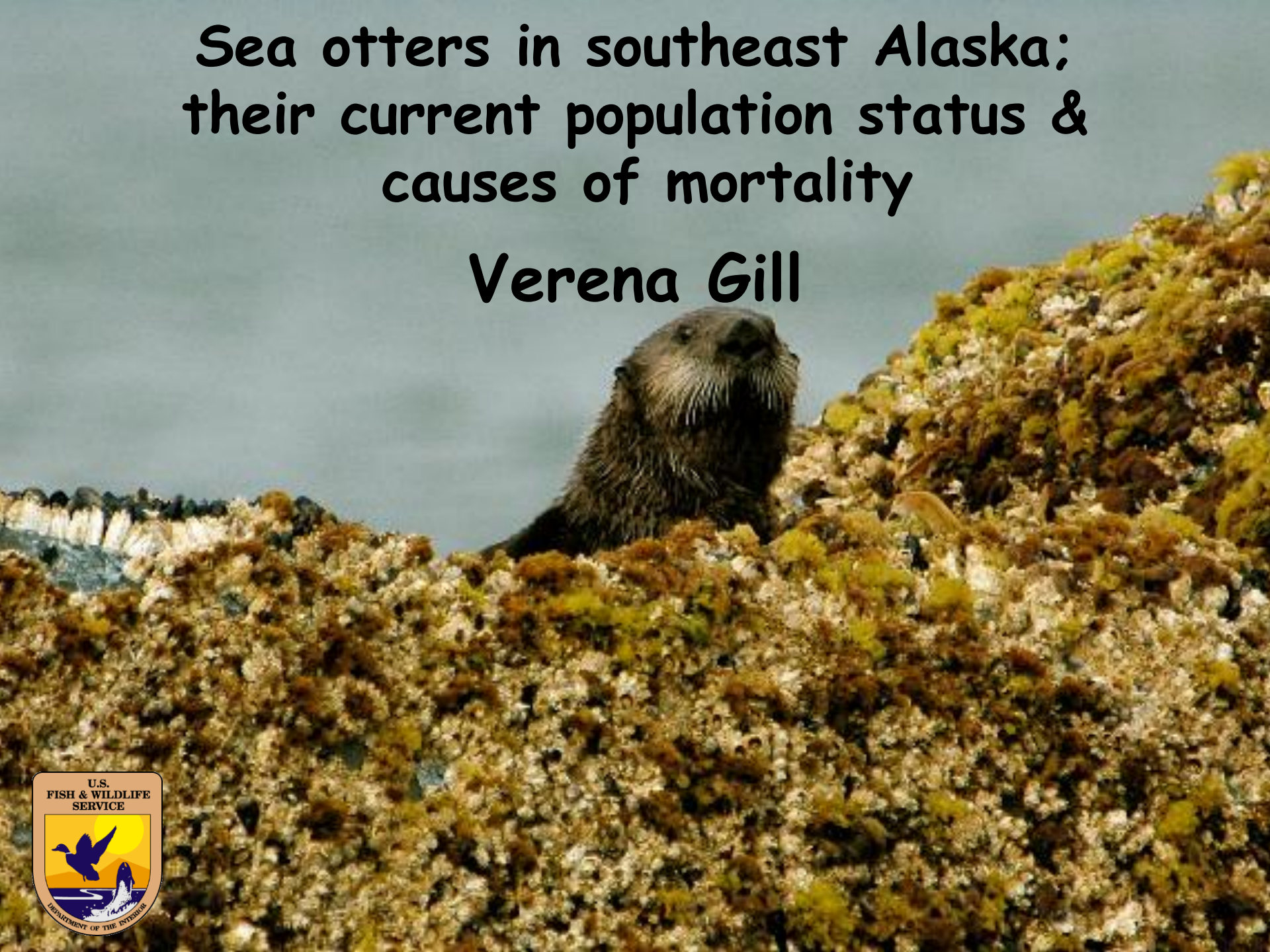
Sea otters in southeast Alaska; their current population status & causes of mortality

Verena Gill

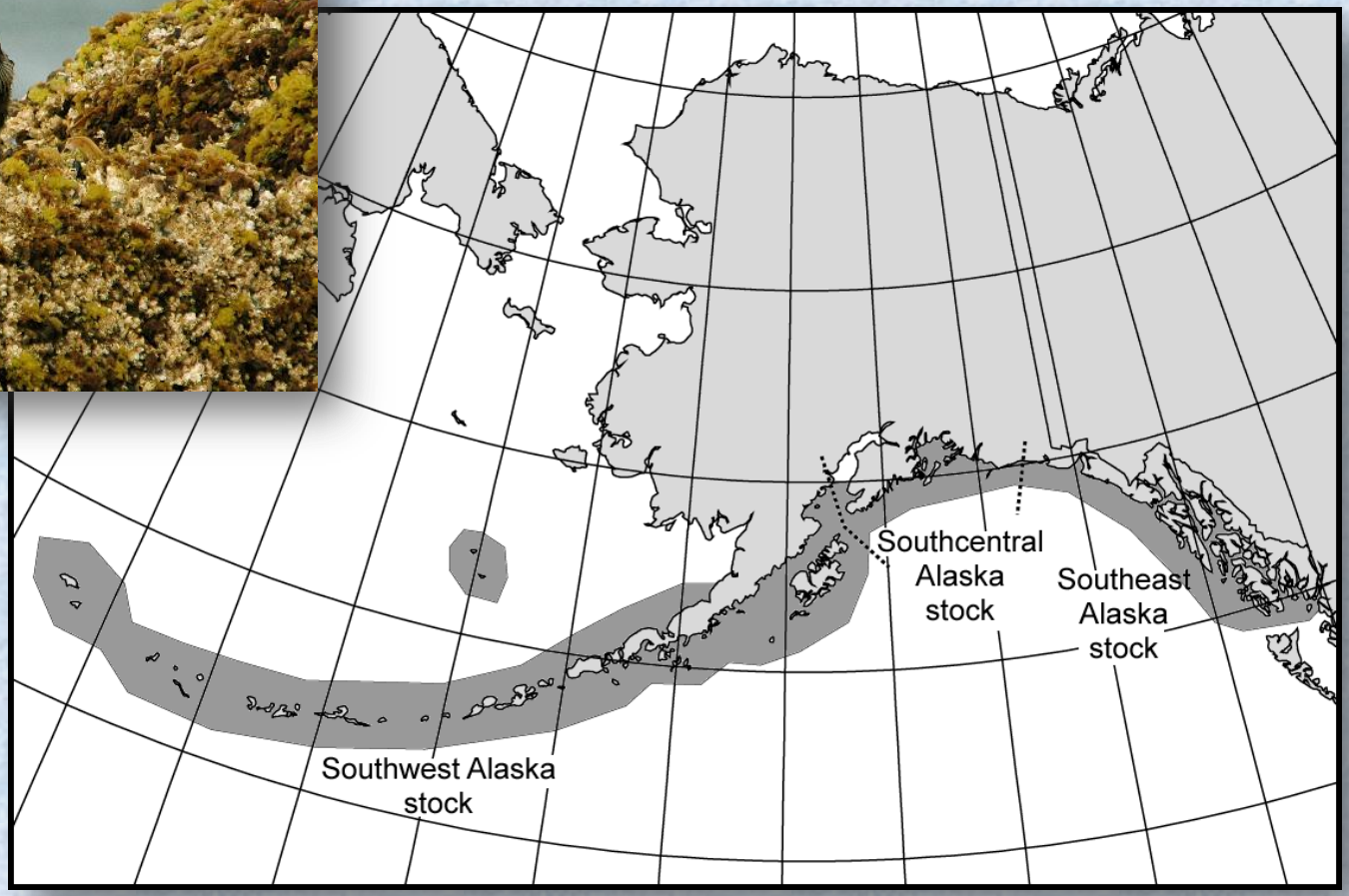


Outline of presentation

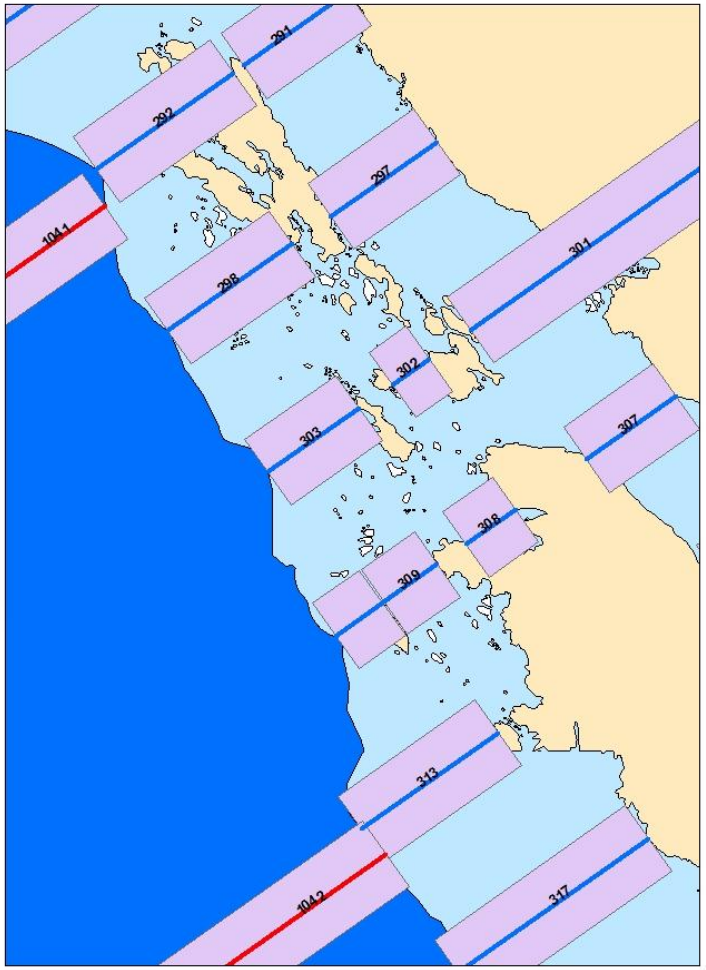
- Population trend & abundance of sea otters in SE Alaska
- Sources of mortality in SE AK

Population trend of sea otters in SE Alaska

There are 3 population stocks of northern sea otters in Alaska



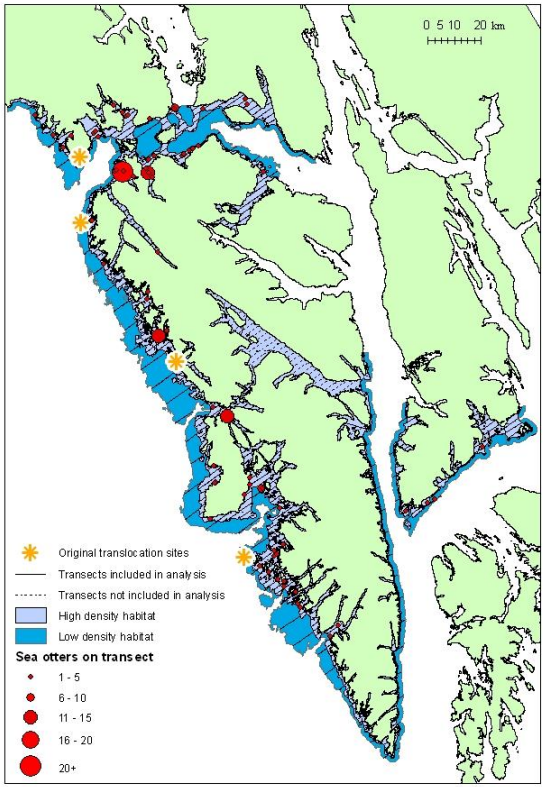
2010-2012 aerial survey in SE AK

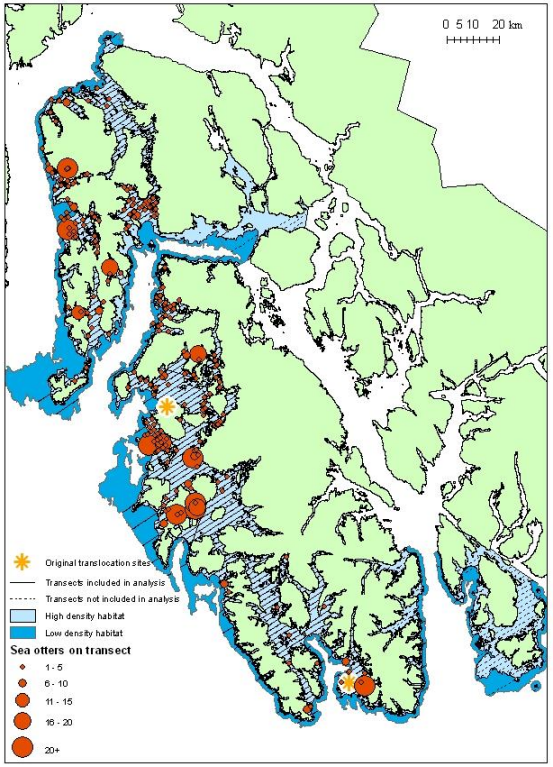


USGS
science for a changing world

U.S. FISH & WILDLIFE SERVICE

Current annual growth rates; 12-14% yr^{-1} increase across stock; but Glacier Bay driving the increase in north





2003 = 10,563

2012 = 25,712

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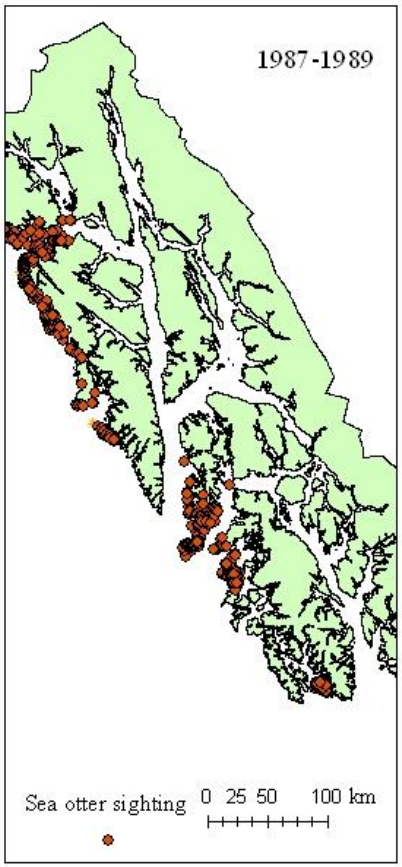
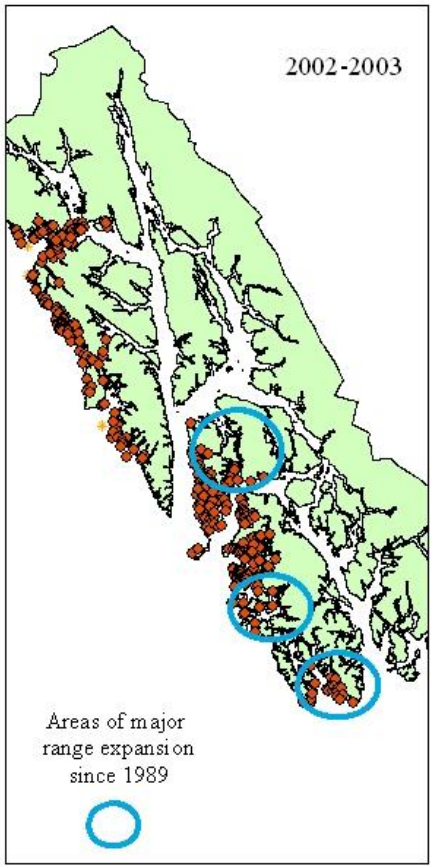
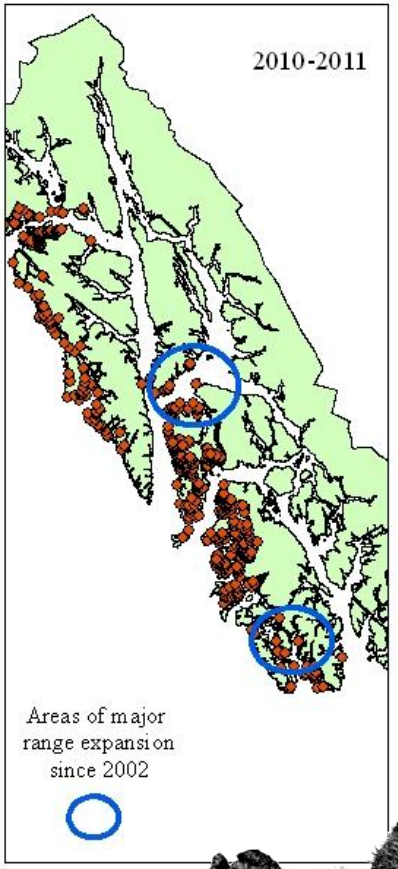
Latest SE stock assessment (2013)

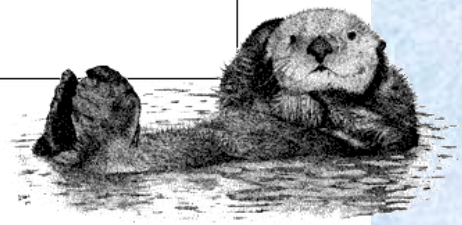
Survey Area	Year	Adjusted Estimate	CV	N_{MIN}	Reference
North Gulf of Alaska	2000	32	0.38	24	USGS unpublished data
Glacier Bay NP	2012	8,508	0.20	7,201	Esslinger, Bodkin, & Weitzman (2013)
Northern Southeast Alaska (NSE)	2011	2,717	0.22	2,270	Gill and Burn unpublished data
Southern Southeast Alaska (SSE)	2010	12,873	0.18	11,099	Gill and Burn unpublished data
Yakutat Bay	2005	1,582	0.33	1,203	Gill and Burn (2007)
Current Total		**25,712**		**21,798**	
2008 SAR Total		10,563		9,136	

Range expansion 1987-2011









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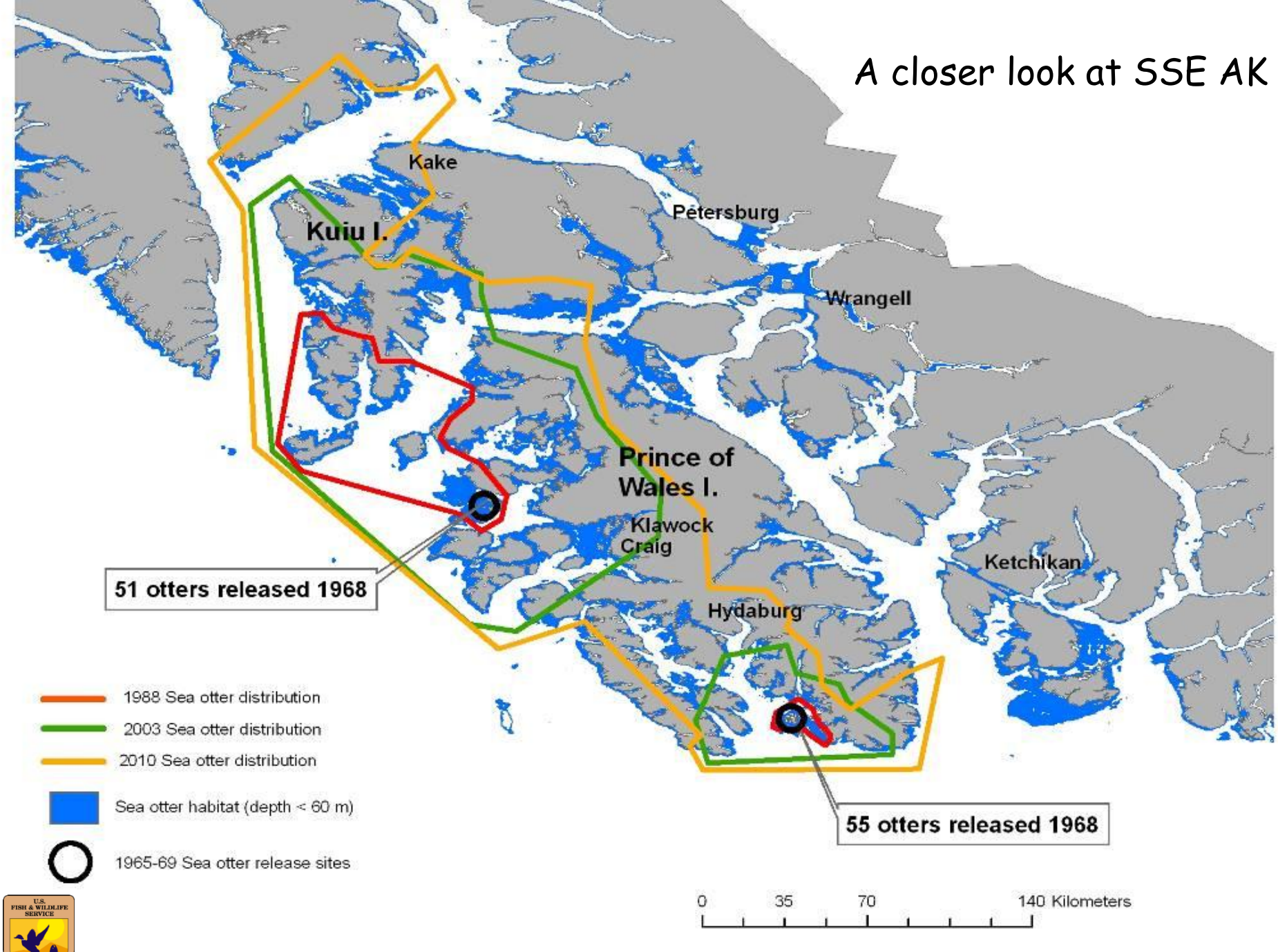
A closer look at SSE AK



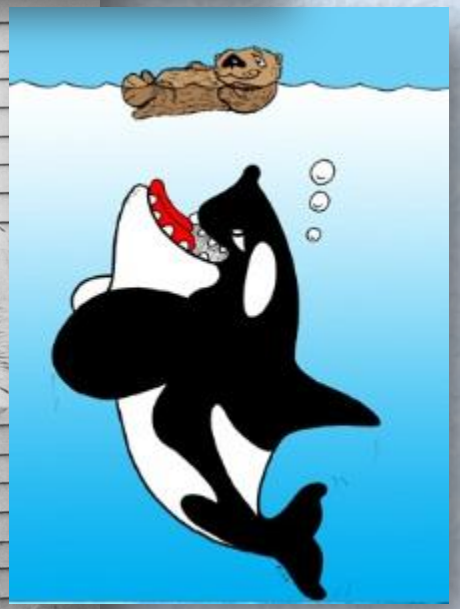
Potential Biological Removal (PBR) of sea otters from SE AK stock is 2,180

PBR = *the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimal sustainable population.*

PBR is the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = N_{MIN} x 0.5 R_{MAX} x F_R. The recovery factor (F_R) for this stock is 1.0 as population levels have been stable or increasing with a known human take. For the SE AK stock of sea otters, PBR = 2,180 animals (21,798 x 0.5(0.2) x 1.0).

*no hunting allowed in Glacier Bay but large pop in GB contributing to PBR

Sources of mortality



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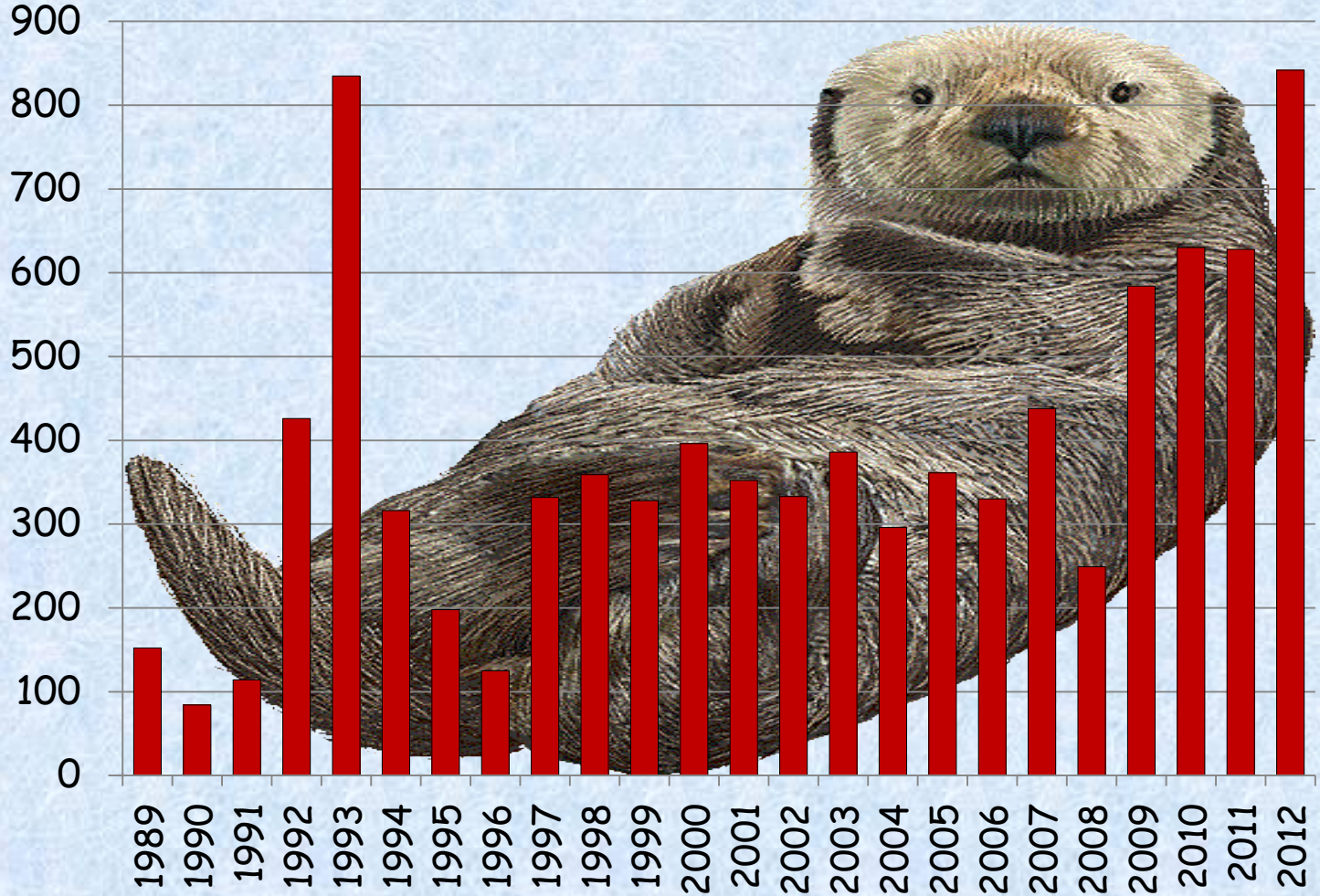
Reported subsistence harvest of sea otters from SE AK, 1989-2012.



Locations of reported subsistence harvest of sea otters from SE AK, last 5 yrs.

Village	2008	2009	2010	2011	2012	total
Coffman Cove	0	0	0	21	0	**21**
Craig (4)	15	44	136	98	63	**356**
Hoonah (5)	30	27	53	28	127	**265**
Hydaburg	0	0	0	20	14	**34**
Juneau	31	33	35	3	7	**109**
Kake	7	2	17	21	94	**141**
Ketchikan	9	0	11	14	0	**34**
Klawock (3)	7	199	58	49	58	**371**
Naukati Bay	0	0	0	3	64	**67**
Pelican	10	3	4	21	2	**40**
Sitka (1)	126	141	218	201	285	**971**
Wrangell	6	18	9	0	11	**44**
Yakutat (2)	8	117	89	149	117	**480**
	249	**584**	**630**	**628**	**842**	**2933**

Even if PBR not reached, local depletion can be a problem

Health and disease program

- When possible, recover all sea otter carcasses reported across Alaska
- Necropsy all depending decomposition status
- Full work up on fresh dead animals
- All live-captured animals are also screened
- Samples to various collaborators for testing and variety of studies

Sample sizes for screening

- Average of 80 dead otters sampled annually across AK; av. 7/yr in SE AK

- Live captures sporadic; 31 otters in SE AK 2011

Testing and studies for sea otter disease surveillance

Testing

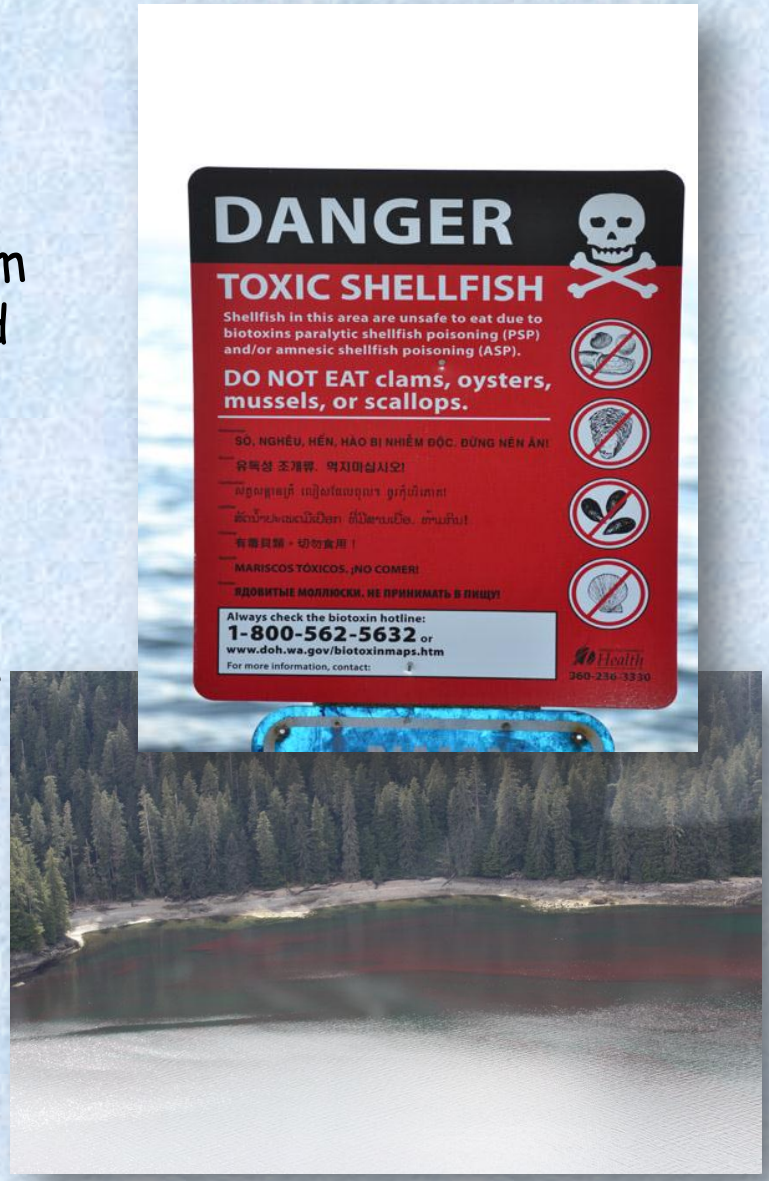
- microbiology, virology, protozoal, fungal, biotoxins, histopathology

Specific studies

- Protozoal encephalitis surveillance
- Bacterial flora surveillance
- Morbillivirus surveillance, focusing on PDV
- Avian influenza surveillance
- Herpes virus surveillance
- *Bartonella* spp. surveillance
- Contaminants (PBDE, PFC)
- Biotoxin surveillance (Domoic acid & PSP)
- Coxiella (Q fever) surveillance
- Clinical pathology (serum chemistry & complete hematologic analyses) of live sea otters

Biotoxin surveillance project

- Project with NOAA
- Urine, pericardial fluid, stomach contents
- 137 sea otters tested for DA and Saxitoxin (PSP) that died 2005-2010 from various causes 39 (28%) had DA detected (Glacier Bay to Kodiak)
- 12 (9%) had PSP detected (Juneau to Kodiak)
- Had otter deaths related to PSP (Kodiak)
- All age classes, all sexes, all years, across range
- 30/31 live captured otters had PSP detected in May 2011 in SE AK



Number of sea otter carcasses recovered in SE AK

Location of carcasses recovered in SE AK

2006-2012

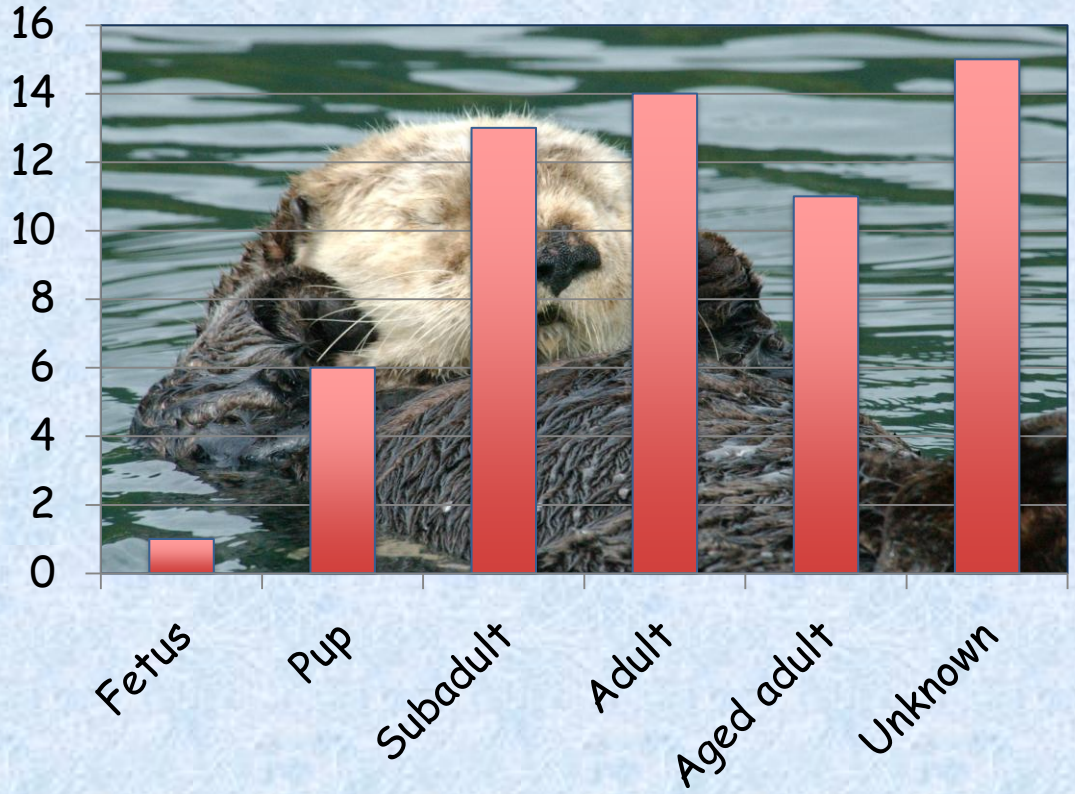
Location	Number
Glacier Bay	32
Sitka	13
Yakutat	2
Craig	1
Juneau	1
Kake	1
TOTAL	**50**

Age & sex composition of carcasses found in SE AK 2006-2012; profile is adult male

Male

Female

Unknown



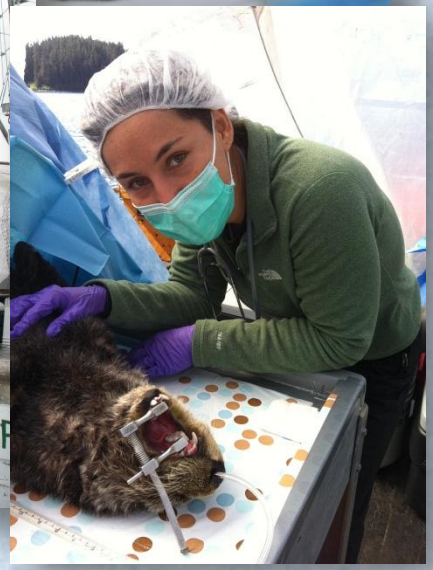
Of documented CODs 2006-2012, trauma is #1 in SE AK

Cause of death	Number
Undetermined	23
Gunshot (not reported hunting)	6
General Trauma	6
Valvular endocarditis	4
Starvation	4
Torsion	2
Pup abandonment	1
Aortic aneurysm	1
Drowning	1
Heart failure	1
Sepsis	1
TOTAL	**50**

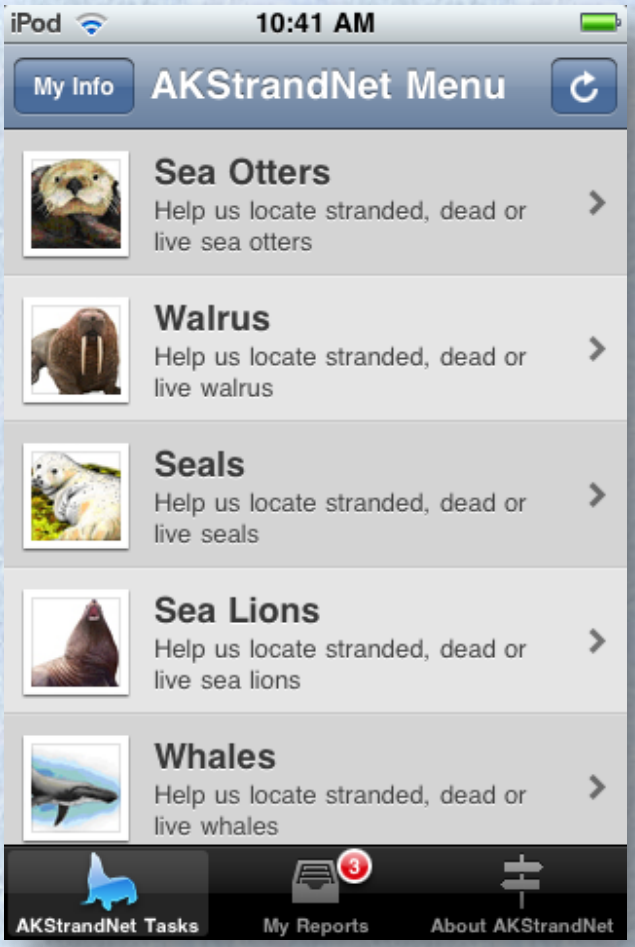
SE AK sea otters are healthy

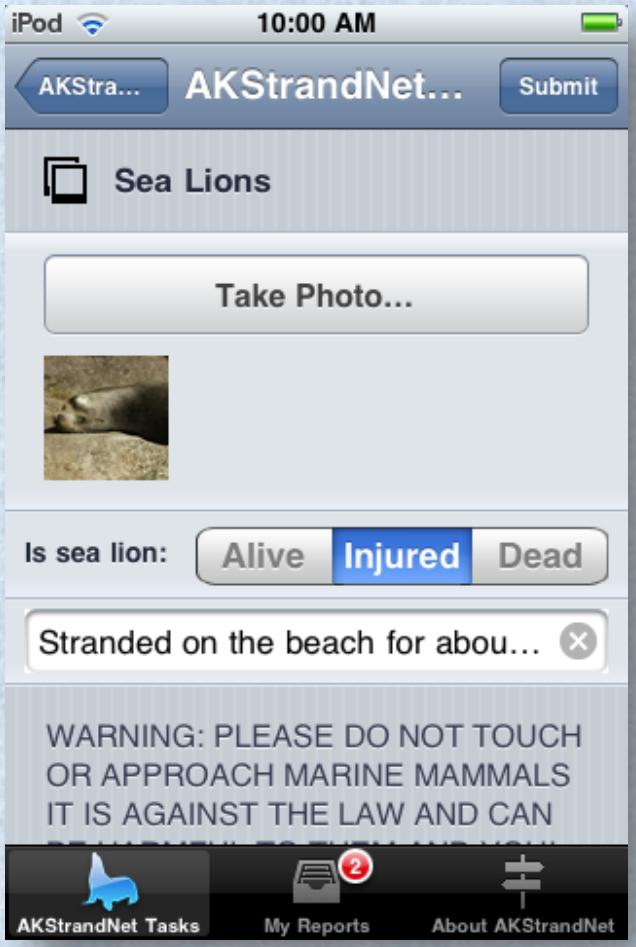
- Survey of live captures and stranded animals show that otters in SE have good body condition, healthy, and relatively disease free compared with other AK stocks.

- Only major current finding is presence of Saxitoxin (PSP).



Ways to increase samples; AKStrandNet on iTunes (free)





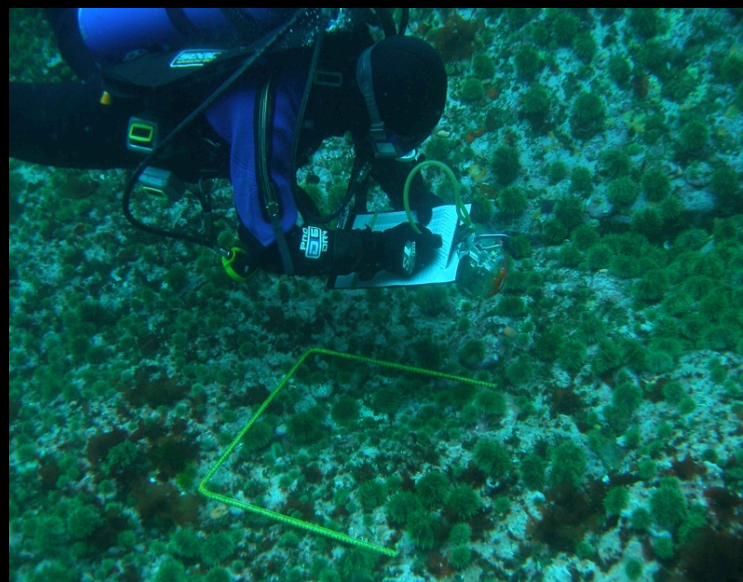
Sea otters and kelp forests

+

-

James A. Estes

University of California
Santa Cruz

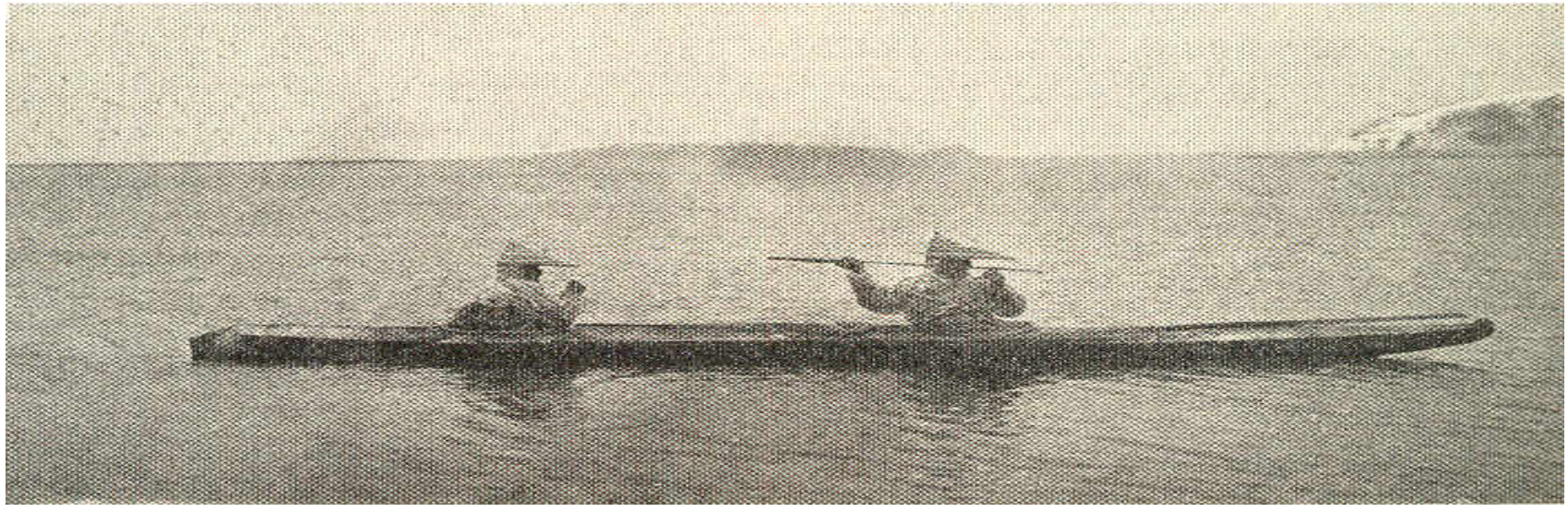


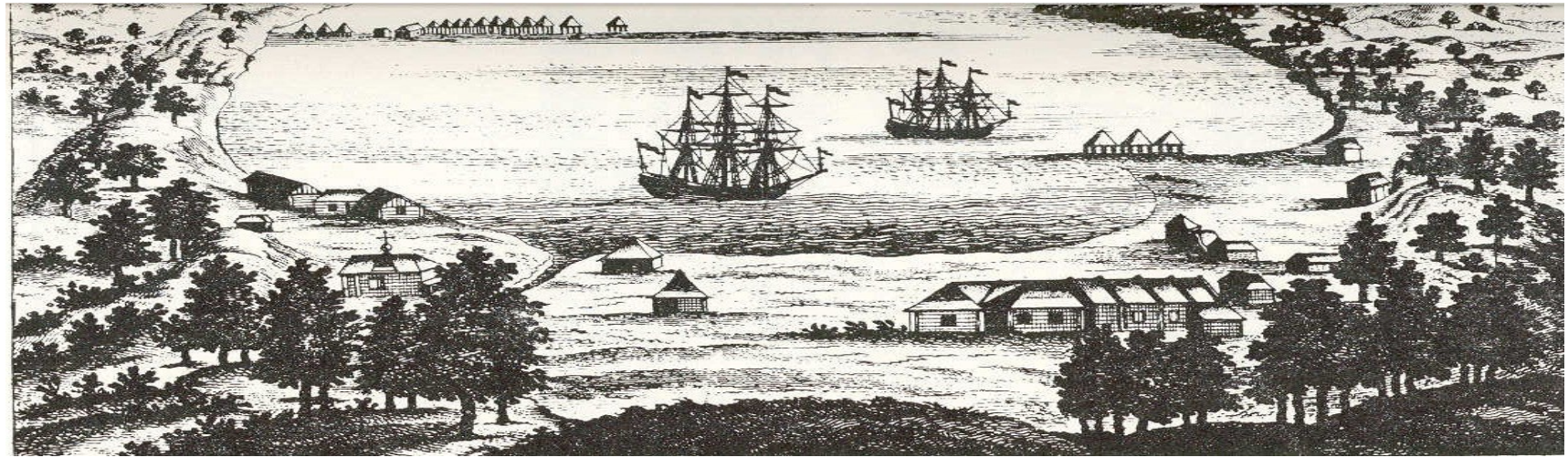
Question?

What are the effects of sea otters on kelp forest ecosystems?

Approaches

History



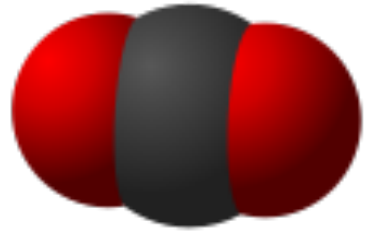


Players

Sea otters

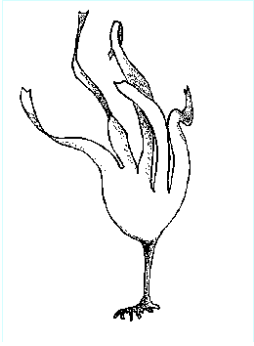
Coastal fishes

Sea urchins

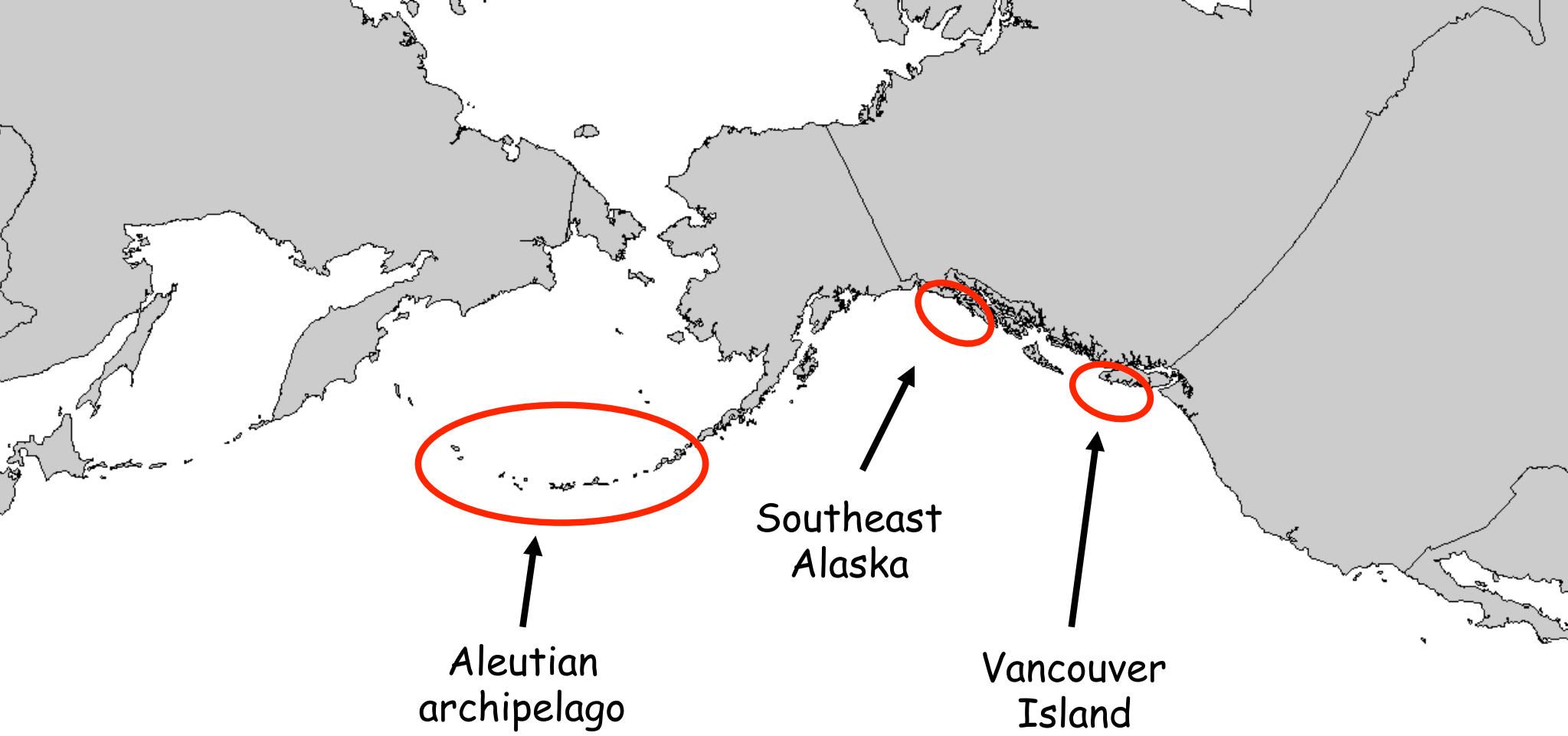


O=C=O

Carbon dioxide



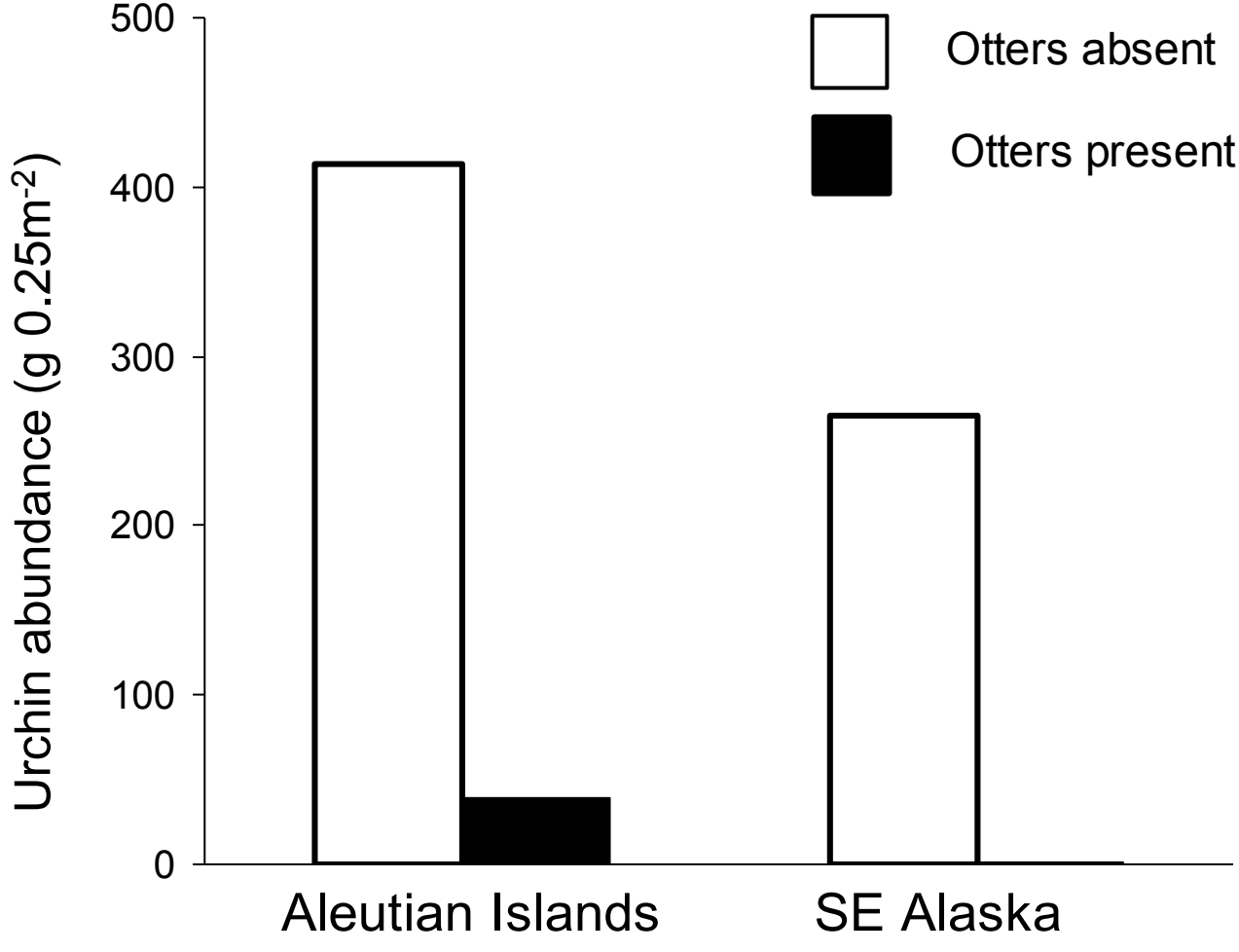
Kelp



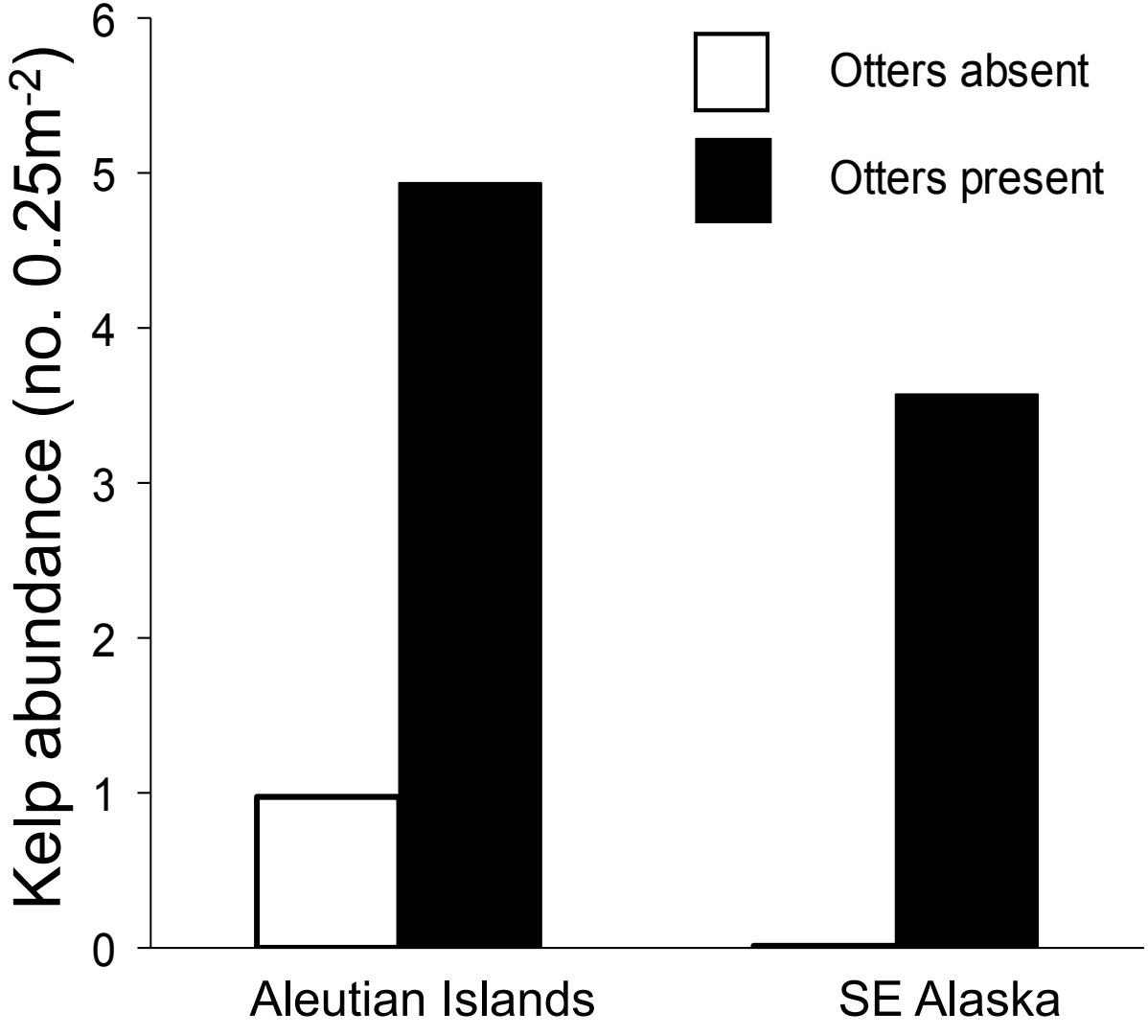
Approach:

- With vs. without otters
- Before vs. after otters

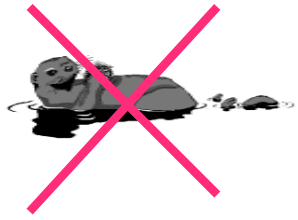
Direct effect--sea otters on sea urchins

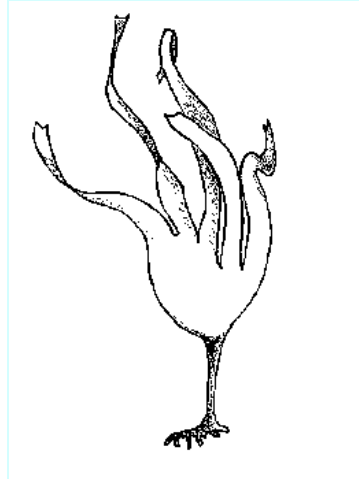


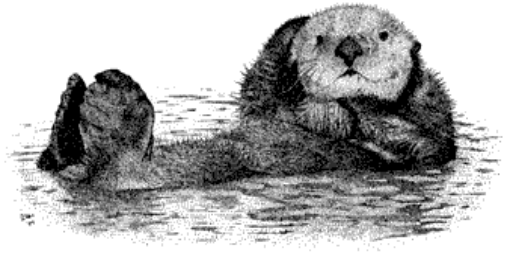
Indirect effect—sea otters on kelp

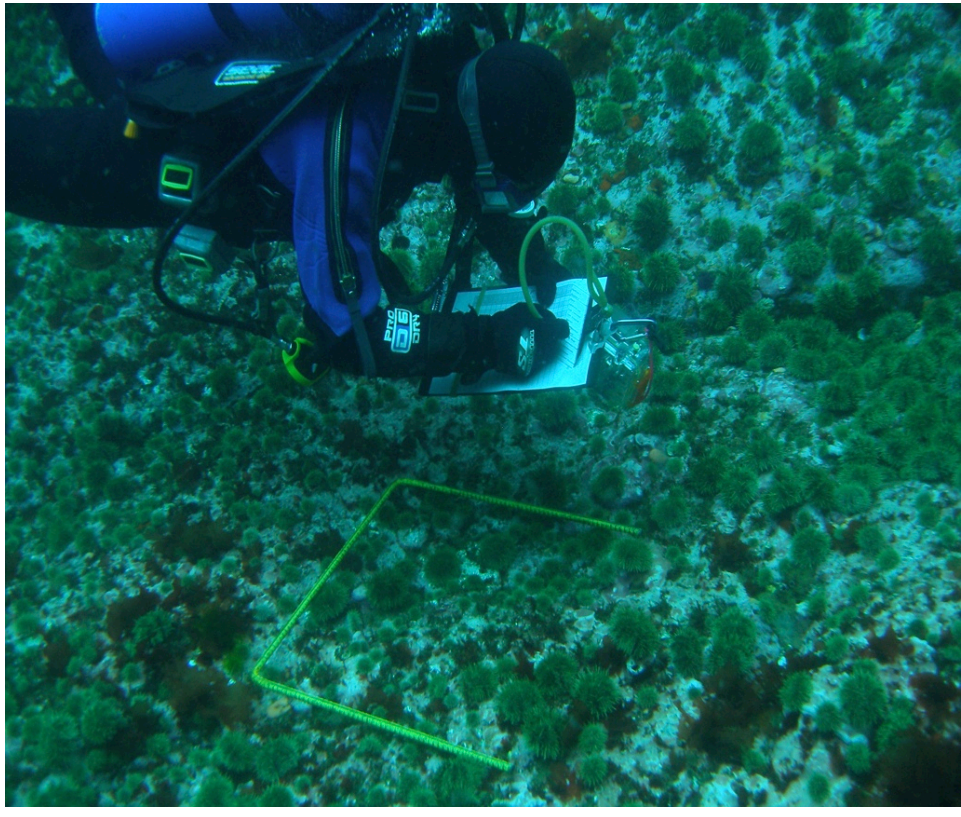


A "trophic cascade"

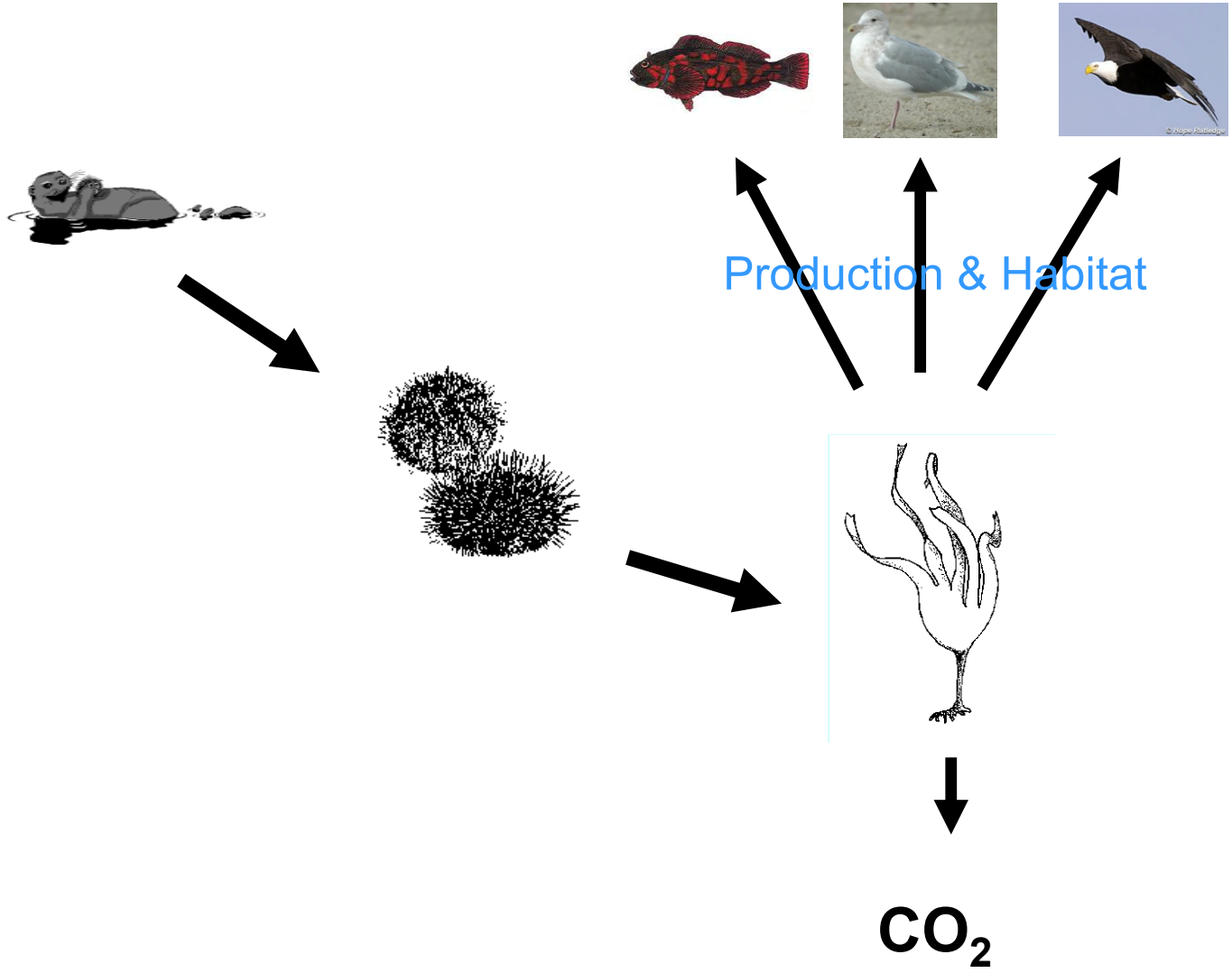








Influences of sea otter-kelp forest trophic cascade on other species and ecosystem processes?

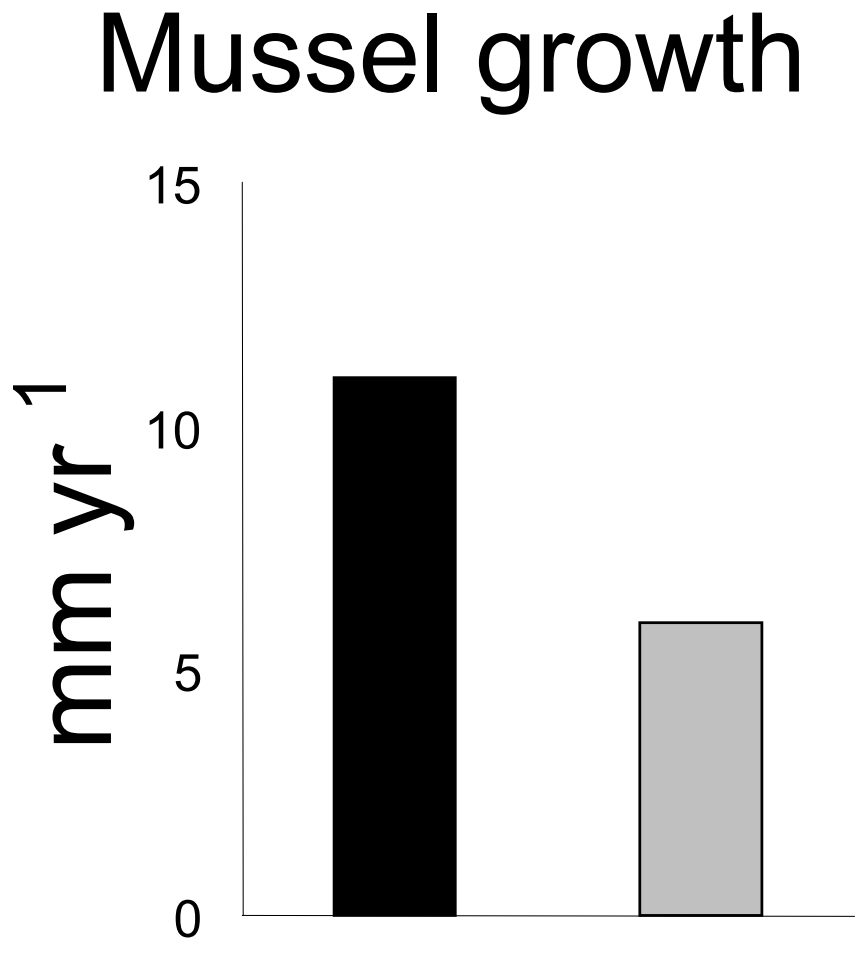


Production

Sea otters

Abundant

Absent



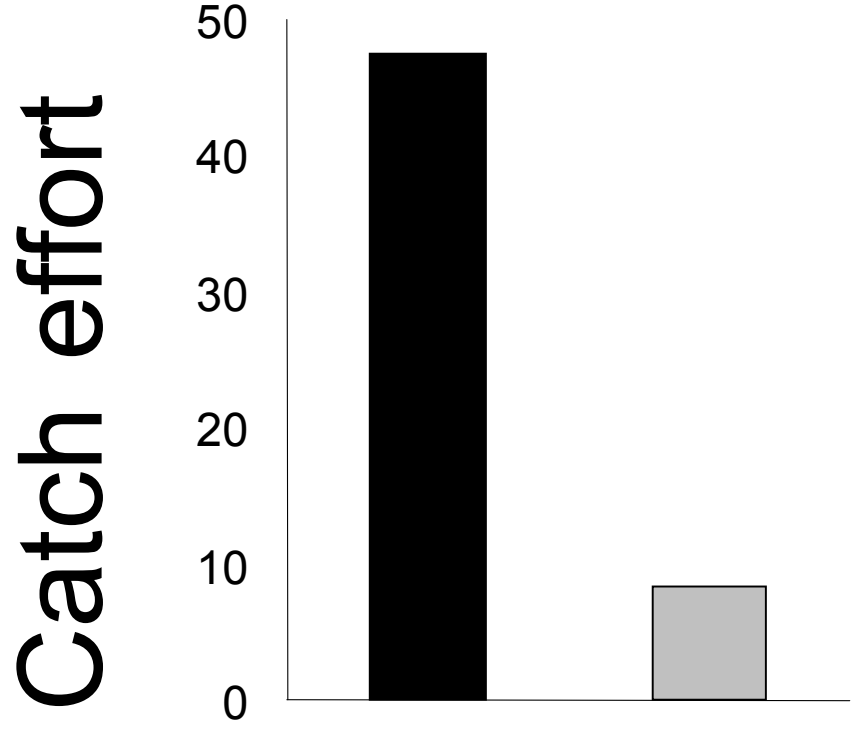
Duggins et al., *Science*, 1989

Kelp forest fish abundance

Sea otters

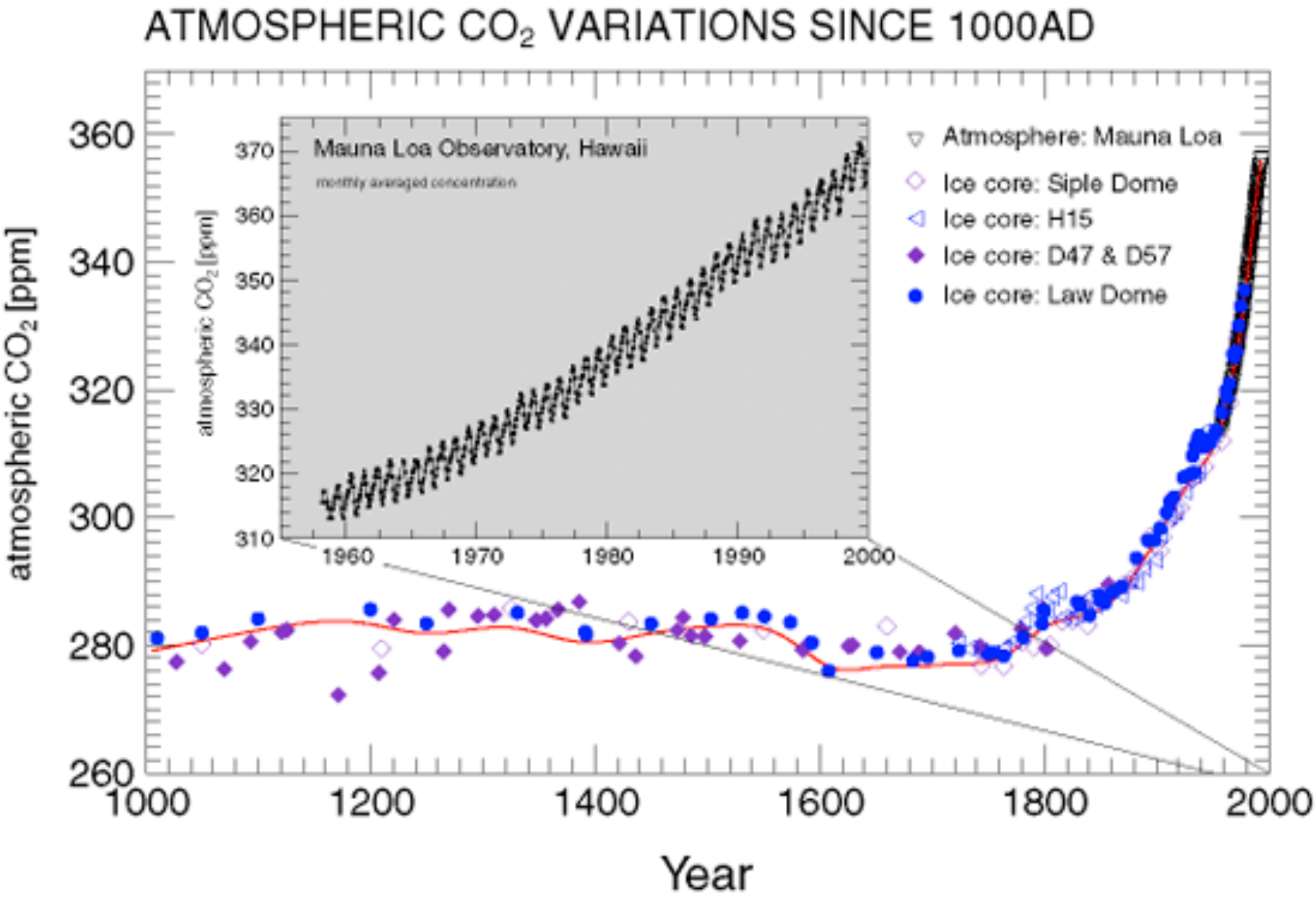
Abundant

Absent

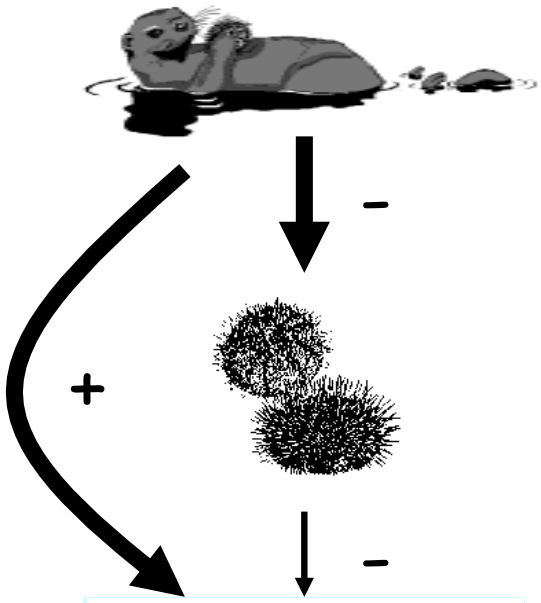


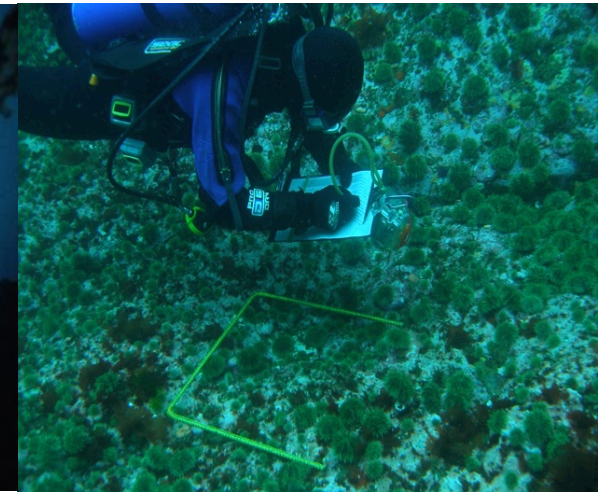
Reisewitz et al., *Oecologia*, 2006

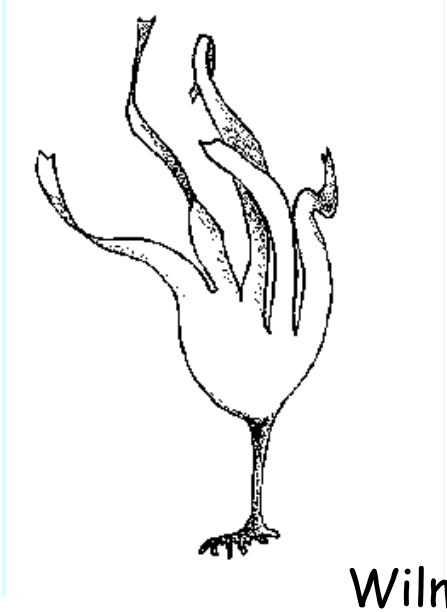
Sea otters and carbon



Mitigation by sea otters?







CO_2

Wilmers et al. *Front. Ecol. Env*, 2012

Comparison of kelp carbon dynamics between scenarios with and without sea otters at ecologically effective densities.

	Sea otters absent	Sea otters present
Kelp biomass (wet weight)	75-133 gm^{-2}	911-1618 gm^{-2}
Kelp carbon	8-14 gCm^{-2}	101-180 gCm^{-2}
NPP	25-70 $gCm^{-2}yr^{-1}$	313-900 $gCm^{-2}yr^{-1}$
	Difference in scenarios with and without otters in Alaska and British Columbia	
Kelp carbon	4.4 to 8.7 TgC	
Atmospheric carbon pool	5.6 to 11 %	
Atmospheric carbon pool since pre-industrial times	21 to 42 %	
Value of kelp carbon standing stock	$304 to $603 million	

Table 2. Potential yearly value of sea otter impact on atmospheric carbon sequestration by kelp. Scenarios represent the percentage of yearly kelp NPP that is transported to the deep ocean where it may persist for long periods of time. We present an order of magnitude variation in scenarios as much uncertainty remains on total carbon transport to the deep ocean.

Sequestration scenarios*	Carbon sequestration $tCyr^{-1}$	Yearly value*
1%	$(1.3 - 4.5) \times 10^5$	\$9-31 million
5%	$(0.6 - 2.3) \times 10^6$	\$44-157 million
10%	$(1.3 – 4.5) \times 10^6$	\$87-314 million
50%	$(0.6 – 2.3) \times 10^7$	\$436-1,570 million

* Yearly value is based on Dec 10, 2010 Futures on the European Carbon Exchange.

Concluding Points

I. Sea otters have a strong ***direct negative effect*** on kelp forest invertebrates (shellfish)

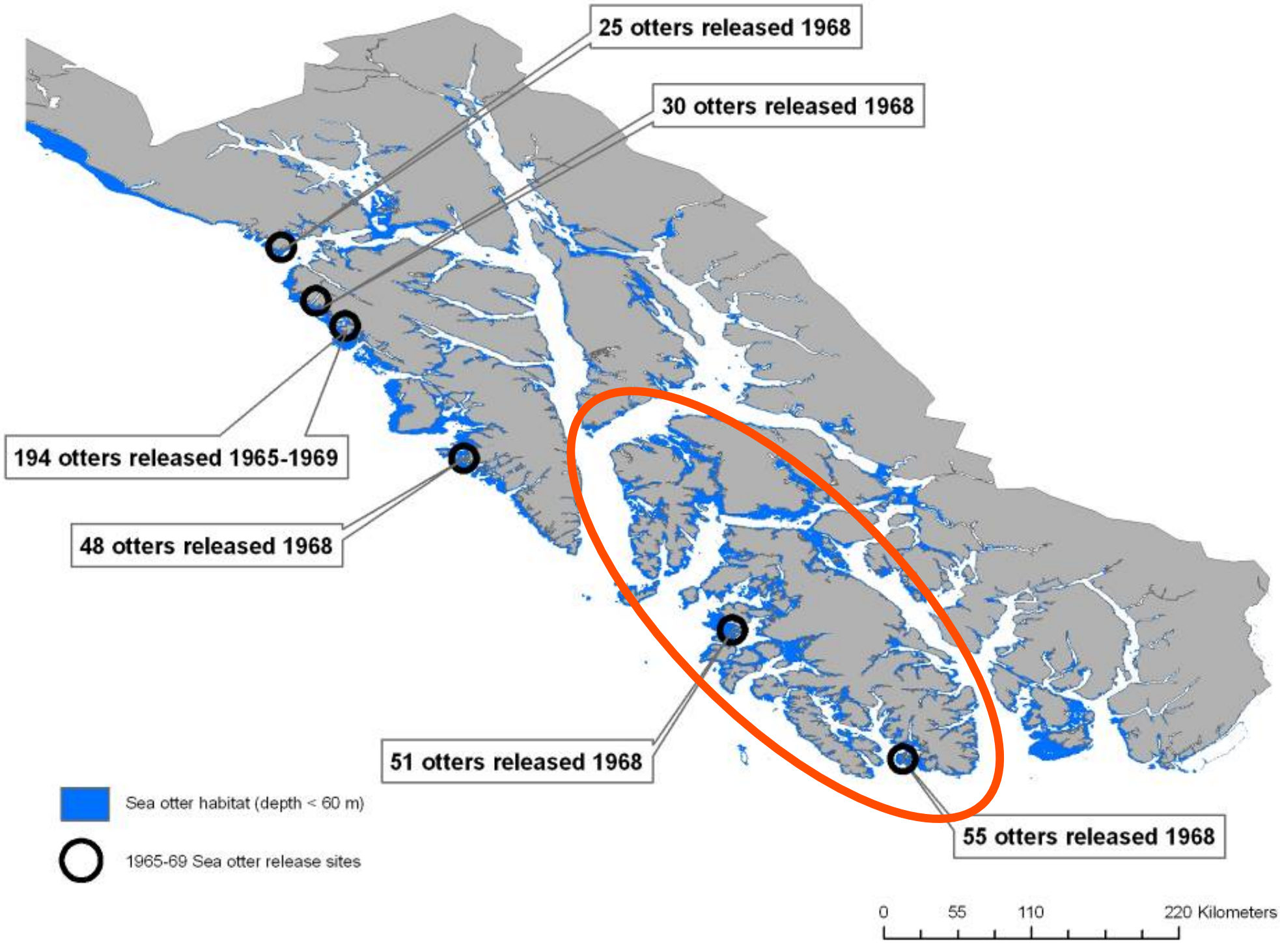
II. This direct negative effect on invertebrates results in a strong ***indirect positive effect*** on kelp abundance and distribution

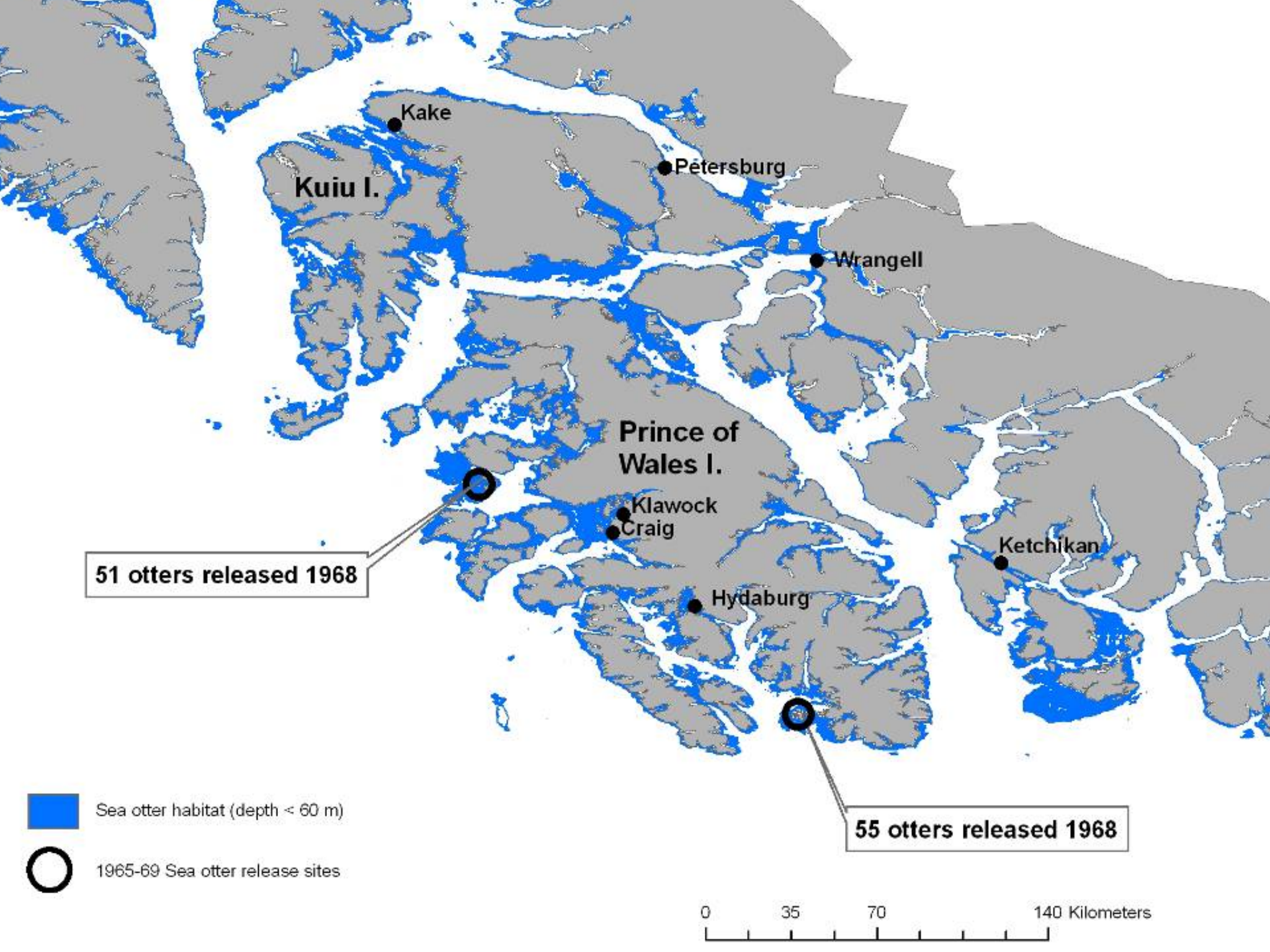
III. Kelp forests have myriad effects of other species and ecological processes

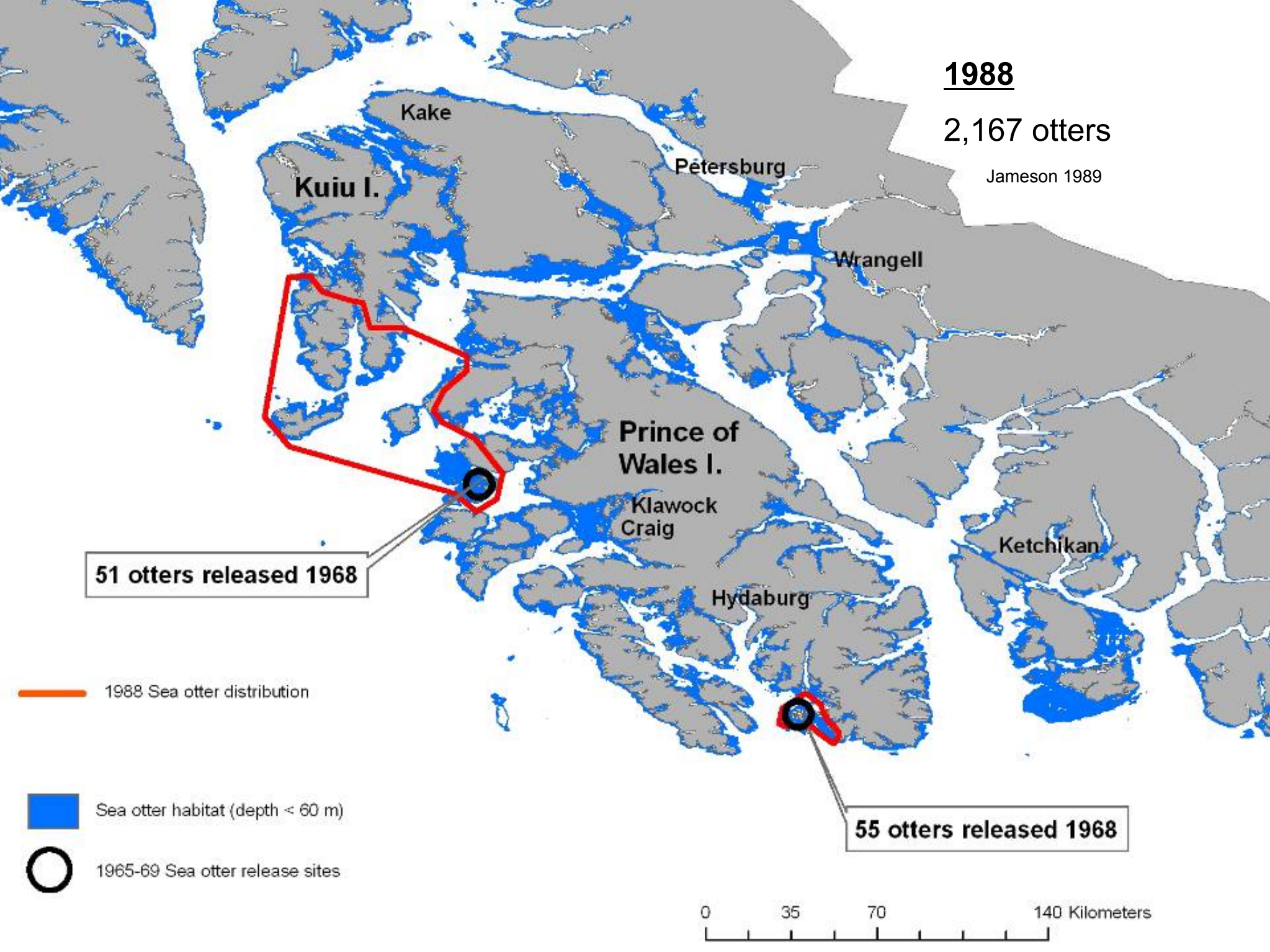
IV. Sea otter management should weigh the costs and benefits of all these effects

Recovery of the sea otter population and conflicts with shellfish users in Southeast Alaska

Ginny Eckert[1], Zac Hoyt[1], Sean Larson[1], Verena Gill[2], Sunny Rice[1]
[1]School of Fisheries & Ocean Sciences, UAF & [2]USFWS


25 otters released 1968
30 otters released 1968
194 otters released 1965-1969
48 otters released 1968
51 otters released 1968
55 otters released 1968
Sea otter habitat (depth < 60 m)
1965-69 Sea otter release sites
0
55
110
220 Kilometers


Kake
Petersburg
Kuiu I.
Wrangell
Prince of
Wales I.
Klawock
Craig
Ketchikan
Hydaburg
51 otters released 1968
55 otters released 1968
Sea otter habitat (depth < 60 m)
1965-69 Sea otter release sites
0
35
70
140 Kilometers


1988
2,167 otters
Jameson 1989
Kake
Petersburg
Kuiu I.
Wrangell
Prince of Wales I.
Klawock
Craig
Ketchikan
Hydaburg
51 otters released 1968
55 otters released 1968
1988 Sea otter distribution
Sea otter habitat (depth < 60 m)
1965-69 Sea otter release sites
0
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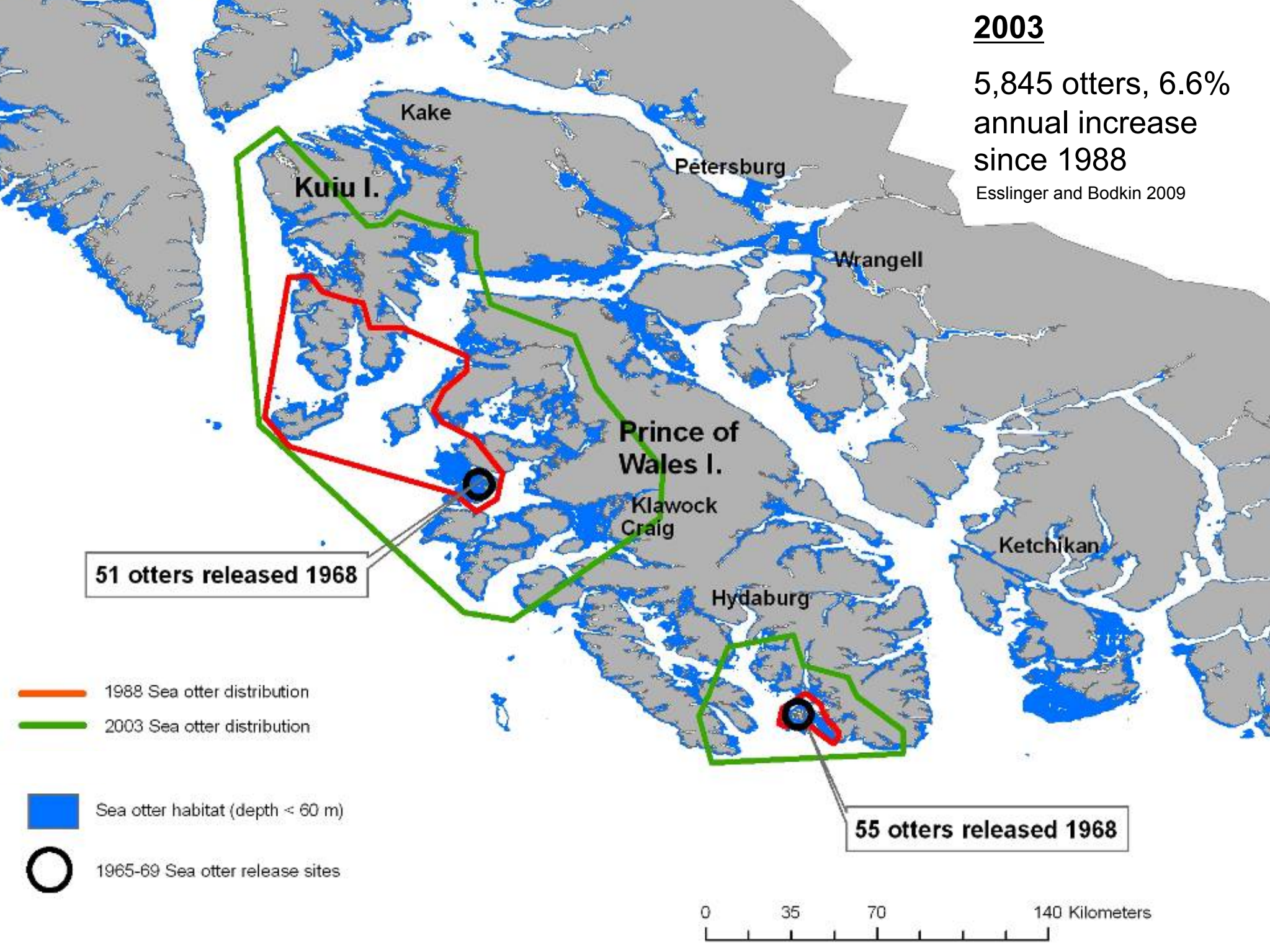
140 Kilometers


2003
5,845 otters, 6.6% annual increase since 1988
Esslinger and Bodkin 2009
Kake
Petersburg
Kuiu I.
Wrangell
Prince of Wales I.
Klawock
Craig
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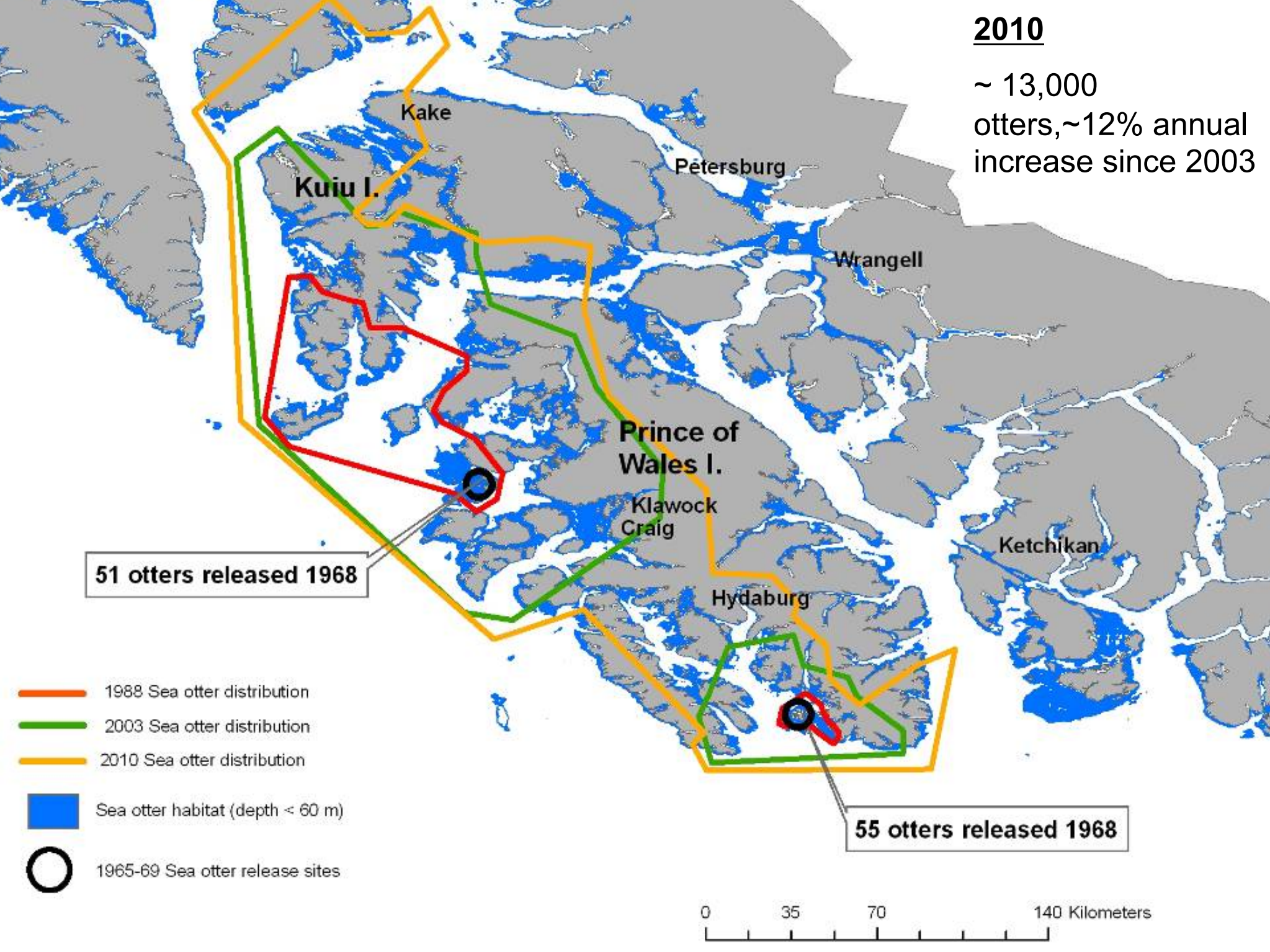
70
140 Kilometers


2010
~ 13,000 otters,~12% annual increase since 2003
Kake
Petersburg
Kuiu I.
Wrangell
Prince of Wales I.
Klawock
Craig
Ketchikan
Hydaburg
51 otters released 1968
55 otters released 1968
1988 Sea otter distribution
2003 Sea otter distribution
2010 Sea otter distribution
Sea otter habitat (depth < 60 m)
1965-69 Sea otter release sites
0
35
70
140 Kilometers

Fisheries affected in southern SE AK

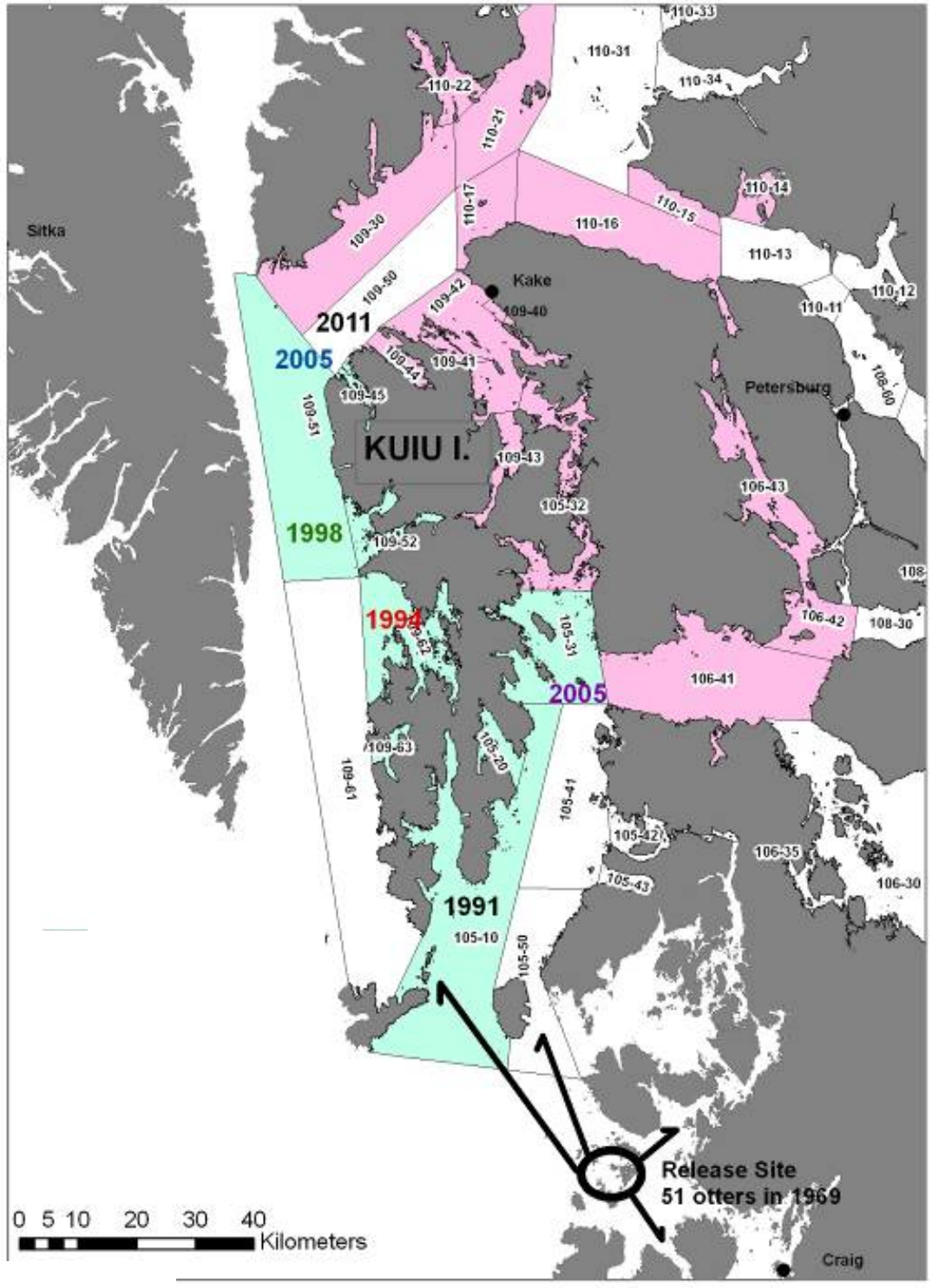
Dungeness crab, *Cancer magister*

Red sea urchin, *Strongylocentrotus franciscanus*

California sea cucumber, *Parastichopus californicus*

Geoduck clam, *Panopea abrupta*

Dungeness crab impacts



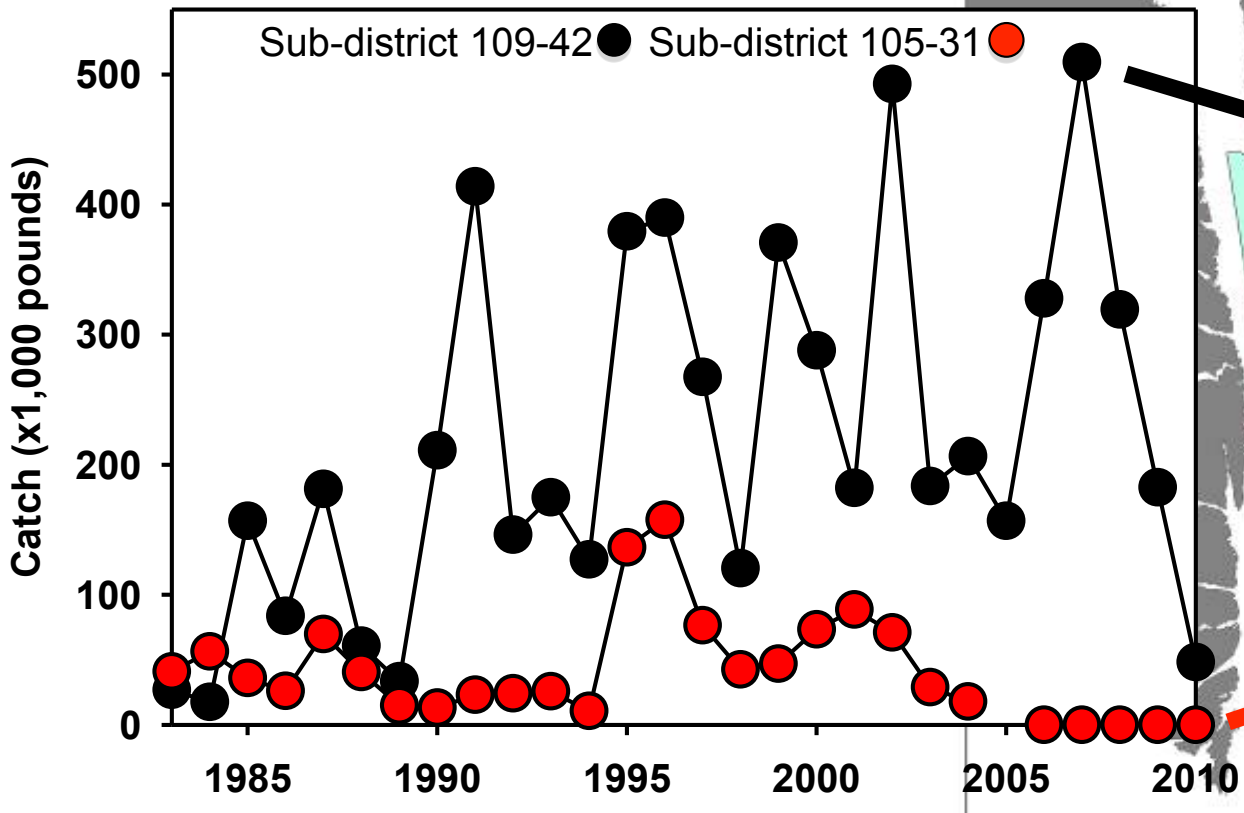
ADF&G subdistricts no longer commercially viable

ADF&G subdistricts still commercially viable

ADF&G subdistricts with little fishing effort or currently unaffected by sea otters

Preliminary, do not distribute. Source : ADF&G 2011

Dungeness crab impacts



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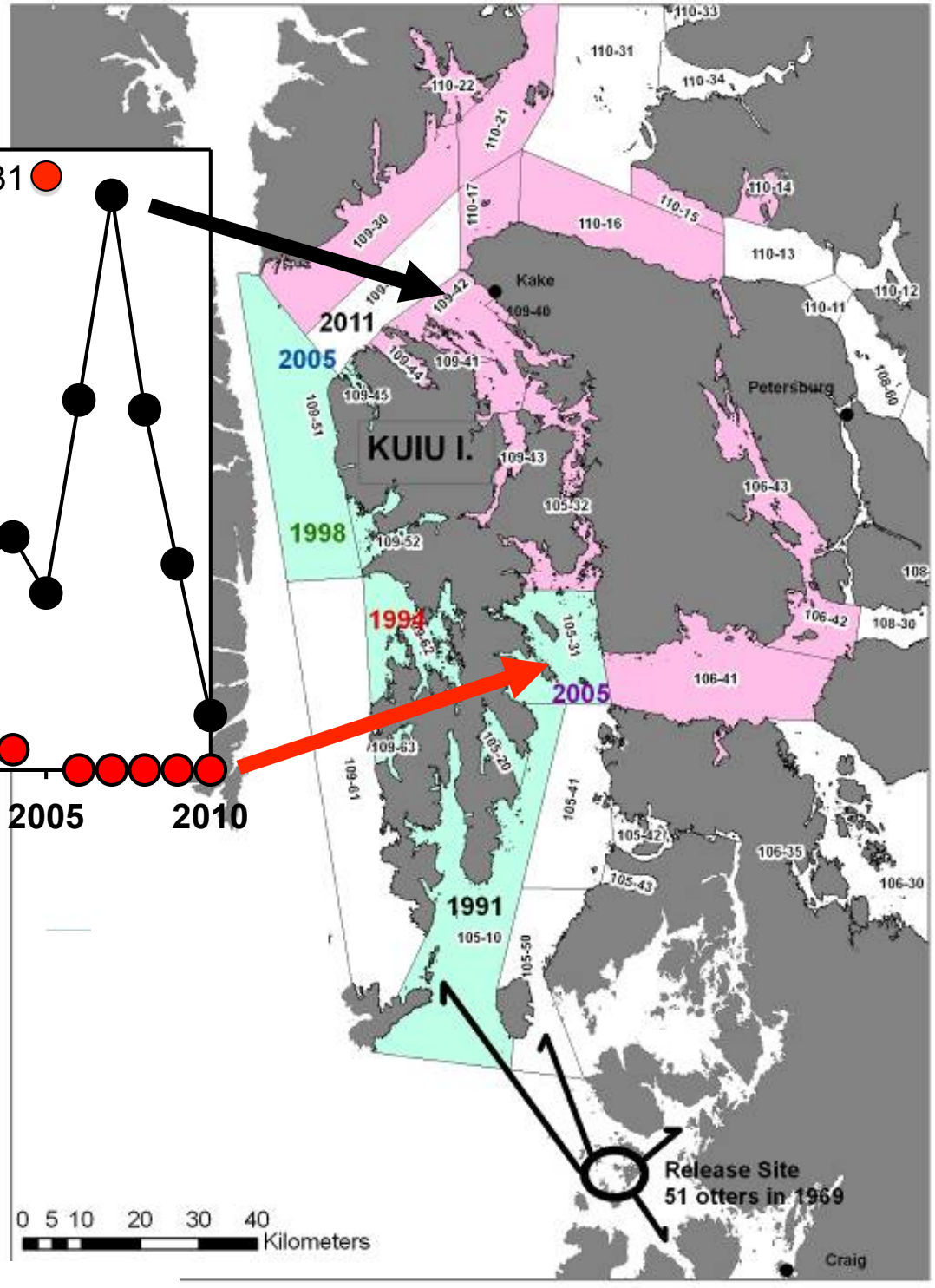
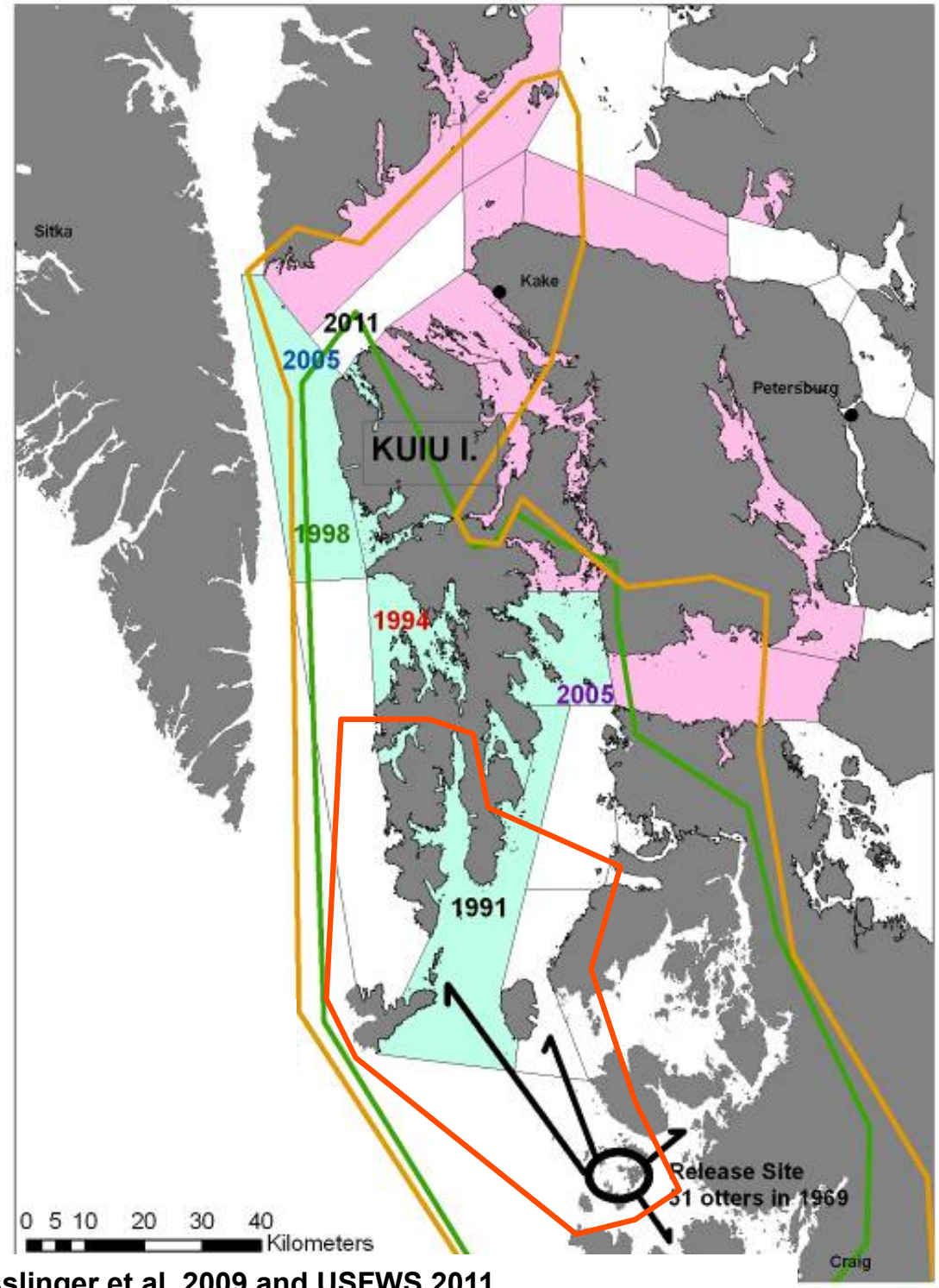


Preliminary, do not distribute. Source : ADF&G 2011

Sea otter persistence and viability of the commercial Dungeness crab fishery appear spatially correlated



1988 sea otter distribution

2003 sea otter distribution

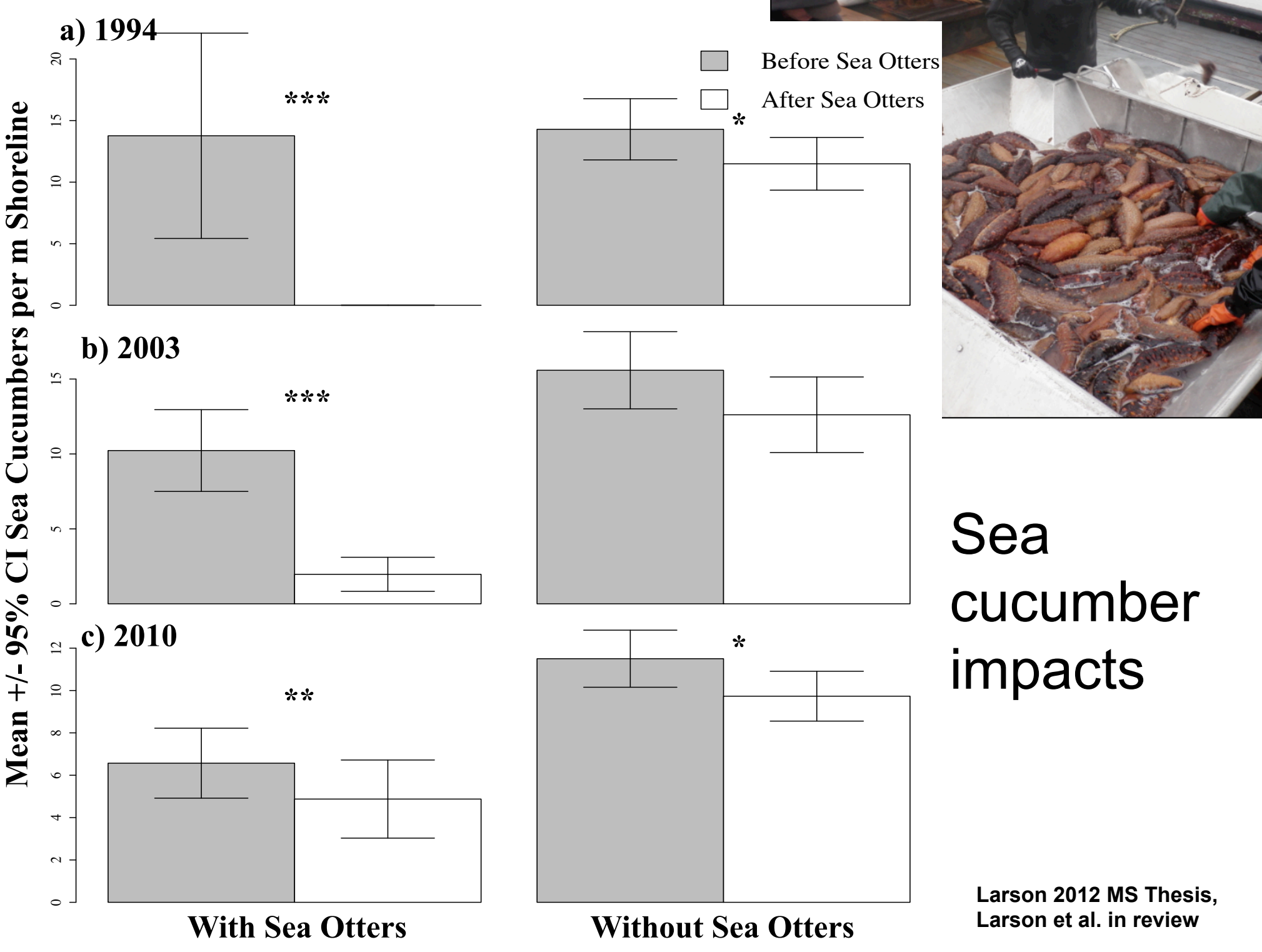
2010 sea otter distribution

ADF&G subdistricts no longer commercially viable

ADF&G subdistricts still commercially viable

ADF&G subdistricts with little fishing effort or currently unaffected by sea otters

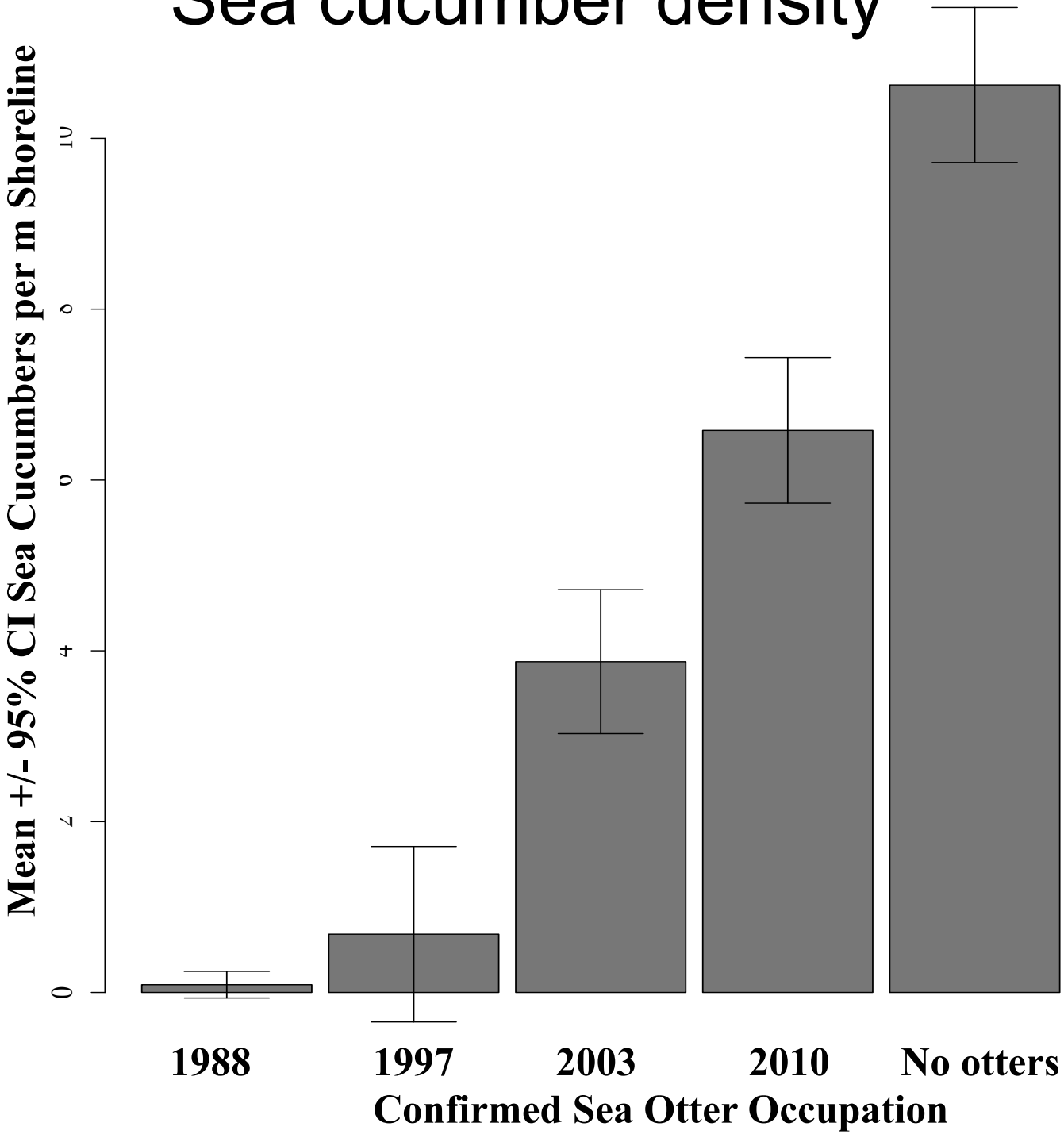
Preliminary, do not distribute. Source : ADF&G 2011, Esslinger et al. 2009 and USFWS 2011.



Sea cucumber impacts

Larson 2012 MS Thesis,
Larson et al. in review

Sea cucumber density

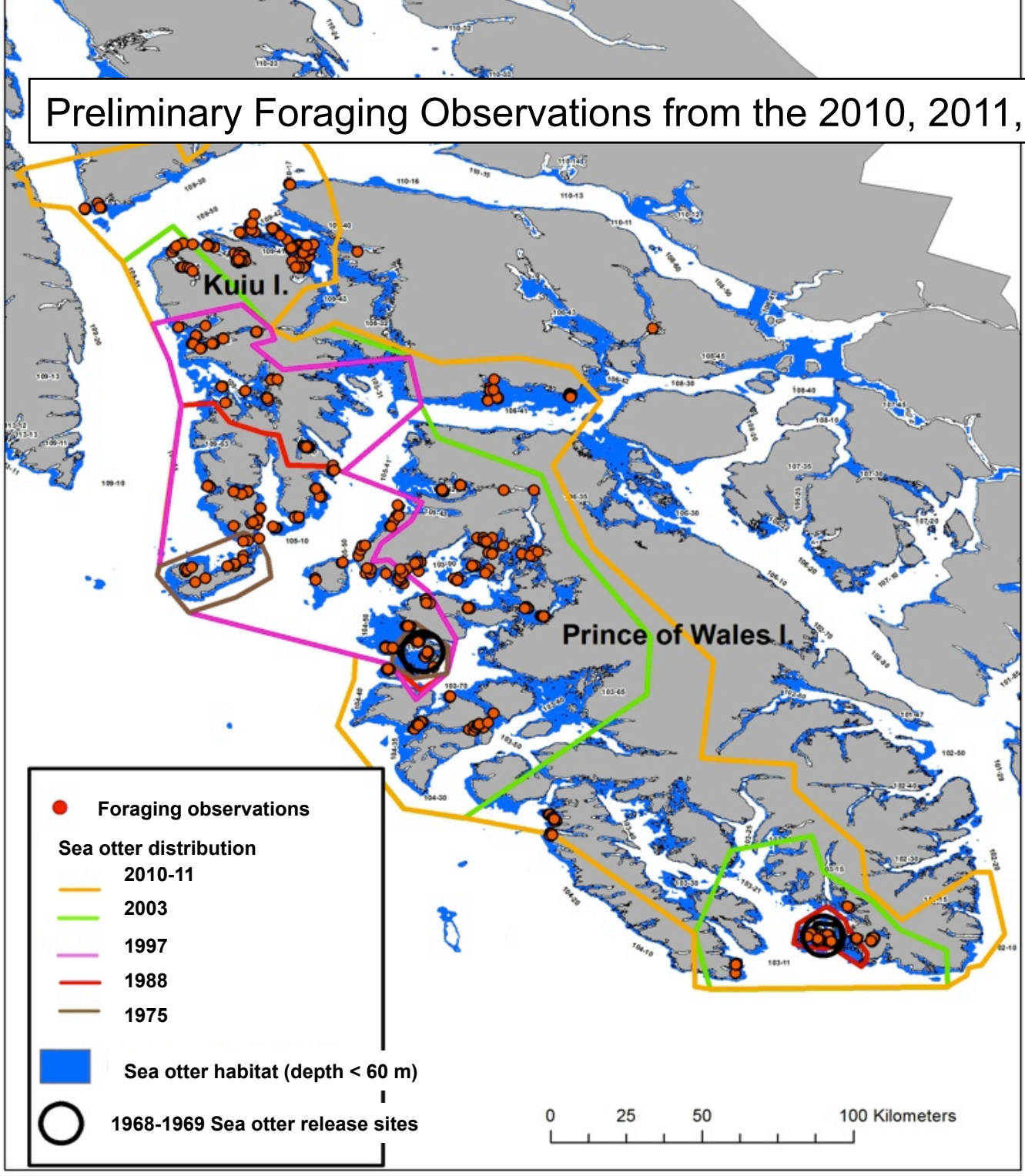


Larson 2012 MS Thesis,
Larson et al. in review

Foraging

data collection

Preliminary Foraging Observations from the 2010, 2011, and 2012 field seasons



6117 foraging dives

9 sampling areas

699 foraging bouts

Hoyt et. al in progress

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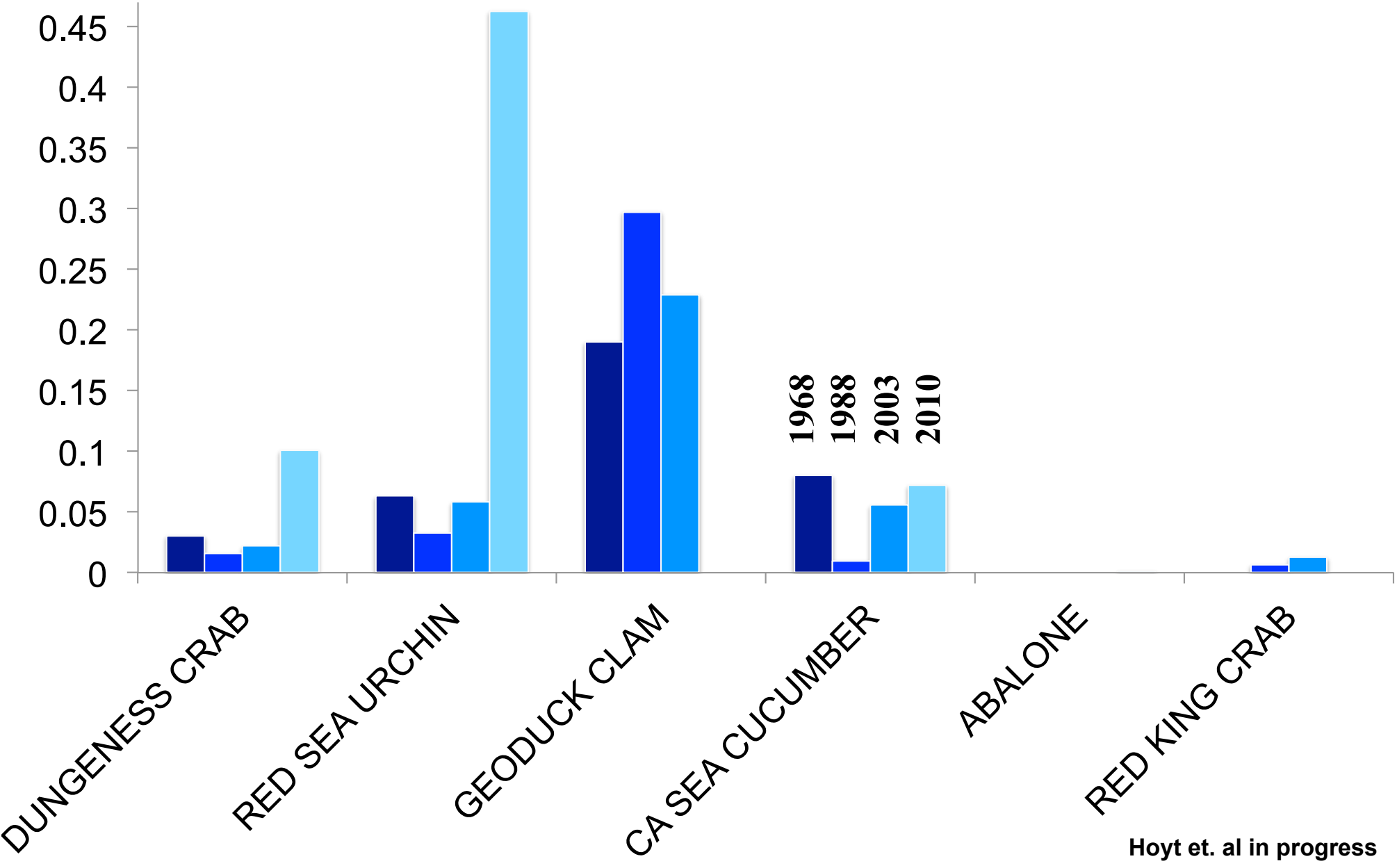
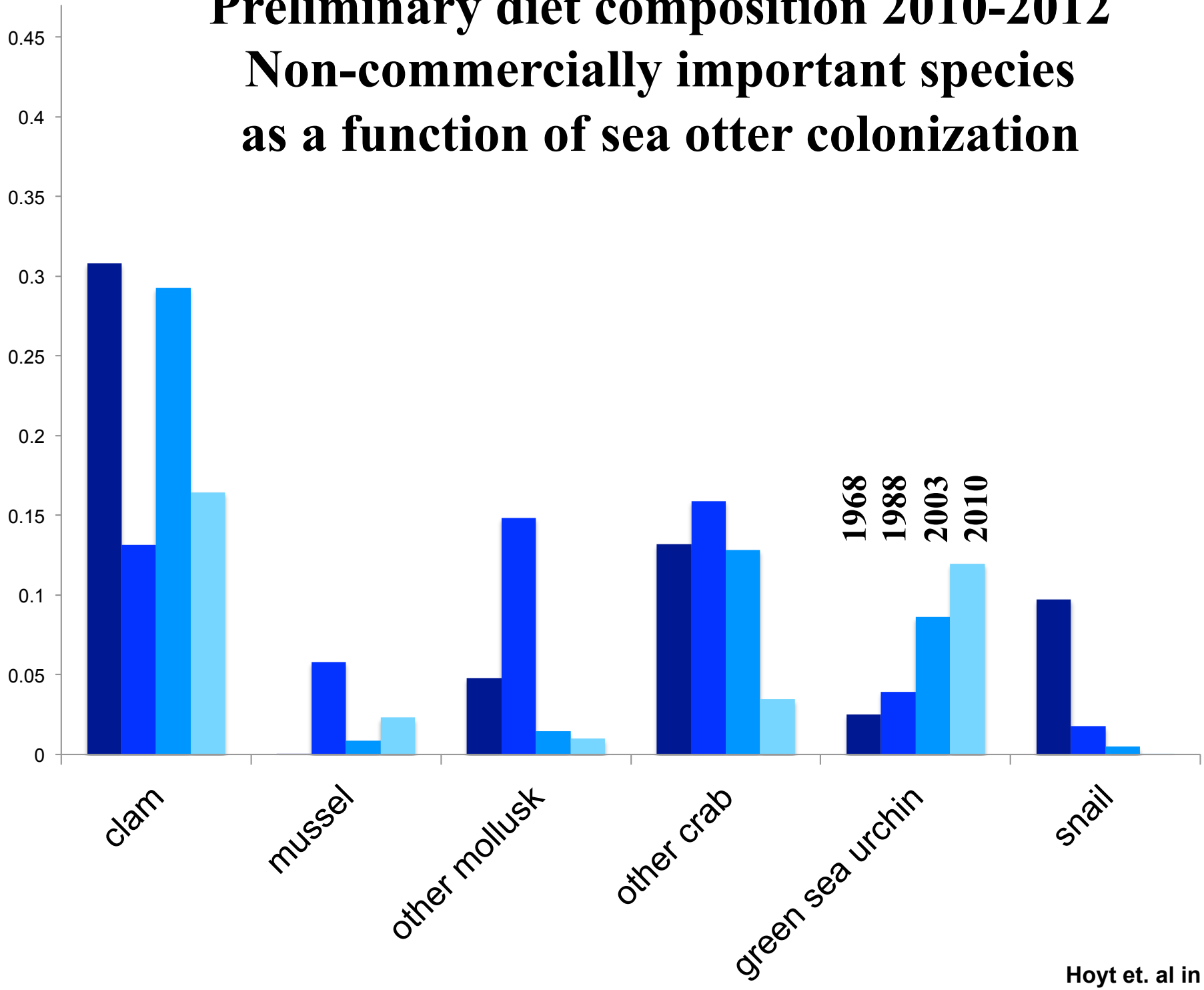
Preliminary diet composition 2010-2012
Commercially important species
as a function of sea otter colonization



Hoyt et. al in progress

Preliminary diet composition 2010-2012
Non-commercially important species
as a function of sea otter colonization



Hoyt et. al in progress

Much information still needed…

1. Other roles of sea otters
   a. role in kelp forest ecosystem
   b. positive fishery impacts (ex. herring, rockfish, salmon)
   c. tourism
2. Are areas without otters suitable otter habitat? Where are they likely to expand?
3. Standing stock biomass of Dungeness crab in the region
4. Changes in fisheries

   e.g. compression of Dungeness fleet
5. Otter distribution and abundance pre-fur trade & shellfish distribution and abundance at that time

Thank you!