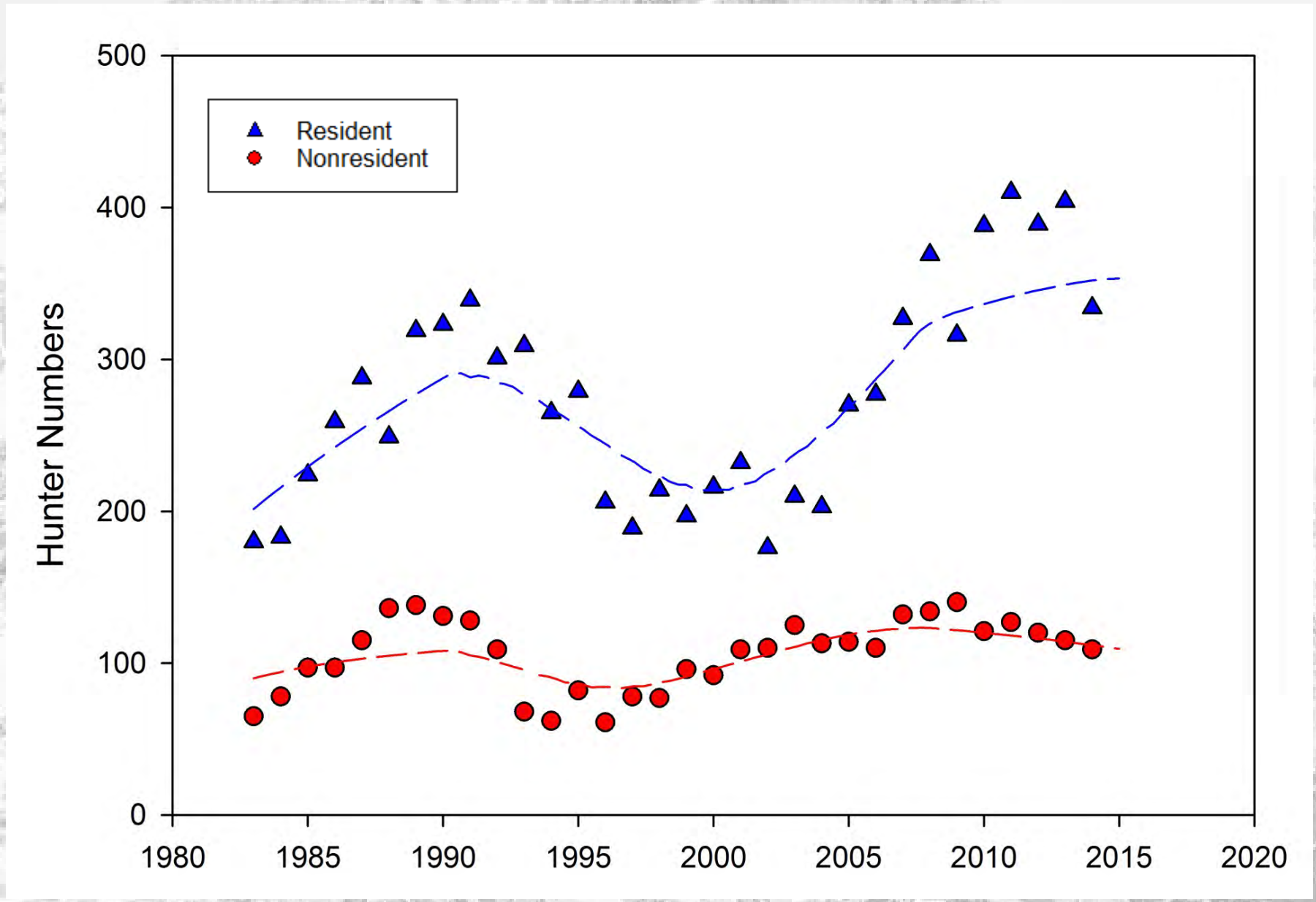
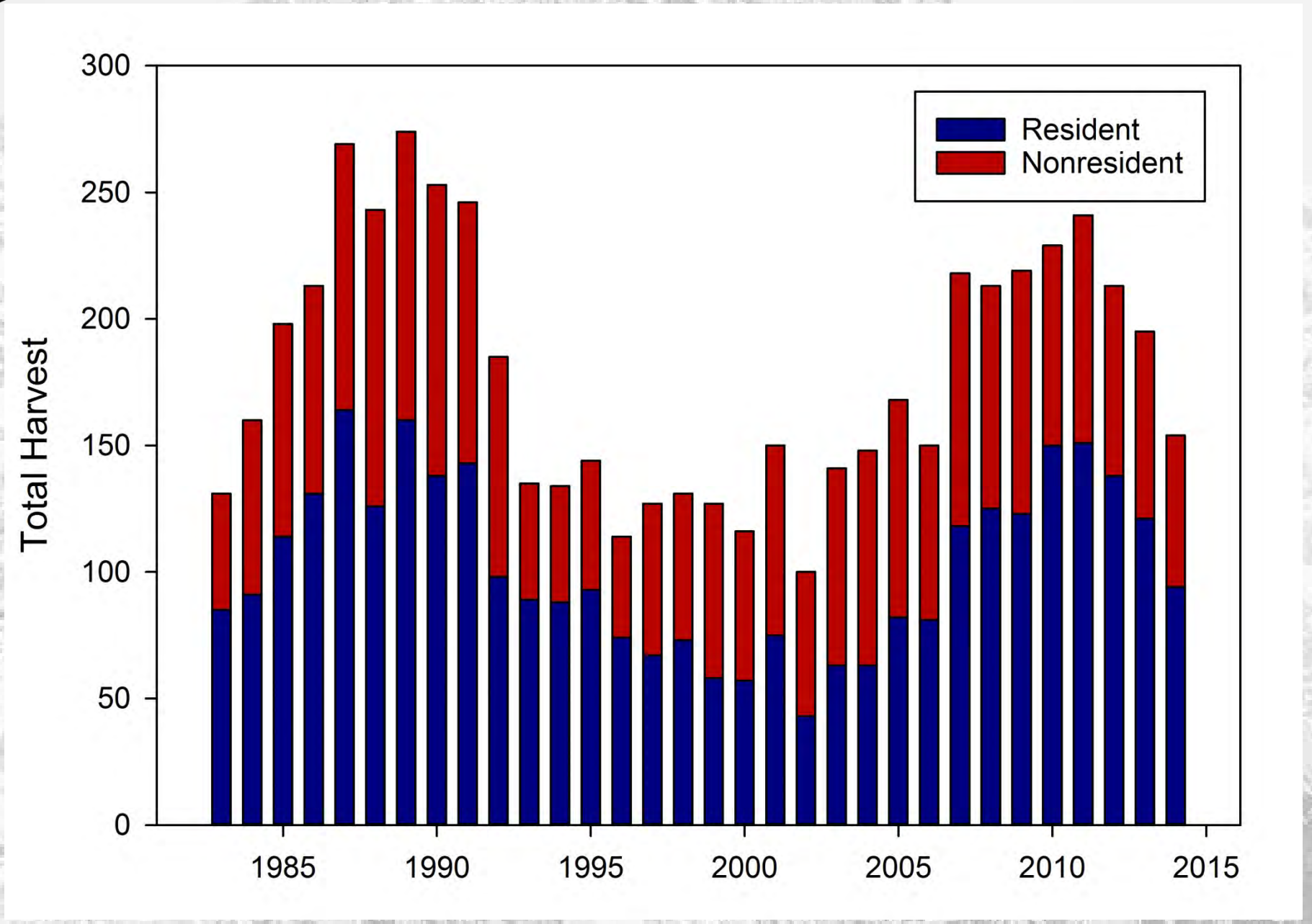
A Summary of the Eastern Brooks Range Harvest and Trends

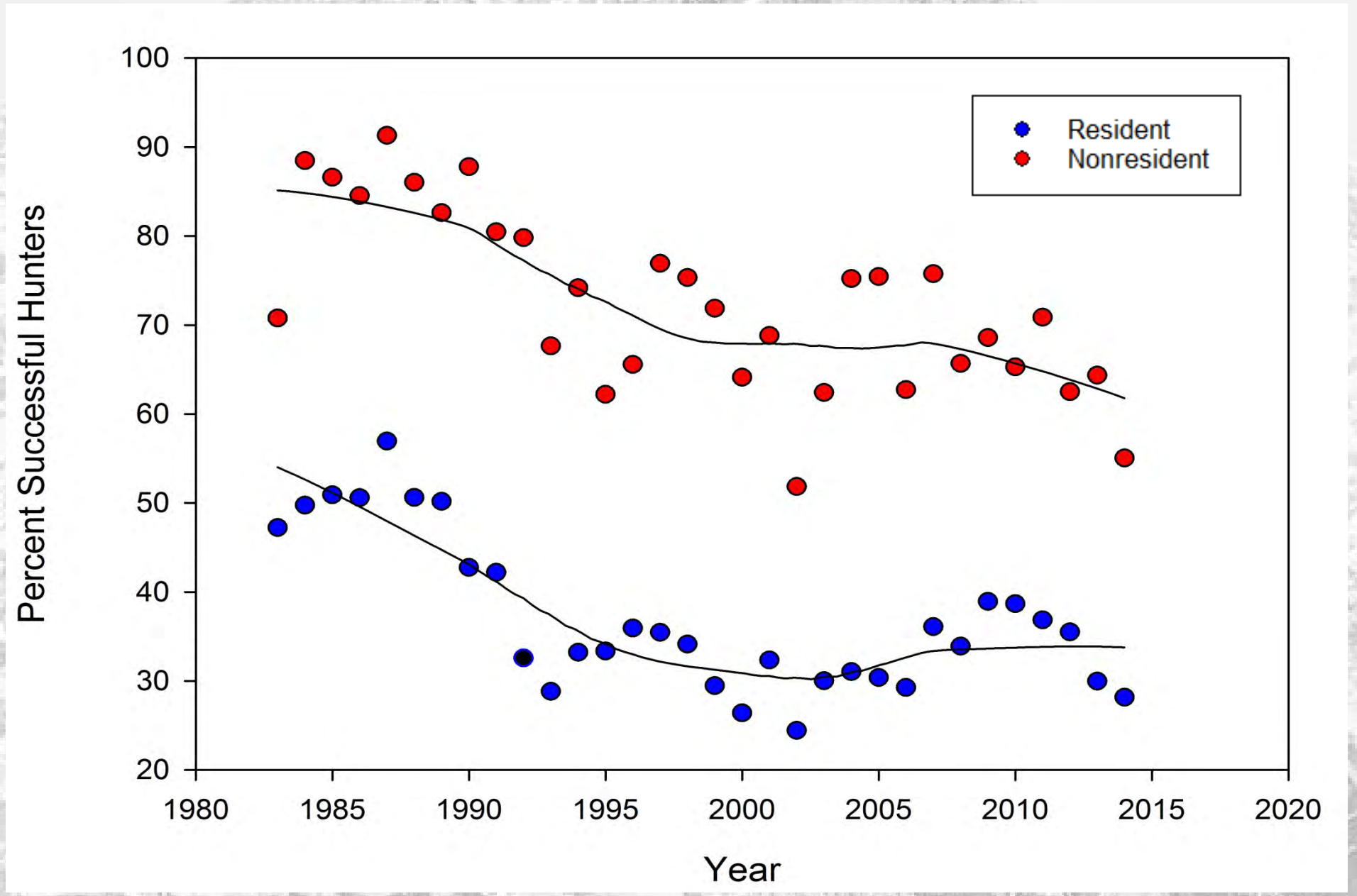
Hunter Numbers GMUs 24A, 25A, 26B, 26C



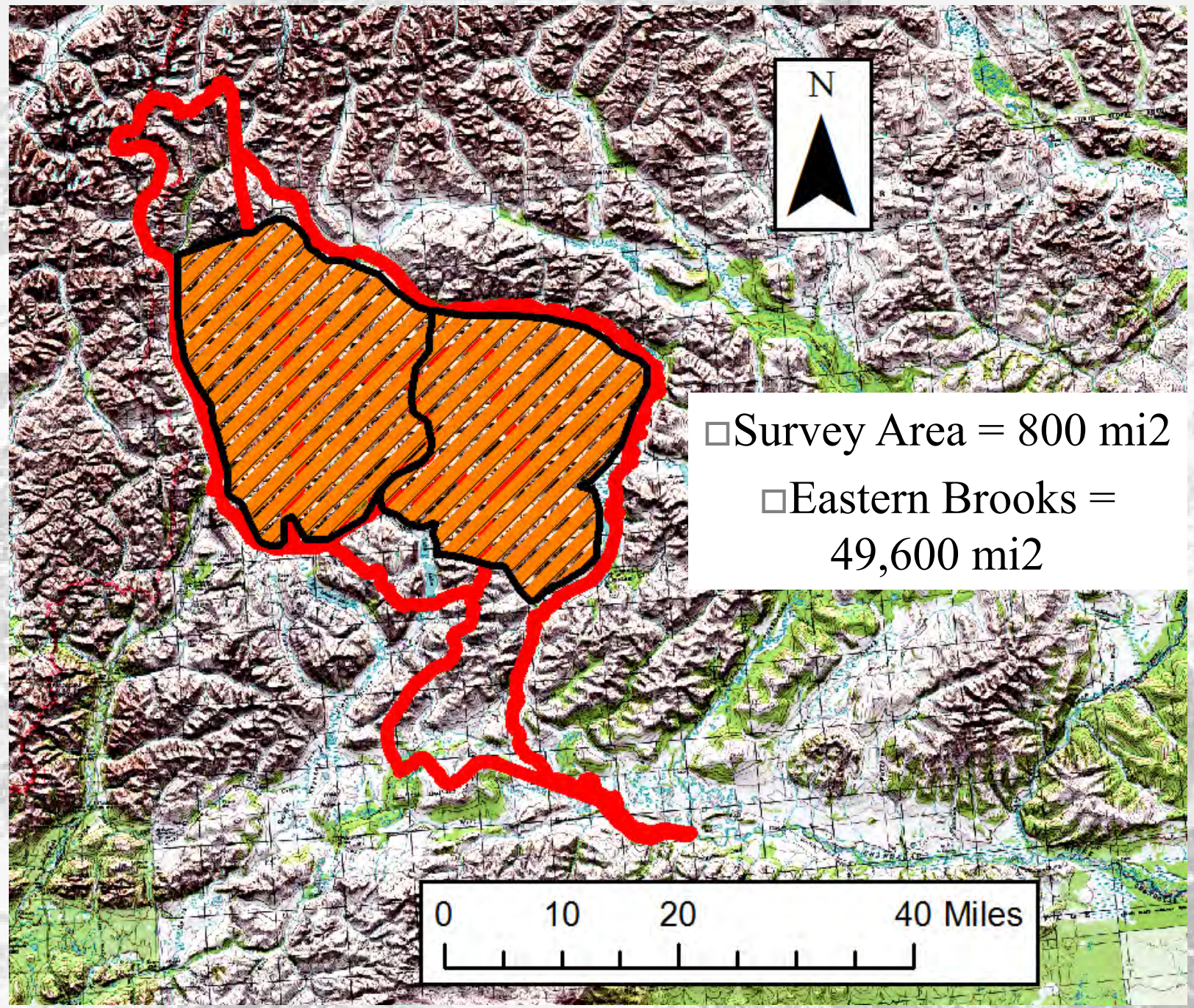
Harvest GMUs 24A, 25A, 26B, 26C



Hunter Success GMUs 24A, 25A, 26B, 26C



Survey Area

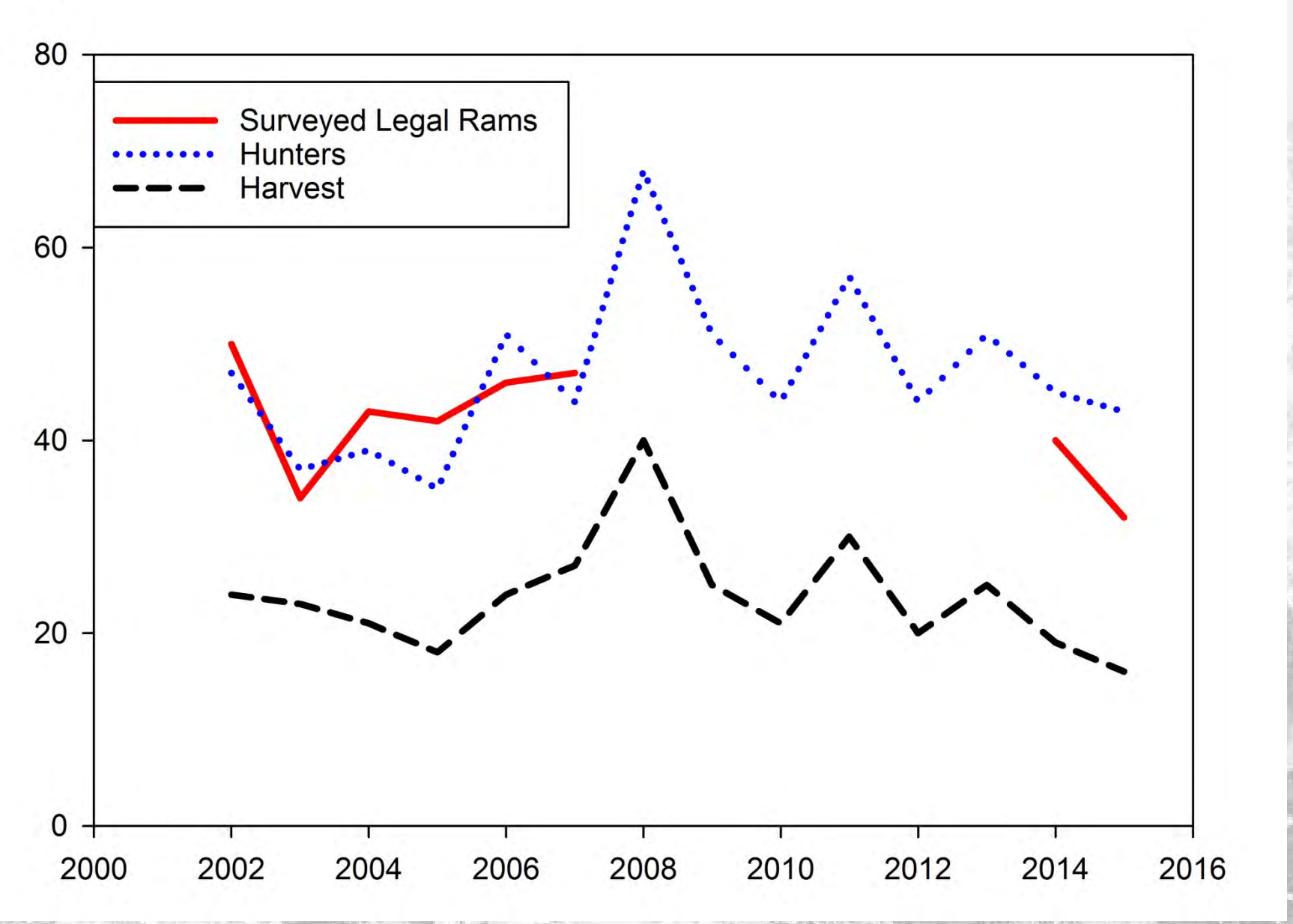


- Survey Area = 800 mi2
- Eastern Brooks = 49,600 mi2

Eastern Brooks Minimum Count Data

Year	Hunters	Harvest	Legal Rams	Sub Legal Rams	Unkown Rams	Ewe Like	Total Adult Sheep	Lambs	Avg Age	Avg horn lenth
2002	47	24	50	380	4	884	1318	221	9.8	35.3
2003	37	23	34	207	13	621	875	114	9.6	36.1
2004	39	21	43	320	9	908	1280	180	8.9	34.6
2005	35	18	42	203	4	636	885	214	9.4	36.7
2006	51	24	46	313	77	857	1293	224	8.8	34.9
2007	44	27	47	152	0	779	978	332	9.3	35.1
2008	68	40	-	-	-	-	-	-	9.6	35.8
2009	51	25	31	298	0	911	1240	295	9.6	35.0
2010	44	21	-	-	-	-	-	-	9.8	34.9
2011	57	30	-	-	-	-	-	-	9	35.7
2012	44	20	30	343	0	1153	1526	212	9.6	35.5
2013	51	25	-	-	-	-	-	-	8.7	34.9
2014	45	19	40	233	0	541	814	13	9.1	34.4
2015	43	16	32	303	1	656	992	180	9.1	35.6

Harvest Hunters and Legal Rams



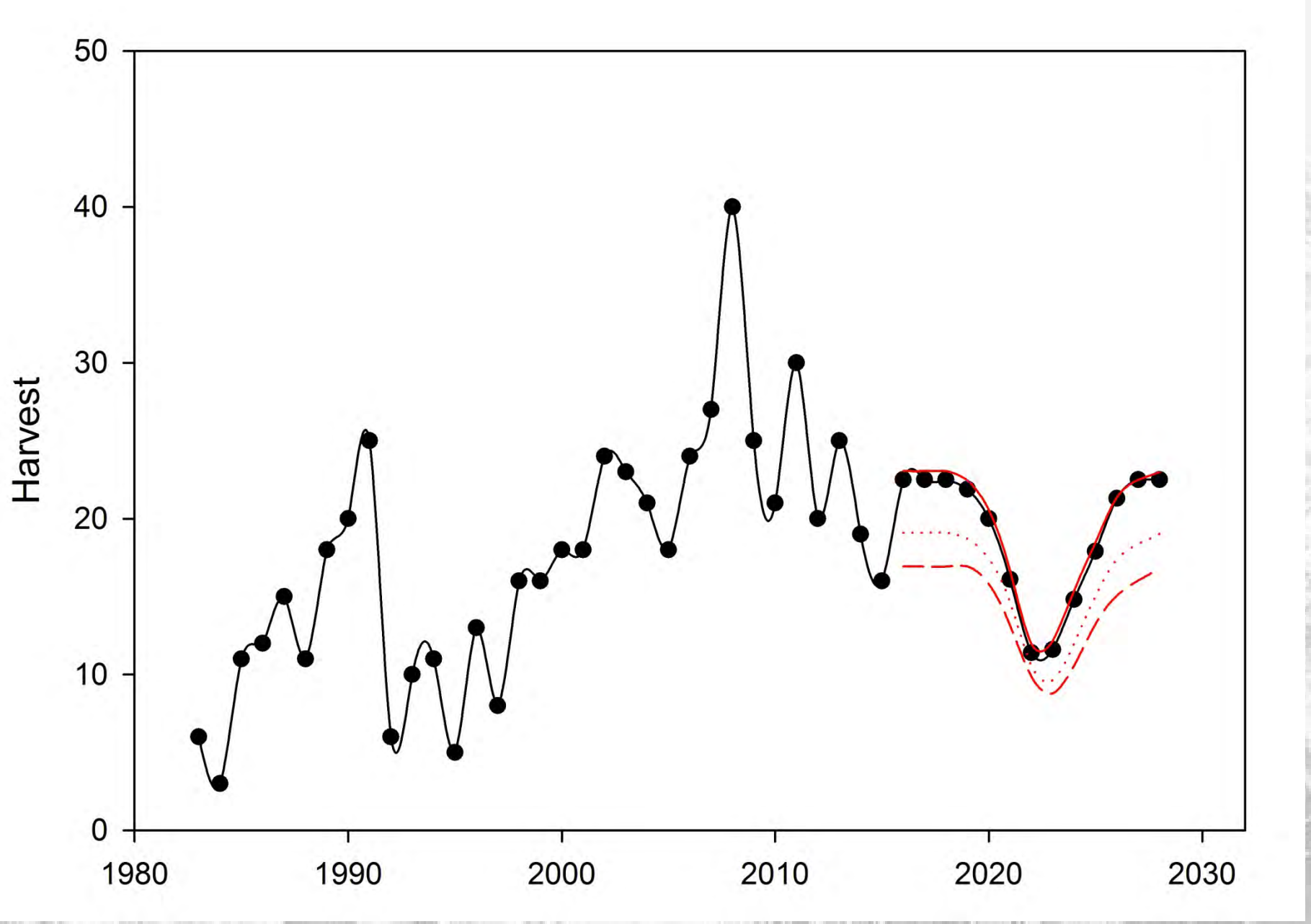
Age Structure of Harvest

Year	Avg Harvest	Avg Hunters	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1983-2015	17.4	35.3	0.4	1.1	2.7	4.4	3.8	2.6	1.1	0.8	0.1
1993-2015	19.5	38.6	0.4	1.3	3.2	5.3	4.1	3.0	1.1	0.7	0.1
2002-2015	23.8	46.9	0.6	1.9	4.6	6.6	4.4	3.4	1.2	0.5	0.0

Example of Age Structure Predictive Model

Year	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Predicted harvest
2016	0.6	1.9	4.5	6.6	4.3	3.4	1.2	0.5	0.07	23
2017	0.6	1.9	4.5	6.6	4.3	3.4	1.2	0.5	0.07	23
2018	0.6	1.9	4.5	6.6	4.3	3.4	1.2	0.5	0.07	23
2019	0	1.9	4.5	6.6	4.3	3.4	1.2	0.5	0.07	22
2020	0	0	4.5	6.6	4.3	3.4	1.2	0.5	0.07	21
2021	0.6	0	0	6.6	4.3	3.4	1.2	0.5	0.07	17
2022	0.6	1.9	0	0	4.3	3.4	1.2	0.5	0.07	12
2023	0.6	1.9	4.5	0	0	3.4	1.2	0.5	0.07	12
2024	0.6	1.9	4.5	6.6	0	0	1.2	0.5	0.07	15
2025	0.6	1.9	4.5	6.6	4.3	0	0	0.5	0.07	18
2026	0.6	1.9	4.5	6.6	4.3	3.4	0	0	0.07	21
2027	0.6	1.9	4.5	6.6	4.3	3.4	1.2	0	0	23
2028	0.6	1.9	4.5	6.6	4.3	3.4	1.2	0.5	0	23

Predictive model based on poor lamb years



Literature Review of the Potential Effects of Selective Harvest of Mountain Sheep

Selective Harvest – A Problem?

- Restrict gene flow
- Cull genetic traits desired by hunters

- Decrease fitness of population through selective mating
- Decrease fecundity

Ram Mountain, Alberta

- Coltman et al. 2003
  - ↓ horn and body mass over 30 years of 4/5 curl hunting
  - Small isolated population of bighorn sheep
  - Argued these changes "will be extremely difficult to reverse"

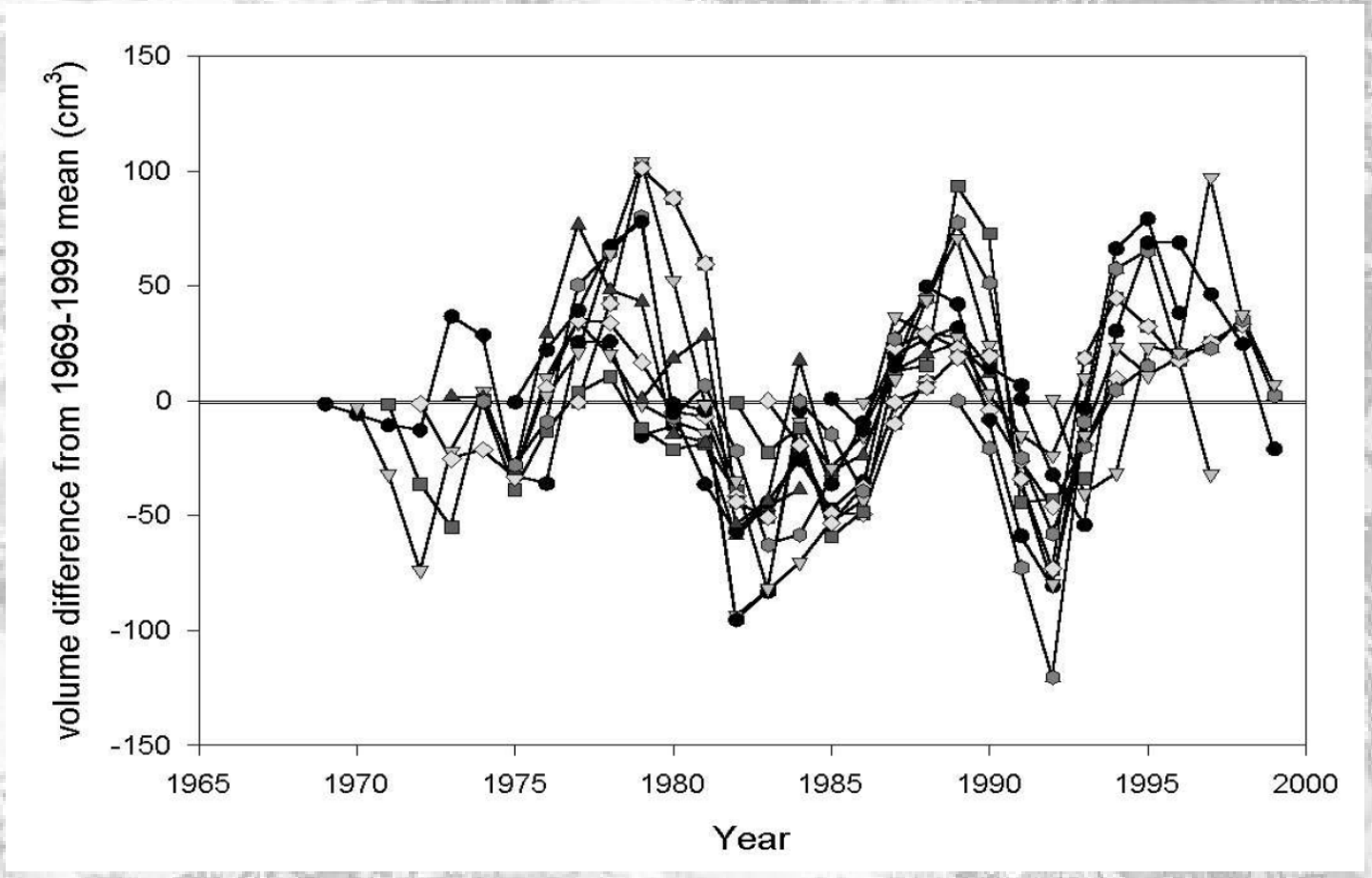
- Traill et al. 2014
  - Reanalyzed Ram Mountain data set
  - Inheritance of body mass was weak
  - ↓ in body mass attributed to environmental and demography

- Pigeon et al. 2016
  - Reanalyzed Ram Mountain data set with 9 additional years
  - Length of horn length recovered by 13%

Dall's Sheep Studies

- Hik and Carey 2000

  Over 31 years, significant 10-year periodicity in horn growth



Dall's Sheep Studies

- Loehr et al. 2010

  -Examined horn growth of over 8000 individuals collected over 42 years

  -Weather (PDO) explained a large proportion of fluctuations in horn growth.

  -Horn growth most sensitive to spring weather

Festa-Bianchet Groups Research

Species	Type	Effect	Reference
Bighorn	Trophy	↓ Horn size over time	Festa-Bianchet 2014
Stone	Trophy	↓ Horn size over time 4 decades of hunting In 0ne of two study areas	Douhard 2016
Bighorn	Trophy	Rams harvested near refuges 3% larger	Pelletier 2014
Mouflon	Trophy	Favoring reproductive contribution of slow growing rams	Garel et al. 2007

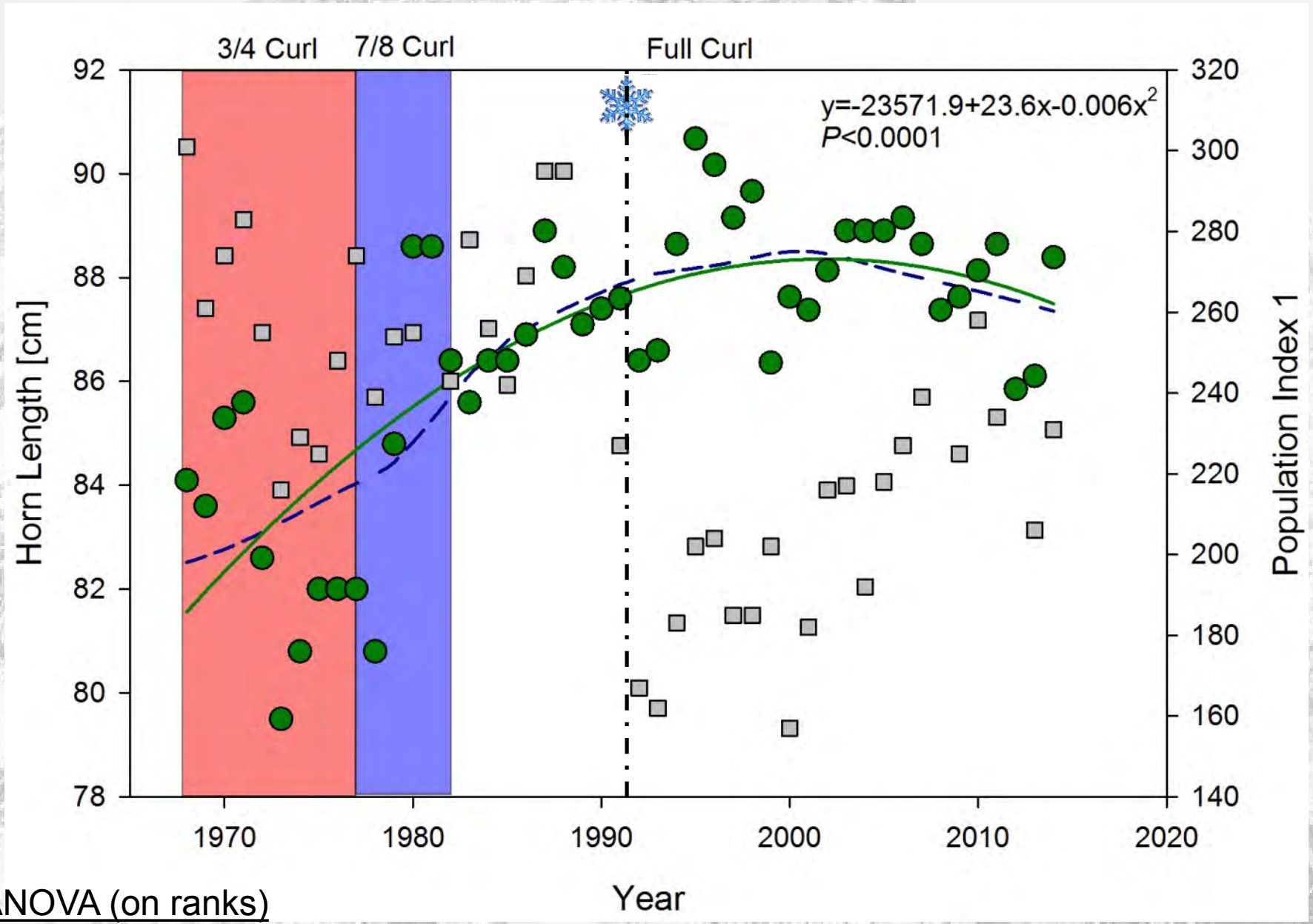
What does this mean for Alaska?

- The effects of selective harvest is not clear or settled
- Situation in Alaska could be very different than Alberta
- Monteith et al. 2013
  - Evaluated trophy records 1900 – 2008
  - Decrease in Bighorn sheep not significant

- Other factors driving horn growth
  - nutritional consequence of density dependence
  - Skewed sex ratio and altered age distribution


Questions?

Hunting Regulation on Horn Length



1-way ANOVA (on ranks)

***P*<0.001**

FC>3/4 (Dunn post hoc)

More Research Fest-Bianchet Group

Species	Type	Effect	Reference
Bighorn	Trophy	↓ Horn size and body mass over time	Coltman et al. 2003
Bighorn	Trophy – same dataset as Coltman	Population and environment drive phenotypic change	Traill 2014
Mouflon	Trophy	Favoring reproductive contribution of slow growing rams	Garel et al. 2007
Bighorn	Trophy	Hunter selection of large horned males ↑ breeding of smaller males	Hogg 1984
NA Mountain	Mature	↑ Mortality of old males leads to ↑mortality of young males	Geist 1971, Heimer 1980, Heimer et al. 1984, Heimer & Watson 1986
Dall's	Mature	No adverse effect of removing old males	Murphy 1990
Dall's	Mature	Sheep harvest driven by weather not horn regulation	Whitten 2001
Bighorn	Trophy	↑ Ewe density ↓ male horn size	Jorgenson et al. 1998
Bighorn	Population	Breeding by small males ↑ genetic diversity	Singer & Zeigenfuss 2002
Bighorn	Population	Genetic bottlenecks not impacting recovery	Wehausen & Ramey 2004