Science, Service, Stewardship

August 2010 Draft Biological Opinion

Effects of the Groundfish Fisheries Off Alaska on ESA Listed Species Including the Western DPS of Steller Sea Lions

NOAA FISHERIES SERVICE

15 Aug 2010- SSC

Outline

- Background
- Analytical Framework
- Analyses
  - Western DPS of Steller Sea Lions
    - Species Status
    - Environmental Baseline
    - Effects of the Action
      - Exposure
      - Response
      - Risk
- Conclusions
- Reasonable Prudent Alternative

Photo credit: NMML Image Gallery

Background

- October 2005: Council requested NMFS reinitiate Formal ESA Section 7 consultation on the groundfish fisheries as authorized under BSAI and GOA FMPs. Due to substantial new information since 2000 Biop and 2003 Supplement.
- March 2006: NMFS coordinated with State of Alaska re: Council reinitiation request; State parallel groundfish fisheries included in reinitiation per State's request.
- June 2006:NMFS reinitiated Formal Consultation.

Background

- April 2008: NMFS notified the Council that more time was required to complete draft Biop.
- April 2009: Council requested that NMFS extend consultation period to incorporate 2009 SSL survey data into draft Biop.
- March 2010: NMFS notified Council that more time was required for internal review of the draft Biop.

Species and Critical Habitat

- western DPS of Steller sea lion
- eastern DPS of Steller sea lion
- Steller sea lion critical habitat
- north Pacific humpback whale
- north Pacific sperm whale
- Other species reviewed in BA

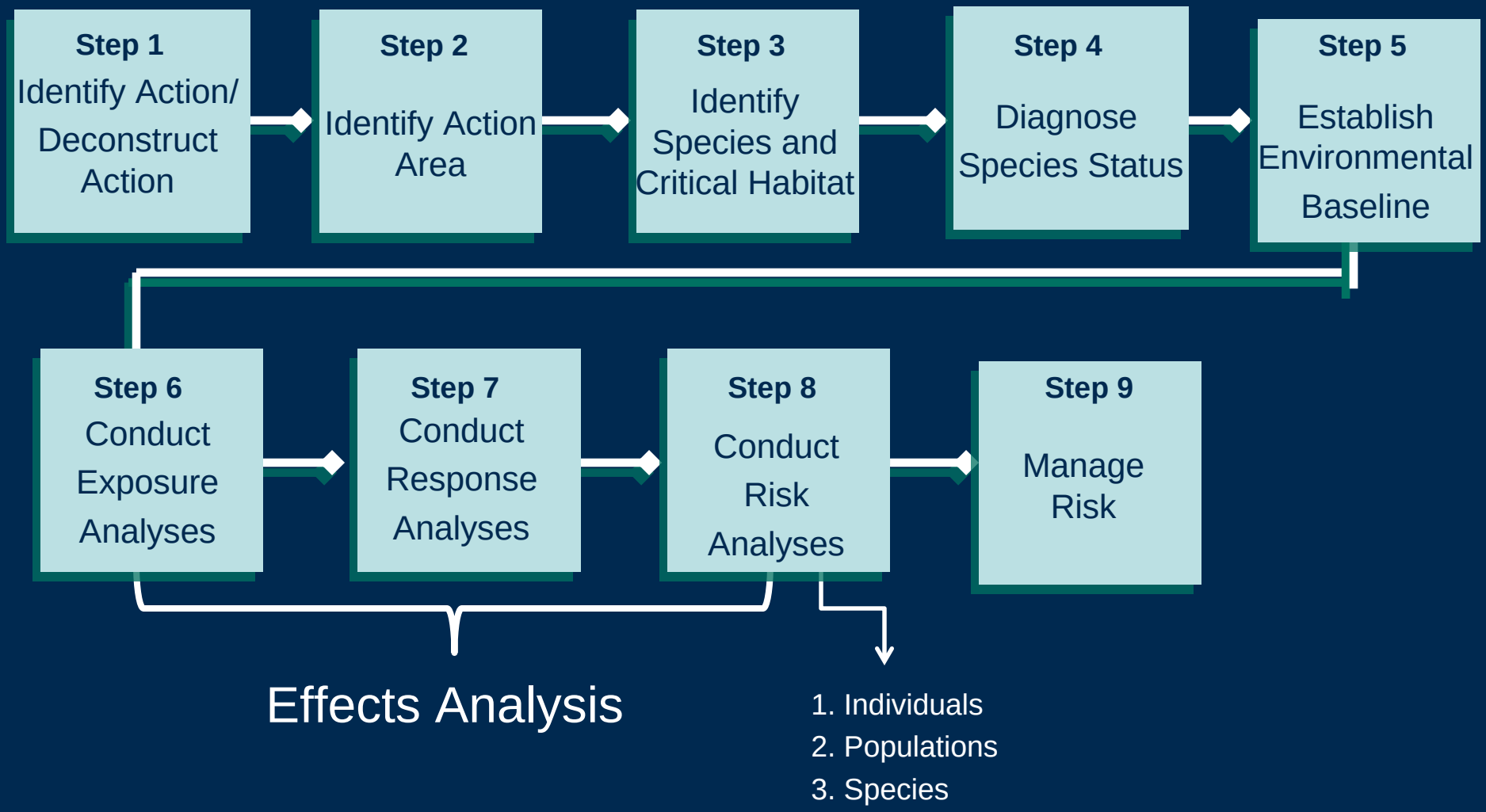
Primary New Information

- Biological Assessment, prepared by NOAA Fisheries Sustainable Fisheries, 2006
- Programmatic SEIS on Alaska Groundfish Fisheries
- Goodman et al. 2002 (description of Action)
- Revised Steller sea lion Recovery Plan, 2008
- High volume of new scientific literature on SSLs since 2003
- New SSL census survey data

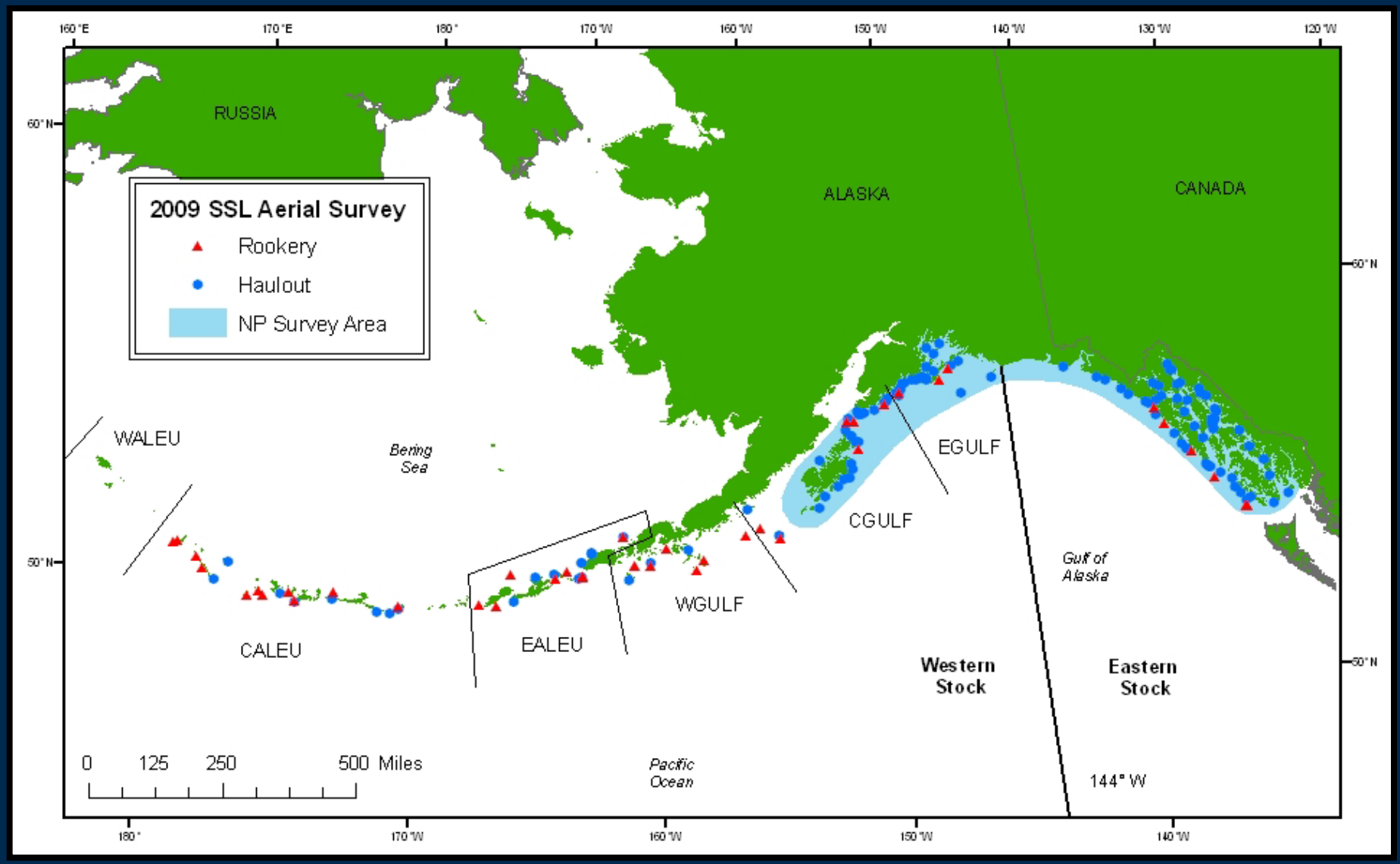
Draft Biop Outline

Chapter	Contents
	Executive Summary
1	Background and Consultation History
2	Description of the Proposed Action
3	Status of Species and Critical Habitat
4	Environmental Baseline
5	Effects of the Action
6	Cumulative Effects
7	Synthesis and Conclusions
8	Reasonable and Prudent Alternative
	Citations
	Tables and Figures
	Appendices

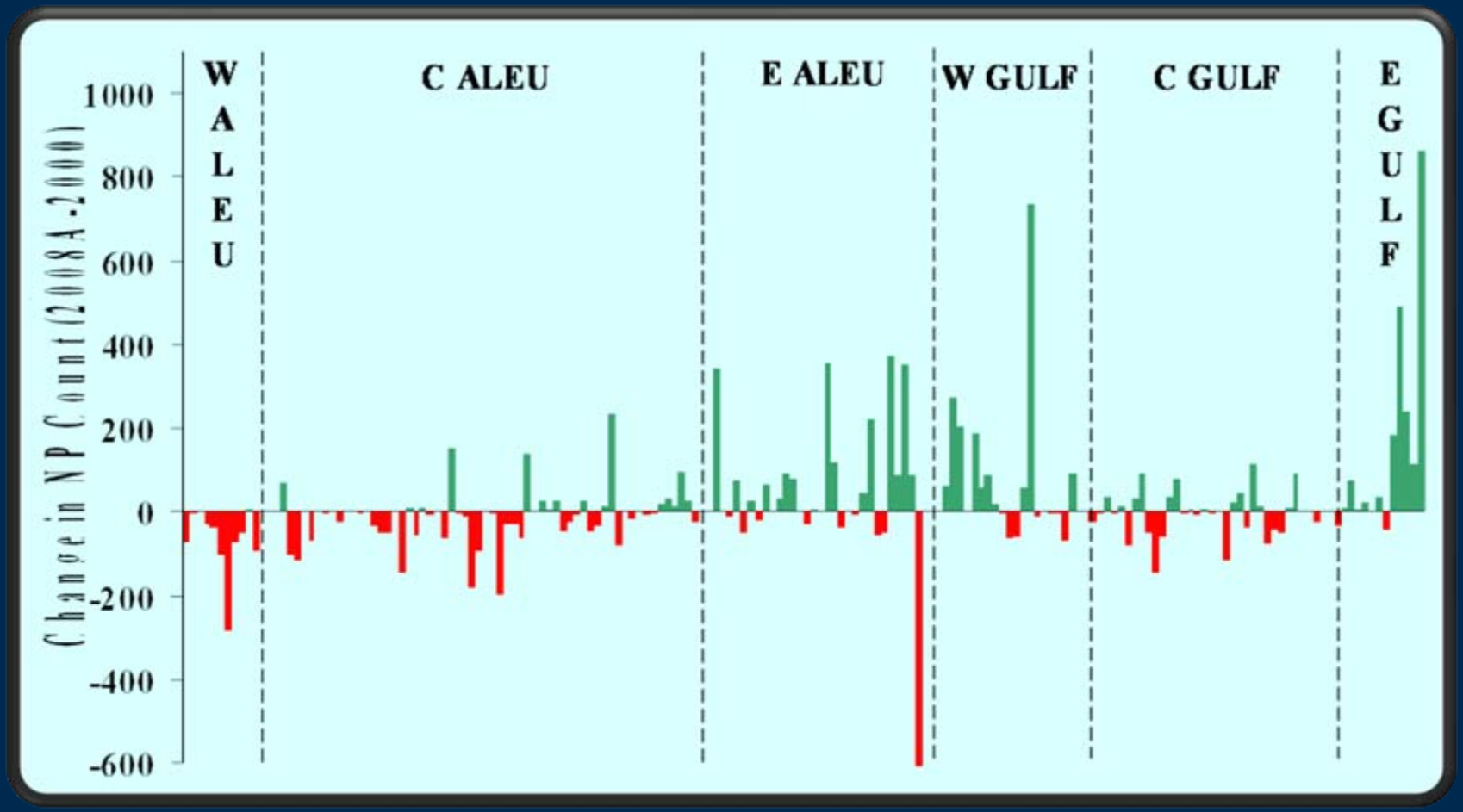
The Analytical Framework



western DPS of SSL Survey Sub-regions

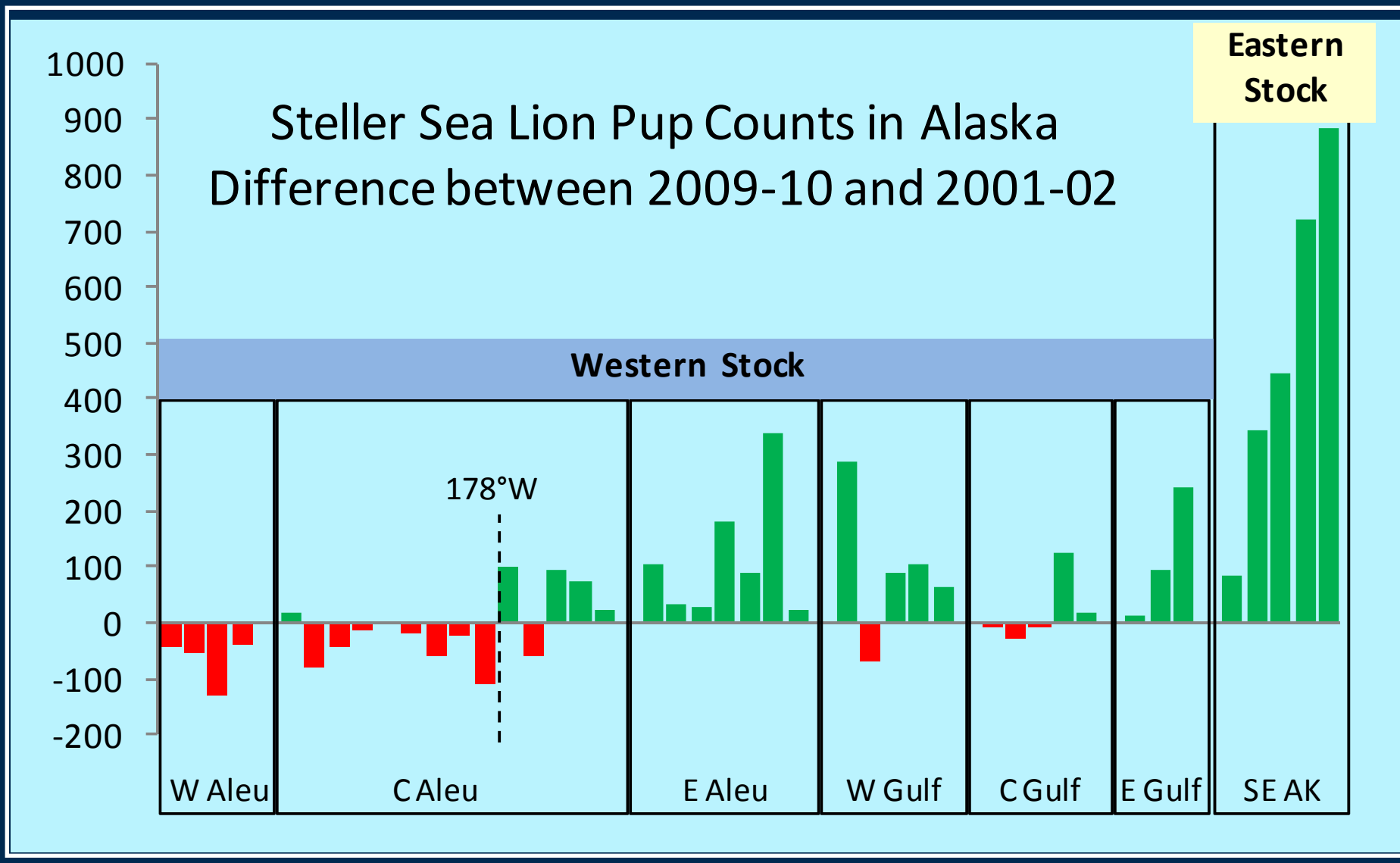


Status of western DPS of SSL



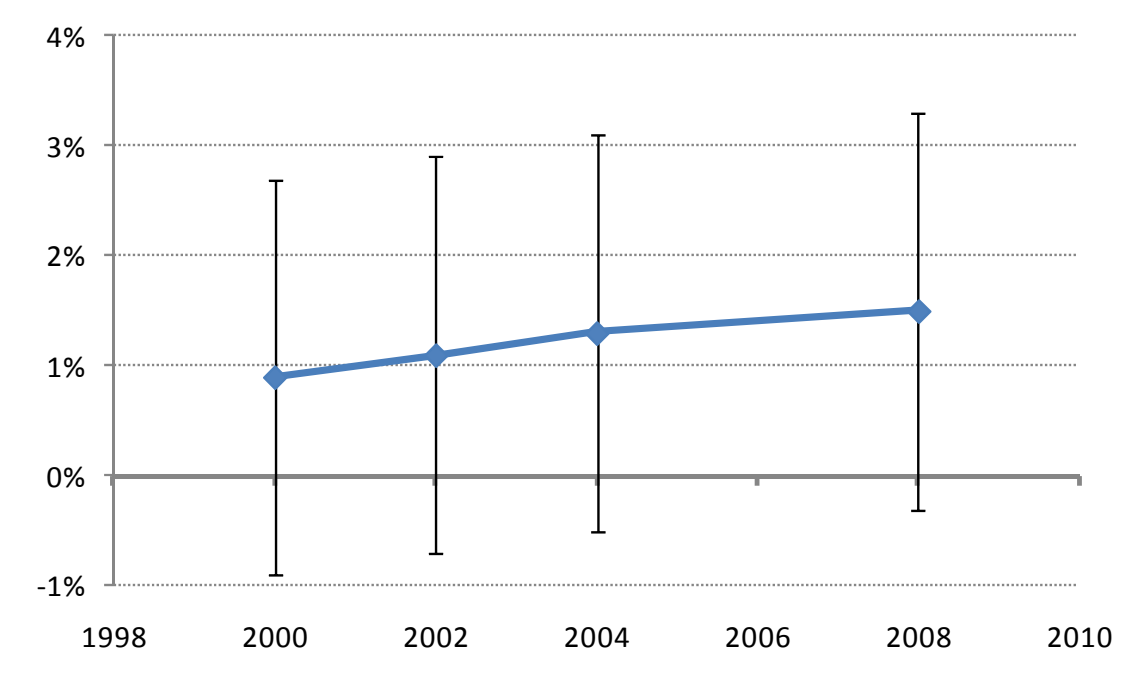
Western SSL Non-Pup Counts in Alaska Compare 2008 to 2000

Status of western DPS of SSL



Western DPS SSL Non-Pup Growth Rates in the 2000s

Annual estimated growth rates 2000-08

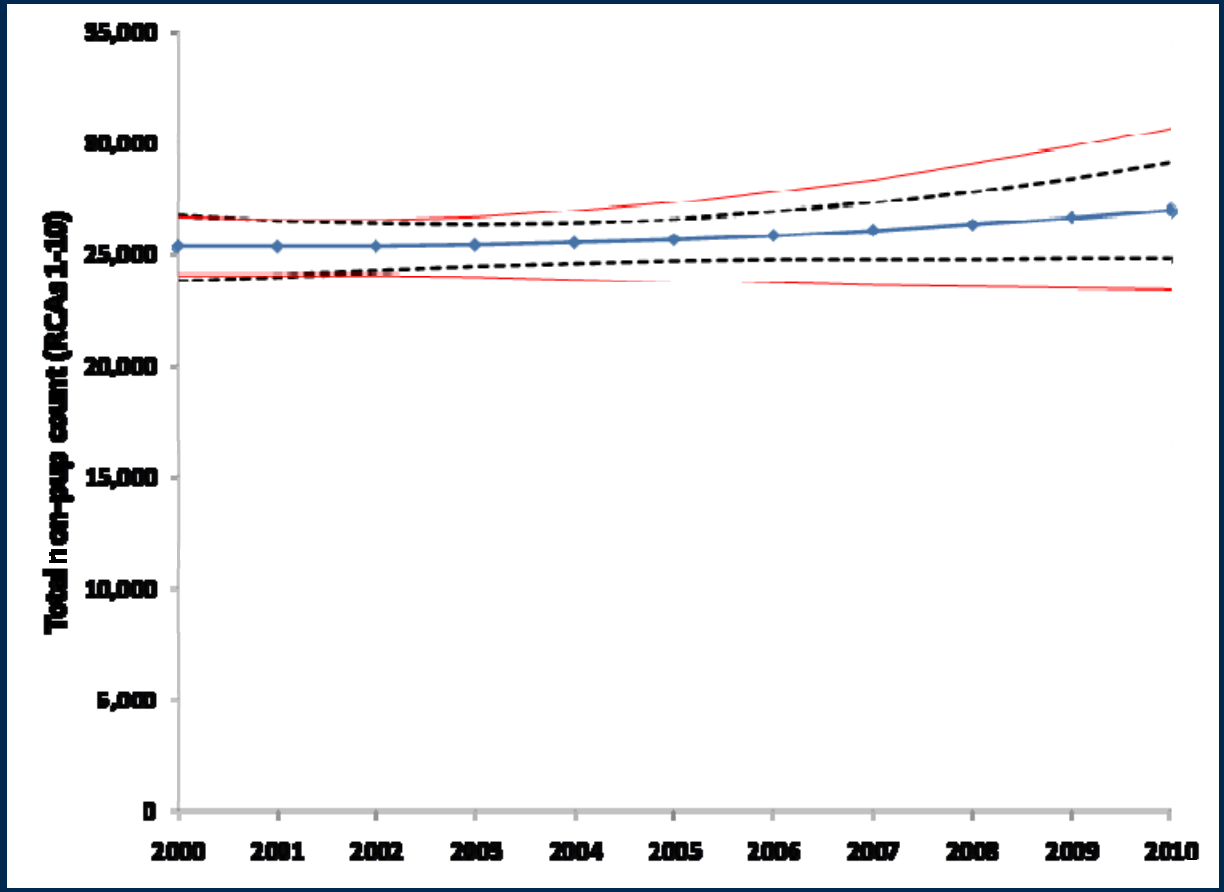


Johnson 2010

2008: ~ 1.5% yr^{-1} but uncertain

Western DPS SSL Non-Pup Growth Rates in the 2000s

Non-pup count as estimated in 2000-10



Ianelli 2010

2008: ~ 1.5% yr^{-1} but uncertain

Western DPS SSL Non-Pup Counts: 2000-2008

From rookeries/haulouts consistently surveyed since 1991

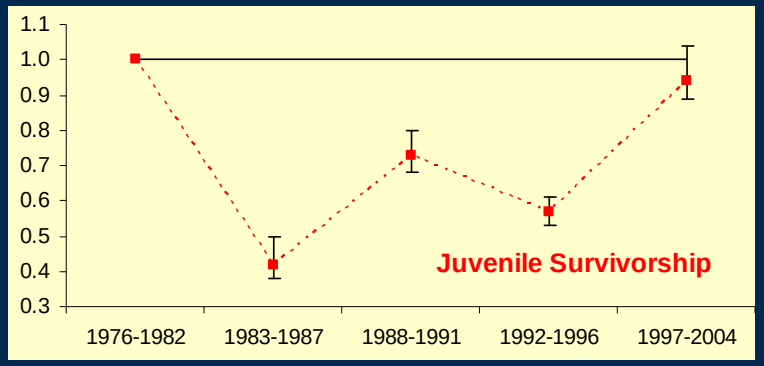
Year	wAI	cAI	eAI	wGOA	cGOA	eGOA	Total
2000	1633	6560	4990	3996	4555	2102	23836
2002	1196	6547	5261	4617	4594	2615	24829
2004	1286	6885	5991	5233	4028	3015	26438
2006	--	--	6031	--	--	3101	--
2008 (adj)	894	5817	6405	5558	4602	3313	26589
Annual Rate of Change	0.935	0.985	1.033	1.041	0.999	1.056	1.014
Overall Change 2000-2008	-45%	-11%	28%	39%	1%	58%	12%

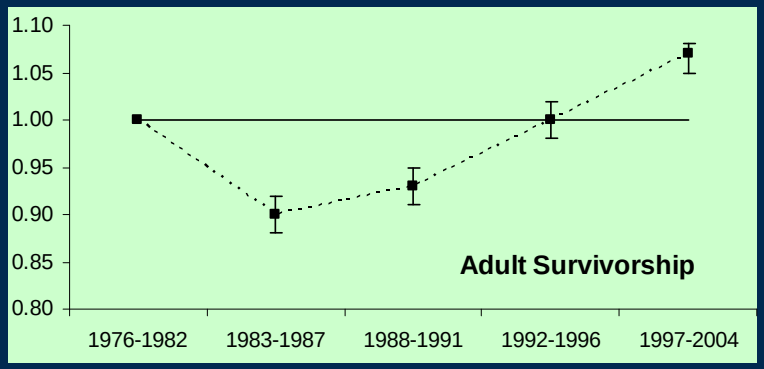
Notes: 1) Russia/Asia subpopulation ROC = 1.043

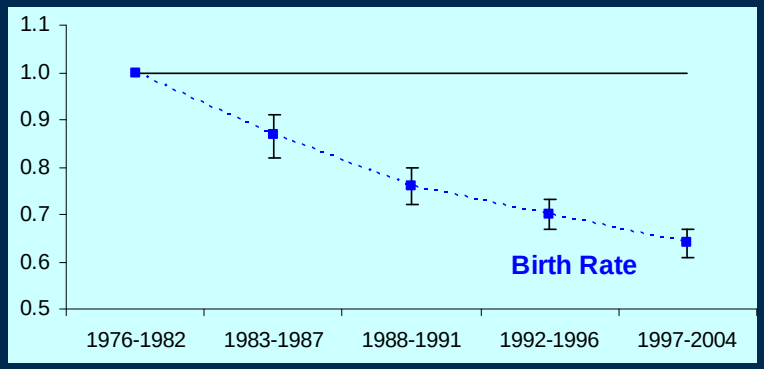
2) Overall wSSL ROC is approximately 1.021

3) If declines in wAI and cAI ended, wSSL ROC in US = 1.025

Central Gulf of Alaska Survivorship and Natality







- Started with mid-1970s life table
- Fit changes in Pup and Non-pup Counts and Size Distribution on Haulouts by changing Vital Rates
- Since late 1980s
  - Increasing survivorship
  - Decreasing birth rate

Holmes, Fritz, York, and Sweeney. 2007. Ecological Applications

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Abundance estimates for mammal eating killer whales: Aleutian Islands

	Line Transect Abundance (2001-2003) (95% CI)	***Mark-recapture Abundance (2004-2010) (95% CI)***
Unimak to Samalga Pass	88 (20-373)	176 (130-252)
Samalga Pass to Kiska	87 (19-391)	90 (48 – 184)
Kiska to Attu	(no sighting effort)	0
Total (Unimak to Kiska)	175 (39 – 764)	266 (178 – 436)

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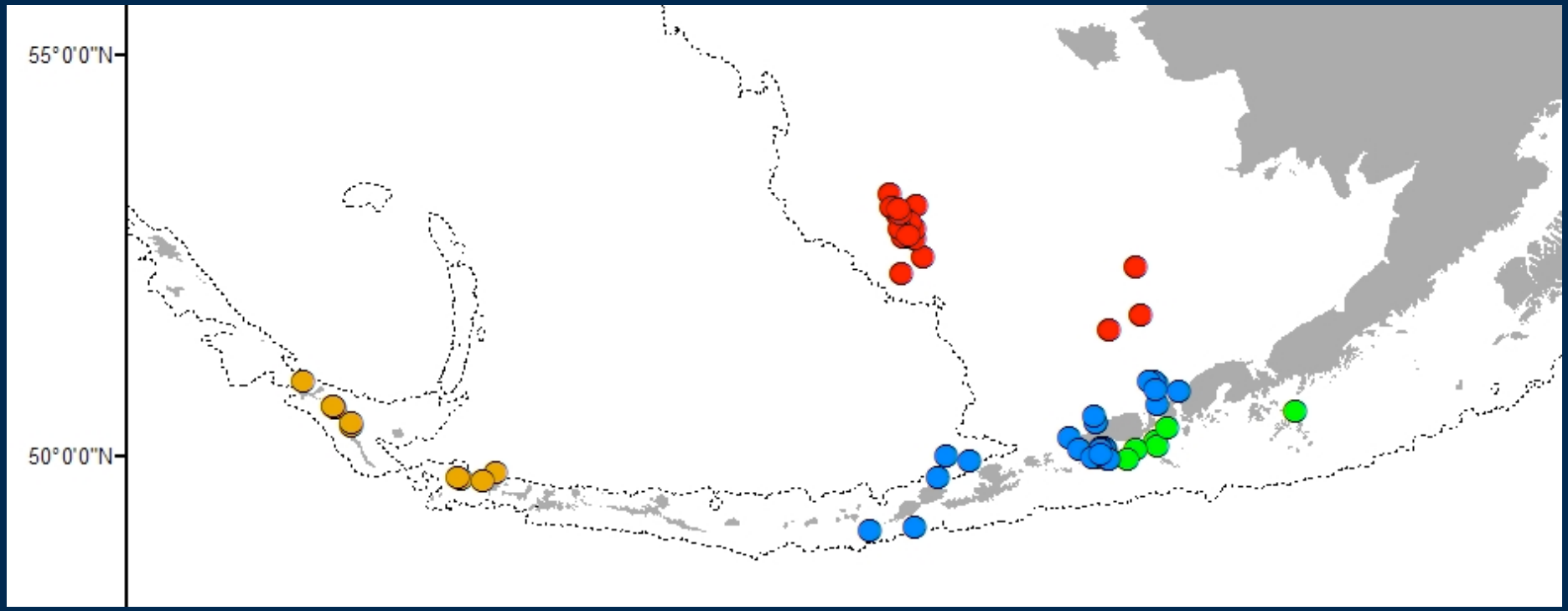
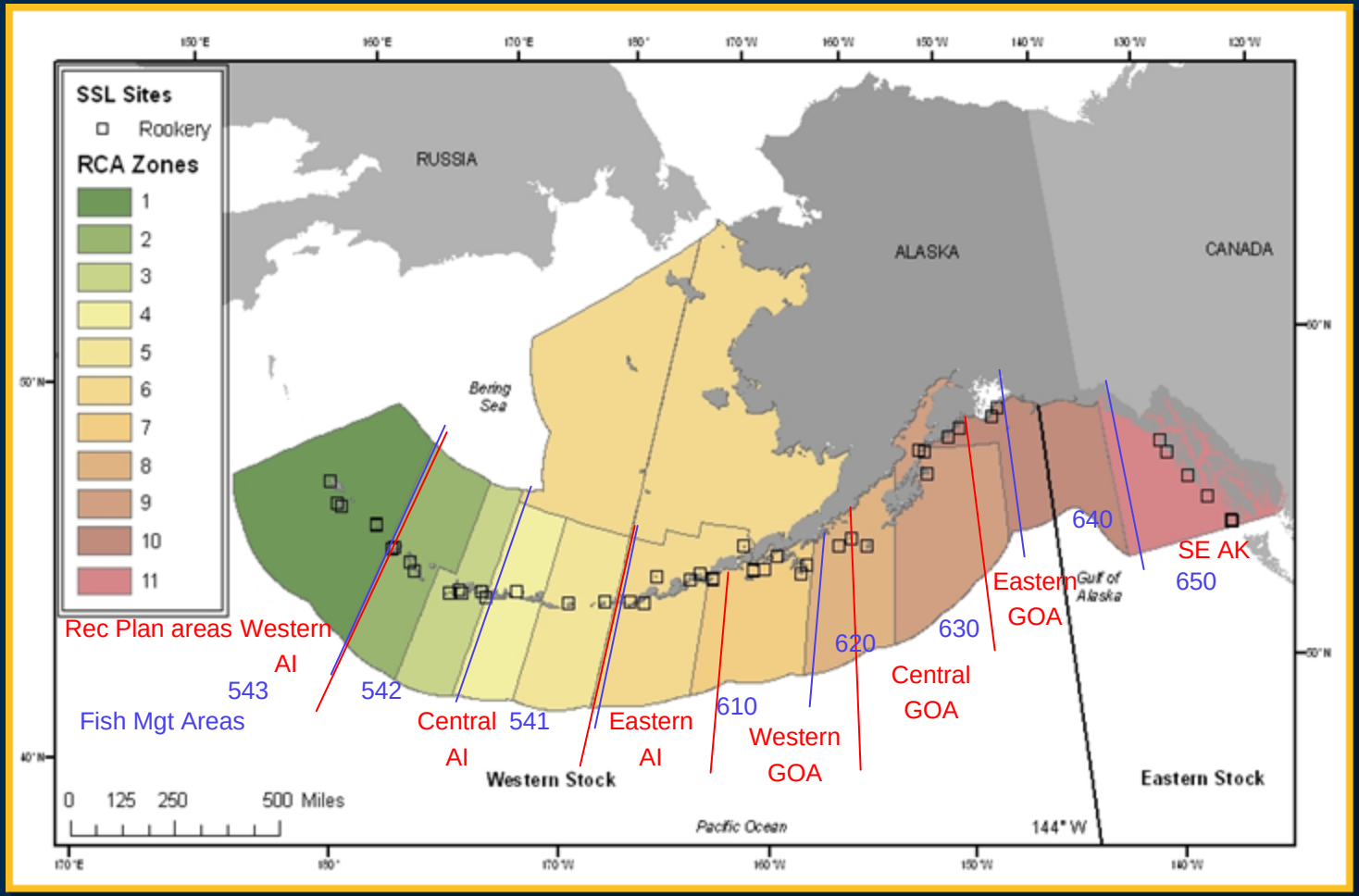
Position of 78 encounters with mammal-eating killer whales (transients) from NMML summer surveys from 2004-2010.



Steller Sea Lion Recovery Plan Areas, Rookery Cluster Areas (RCAs), and NMFS Groundfish Fishery Management Areas

RCA Eastern Boundary	
1	177°E
2	180°
3	177°W
4	174°W
5	170°W
6	165°W
7	159°W
8	154°W
9	147°W
10	140°W



Chapter 4 - Baseline Results

	What We Knew in 2000		What We Know Now	
	Contributor to Decline	Current Stressor	Contributor to Decline	Current Stressor
Environmental Change	Possible	Possible	Likely	Likely
Indirect Fisheries Effects	Possible	Possible	Likely	Likely
Direct Human Effects	Likely	Possible	Yes	Unlikely
Predation				
Killer Whales	Possible	Possible	Possible	Possible
Sharks	Possible	Possible	No	No
Inter-Specific Competition	Possible	Possible	Possible	Possible
Disease	Possible	Possible	Unlikely	Unlikely
Contaminants	Possible	Possible	Possible	Possible

Number of SSL food habit samples: Summer (May – Sept)

Gulf of Alaska Aleutians

		eastern	*central*	*Western*	*eastern*	*central & western*	*Total*
1990-98	NMML		241	317	322	1222	2102
1999-05	NMML	38	85	184	290	483	1080
1999-05	UAF		501				501
2008	NMML						0
Total			827	501	612	1705	3683

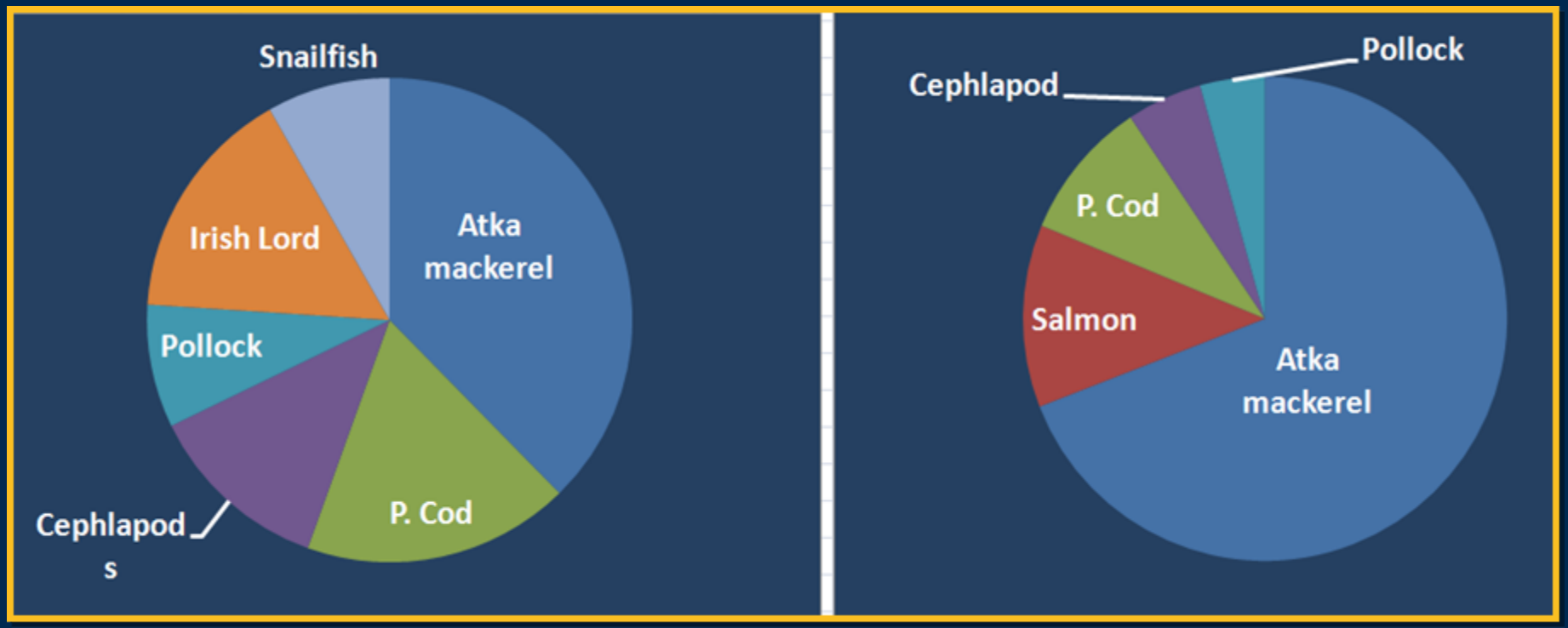
Number of SSL food habit samples: Winter (December – April)

Gulf of Alaska Aleutians

		eastern	*central*	*western*	*eastern*	*central*	*Total*
1990-98	NMML		333	612	567	148	1660
1999-05	NMML		204	42	773	301	1320
1999-05	UAF		724				724
2008	NMML					305	305
Total			1261	654	1340	754	4009

Frequency of Occurrence of Prey Items in SSL scats collected 1999-2005

Western and Central AI

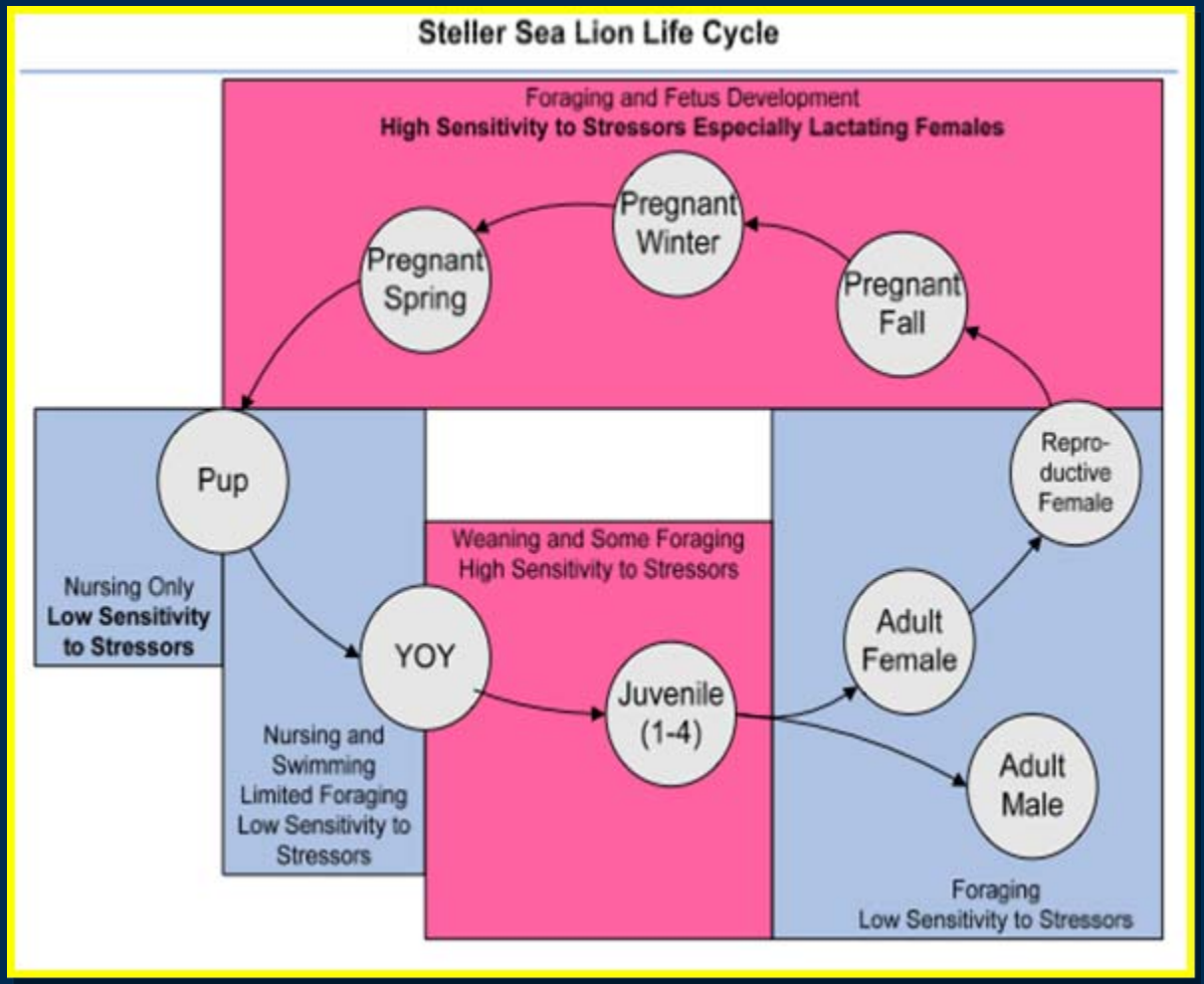


Winter

Summer

Effects of the Action Framework for the Analysis

- Exposure Analysis: Species or Critical Habitat exposed to environmental effects (direct and indirect) of the action?
- Response Analysis: If exposed, what is the response of individuals; populations; and species or Critical Habitat?



Evidence for Nutritional Stress: wDPS

- Evidence and data gaps for assessing potential biological manifestations of nutritional stress in wDPS of SSL presented in Table 3.17
- Of n=32 indicators, data are available to assess 17; data not yet analyzed for 3.
- Of the indicators assessed for nutritional stress, 13 were negative and 1 was positive.

Negative		Positive
Emaciated Pups (<4 wks)	Reduced pup counts	Reduced Birth Rate
Reduced pup size	Reduced non-pup counts	
Reduced pup weight	Change in blood chemistry	
Reduced growth rate	Increased disease	
Reduced survival		

Fishery Harvests of SSL Prey Species

- Harvests of Pollock, P. Cod, and Atka mackerel in the BS, AI, and GOA:
  - Appendix III: Total catch and estimates of catch in critical habitat from 1991-2008
    - Proportion of catch by critical habitat zones and calendar quarter for each species, gear, and area
  - Appendix IV: Finer scale look at Appendix III data –by RCA groups
    - Also, snapshot comparison 1999 vs. 2008 catch in critical habitat; total catch and estimated biomass.
  - Catch in critical habitat estimates: extrapolated observer data

Table 5.3. Summary of catch statistics by sub-region and RCA.

Fishery Mgt Area	RCA	Forage Biomass 2008 (top row) and Total Harvest by RCA (bottom row)			Fraction of Biomass Harvested by RCA	
		AM	P. Cod	Pollock	AM	P. Cod
543	1	62,154 16,509	39,939 9,151	18,794 114	0.27	0.23
542	2	91,050 17,917	21,519 2,870	40,038 123	0.20	0.13
542	3	81,236 4,560	23,068 1,441	13,074 168	0.06	0.06
541	4	20,173 53	7,403 6,910	1,907 470	0.00	0.93
541	5	216,994 18,650	80,223 11,821	198,830 404	0.09	0.15
610	6	74,149 447	934,201 140,492	4,438,756 992,601	0.01	0.15

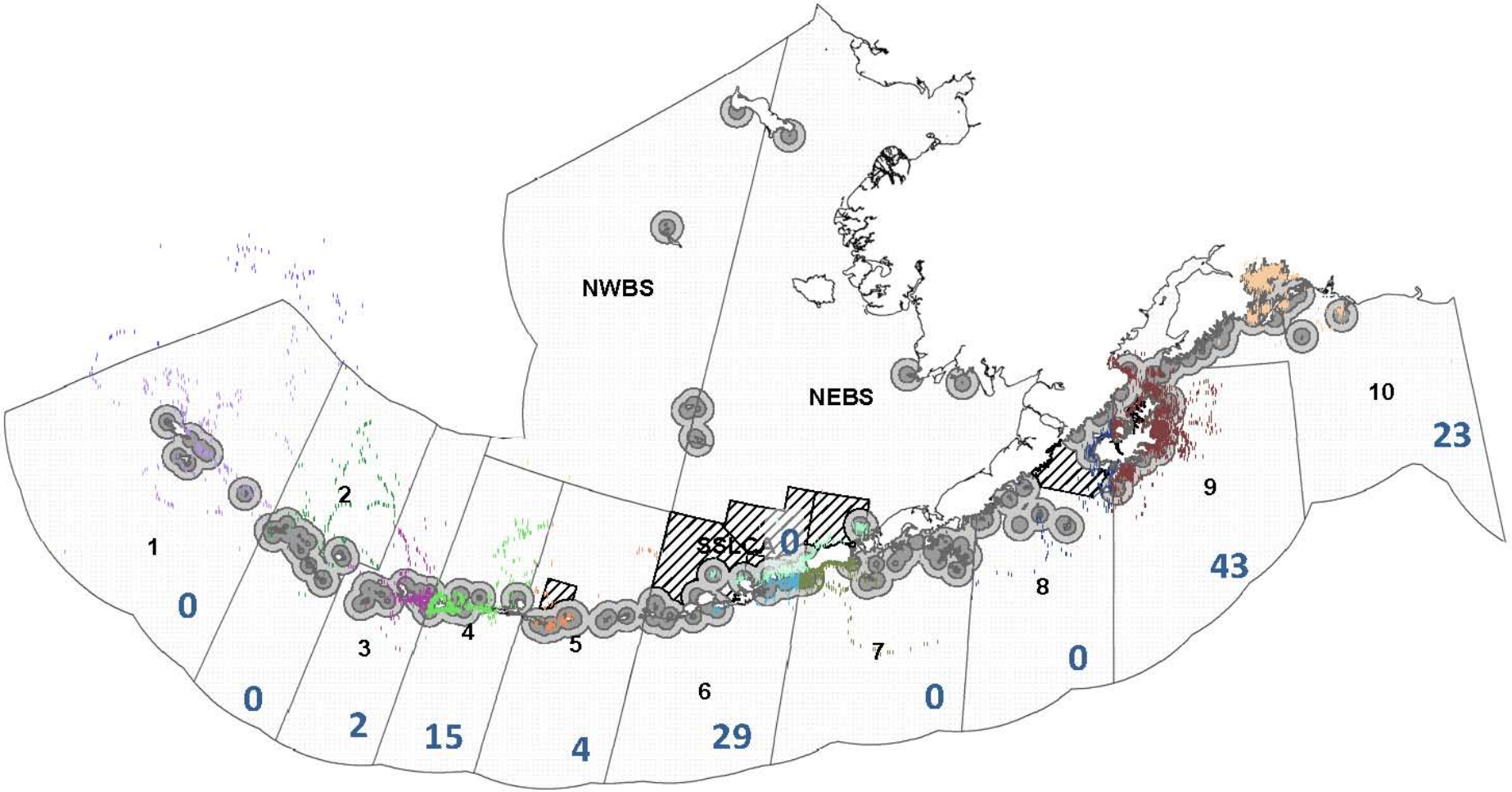
Telemetry

Proportion of 14,441 locations associated with diving to >4m for 116 juvenile SSLs based on distance to nearest rookery or haulout.

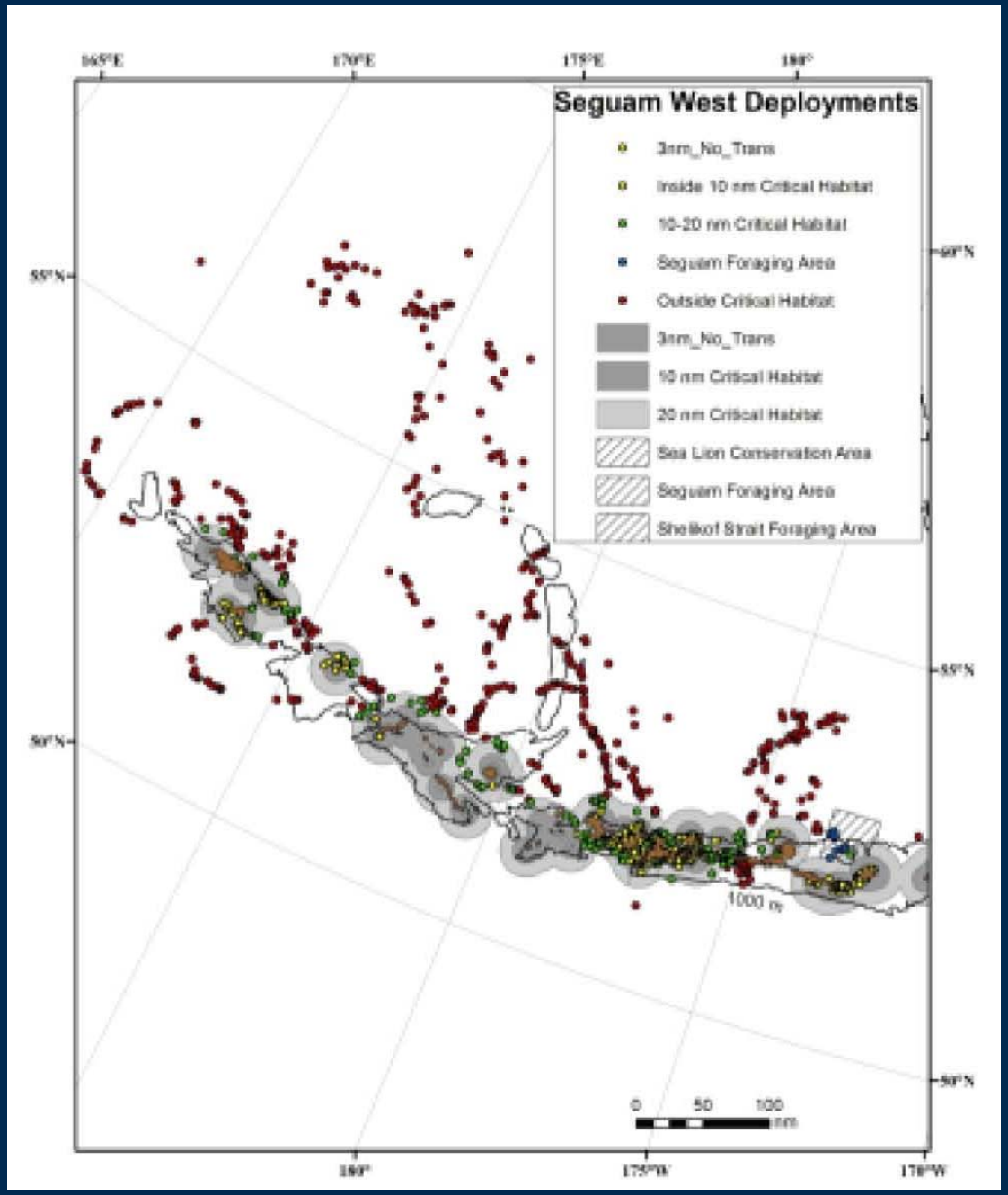
	Prince William Sound		Kodiak		Eastern Aleutians		Central/Western Aleutians	
Zone	Summer[1]	Winter[2]	Summer	Winter	Summer	Winter	Summer	Winter
Inside CH								
0-10 nm	92.0%	94.5%	86.8%	93.0%	88.5%	91.2%	68.8%	100.0%
10-20 nm	7.1%	4.6%	7.5%	5.2%	5.5%	6.9%	8.8%	0.0%
>20 nm	0.0%	0.1%	0.3%	0.3%	2.8%	0.2%	0.5%	0.0%
Outside CH	0.9%	0.9%	5.4%	1.6%	3.3%	1.7%	21.9%	0.0%

Summer: April – Sept. Winter: Oct. – Mar.

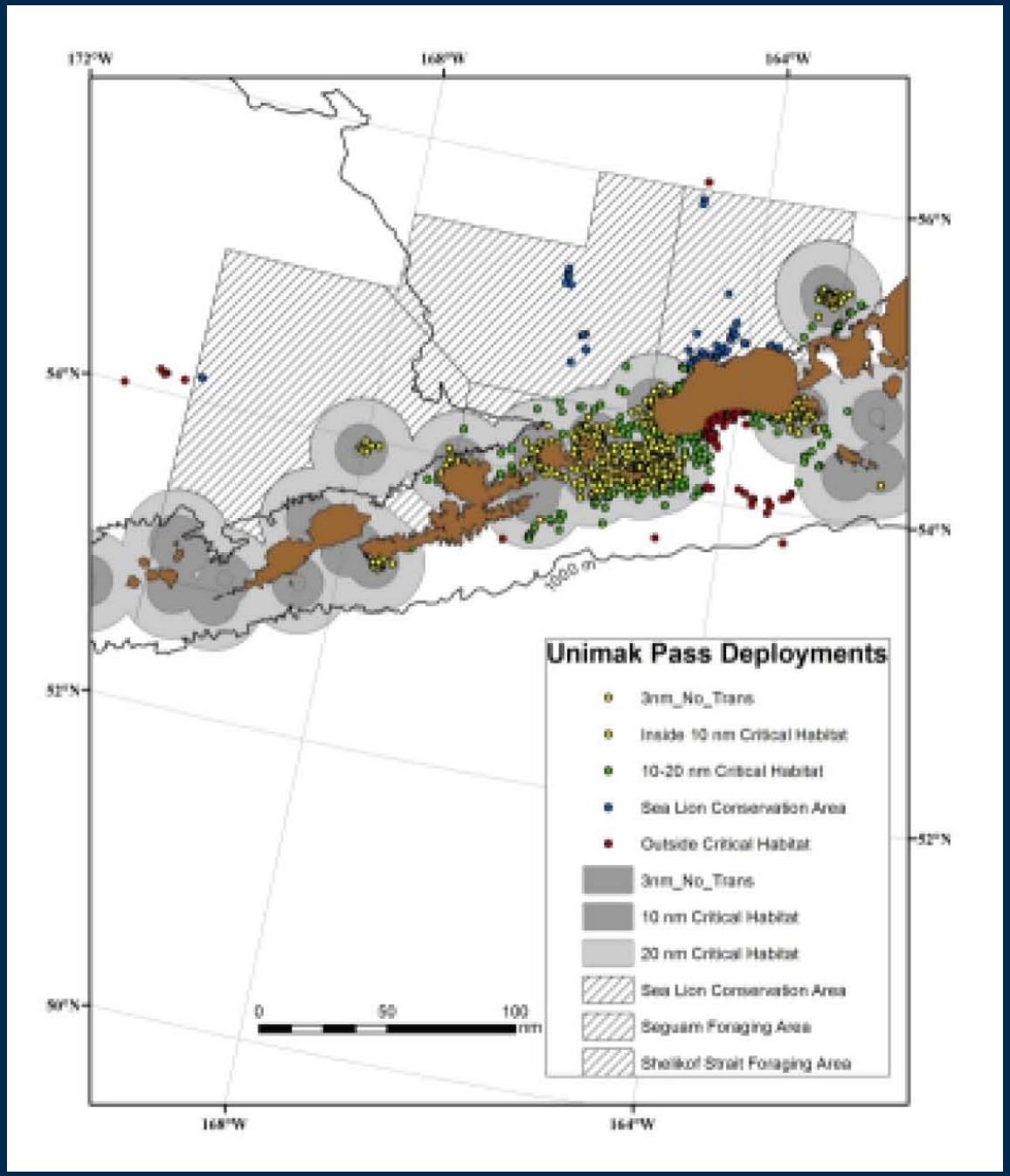
Juvenile Steller sea lion locations associated with diving to > 4m (NMML/ADFG 2000-2005)



Sea lions tagged by zone



Juvenile SSL Telemetry locations with diving depth > 4m – Western & Central AI



Juvenile SSL Telemetry locations with diving depth > 4m – Eastern AI

Analytical Approach

- Fine scale analysis of SSL exposure and response (RCA analysis)
- Synthesized available information by sub-region:
  - Pup and non-pup trends
  - SSL Prey dynamics, prey preferences
  - Natality Information
  - Harvests of SSL prey inside and outside of critical habitat
  - Harvests relative to overall forage biomass
  - Sea lion consumption of prey relative to overall forage biomass

Jeopardy Standard

Federal agencies must insure that their actions are not likely to result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution.

Adverse Modification of Designated Critical Habitat

- Does the action reduce the value of critical habitat for the conservation of the species?
- NMFS must determine whether affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term under the effects of the Action, environmental baseline, and any cumulative effects.

Final Recovery Plan Criteria (2008) for Western DPS

Reclassified as threatened if non-pup counts increase at significant rate for 15 years; delisted if counts increase for 30 years at significant rate (avg annual rate 3%)

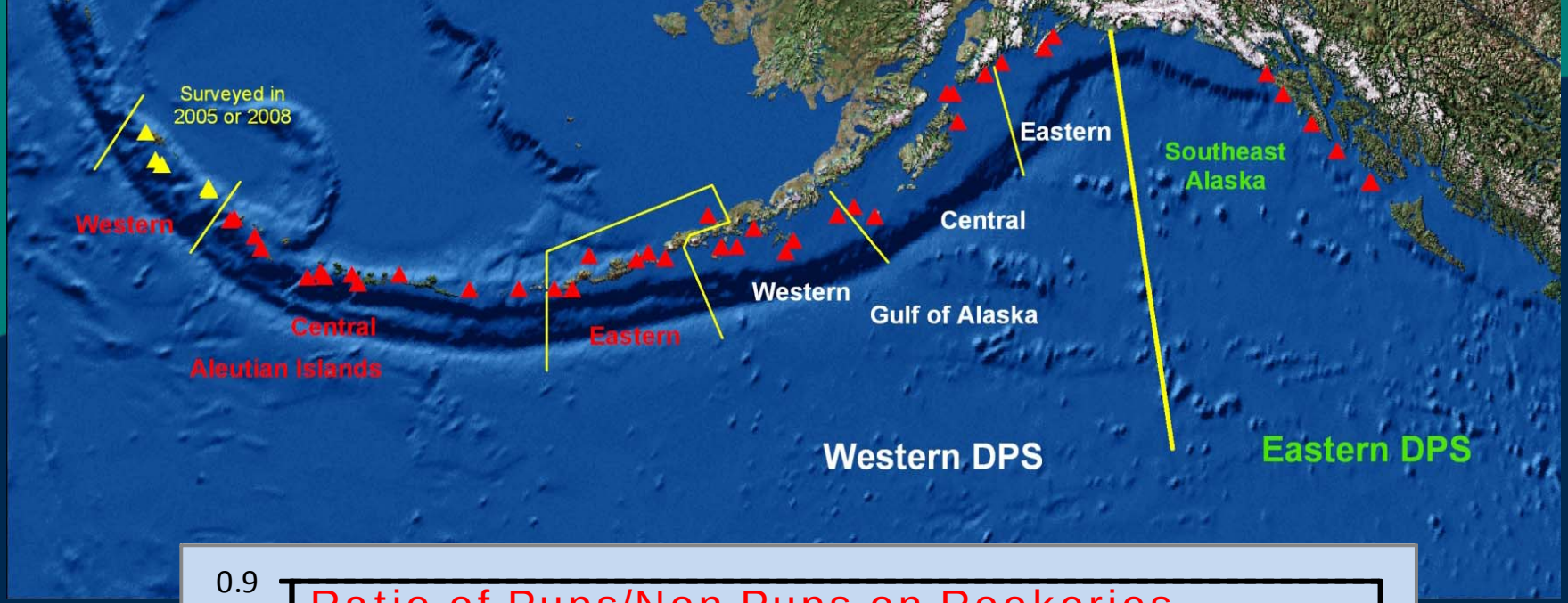
Trends in at least 5 of 7 subregions must be consistent with overall trend; no two juxtaposed subregions can be in significant decline

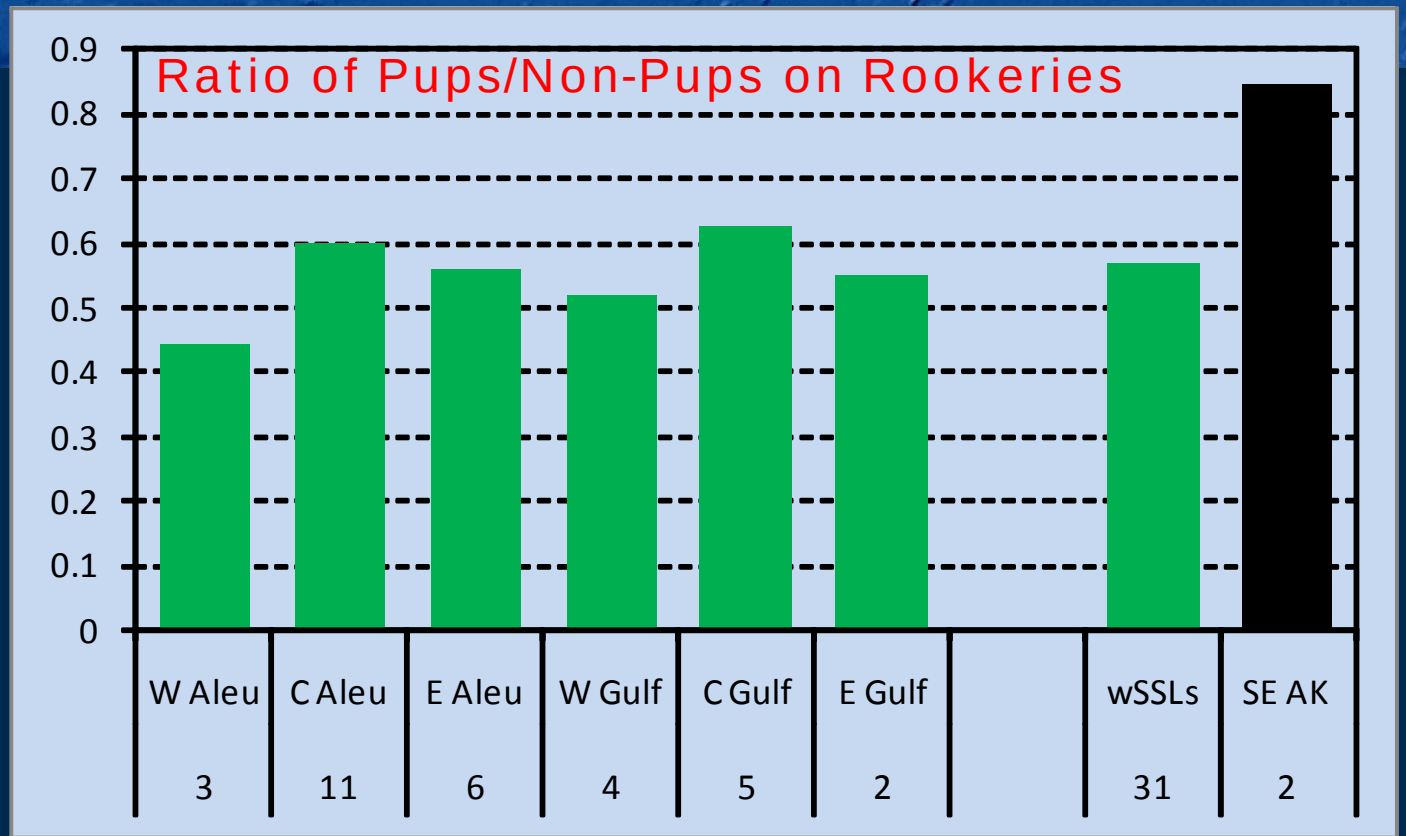
2) C GOA
3) W GOA
4) E Aleutians
6) W Aleutians
7) Russia/Asia

No 50% Subregion Decline

Summary of Weight of Evidence – Chapter 7

- Primary factor(s) driving steep declines in 1980s not likely to ever be identified with assurance
- Contemporary data indicate:
  - adult and juvenile survival rates similar to pre-decline
  - decreases in birth rate of ~ 30% relative to pre-decline
- Pup to non-pup ratios are an indicator of birth rate
- Pup to non-pup ratios in wAI are lowest of any wDPS sub-region; all wDPS ratios lower than eDPS ratios
- Nutritional stress likely explanation for decreased birth rates in wDPS; other explanations, disease and contaminants appear insignificant


Surveyed in
2005 or 2008
Western
Central
Aleutian Islands
Eastern
Western
Gulf of Alaska
Central
Eastern
Southeast
Alaska
Western DPS
Eastern DPS


Ratio of Pups/Non-Pups on Rookeries
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
W Aleu
3
C Aleu
11
E Aleu
6
W Gulf
4
C Gulf
5
E Gulf
2
wSSLs
31
SE AK
2

Summary of Weight of Evidence – Chapter 7

- Primary focus of jeopardy analysis: 2 of 7 Recovery Plan sub-regions in continued decline
- Continued declines in western and central AI in light of continued fisheries targeting SSL prey of concern
- Fishery measures implemented in 2003 likely mitigating impacts in other sub-regions
- Critical habitat in the AI west of 178°W
  - Open to up to 60% of annual AM harvest
  - Open to fixed gear P. cod with few restrictions

Summary of Weight of Evidence – Chapter 7

- Past and present, potentially interacting, factors leading to declines in SSL abundance and limiting rate of recovery:
  - Change in carrying capacity
  - Competitive interaction for prey with other predators (e.g. Arrowtooth flounder)
  - Competitive interaction for prey with fisheries
  - Predation by killer whales
  - Direct mortality; implicated as important in decline through 1980s
  - Disease and contaminants (bulk of evidence does not support, though data are scarce)

Summary of Weight of Evidence – Chapter 7

Telemetry

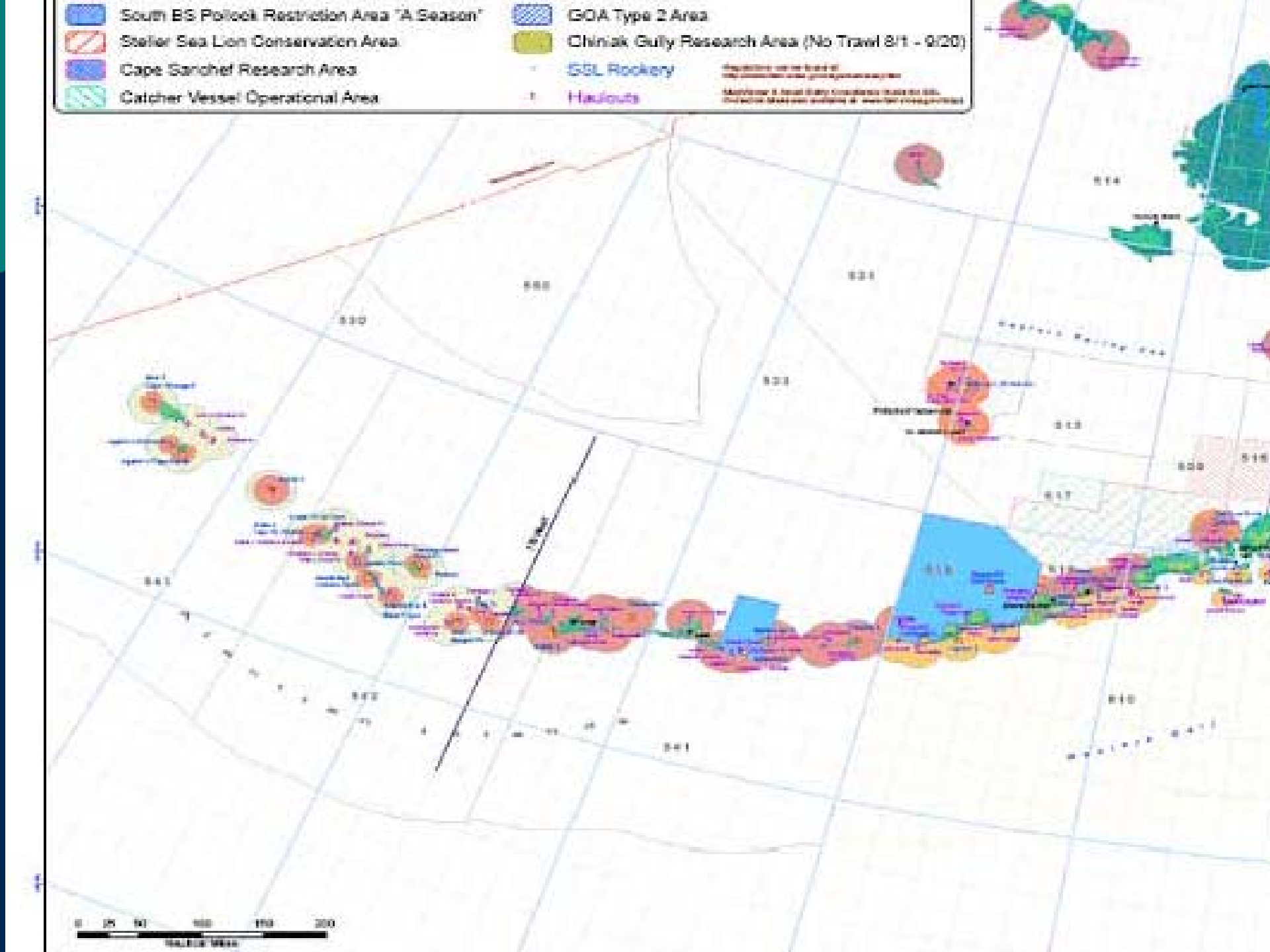
- Recent analyses of telemetry data confirm disproportionately high use of nearshore zones; 0-10nm > 0-20nm > outside 20nm
- However, RCAs 1-3, disproportionate amount foraged outside 20nm; foraging strategies appear to vary by sub-region

Diet

- Dependence on prey species varies by sub-region
- Forage biomass ratios of pollock, P. cod, and AM in CH relatively low in AI

Conclusions – Chapter 7

- Some conservation measures implemented since 2000 FMP Biop effective in ameliorating stressors, esp. in some sub-regions.
- However, measures not adequate to prevent Jeopardy or Adverse modification
- Basis:
  - Continued decline in abundance SSLs in western and central AI; low pup:nonpup ratio in wAI
  - Spatial and temporal distribution of fisheries, overall harvest amounts of important prey, and low overall forage availability in western and central AI


South BS Pollock Restriction Area "A Season"
Steller Sea Lion Conservation Area
Cape Sarichef Research Area
Catcher Vessel Operational Area
GOA Type 2 Area
Chinook Gully Research Area (No Travel 8/1 - 9/20)
SSL Rookery
Haulouts

Conclusions – Chapter 7

- Fishery effect remains equivocal
- The possibility that fishery interaction may be the primary cause of the observed declines in natality can not be eliminated
- Weight of evidence indicates that competition between fisheries for AM and P. cod in the western and central AI may compromise the availability of food resources for SSLs sufficient to jeopardize their continued existence or modify their critical habitat

RPA Performance Standards– Chapter 8

Changes in fishery management measures resulting from Biop should:

- Be commensurate with rate of SSL declines; more stringent measures in sub-regions with greater declines
- Conserve the value of CH foraging zones and offshore foraging areas used most extensively by SSLs
- Disperse fishery removals in time and space to prevent removals from locally depleting prey field
- Consider distributional effects of time and area closures not combined with reductions in TAC to avoid concentrating removals in another time and space that may be deleterious to foraging SSLs

RPA Performance Standards (cont'd) – Chapter 8

Changes in fishery management measures resulting from Biop should (cont'd):

- Conserve prey availability inside trawl exclusion zones where prey (e.g. AM) tagging studies indicate high movement from inside to outside exclusion zones (e.g. Amchitka North in Area 542)
- Consider fishery removals in State waters
- Maintain or establish 3nm groundfish fishing closures around rookeries
- Be implemented in a timely manner given the decline in SSL abundance in two sub-regions

RPA– Chapter 8 Organization

- Recaps indicators and evidence (pg 357)
- Rationale for mitigation measures by Fishery Management Areas
- RPA for each Area
- Intended Effect of RPA for each Area
- Description of how the RPA removes likelihood of Jeopardy and Adverse Modification
- Adaptive Management Discussion

RPA– Chapter 8

Area 543 – Western AI Sub-region

Pacific cod

1. Close the directed fishery and prohibit retention of Pacific cod in Area 543.

Atka mackerel

1. Close the directed fishery and prohibit retention of Akta mackerel in Area 543

*Note: RPA measures specific to Federal and Parallel groundfish fisheries (not State GHL)

RPA– Chapter 8

Area 542 – Central AI Sub-region (west)

Groundfish

1. Close waters from 0-3 nm around Kanaga Island/Ship Rock to directed fishing for groundfish

Pacific cod

1. Nontrawl: Close 0-10 nm zone of CH to directed P. cod fishing year-round. Close 10-20 nm zone of CH to directed P. cod fishing January 1 through June 10.
2. Trawl: Close 0-20 nm zone of CH year-round to directed fishing for P. cod.
3. Prohibit P. cod fishing November 1 through December 31.

RPA– Chapter 8

Area 542 (cont'd) – Central AI Sub-region (west)

Atka Mackerel

1. Close 0-20 nm zone of CH to directed AM fishing year-round.
2. Set AM TAC for Area 542 to no more than 47% of ABC.
3. Change the AM seasons to January 20 through June 10 for the A season and June 10-November 1 for the B season.

RPA– Chapter 8

Area 541 – Central AI Sub-region (east)

Pacific cod

1. Close 0-10 nm zone of CH to directed P. cod fishing year-round.
2. Nontrawl: Close 10-20 nm zone of CH to P. cod directed fishing January 1 through June 10.
3. Trawl: Close10-20 nm zone of CH to directed P. cod fishing June 10 through November 1.
4. Prohibit P. cod fishing November 1 through December 31.

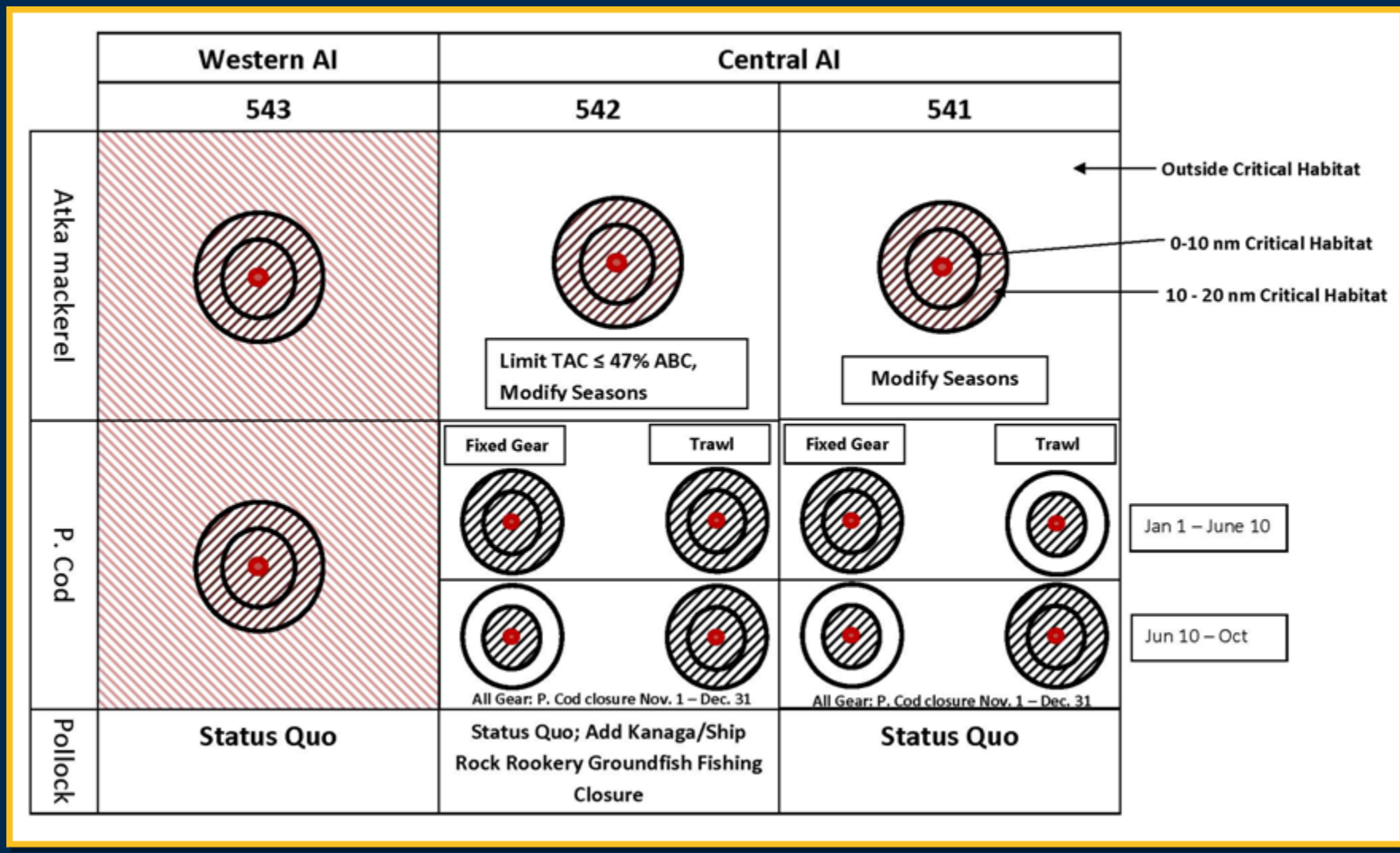
RPA– Chapter 8

Area 541 (cont'd) – Central AI Sub-region (east)

Atka mackerel

1. Available data do not indicate need to further modify fishery management measures within this fishery management area. However, elimination of platoon management system provides opportunity to further disperse AM seasons to January 20 through June 10 for the A season and June 10 through November 1 for the B season.

Depiction of the RPA for Fishery Management Areas 543, 542, and 541



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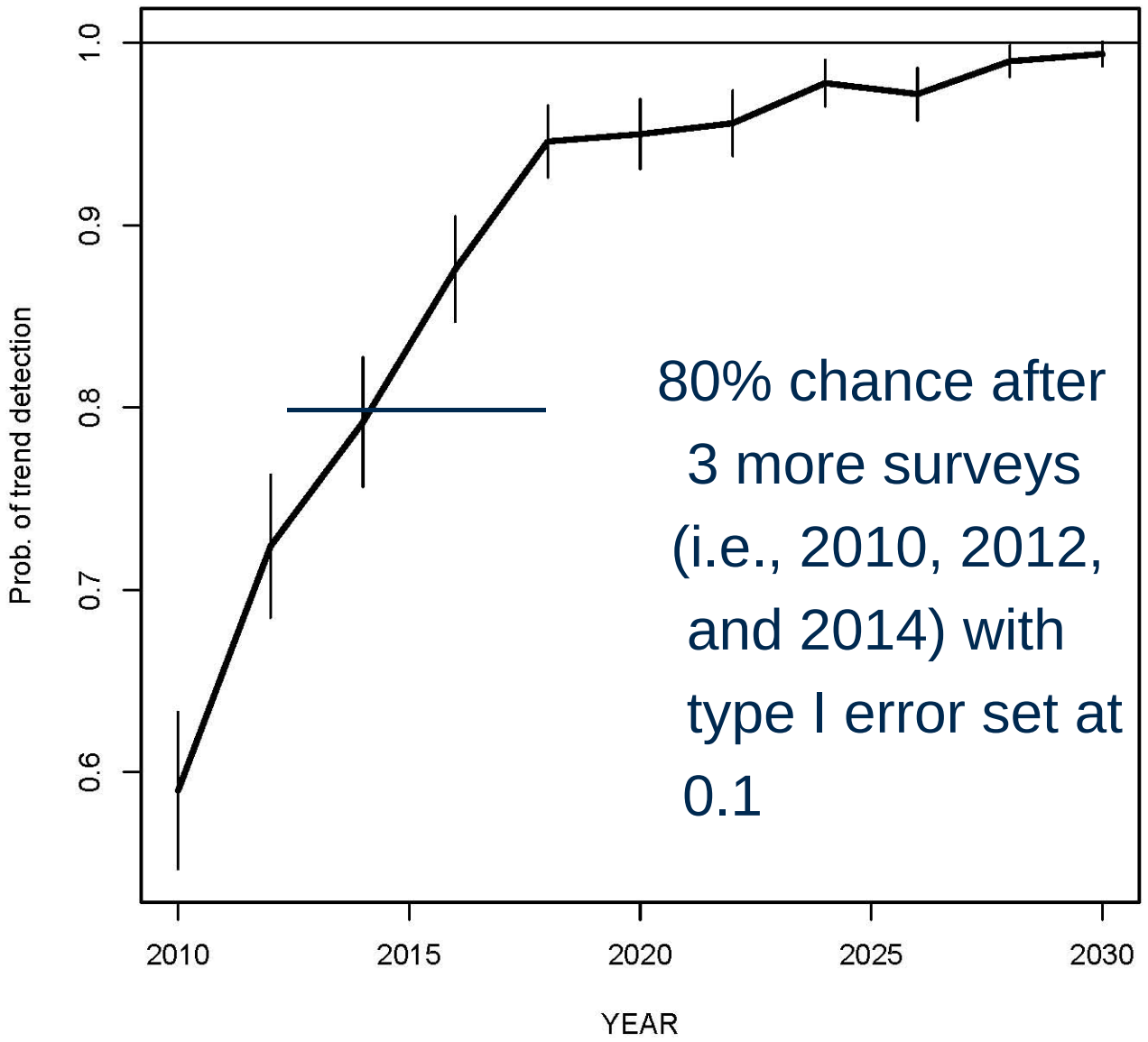
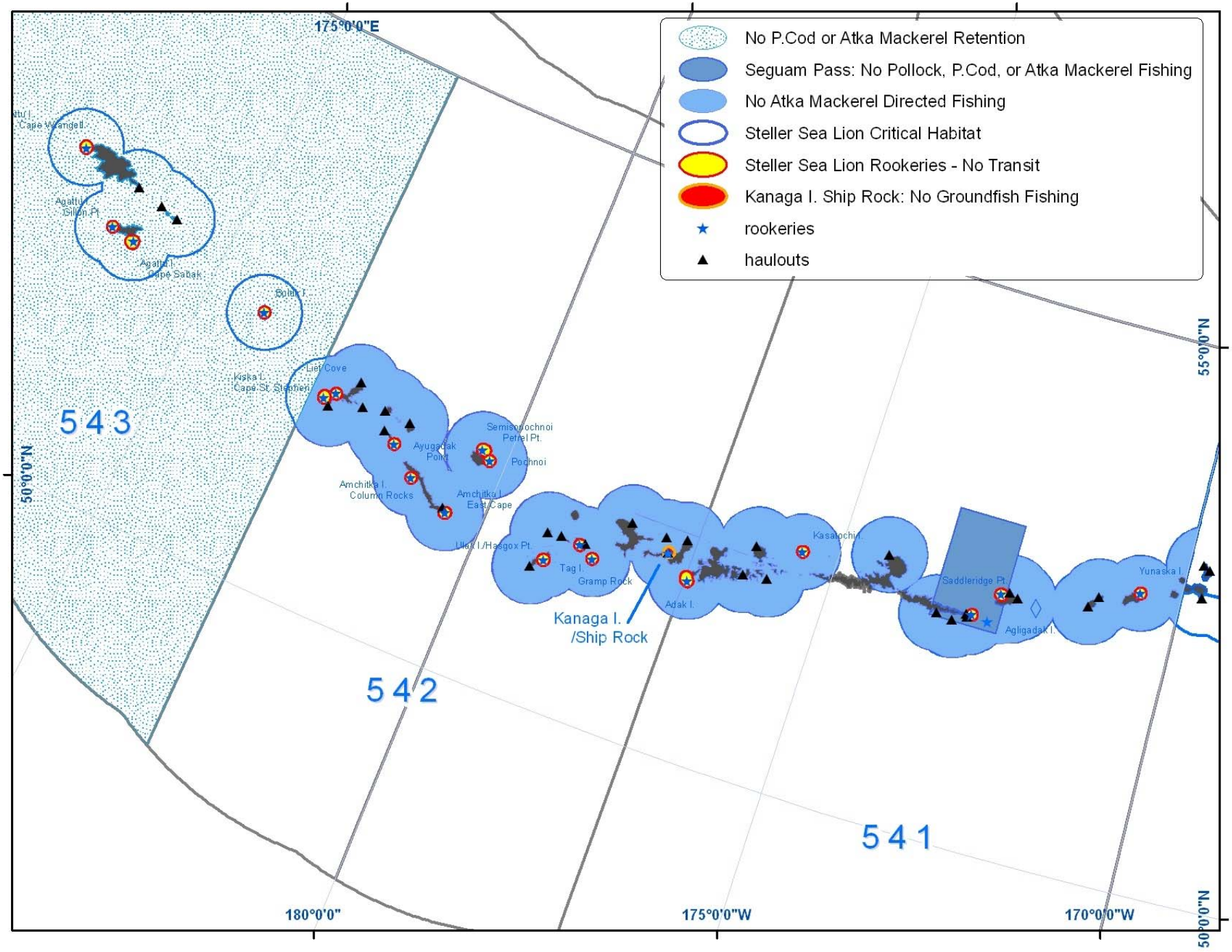
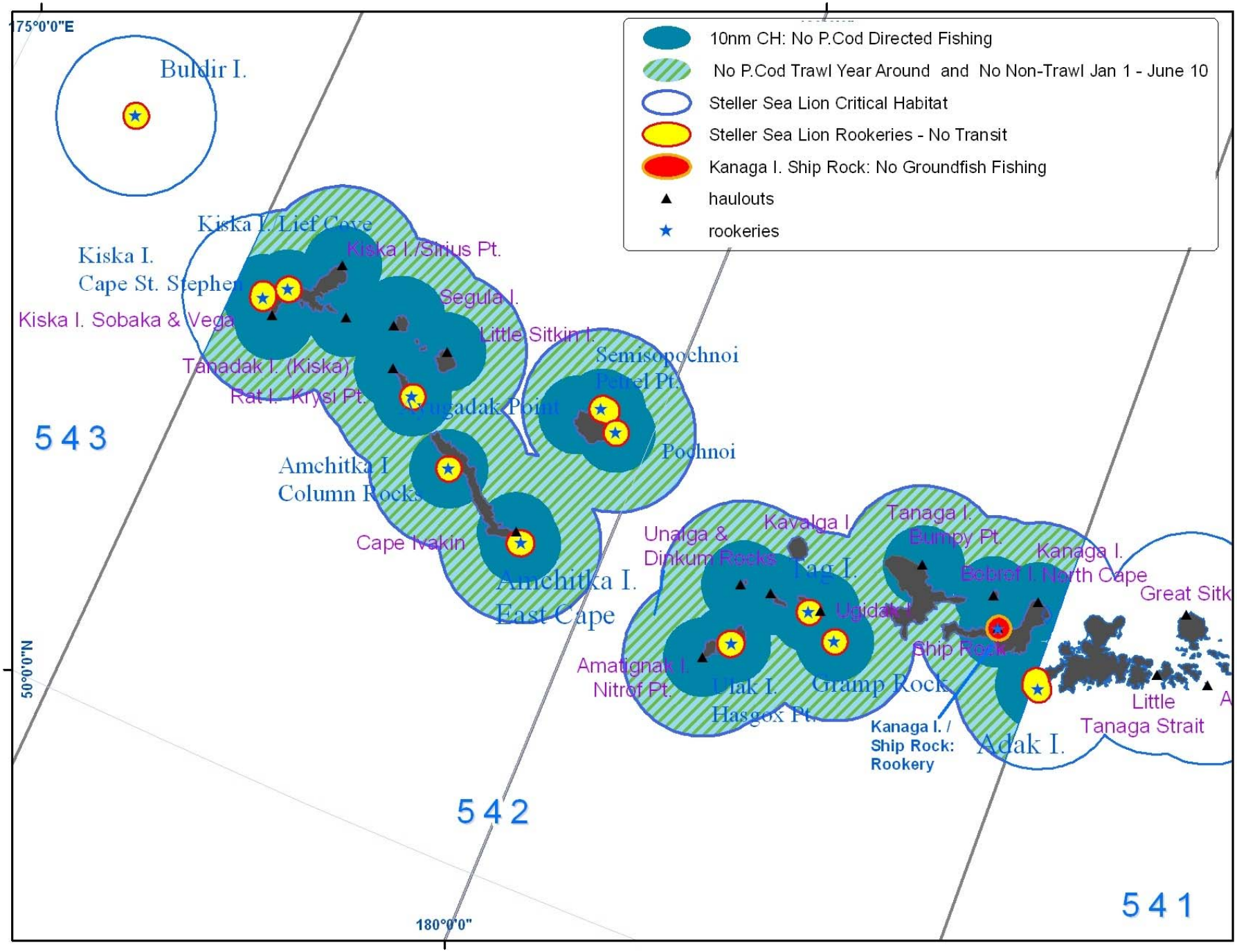
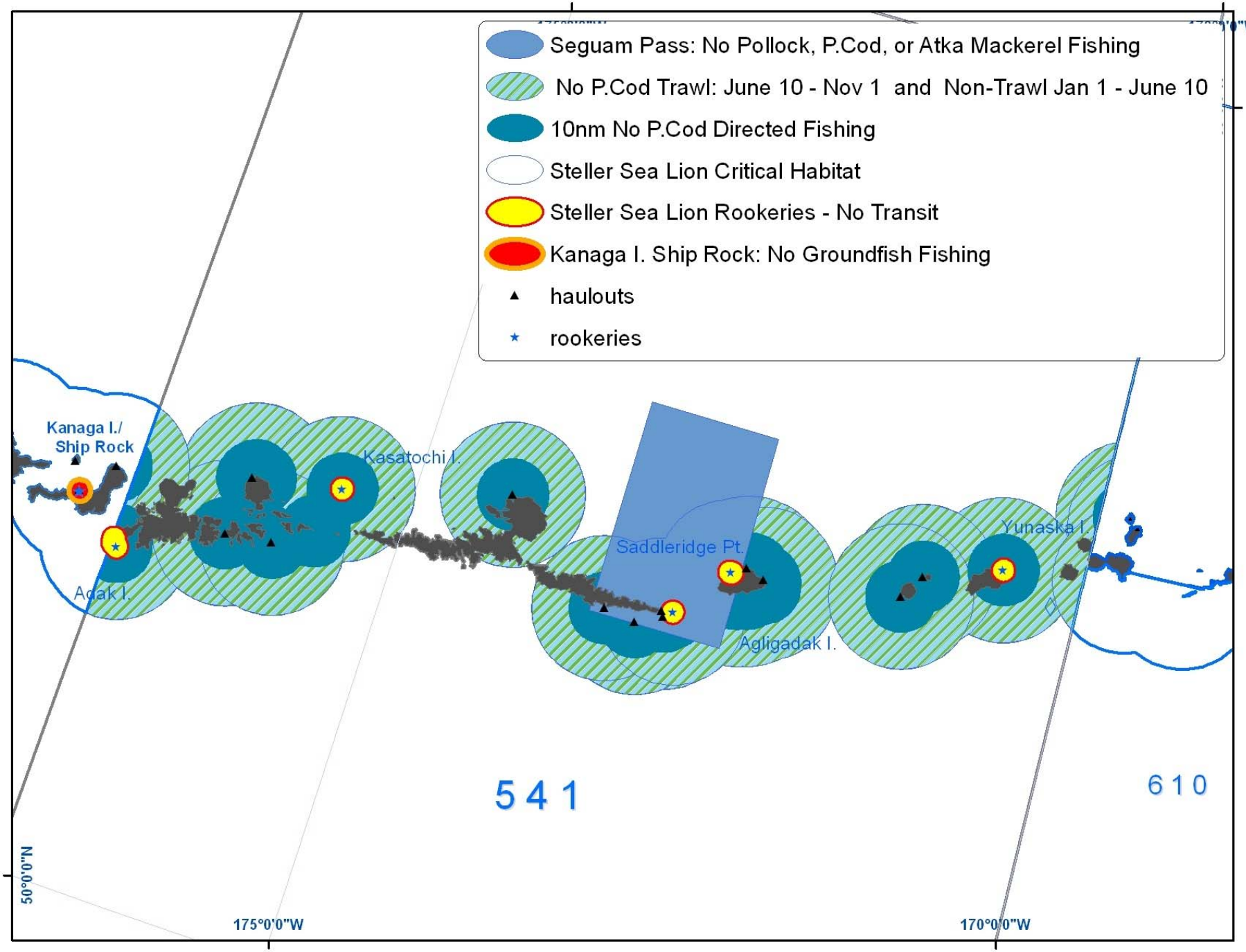
Probability of detecting +trend in SSL abundance



80% chance after 3 more surveys (i.e., 2010, 2012, and 2014) with type I error set at 0.1


No P.Cod or Atka Mackerel Retention
Seguam Pass: No Pollock, P.Cod, or Atka Mackerel Fishing
No Atka Mackerel Directed Fishing
Steller Sea Lion Critical Habitat
Steller Sea Lion Rookeries - No Transit
Kanaga I. Ship Rock: No Groundfish Fishing
rookeries
haulouts
175°0'0"E
55°0'0"N
50°0'0"N
180°0'0"
175°0'0"W
170°0'0"W
543
542
541
Agattu I.
Cape Sabak
Buldir I.
Kiska I.
Cape St. Stephen
Lief Cove
Ayugadak Point
Semisopochnoi
Petrel Pt.
Pochnoi
Amchitka I.
Column Rocks
Amchitka I.
East Cape
Ulak I./Hasgox Pt.
Tag I.
Gramp Rock
Kanaga I.
/Ship Rock
Adak I.
Kasatochi I.
Saddleridge Pt.
Agligadak I.
Yunaska I.

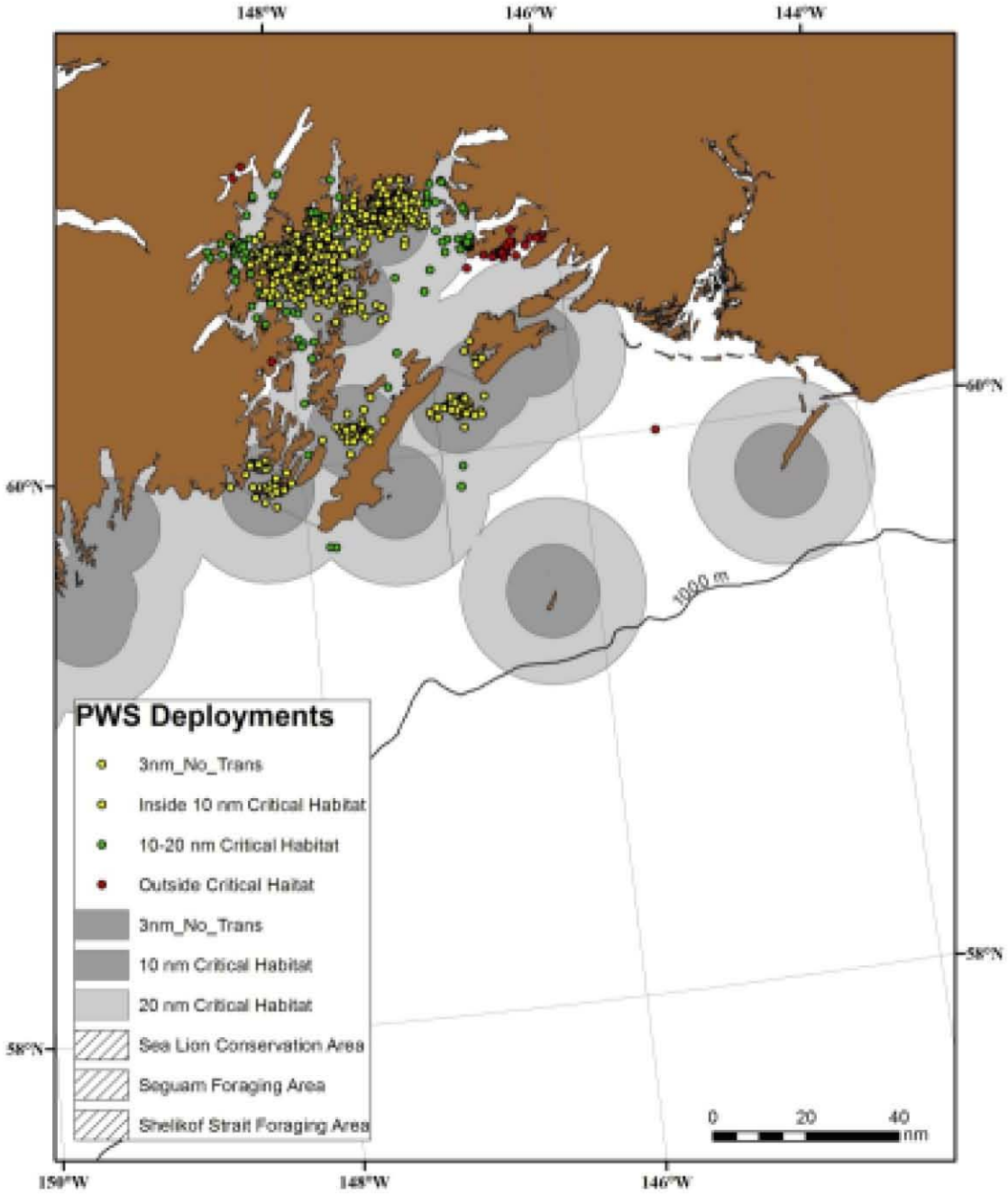

10nm CH: No P.Cod Directed Fishing
No P.Cod Trawl Year Around and No Non-Trawl Jan 1 - June 10
Steller Sea Lion Critical Habitat
Steller Sea Lion Rookeries - No Transit
Kanaga I. Ship Rock: No Groundfish Fishing
haulouts
rookeries
175°0'0"E
Buldir I.
Kiska I. Lief Cove
Kiska I./Sirius Pt.
Kiska I.
Cape St. Stephen
Segula I.
Kiska I. Sobaka & Vega
Little Sitkin I.
Semisopochnoi
Tanadak I. (Kiska)
Petrel Pt.
Rat I. Krysi Pt.
Pochnoi
543
Amchitka I
Column Rocks
Cape Ivakin
Amchitka I.
East Cape
Unalga &
Dinkum Rocks
Kavalga I.
Tanaga I.
Bumpy Pt.
Kanaga I.
Tag I.
Bobrof I. North Cape
Great Sitk
Ugidak I.
Ship Rock
Amatignak I.
Nitrof Pt.
Ulak I.
Gramp Rock
Hasgox Pt.
Kanaga I. /
Ship Rock:
Rookery
Little
Tanaga Strait
Adak I.
542
541
180°0'0"
50°0'0"N

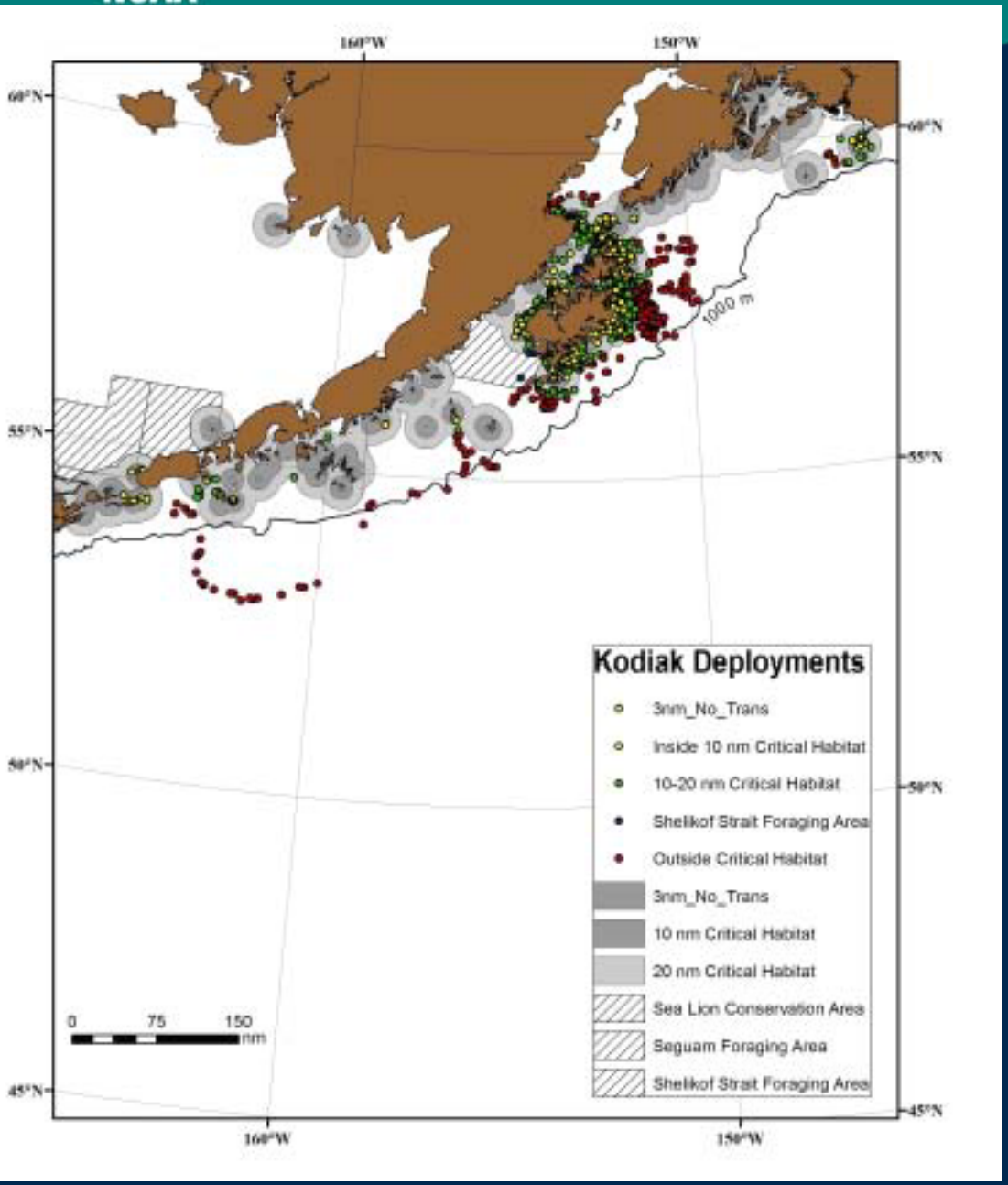

Seguam Pass: No Pollock, P.Cod, or Atka Mackerel Fishing
No P.Cod Trawl: June 10 - Nov 1 and Non-Trawl Jan 1 - June 10
10nm No P.Cod Directed Fishing
Steller Sea Lion Critical Habitat
Steller Sea Lion Rookeries - No Transit
Kanaga I. Ship Rock: No Groundfish Fishing
haulouts
rookeries
Kanaga I./
Ship Rock
Kasatochi I.
Saddleridge Pt.
Yunaska I.
Adak I.
Agligadak I.
541
610
50°0'0"N
175°0'0"W
170°0'0"W

NOAA
FISHERIES
SERVICE

Questions?

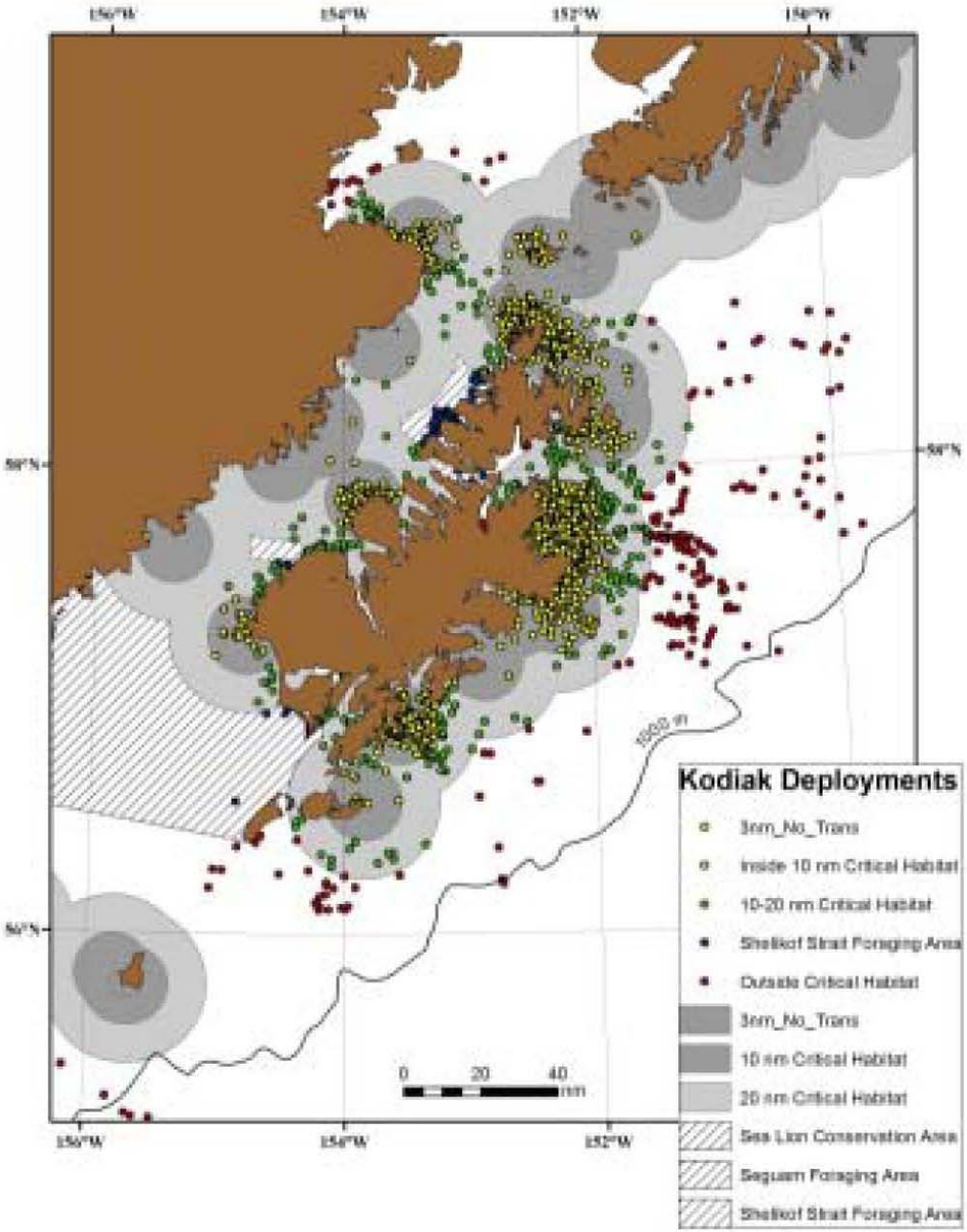
Telemetry locations in PWS





Telemetry locations around Kodiak

Telemetry Locations Around Kodiak



Fishery Mgt Area	RCA	Forage Biomass 2008 (top row) and Total Harvest by RCA (bottom row)			Fraction of Biomass Harvested by RCA			Fraction of 2008 Total Catch taken from CH (top) and Fraction of 2008 Forage Biomass taken from CH		
		AM	P. Cod	Pollock	AM	P. Cod	Pollock	AM	P. Cod	Pollock
543	1	62,154 16,509	39,939 9,151	18,794 114	0.27	0.23	0.01	0.36 0.10	0.95 0.22	0.61 0.00
542	2	91,050 17,917	21,519 2,870	40,038 123	0.20	0.13	0.00	0.48 0.09	0.86 0.12	0.27 0.00
542	3	81,236 4,560	23,068 1,441	13,074 168	0.06	0.06	0.01	1.00 0.06	1.00 0.06	0.96 0.01
541	4	20,173 53	7,403 6,910	1,907 470	0.00	0.93	0.25	0.98 0.00	0.83 0.77	0.15 0.04
541	5	216,994 18,650	80,223 11,821	198,830 404	0.09	0.15	0.00	0.01 0.00	0.76 0.11	0.85 0.00
610	6	74,149 447	934,201 140,492	4,438,756 992,601	0.01	0.15	0.22	0.91 0.01	0.07 0.01	0.25 0.06
610	7		168,227 18,661	118,114 13,986		0.11	0.12		0.64 0.07	0.70 0.08
620	8		53,508 11,481	211,585 17,225		0.21	0.08		0.75 0.16	0.59 0.05
630	9		128,096 24,226	107,941 16,314		0.19	0.15		0.48 0.09	0.79 0.12
640	10		12,556 2,109	42,961 1,166		0.17	0.03		0.76 0.06	0.60 0.02

Potential Biological Effects	1980s	1990s	2000-2004
More emaciated pups (<4 wks)	U	U*	N(H)
More emaciated pups (>4 wks)	U	U	U
More emaciated juveniles	U	N(H,G)	U
More emaciated adults	U	N(H,G)	U
Reduced pup survival (to 4 wks)	U*	U*	U
Reduced adult body size	Y(H)	U	U
Reduced juvenile body size	Y(H)	U*	U
Reduced pup body size	U	N(G), U*(H)	N(H)
Reduced birth weight	N or U?	U	U
Reduced pup weight	?	N(G),U*(H)	N(H)
Reduced growth rate	Y(H)	N(G)	N(H)
Reduced pup survival	? OR U	U*	N(H)
Reduced juvenile survival	Y(H)	Y	N(H)
Reduced adult survival	Y(H)	N	N(H)
Reduced overall survival	Y(H)	Y(H,G)	N(H)
Reduced birth rate	Y(H)	Y(H)	Y(H)
Reduced pup counts	Y(H)	Y(H)	N(H)
Reduced non-pup counts	Y(H)	Y(H)	N(H)
Increased reproductive failure	Y(H)	U	U
Change in pup blood chemistry (increased fasting)	U	N(G)	N
Change in juvenile blood chemistry (increased fasting)	U	U*	N
Delayed sexual maturity	U	U	U
Change in metabolic rate	U	U	U
Decreased body condition (adult females on rookeries)	U	U* (N(G))	U
Reduced adult perinatal fast	U	N(G)	U
Longer foraging trip duration	U	N(G)	U*
Increased susceptibility to disease (haptoglobin)	U	U*	U
Increased incidence of disease	U	N(G)	N(H,G)
Increased susceptibility to predation	U	U	U
Altered weaning age	U	U*(G)	U*
Decreased weaning size	U	U	U
Traditional ecological knowledge re. body condition	?	U*	U*

Table 3.17. Data gaps for assessing potential biological manifestations of nutritional stress in the western DPS of SSLs.

Comparison with previous decade (H = historical) or with the eastern DPS (G= geographical).

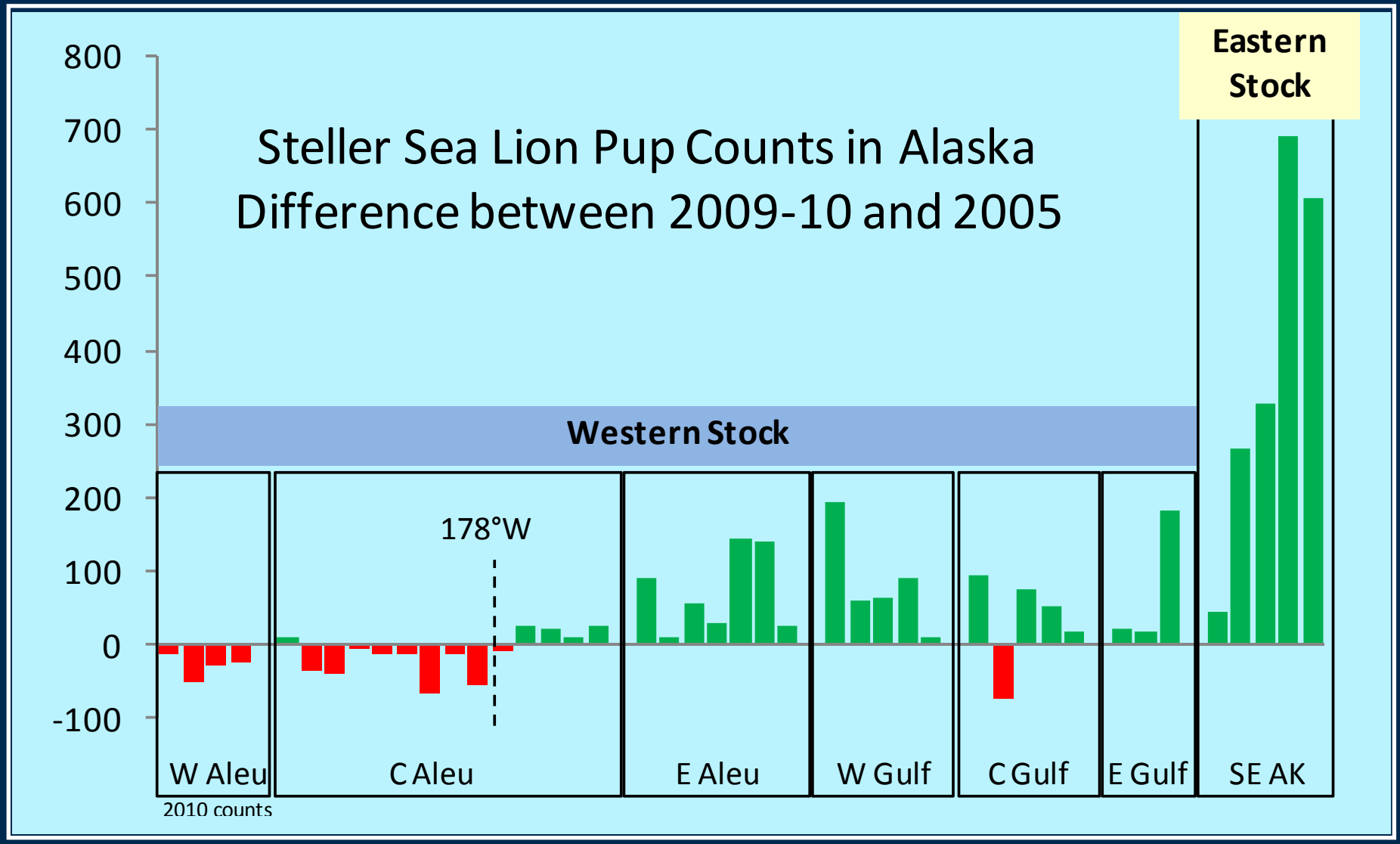
Y = data available; effect indicated

N = data available; no effect indicated

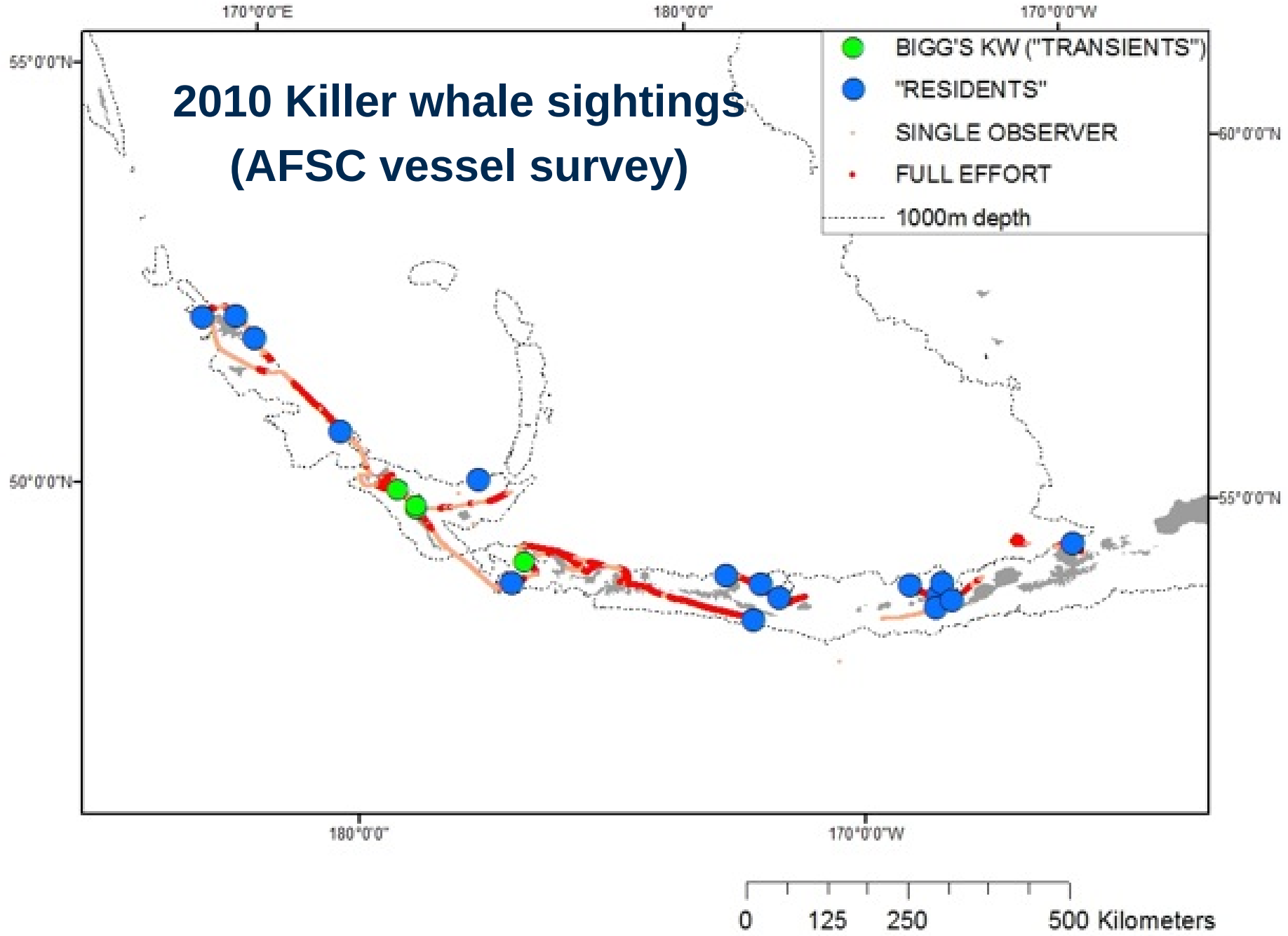
U = Unknown, no data available

U* = Data available but not analyzed

Status of western DPS of SSL



SSL Sub-Region	Fishery Management Area	RCA	Primary Prey (% FO)	
			Summer	Winter
wAI	543	1	1.Atka mackerel (96) 2.Salmon (17) 3.Cephlapods (13) 4.Pollock (7) 5.P. Cod (6)	1.Atka mackerel (55) 2.P. Cod (26) 3.Irish Lord (23) 4.Cephlapods (18) 5.Pollock (12) 6.Snailfish (12)
cAI	542	2 3		
	541	4 5		
eAI	610	6	1.Pollock (46) 2.Salmon (38) 3.Herring (35) 4.Sand Lance (34) 5.Atka mackerel (32) 6.Rock Sole (19) 7.P. Cod (18)	1.Pollock (53) 2.Atka mackerel (43) 3.P. Cod (39) 4.Irish Lord (35) 5.Sandlance (28) 6.Salmon (25) 7.Arrowtooth (21)
wGOA	620	7 8	1.Sandlance (65) 2.Salmon (57) 3.Pollock (53) 4.P. Cod (36) 5.Atka mackerel (21) 6.Arrowtooth (14)	1.Pollock (93) 2. P. Cod (31) 3.Salmon (17) 4.Sandlance (17) 5.Arrowtooth (7)
cGOA	630	9	1.Salmon (56) 2.Pollock (46) 3. Arrowtooth (45) 4.Sandlance (16) 5.Capelin (13) 6.Herring (12)	1.Pollock (44) 2.P. Cod (43) 3.Sand Lance (38) 4. Arrowtooth (31) 5.Salmon (29) 6.Irish Lord (17)
eGOA	640	10	1.Salmon (84) 2.Sand Lance (39) 3.Herring (24) 4.Capelin (13) 5.Pollock (8) 6.P. Cod (5) 7.Arrowtooth (5)	not available


2010 Killer whale sightings
(AFSC vessel survey)
BIGG'S KW ("TRANSIENTS")
"RESIDENTS"
SINGLE OBSERVER
FULL EFFORT
1000m depth
170°0'0"E
180°0'0"
170°0'0"W
55°0'0"N
50°0'0"N
60°0'0"N
55°0'0"N
180°0'0"
170°0'0"W
0
125
250
500 Kilometers