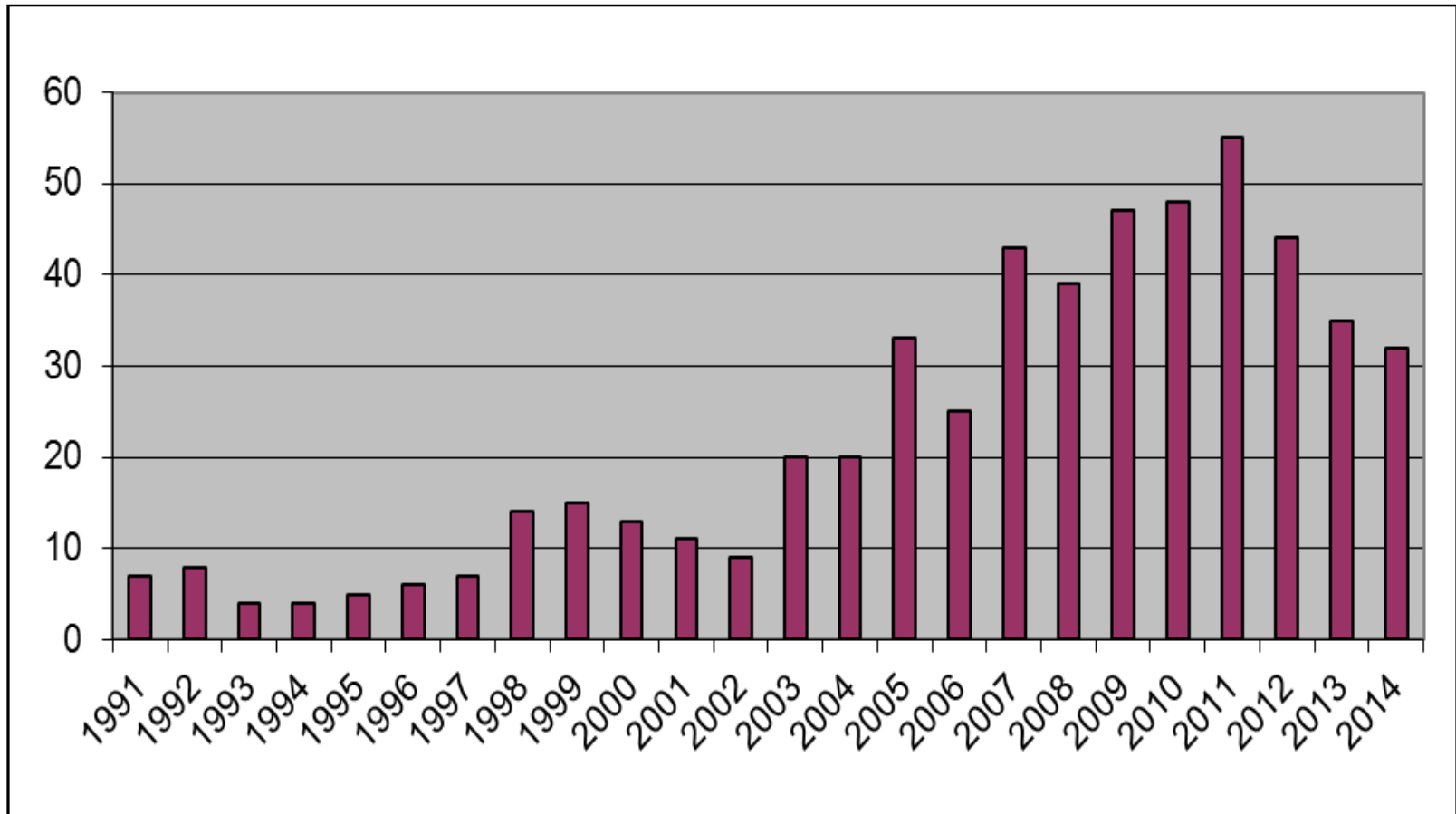
Salmon availability comparison: Togiak and Kodiak

	Togiak ^a	Kodiak ^b
Total salmon (millions of kg)	3.7	12.7
Area (thousands of km ²)	21	12
Independent bears	579	2,300
Salmon kg/bear (thousands)	6.4	5.5

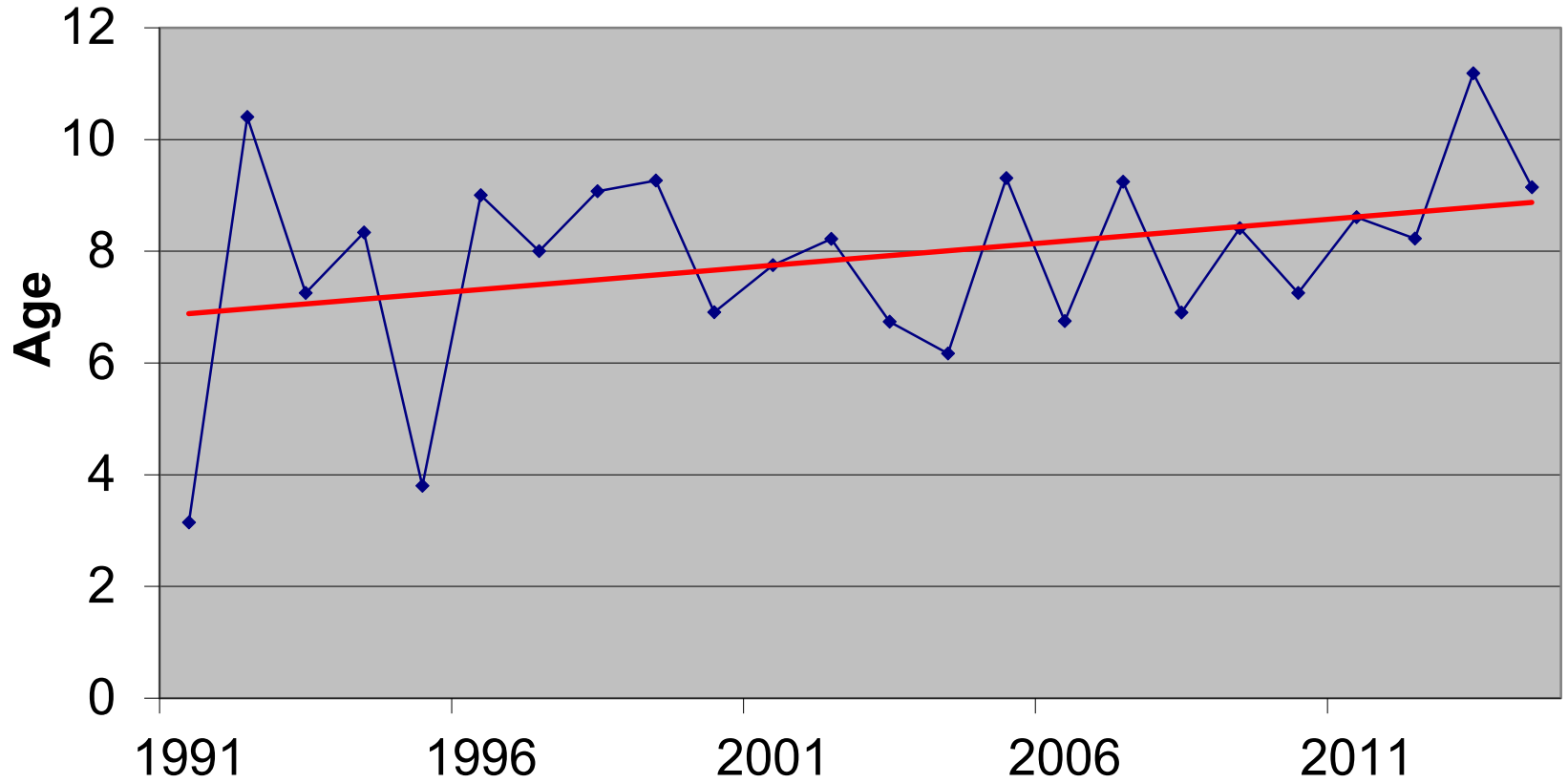
^aValues from ADFG sources and Walsh et al. 2010. Application of a double-observer aerial line-transect method to estimate brown bear population density in southwestern Alaska. *Journal of Fish and Wildlife Management* 1(1)45-58.

^bValues from Van Daele et al. 2013. Salmon consumption by Kodiak brown bears with ecosystem management implications. *Can. J. Zool.* 91: 164-174.

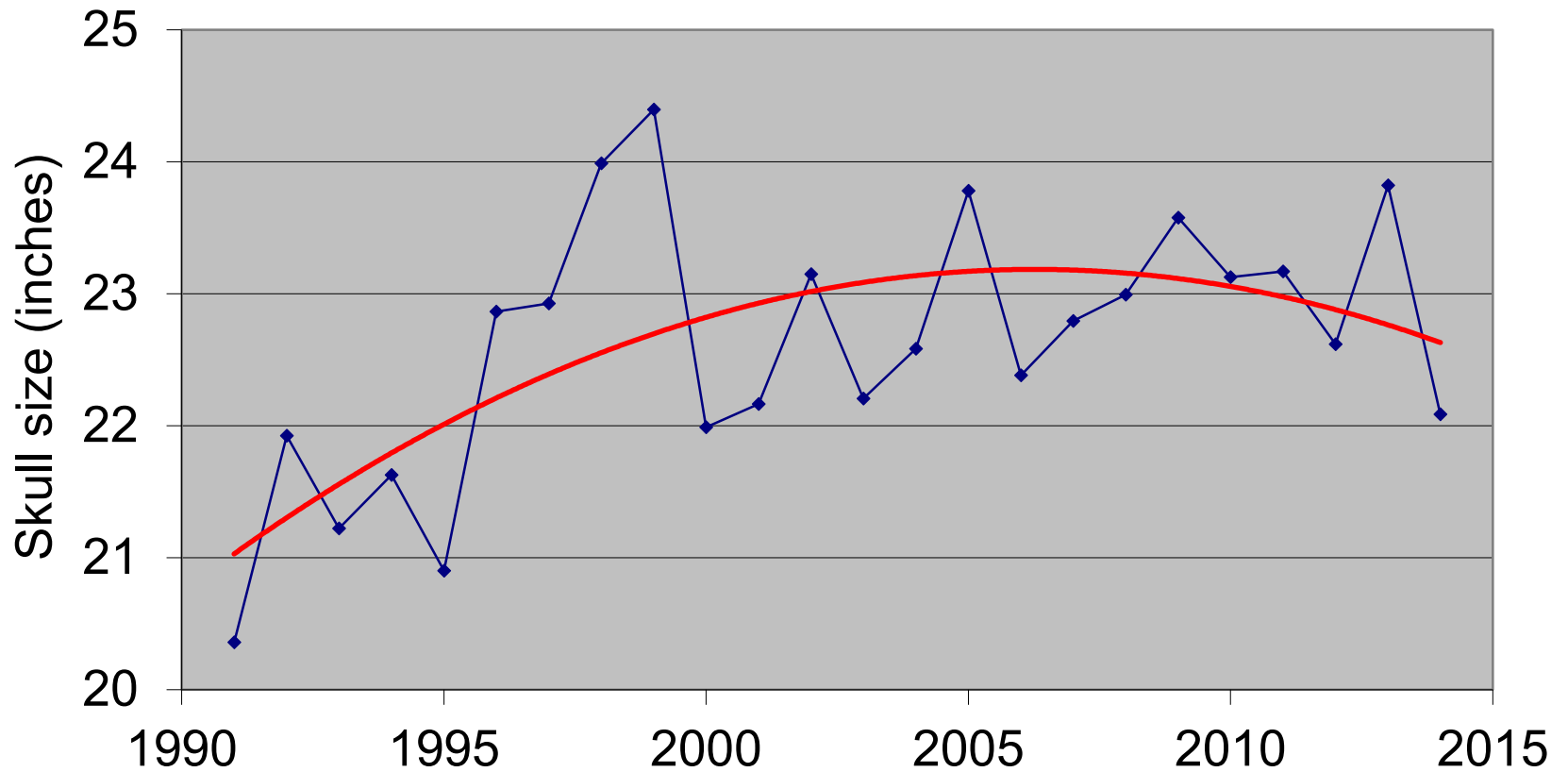
Togiak Refuge Brown Bear Harvest



Age of harvested bears



Skull size of harvested bears



Bear status conclusions:

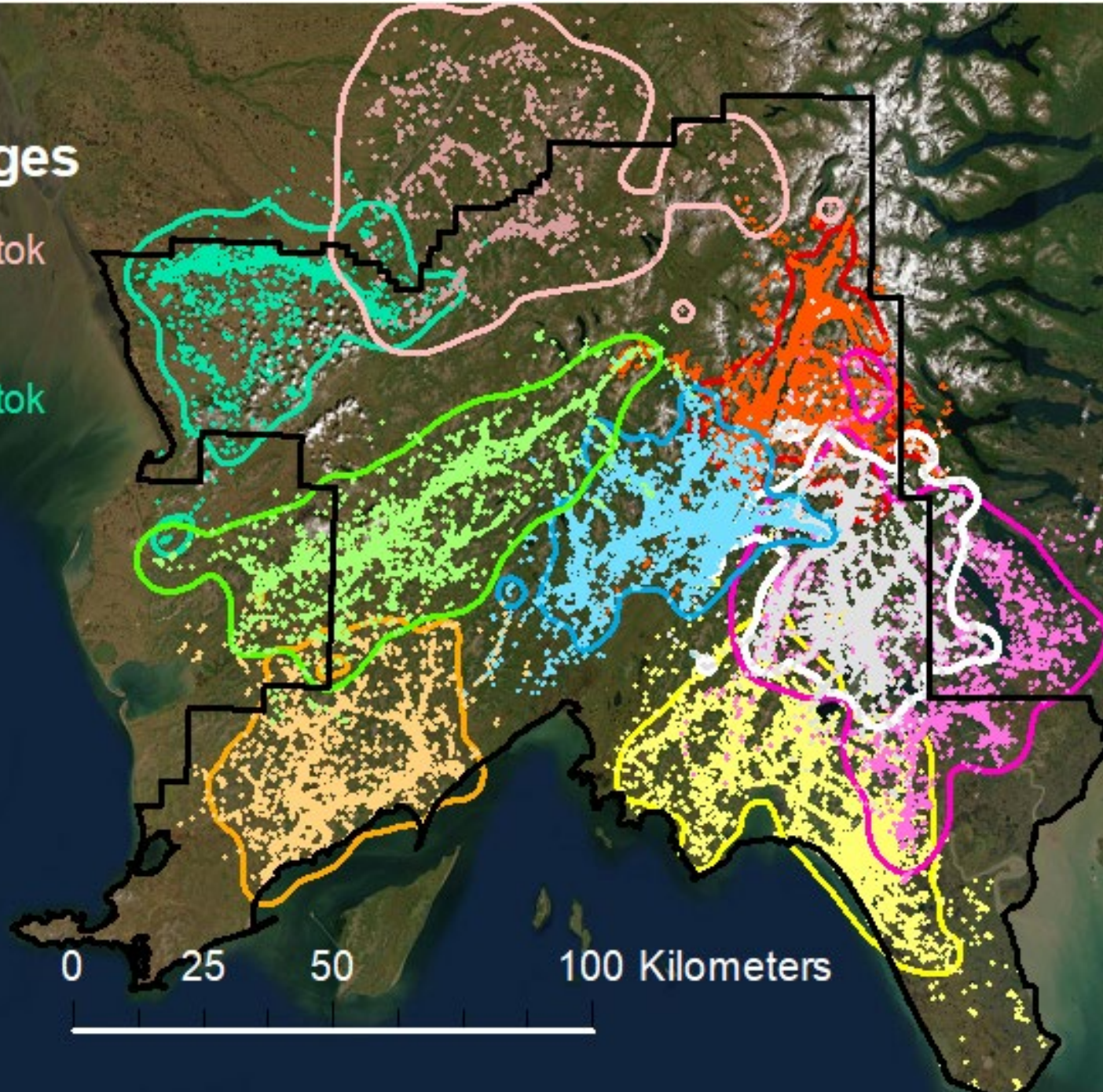
- Togiak Refuge has a moderately abundant bear population
- Population size is strongly influenced by salmon availability
- Harvest has increased but has not caused a decreased age or size structure

Wolf status

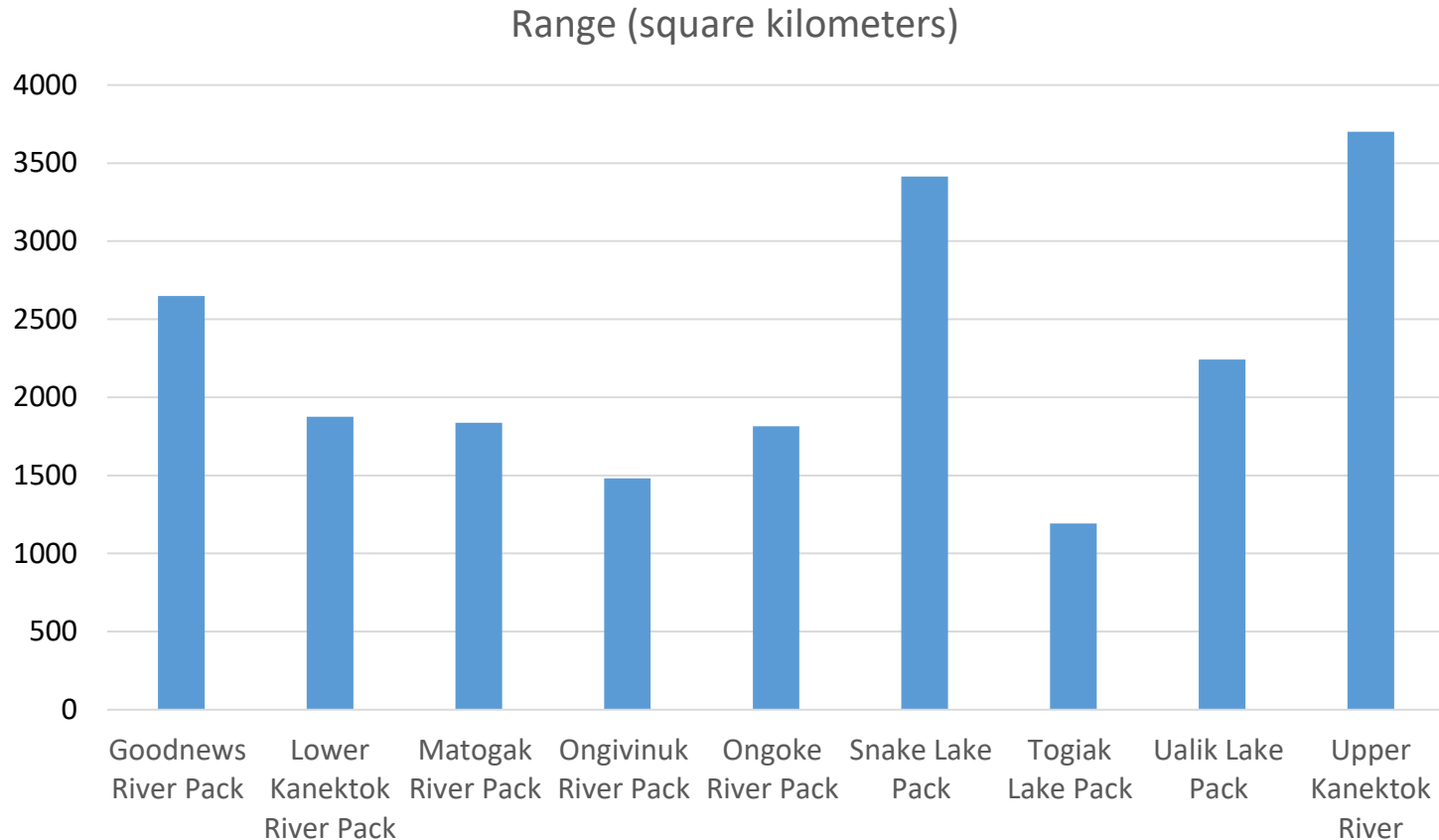
- Radio-telemetry project 2007-2011 focused on Nushagak Peninsula caribou.
- Refuge-wide wolf study 2015—present Focused on moose predation.
- 85 total wolves captured (68 individuals)
- >200,000 locations collected

Wolf pack ranges

- Upper Kanektok
- Goodnews
- Lower Kanektok
- Matogak
- Ongivinuk
- Ongoke
- Snake Lake
- Togiak Lake
- Ualik Lake



Pack range size



- Ranges average 2,245 square kilometers.

Wolf pack ranges

Upper Kanektok

Goodnews

Lower Kanektok

Matogak

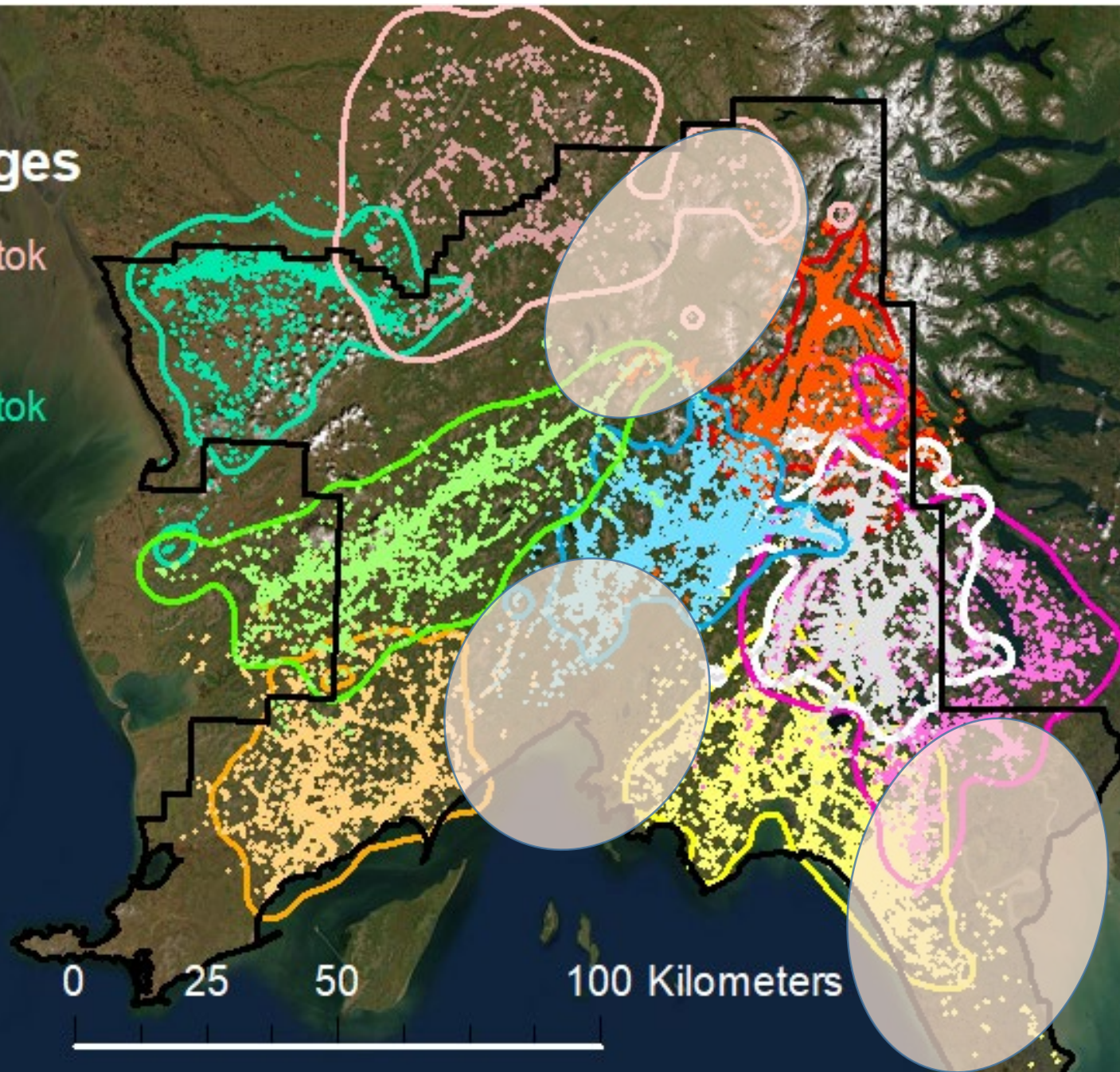
Ongivinuk

Ongoke

Snake Lake

Togiak Lake

Ualik Lake



0 25 50 100 Kilometers

Estimated wolf pack size

Unshaded values are count data.
Gray shaded values are averages
of count data.

Pack averages:

Spring – 6.7

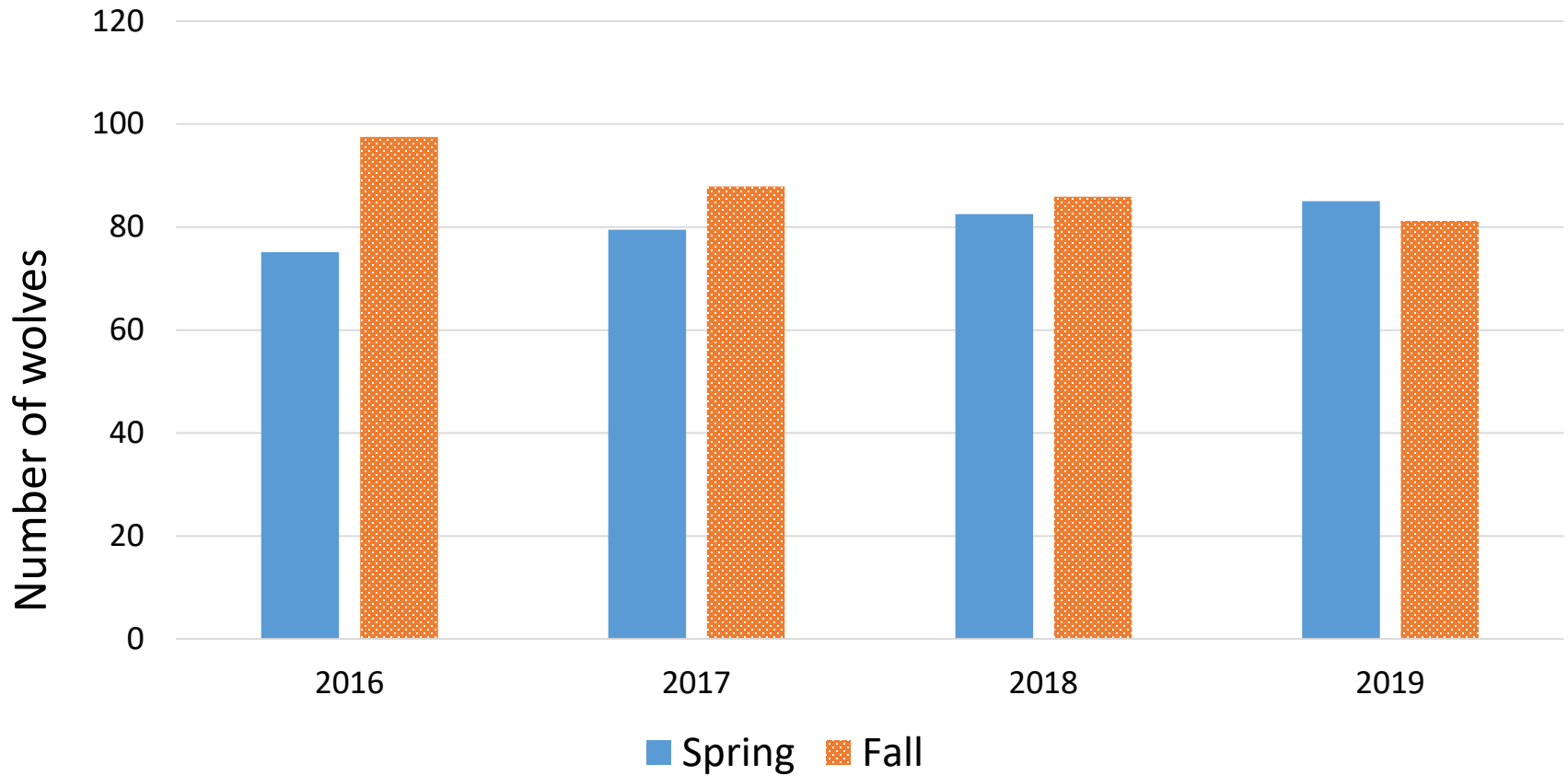
Fall – 7.2

Pup production:

4.3 pups/litter (n = 13)

Pack	Season	2016	2017	2018	2019	Average
<u>Togiak</u>	Spring	7	11	5	10	8.3
	Fall	14	5	10	8.0	9.3
<u>Ualik</u>	Spring	6	2	4	5	4.3
	Fall	9	4	5	8	6.5
<u>Ongoke</u>	Spring	2	7	9	6.0	6.0
	Fall	7	9	3	2	5.3
<u>Ongiviniuk</u>	Spring	7.5	6	9	7.5	7.5
	Fall	6	9	9	7	7.8
Upper <u>Kanektok</u>	Spring	6.7	12	6.7	6.7	8.0
	Fall	12	7.2	7.2	7.2	8.4
<u>Goodnews</u>	Spring	6.7	6	5	6.7	6.1
	Fall	7.2	8	7.2	7.2	7.4
Lower <u>Kanektok</u>	Spring	6.7	3	6.7	6.7	5.8
	Fall	7.2	7.2	7.2	7.2	7.2
Snake	Spring	5.7	5.7	8	5	6.1
	Fall	6.4	8	5	8	6.9
<u>Nushagak</u>	Spring	6.7	6.7	6.7	6.7	6.7
	Fall	7.2	7.2	7.2	6	6.9
<u>Matogak</u>	Spring	6.7	6.7	9	9	7.9
	Fall	7.2	9	9	6.3	7.9
<u>Ungalikthluk</u>	Spring	6.7	6.7	6.7	6.7	6.7
	Fall	7.2	7.2	7.2	7.2	7.2
<u>Nenevok</u>	Spring	6.7	6.7	6.7	9	7.3
	Fall	7.2	7.2	9	7.2	7.6
Total	Spring	75	79	83	85	81
	Fall	98	88	86	81	88

Estimated Togiak Refuge wolf population size 2016-2019



Average: Spring: 81
Fall: 88

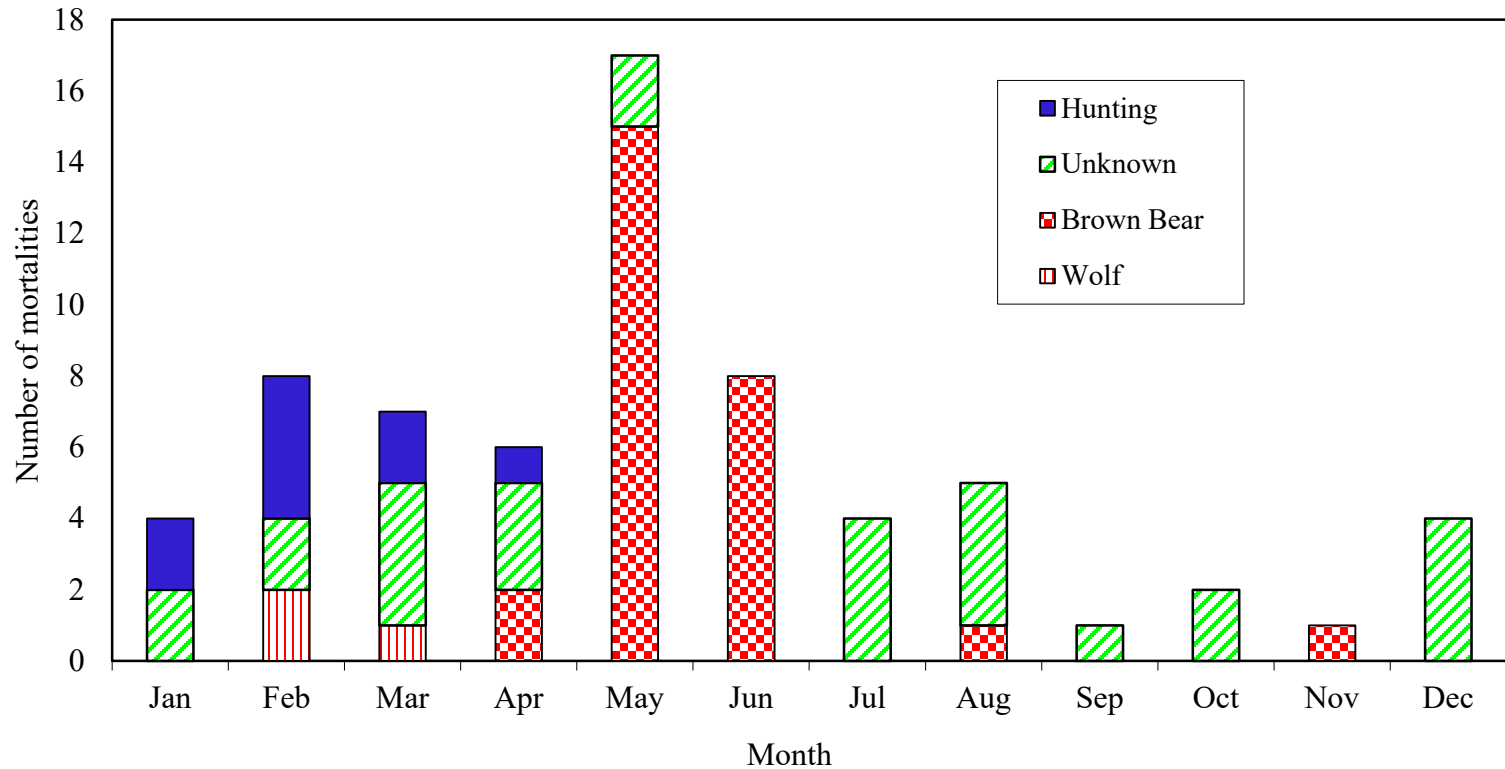
Wolf status conclusions:

- The Togiak Refuge wolf population is composed of approximately 12 packs
- The total population is variable, but averages approximately 100.
- Pack territories average about 2,200 km²
- The area is at or near population saturation, suggesting that growth is unlikely

Wolf and bear predation on Togiak Refuge moose

- Cow moose mortality study
- Nushagak Peninsula caribou wolf predation study
- Wolf and bear diet study

Causes of mortality of radio-collared female moose, 1998-2020

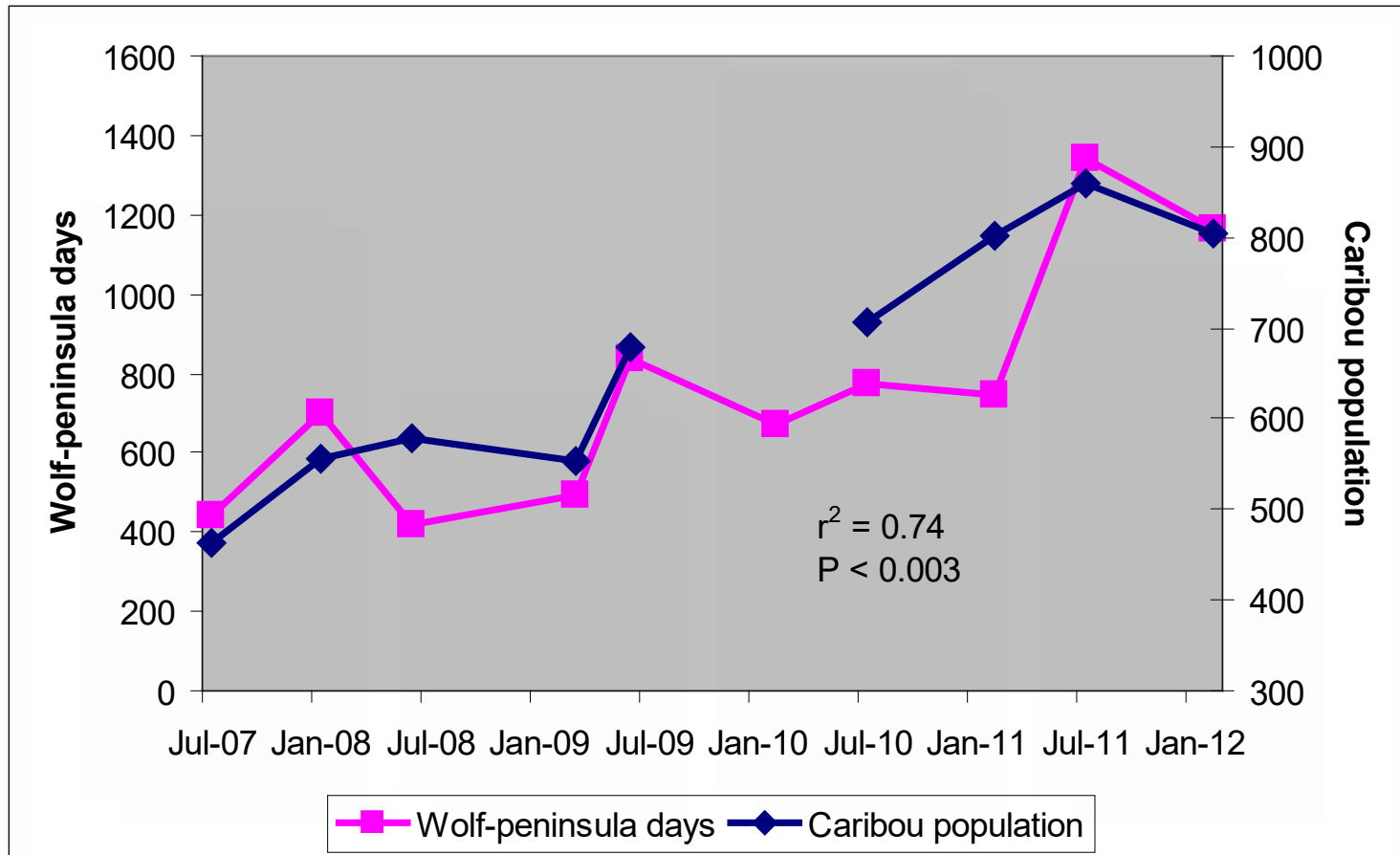


*Data from Aderman, A. R., S. J. Lowe and J. D. Woolington. 2013. Monitoring moose demographics at Togiak National Wildlife Refuge, southwestern Alaska, 1998-2011. Togiak National Wildlife Refuge and Alaska Department of Fish and Game, Dillingham AK. 25pp, and unpublished data.

Annual mortality of female moose, 1998-2020

- Sample size of radio-collared cows: average = 34.7 (range: 19-44 annually)
- Annual mortality: average = 3.0 (range: 1-7)
- Total annual mortalities: 67 of 764 cow/years = 8.8%
- Overall mortality due to bear predation: 40%
- Annual mortality of cow moose due to bear predation: 3.5%

Relationship of caribou population and wolf use of Nushagak Peninsula, 2007-2012



Walsh, P. and J. Woolington. 2019. Influence of wolf predation on population momentum of the Nushagak Peninsula caribou herd, southwestern Alaska. *Rangifer* 39, (1), 2019: 1-10, DOI: <https://doi.org/10.7557/2.39.1.4455>.

Wolf and brown bear diet study, 2015-present

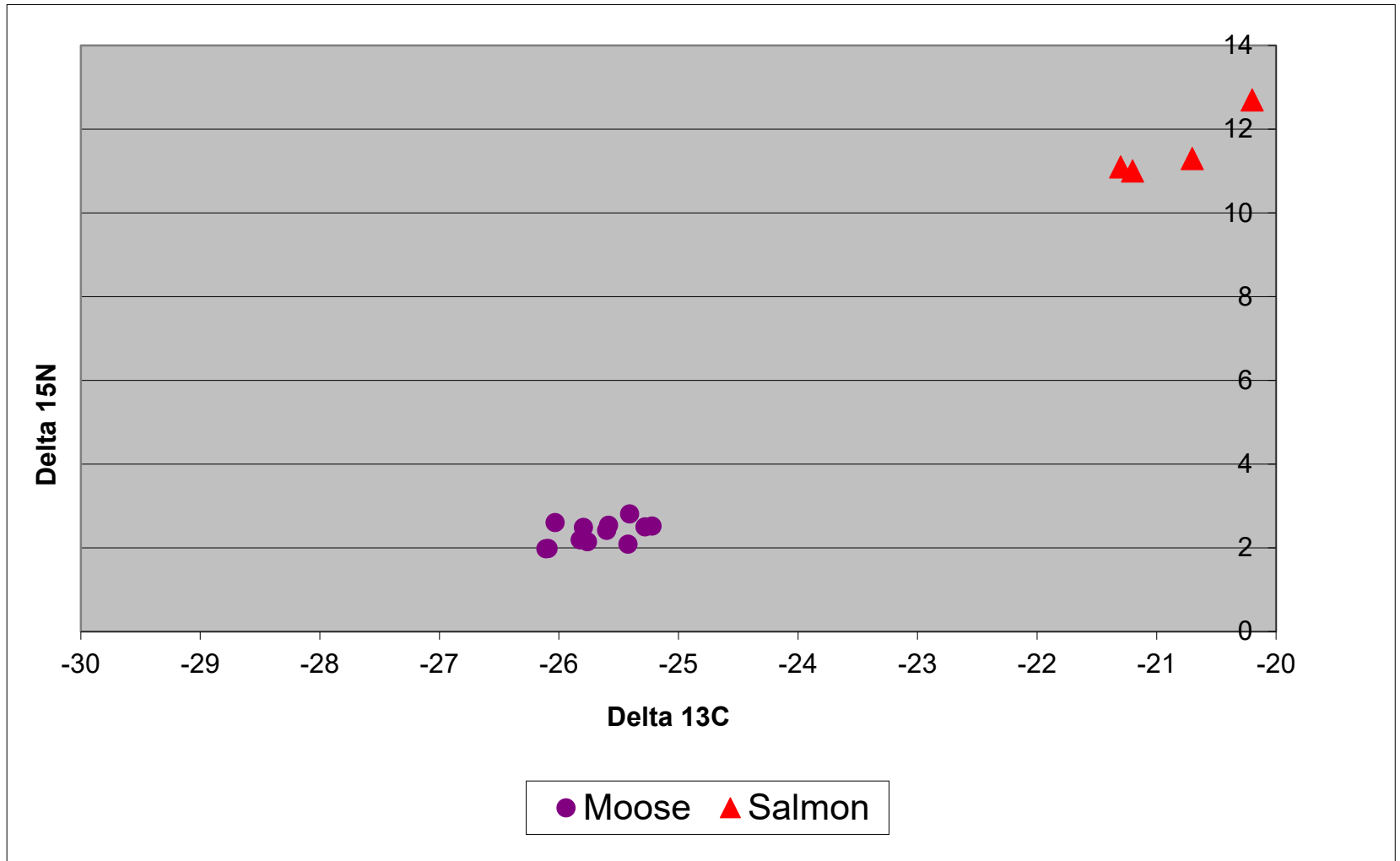
Objective:

- Determine the quantity of moose annually preyed upon by wolves and brown bears throughout Togiak Refuge.

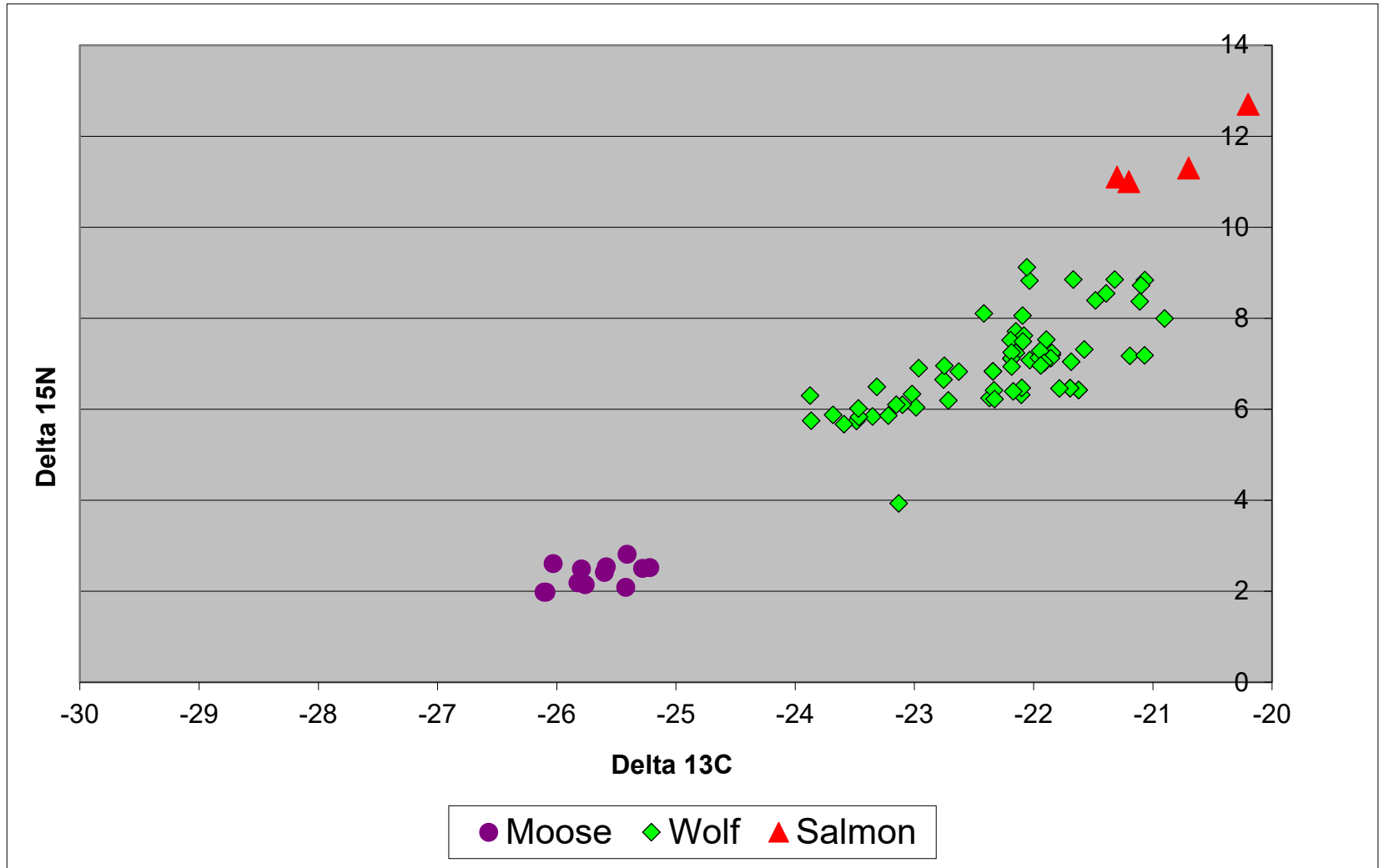
Methods

- Wolf and moose diet determined by stable isotope analysis
- Isotopes are forms of elements that can be distinguished from each other
- Animals are composed of the elements in their diet
- Animals that have different diets are isotopically different

Isotopic composition of moose and salmon



Isotopic composition of Togiak Refuge wolves and moose and salmon



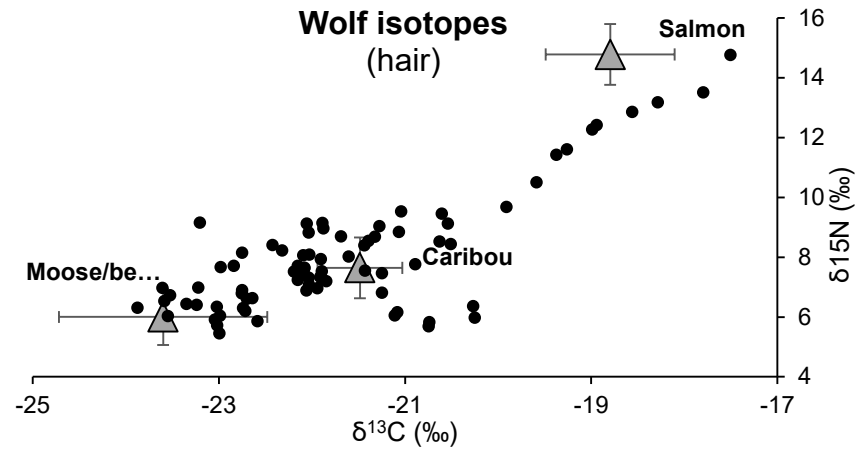
A person wearing camouflage clothing is shown in a forest setting. They are holding a blue bag and a bundle of brown hair samples. The background consists of tree trunks and foliage.

Tissue samples

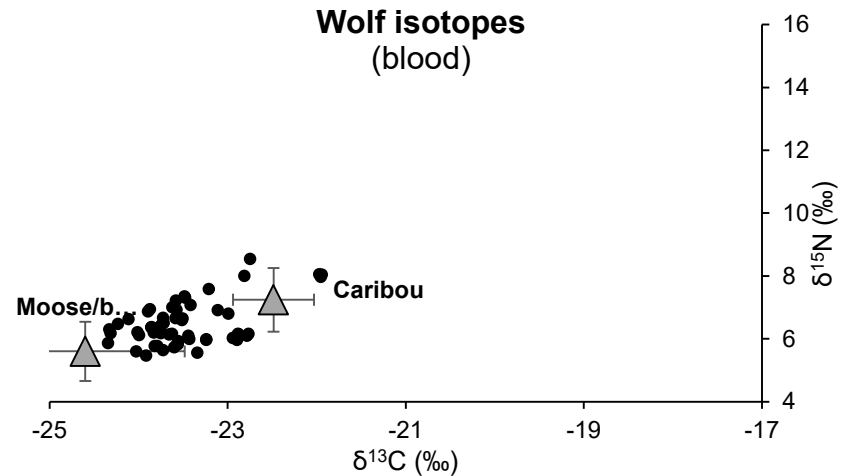
Bear hair (n = 291)
Wolf hair (n = 102)
Wolf blood (n = 61)

Wolf diets inferred from stable isotopes

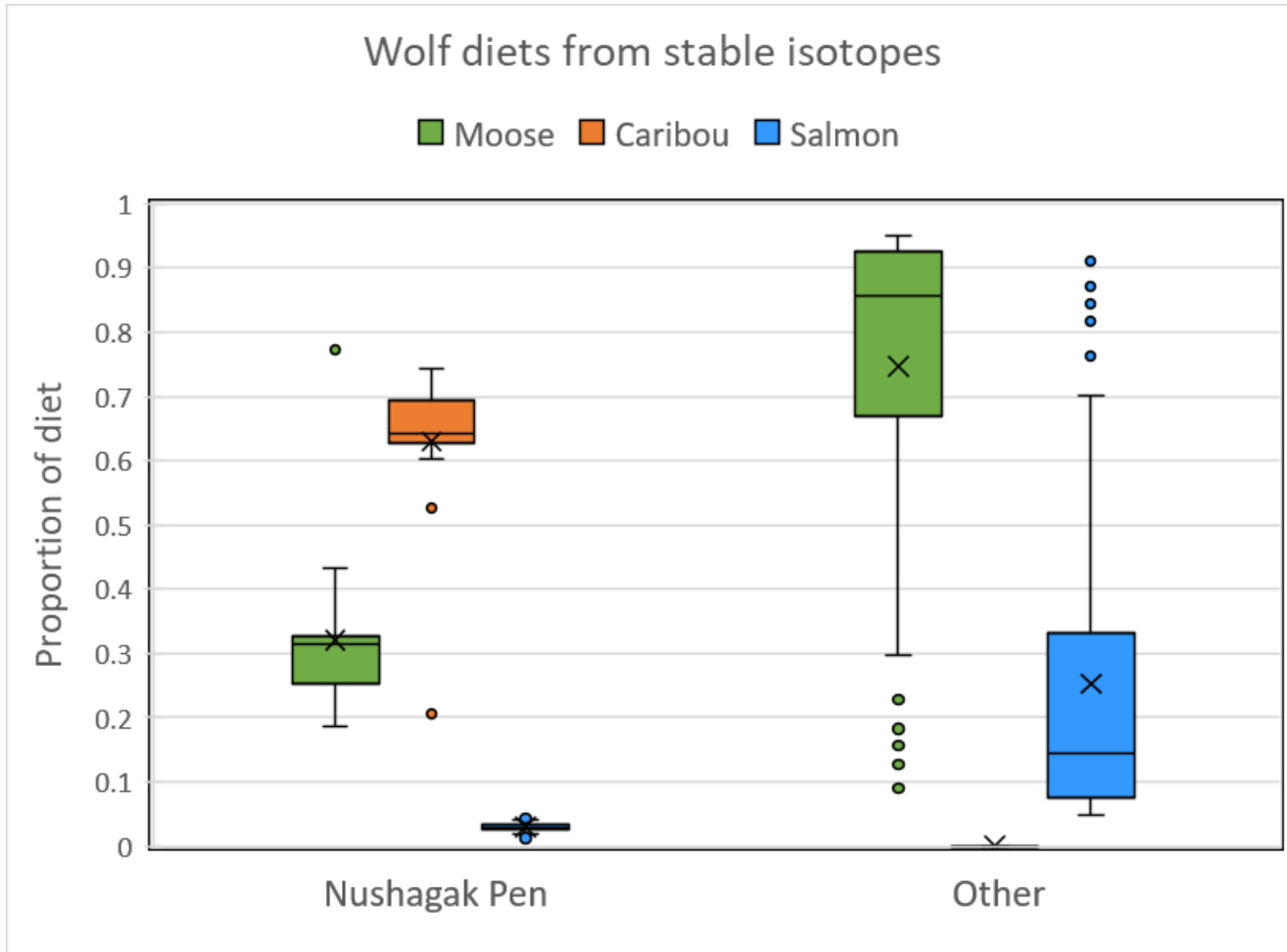
Summer



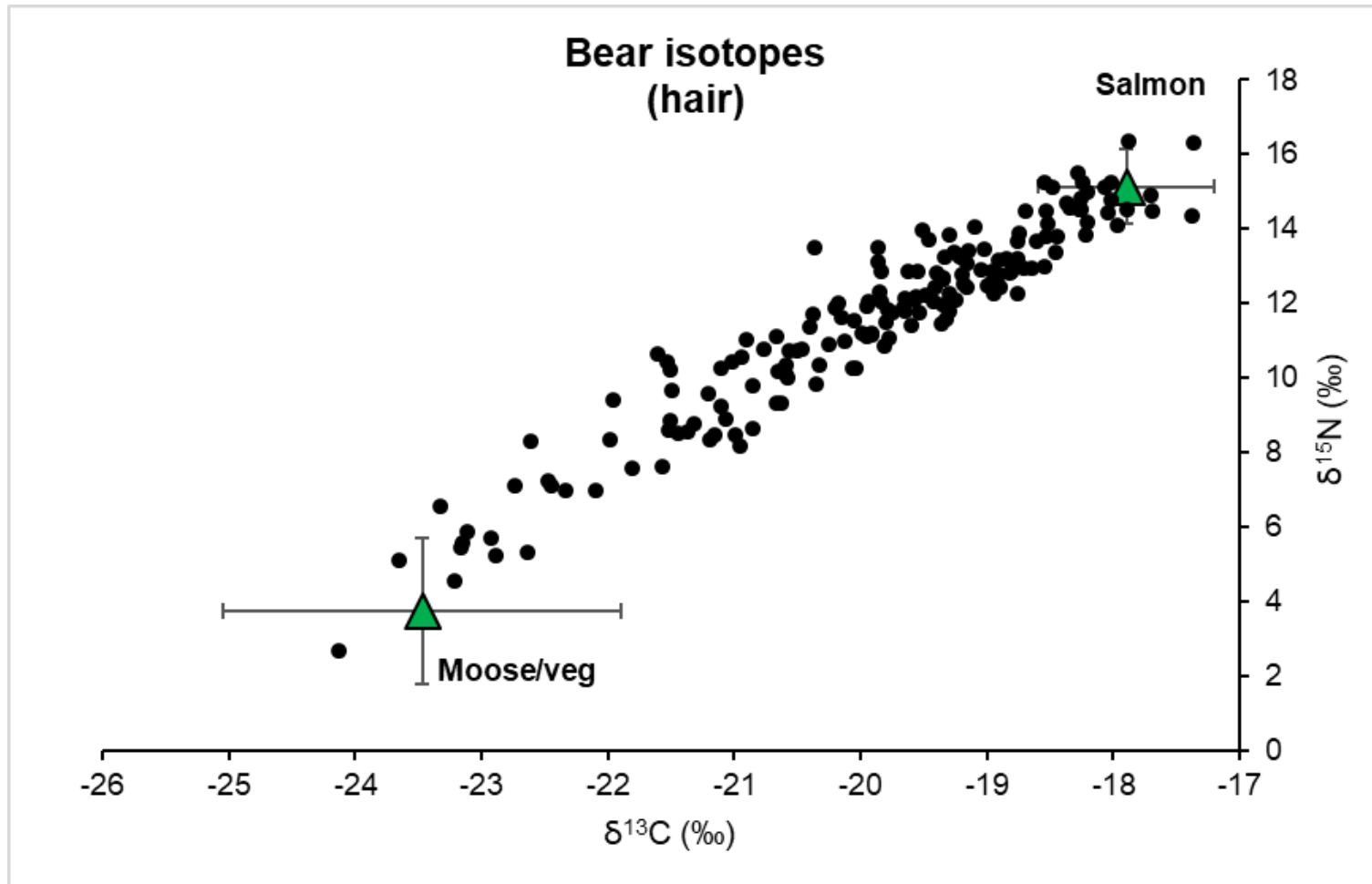
Winter



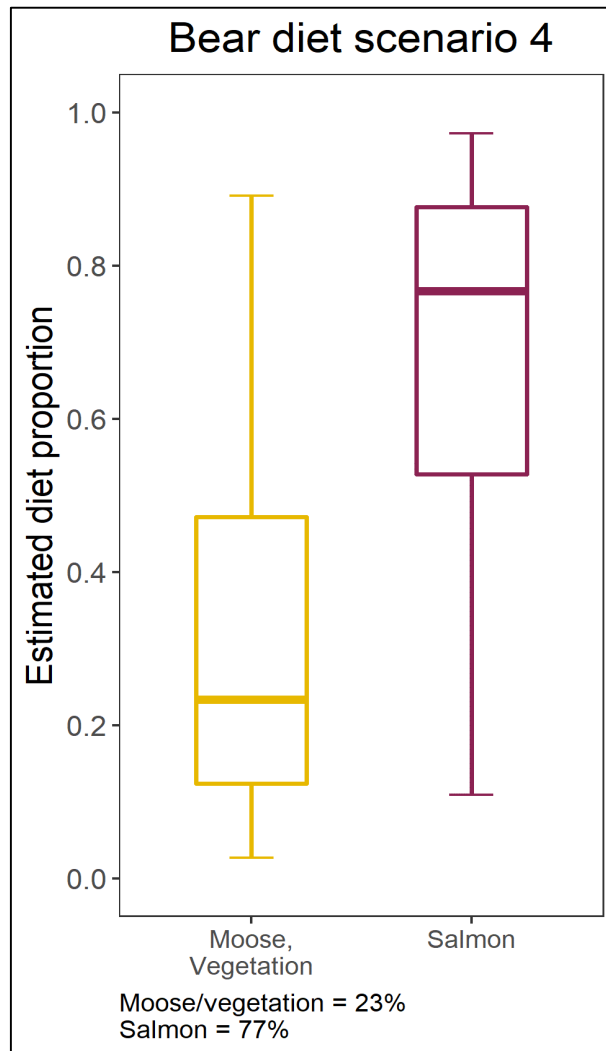
Preliminary wolf summer diet proportion estimate



Bear diets inferred from stable isotopes



Preliminary bear diet proportion estimate



Togiak Refuge moose population growth, 1991-2020

