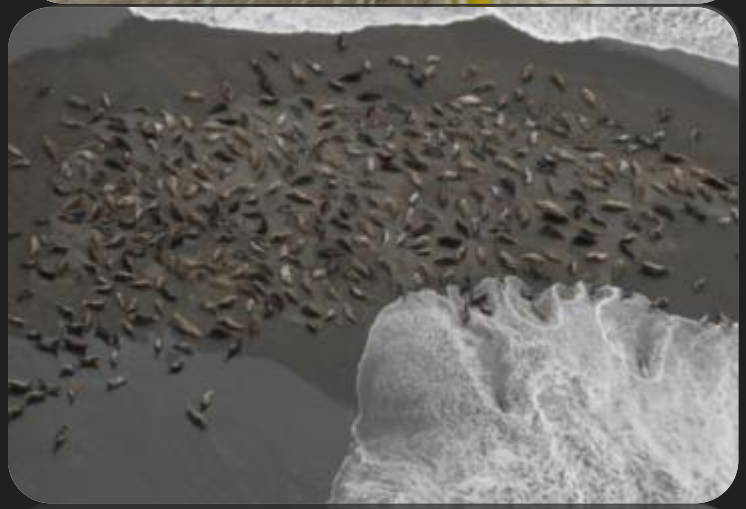
Harbor Seals in Tidewater Glacial Fiords in Alaska and Responses to Cruise Ships

Advance Notice of Proposed Rulemaking Public Meetings
on Disturbance to Harbor Seals in Glacial Habitats

Juneau, Alaska, April 22, 2013
Yakutat, Alaska, April 23, 2013

John Jansen
National Marine Mammal Laboratory
NOAA Fisheries

NOAA | AFSC | NMML



Harbor Seals in Alaska

Non-Migratory – Resident in Alaska Year Round

Mostly Within Near-shore (~20 mi) Habitats

Important Part of Coastal Marine Ecosystem

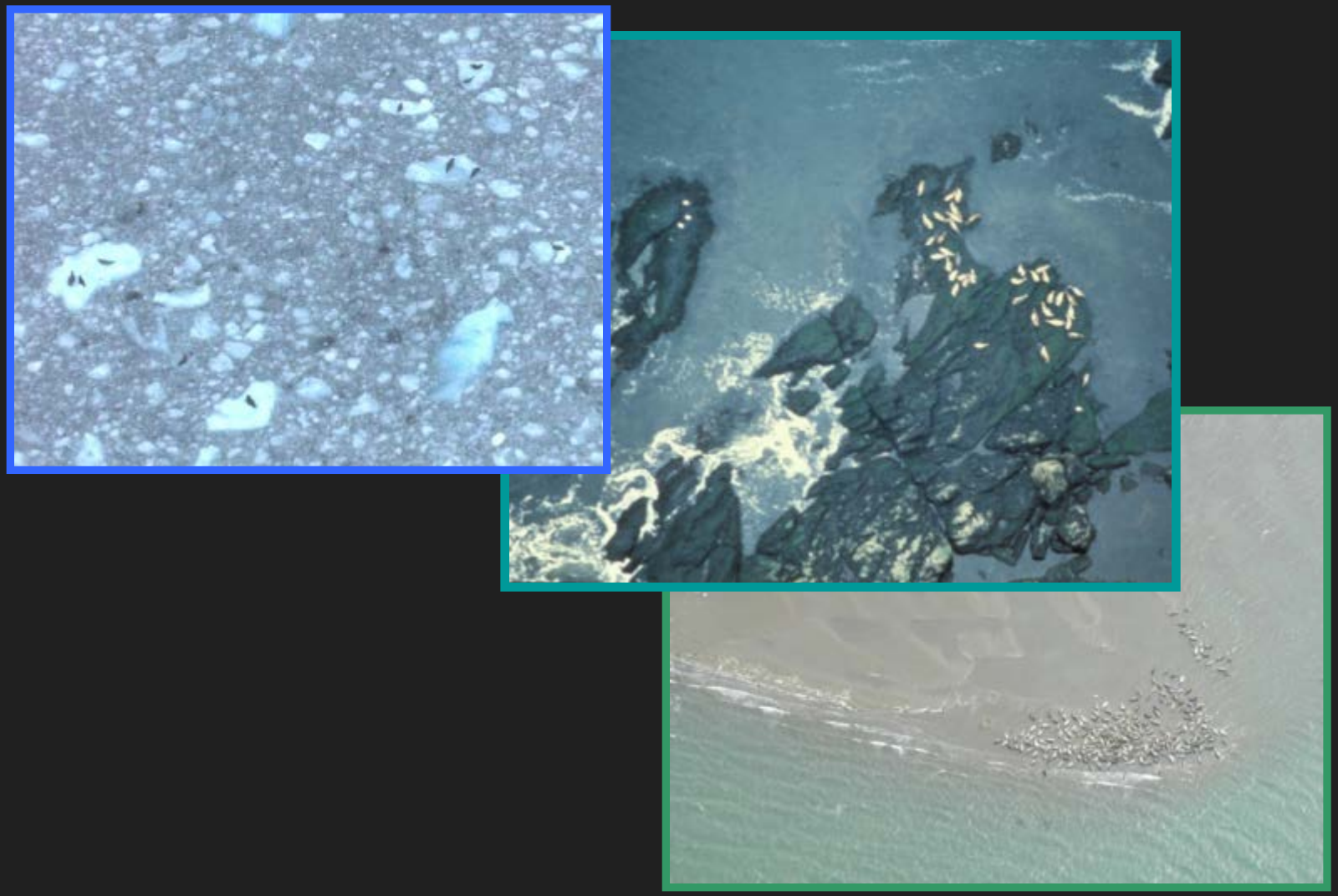
- Nutrition and culture
- Predators on many species of fish and invertebrates
- Prey of killer whales, wolves, bears, eagles
- Commercial, recreational, aesthetic value of healthy ecosystem

- Statewide: 152,000

Distribution of Harbor Seals

~2,500 miles

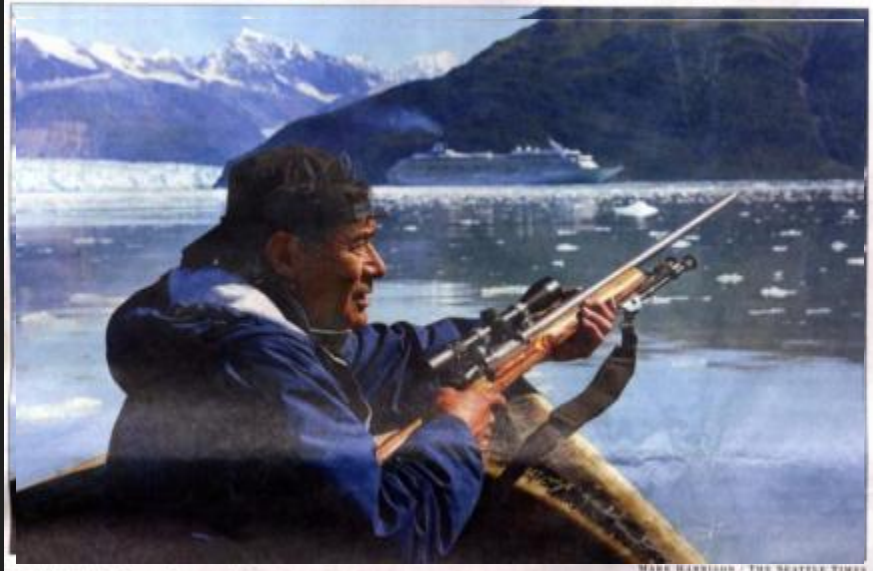
Diversity of Haul-out Sites



The Seattle Times
Sunday
Seattle Post-Intelligencer
AUGUST 31,
$1

TODAY'S WEATHER
Morning clouds; otherwise mostly sunny.
High 76, low 56. | B 8

Rush of cruise ships to Alaska delivers dollars — and doubts



MARK HARRISON / THE SEATTLE TIMES

Tlingit hunter Ray Sensmeier *scans the floating ice of Disenchantment Bay for harbor seals as a cruise ship departs the bay after sailing in for a close look at Hubbard Glacier near Yakutat, Alaska. The tribe is seeing fewer seals and fears the ships are to blame.*

Most communities welcome tourists and their money, but to some, the cost to their environment is too high

BY CRAIG WELCH / *Seattle Times staff reporter*

YAKUTAT, Alaska — Ray Sensmeier propped the .223-caliber rifle on the bow of the skiff and took aim at a pharp harbor seal splayed out on a cradle of blue ice.

The Tlingit Indian steadied his finger on the trigger. Icebergs the size of garage doors scraped the boat's hull. Sensmeier cursed.

Behind his prey, drifting perilously into his line of fire, was a gleaming white cruise ship, its 1,500 passengers and crew suddenly the biggest city for hundreds of miles. Unable to safely take his shot, Sensmeier jerked the barrel away, disgusted.

Even in one of Southeast Alaska's most remote corners, where natives have been hunting seals for at least 1,000 years, it's hard to escape the presence of the cruise-ship industry.

The industry has exploded in Alaska in the past decade, with more than 500 cruises a summer now carting 750,000 people or more north from Seattle, San Francisco and Vancouver, B.C. — most to a region with a combined population of roughly 60,000.

PLEASE SEE *Alaska* ON A 18

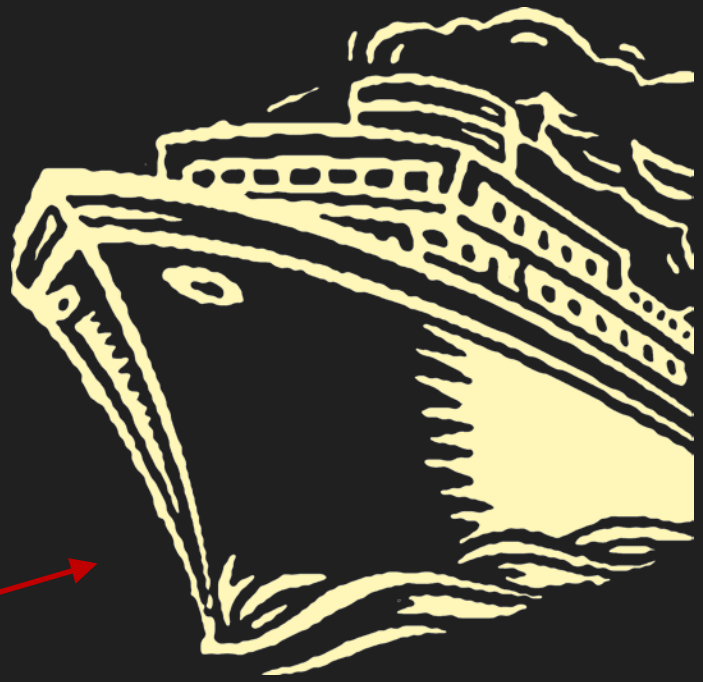
The allure of big boats

A look at the large, luxurious ships that carry thousands to Alaska; tips for booking a trip.

TRAVEL, SECTION M

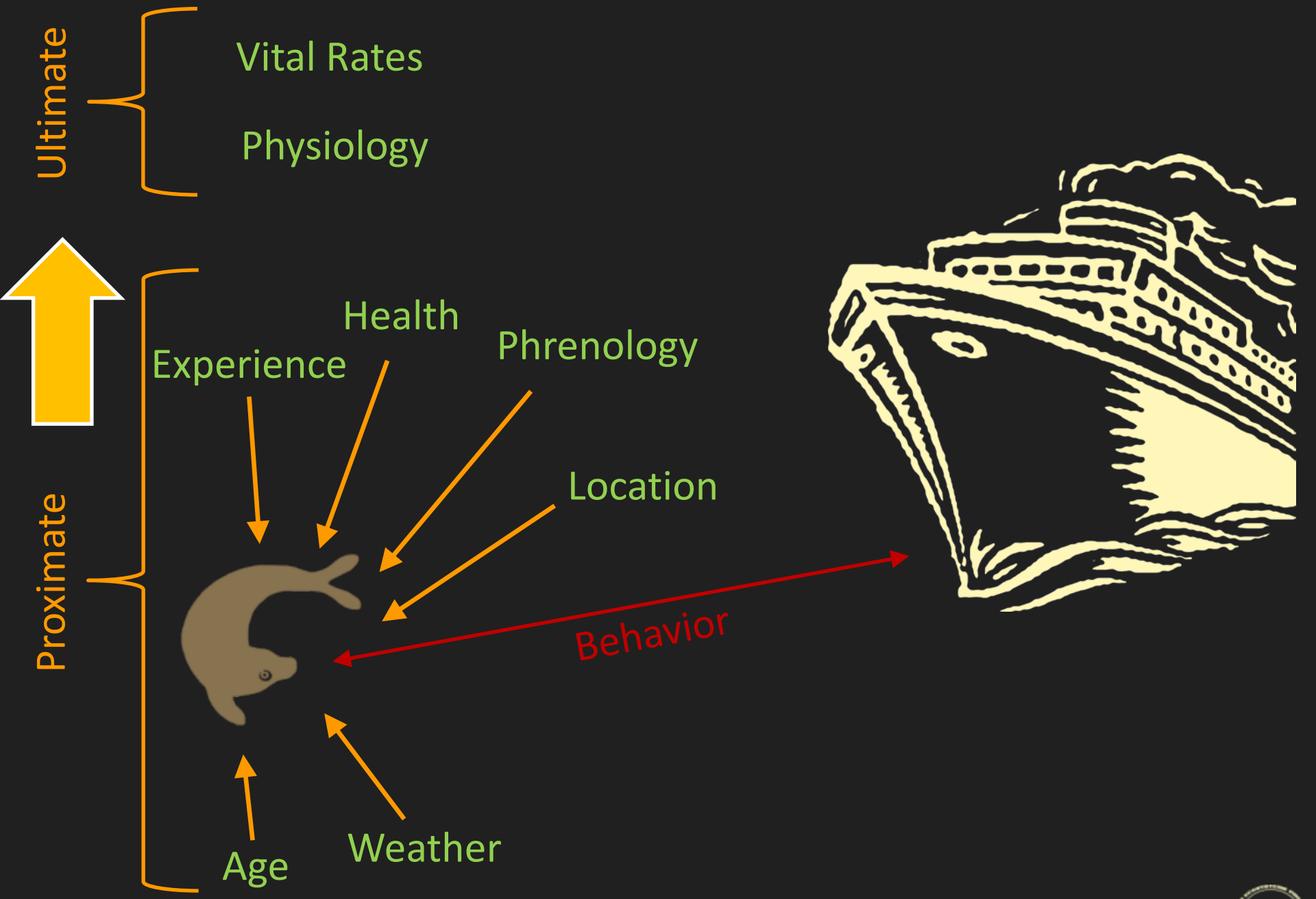
How Close is Too Close?

Assessing the potential that short-term disturbance of seals by cruise ships spells long-term impacts



Polar Ecosystem Program

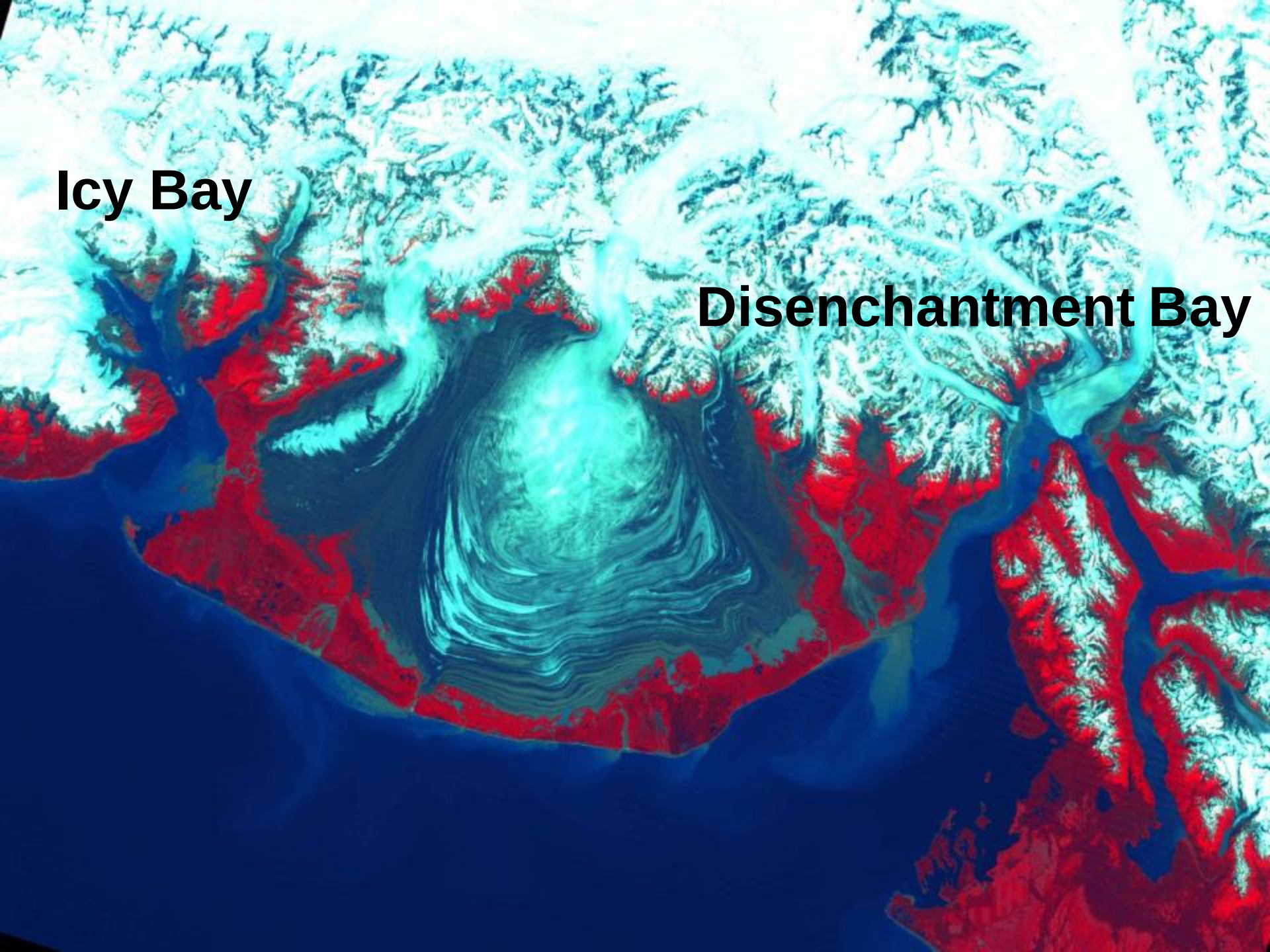
National Marine Mammal Laboratory, Alaska Fisheries Science Center, NOAA, Seattle, WA USA


Ultimate
Vital Rates
Physiology
Proximate
Experience
Health
Phrenology
Location
Behavior
Age
Weather


What defines disturbance?
Proximate (avoidance)
Ultimate (fitness)

Glacial Ice Seals 101

- Ice calved by tidewater glaciers provides a platform for seals any time of day
- Represent 10-15% of the Alaska abundance
- Aggregations of seals number up to 6000
- Seal numbers peak during pupping and molting
- All cruises to Alaska include a stop at a tidewater glacier causing daily visits of up to five ships

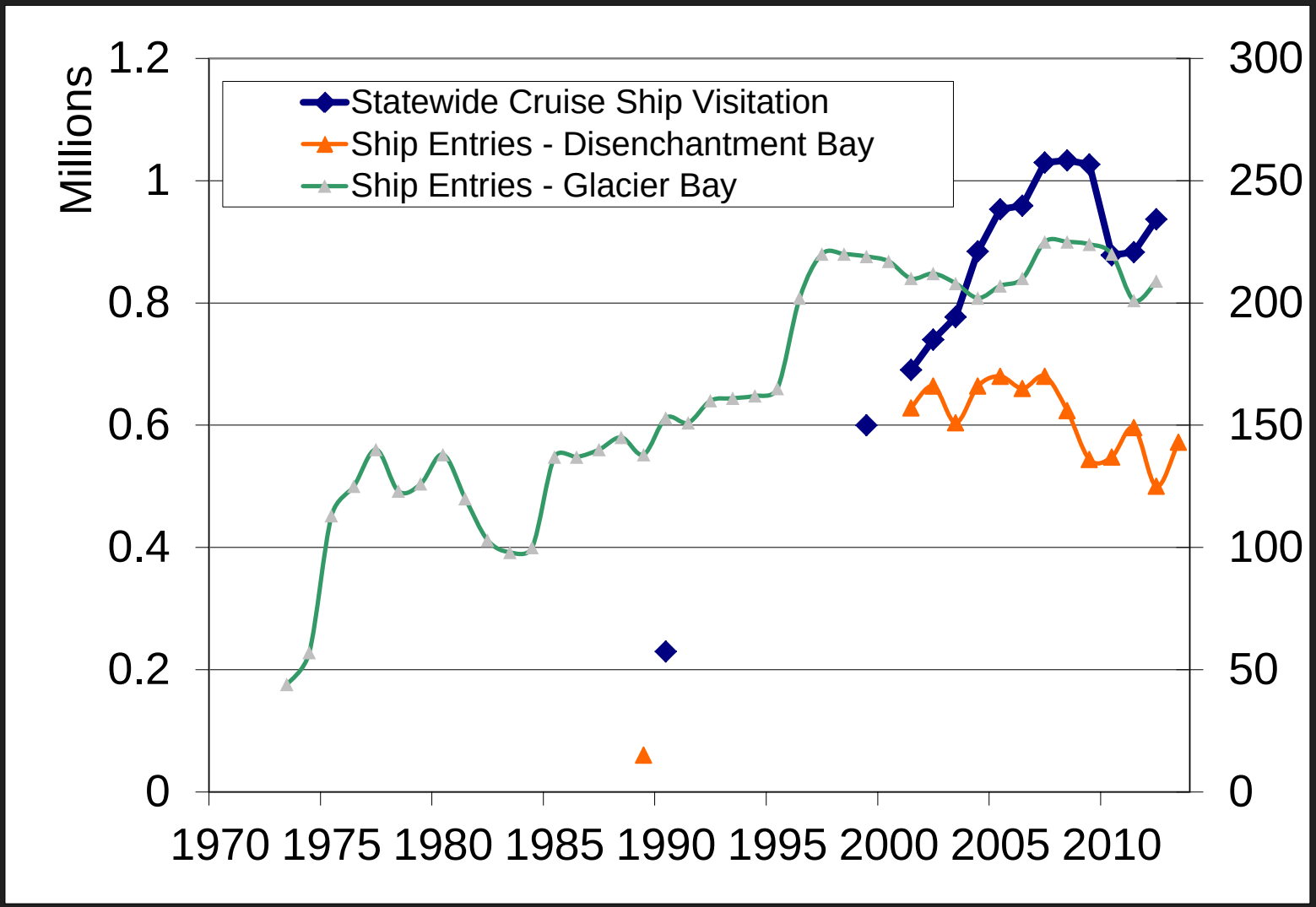

Icy Bay
Disenchantment Bay

ALASKA CRUISE SHIP TIMELINE

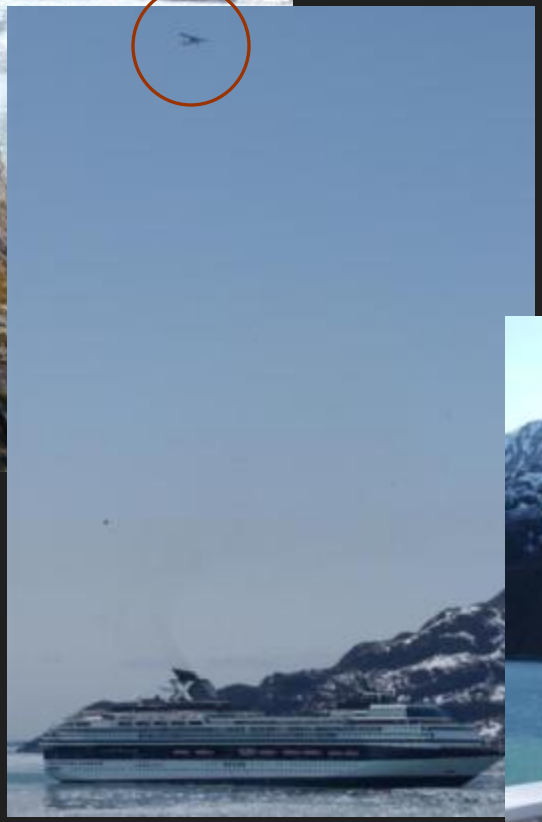
Present

NOAA | AFSC | NMML

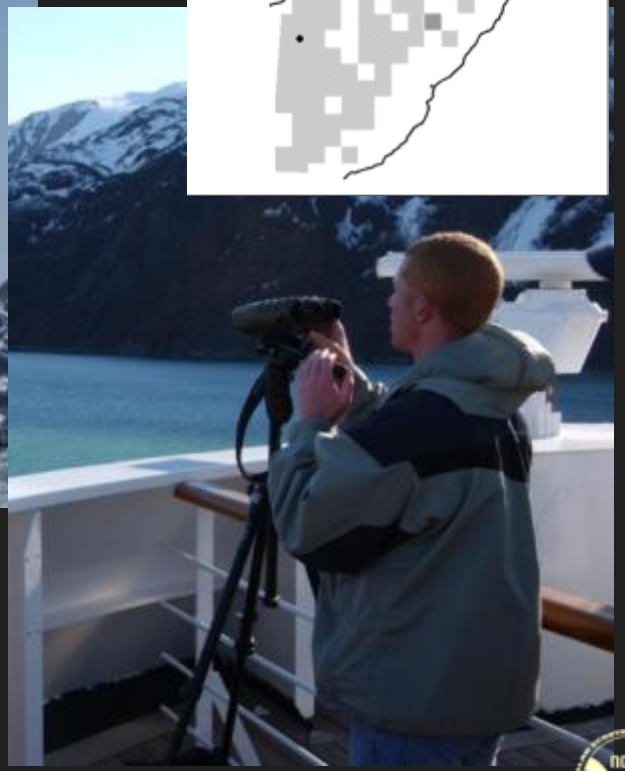
Trends in Cruise Ship Visits: 1970 to present

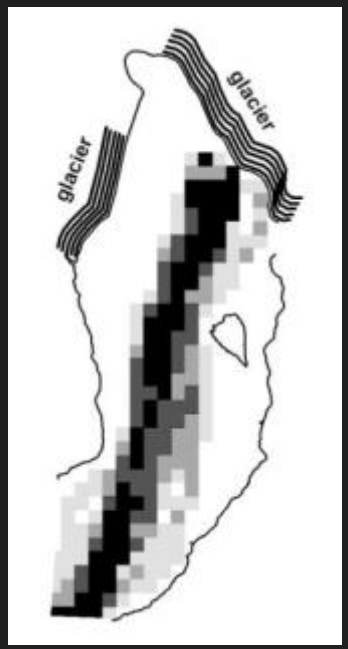


Empirical Data



Seal and Ice distribution





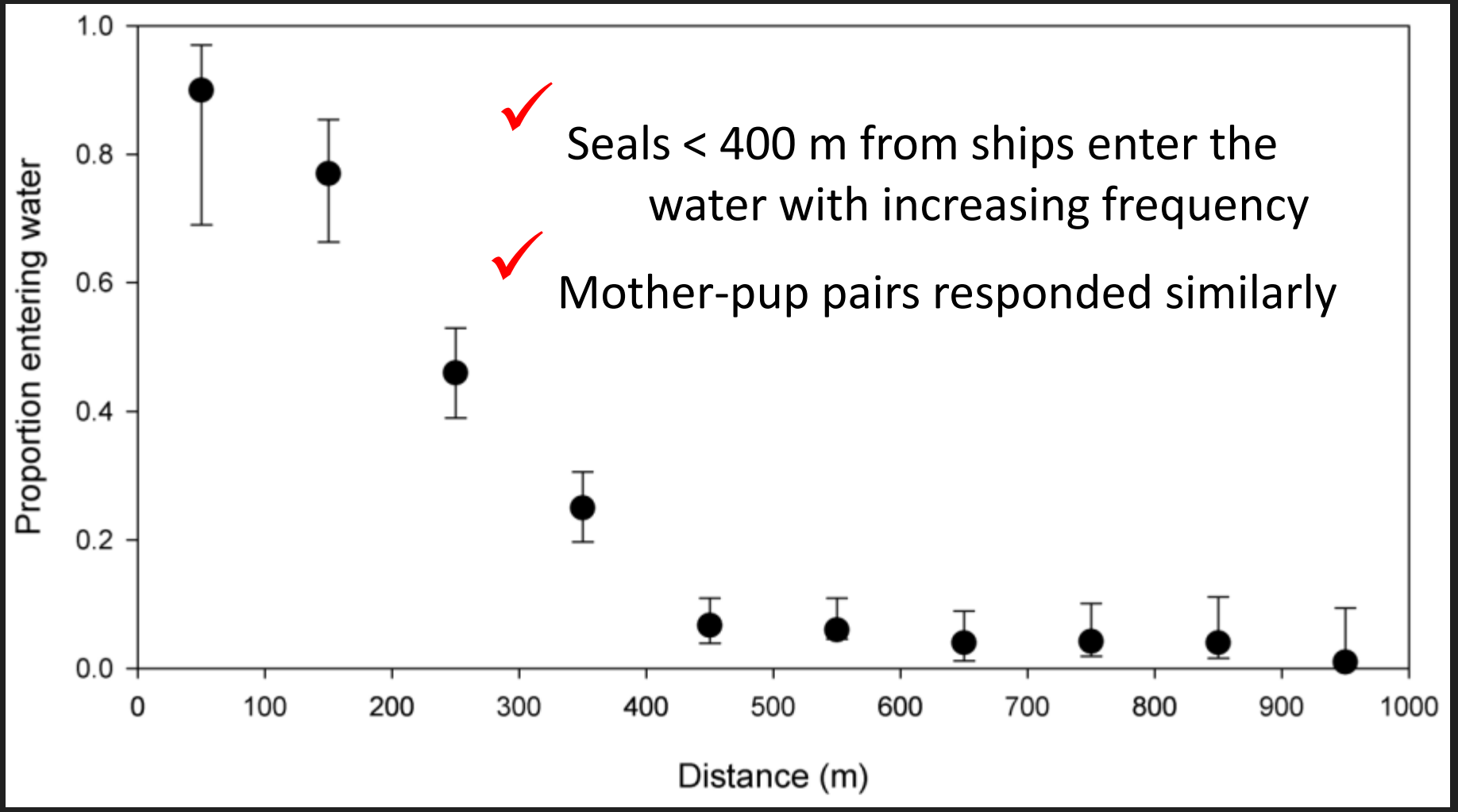
Cruise ship residence time

<u>Fine-scale sampling</u>: conducted behavioral observations of harbor seals using cruise ships as platforms

Seal behavior was categorized as:

1) resting, 2) alert, 3) active, or 4) entering the water

Estimates of the proportions of harbor seals entering the water in response to approaching cruise ships



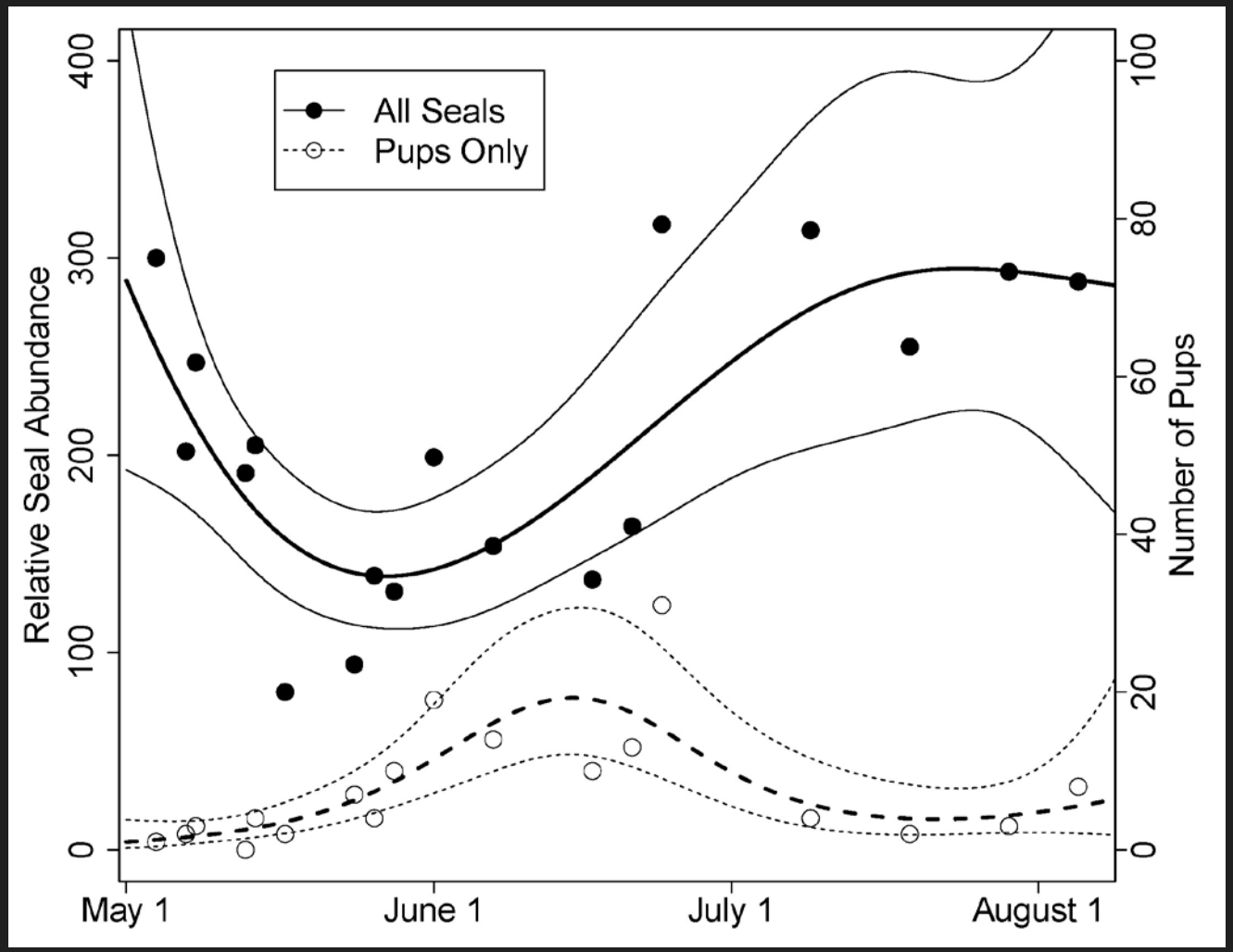
J. K. Jansen et al. 2010. Reaction of harbor seals to cruise ships. Journal of Wildlife Management. 74: 6

Medium-scale sampling

Video camera recorded a 70-meter strip under the plane

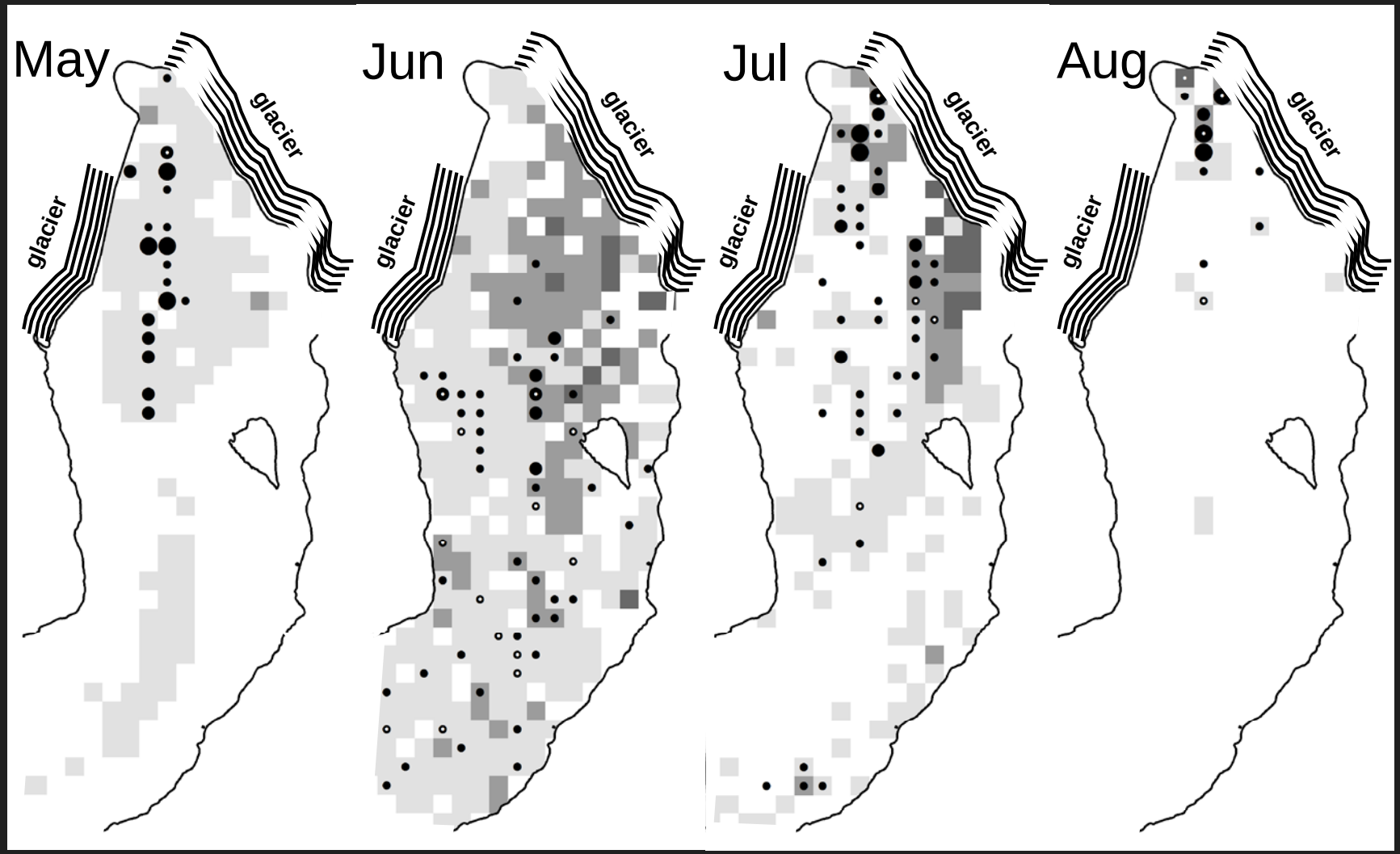
Seasonal abundance of harbor seals

(pupping to molting)



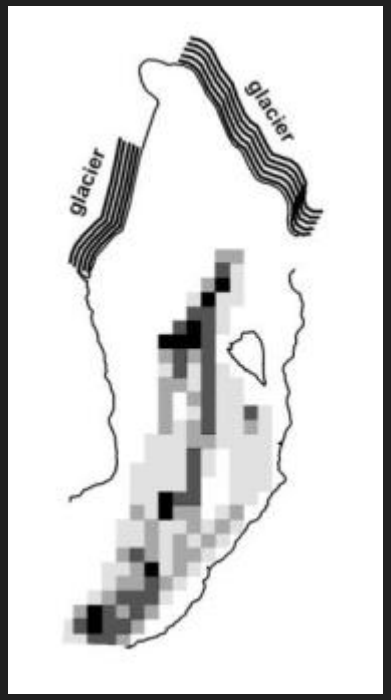
Seasonal distribution of harbor seals

(pupping to molting)

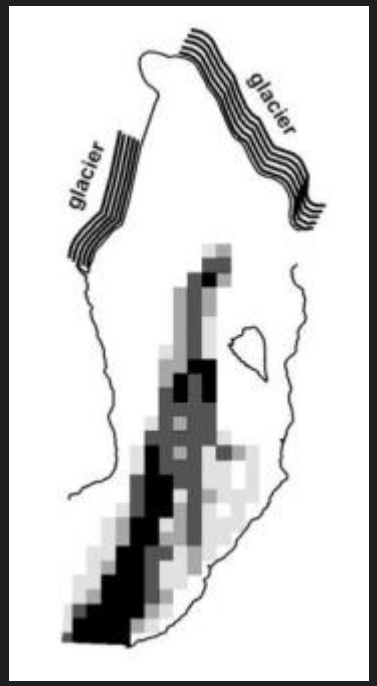


Seasonal distribution of ships

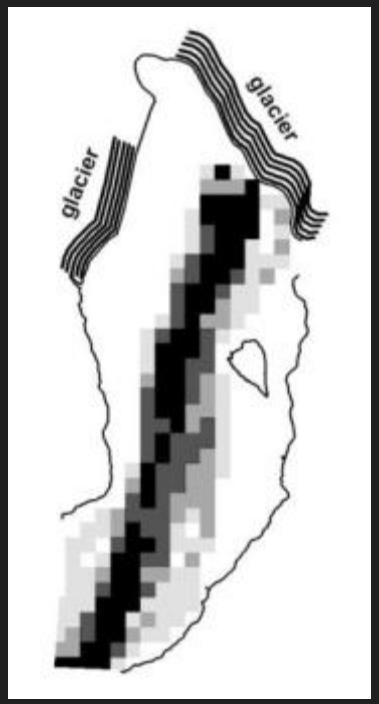
May



June



July



Space-Time Regression Model

- Tested hypotheses related to the effects of environmental factors (e.g. ship disturbance) on seal distribution and abundance separately

- Tested all factors simultaneously:

ship activity, ship distance, number of ships, ice class, total ice cover, precip, wind speed.

Ver Hoef, J. M., and J. K. Jansen. 2007. Space-time zero-inflated count models of harbor seals. Environmetrics 18:697-712.

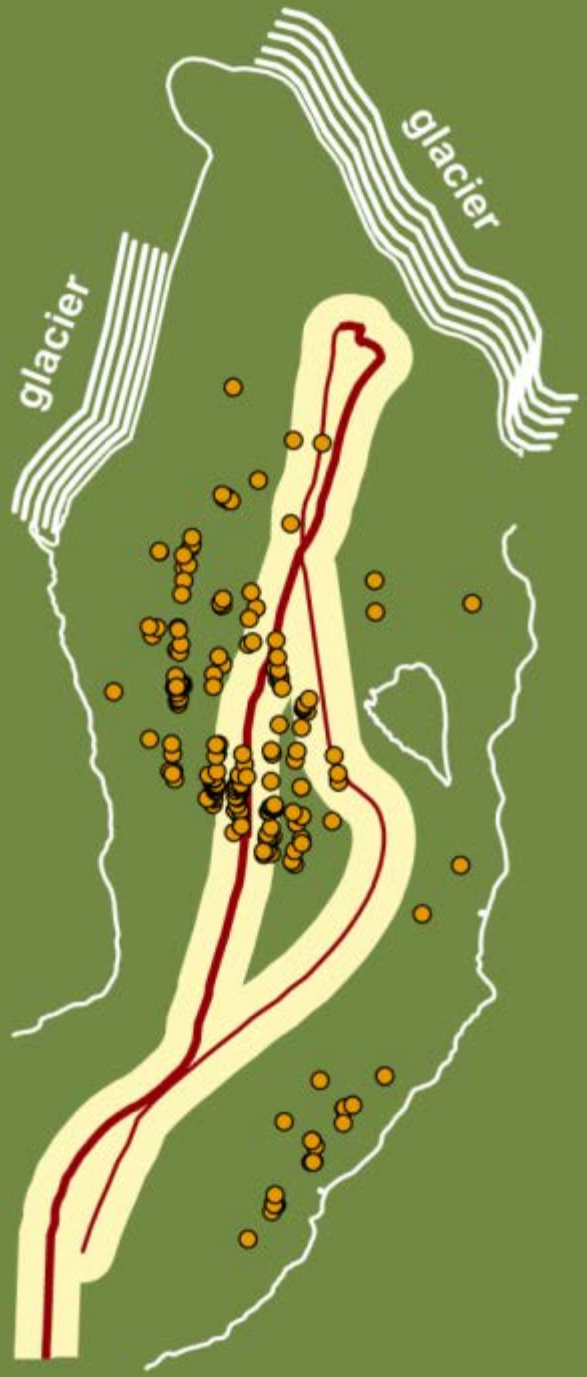
Results of space-time model (cont.)

— Precipitation, wind speed, and total ice cover did not have a significant effect on the distribution or abundance of seals or mother-pup pairs

— Frequency of ship visits did not have an effect on the abundance or distribution of seals

— Seals did not appear to avoid ship corridors

— Mother-pup pairs showed no reactions that differed significantly from other seals



Interpolative density surface model

Generates grid of expected seal densities from areas outside images

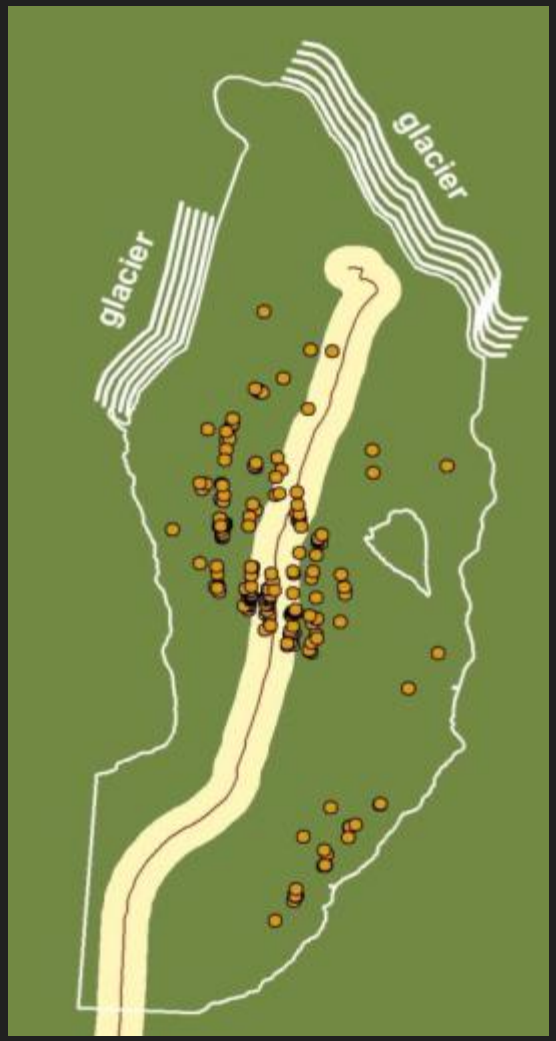
Behavioral response data used to estimate probability of flushing seals

An estimated 1544 seals were present just prior to the arrival of the cruise ship

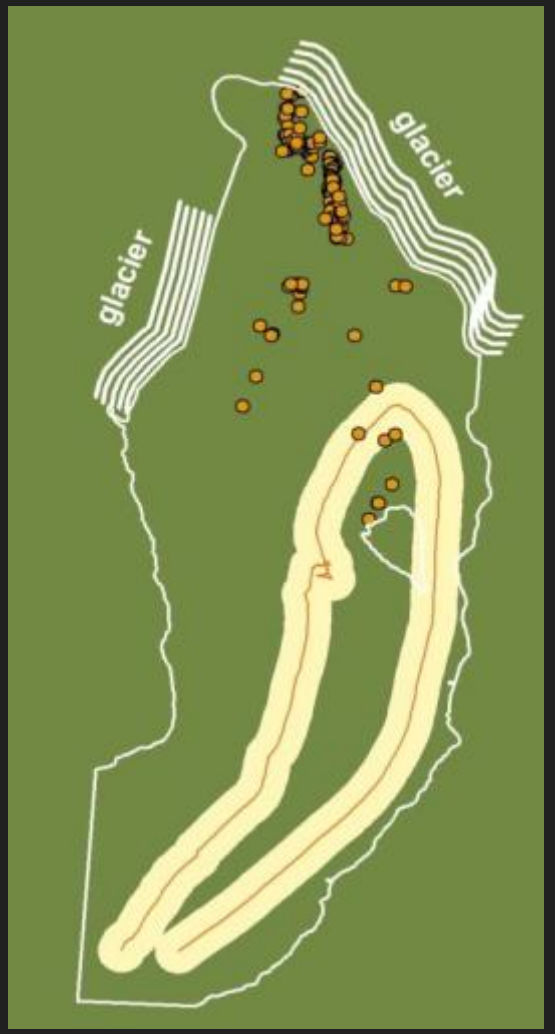
An estimated 4% (62 seals) were flushed into the water on the inbound and 16% (247) on the outbound

Estimated Effects Population-wide

2% estimated to flush
(24 seals; 9 pups)



16% estimated to flush
(247 seals; 12 pups)



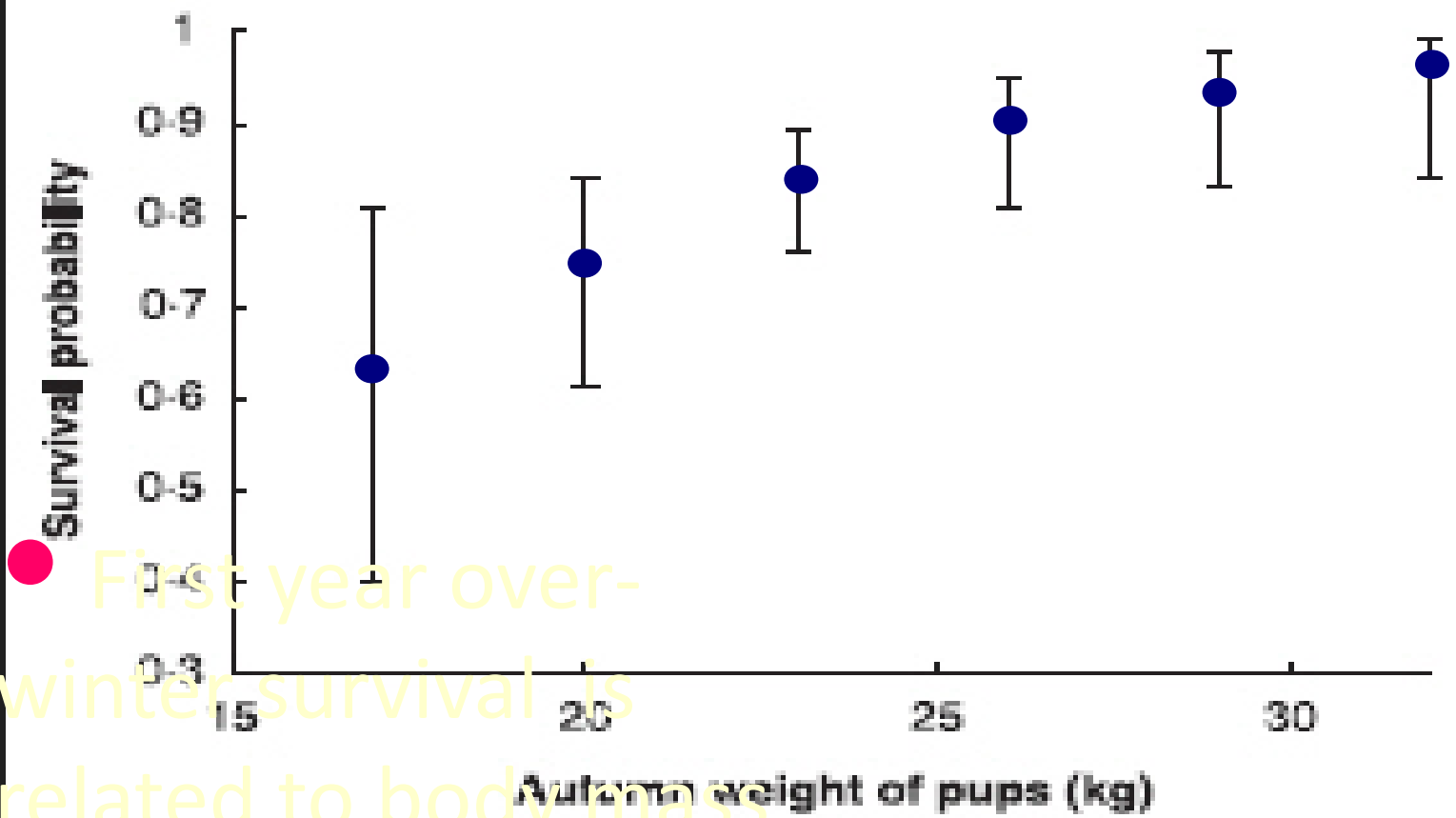
1% estimated to flush
(7 seals)

Findings

- Seals < 500 m from ships enter the water with increasing frequency
- A significant number of seals present may be disturbed on a given day
- The gist: Cruise ships cause seals to spend more time in the water
(mothers and pups respond similarly)


So……seals go into the water
SO WHAT?

Impacts on Survival

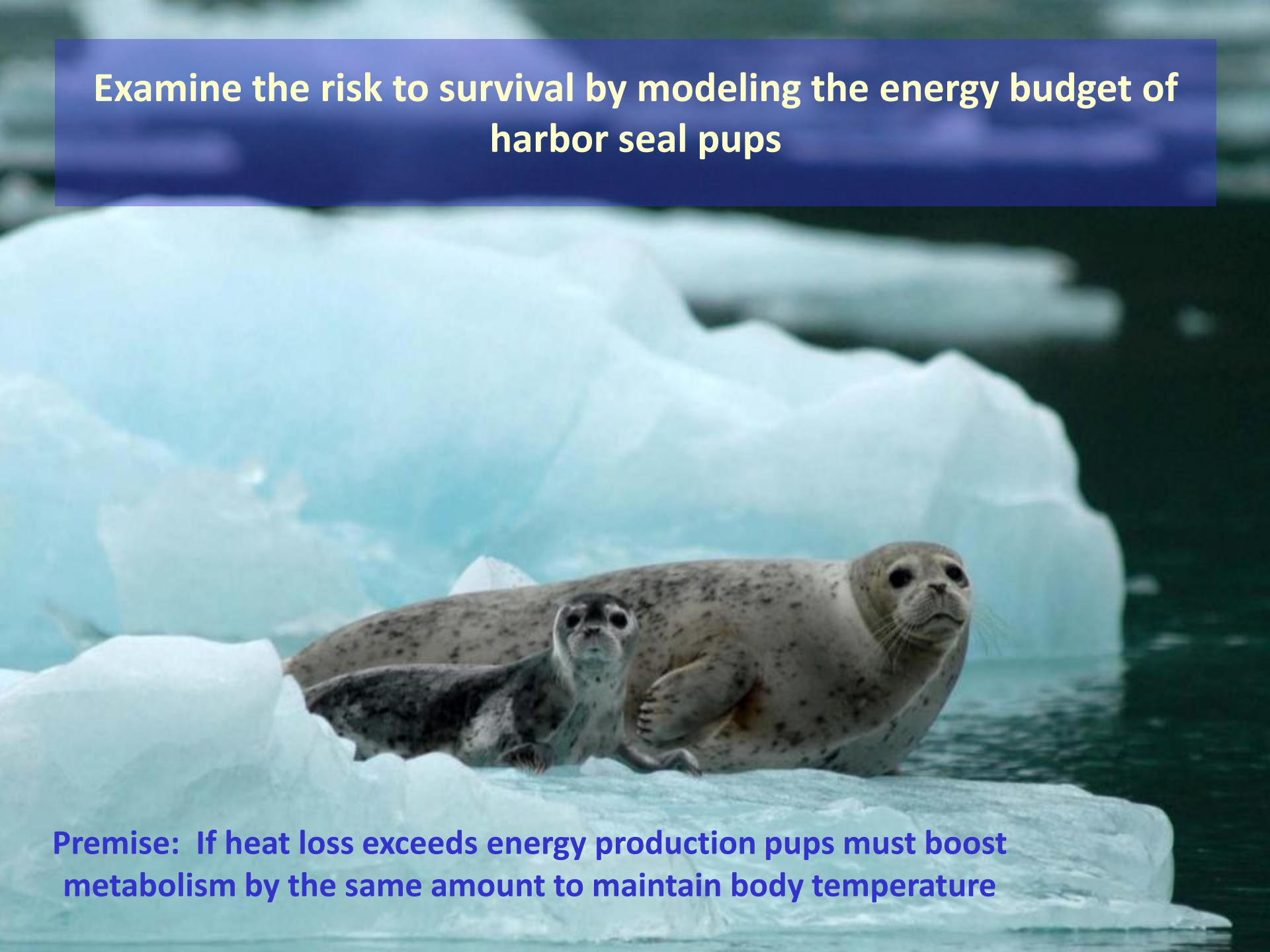


First year over-winter survival is related to body mass

Fig. 4. First year winter survival of Harbour Seal pups in the northern Skagerrak is significantly related to their body mass in the autumn. Error bars denote 95% confidence limits for each given weight.

Harding et al. 2005

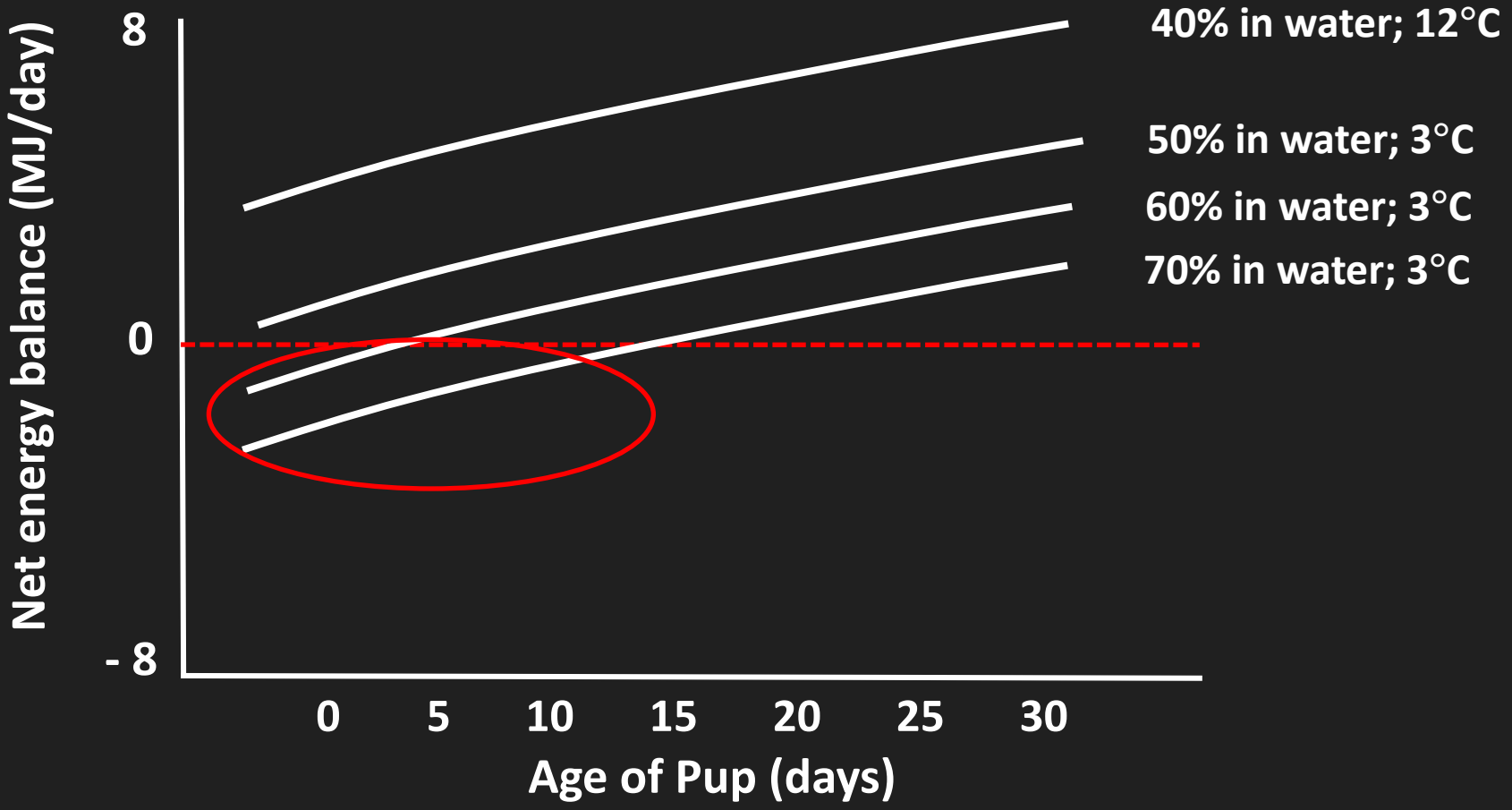
Examine the risk to survival by modeling the energy budget of harbor seal pups



Premise: If heat loss exceeds energy production pups must boost metabolism by the same amount to maintain body temperature

Seal parameter	Value	Location	Source
Pup birth weight	9.97 kg	Icy and Dbay, Alaska	Pitcher 1979
Pup growth rate	0.6 kg/day	Sable I., NS	Bowen et al. 2001
Seal body temperature	38 ° C	Captive	Hind and Gurney 1998
Lactation duration	24 d	Sable I.	Bowen et al. 2001
Field metabolic rate (FMR)	Mass dependent	Generalized	Boyd 2002
Resting metabolic rate (RMR)	Mass dependent	Captive	Rosen and Renouf 1998
Swimming metabolic rate (SMR)	Activity dependent [a]	Captive	Davis et al. 1985
% time in water – newborn	40	Sable I. ; Svalbard Arch.	Bowen et al. 1999; Jorgensen et al. 2001
% time in water – weaning age	70	PWS, Alaska; Svalbard Arch.	Rehberg and Small 2001; Jorgensen et al. 2001
Blubber thermal conductivity	0.19 $W \bullet m^{-1} \bullet K^{-1}$	Captive	Kvadshein and Folkow 1997
Blubber thickness	Mass dependent	Generalized	Harding et al. 2005
Body surface area	Mass Dependent	Generalized	Lavigne 1982

Generalized FMR Model



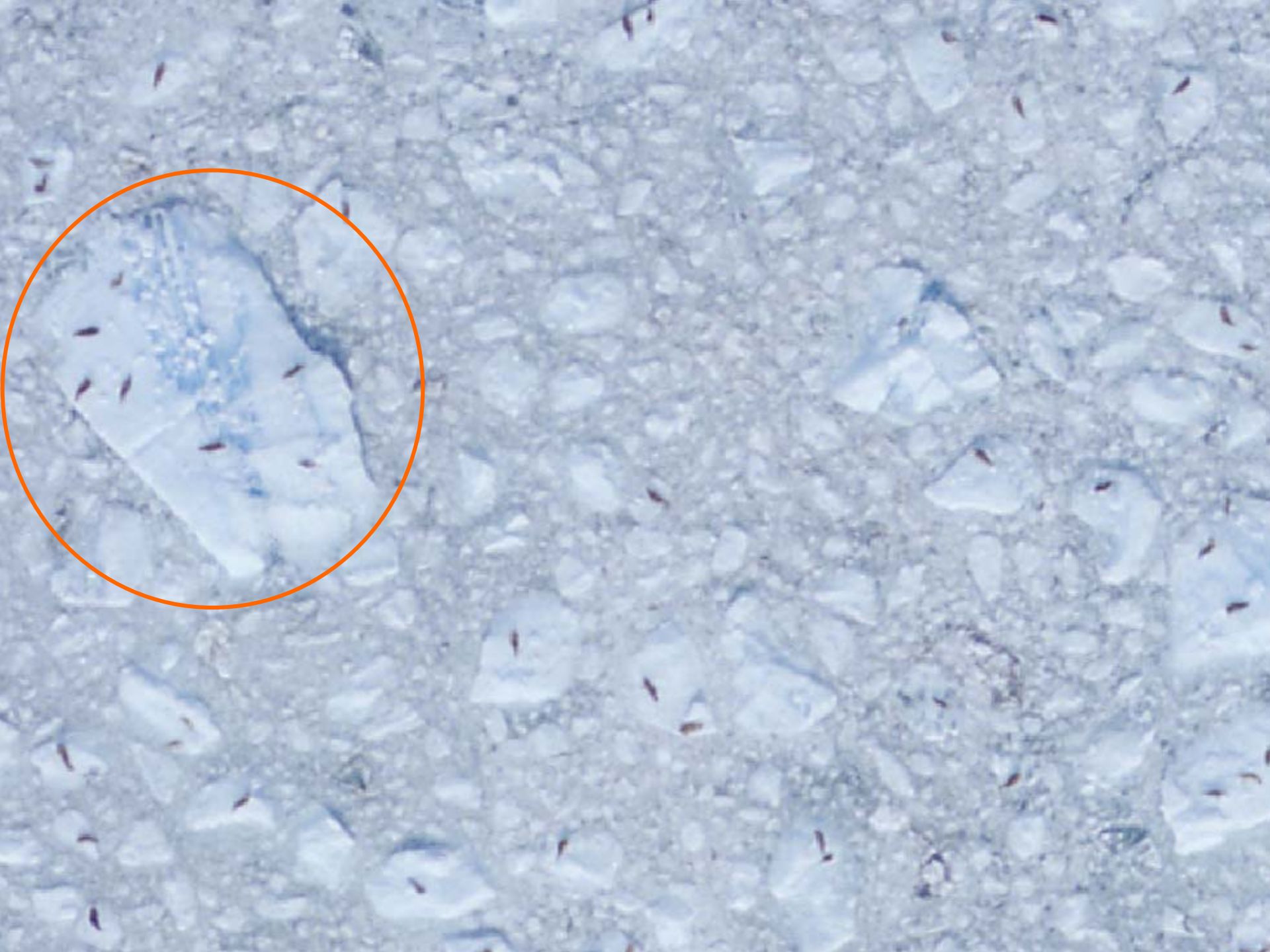
- Pups (<15 d age) that spend >50% time in water have increased risk of negative energy balance
- An energy deficit means compromised mass (blubber) and lower survival to weaning or first winter

Example of large-scale photogrammetry

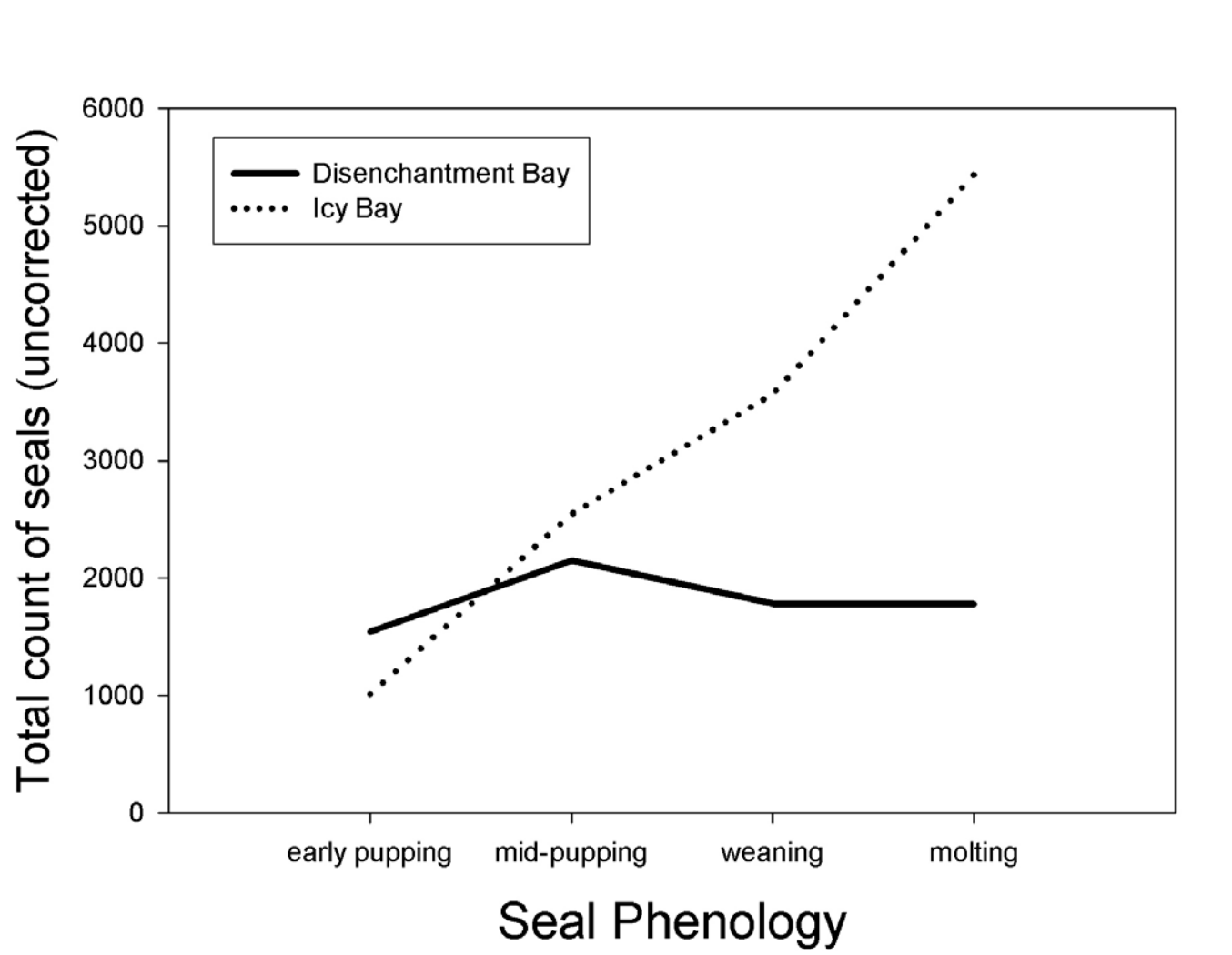
Glacial ice in Icy Bay (near Guyot Glacier)

2000’ altitude

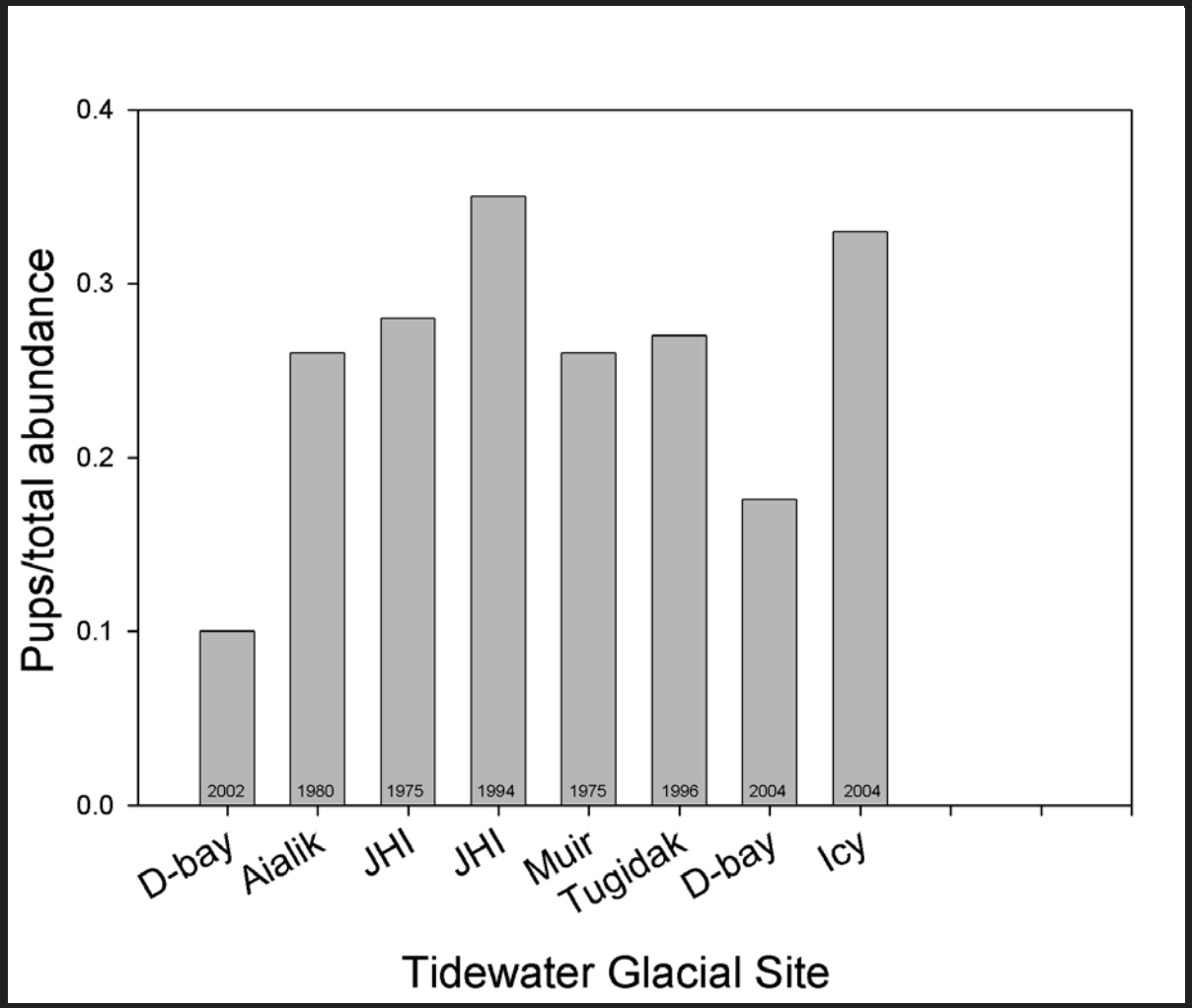
1837 harbor seals hauled out on ice are visible in this image frame (3000’x3000’)



Comparison of seasonal abundance: disturbed vs. undisturbed sites

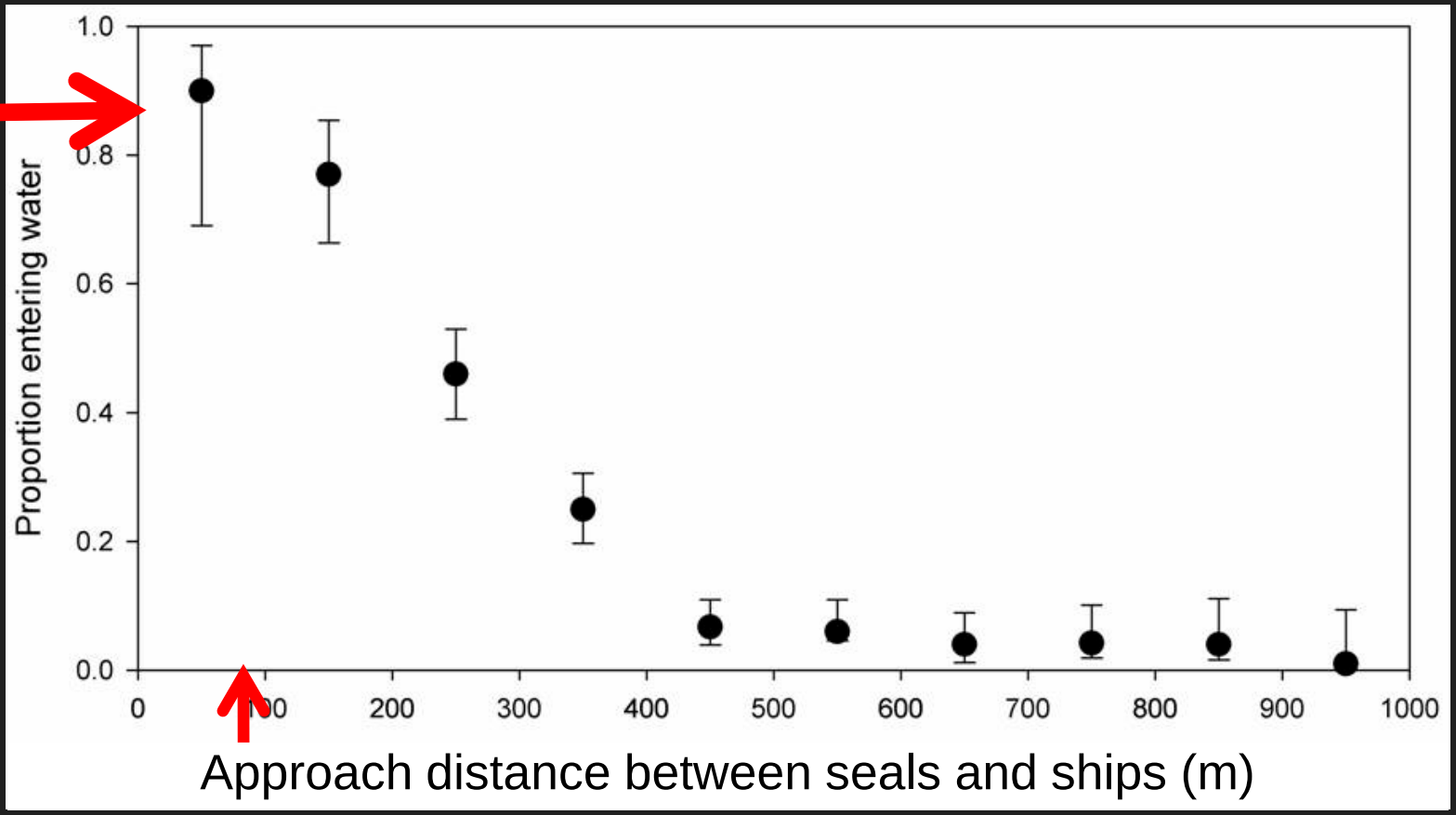


Comparison of pup productivity between glacial sites



Long-term consequences?

Allowable Levels of Disturbance



Use observers to maintain seal-ship separation

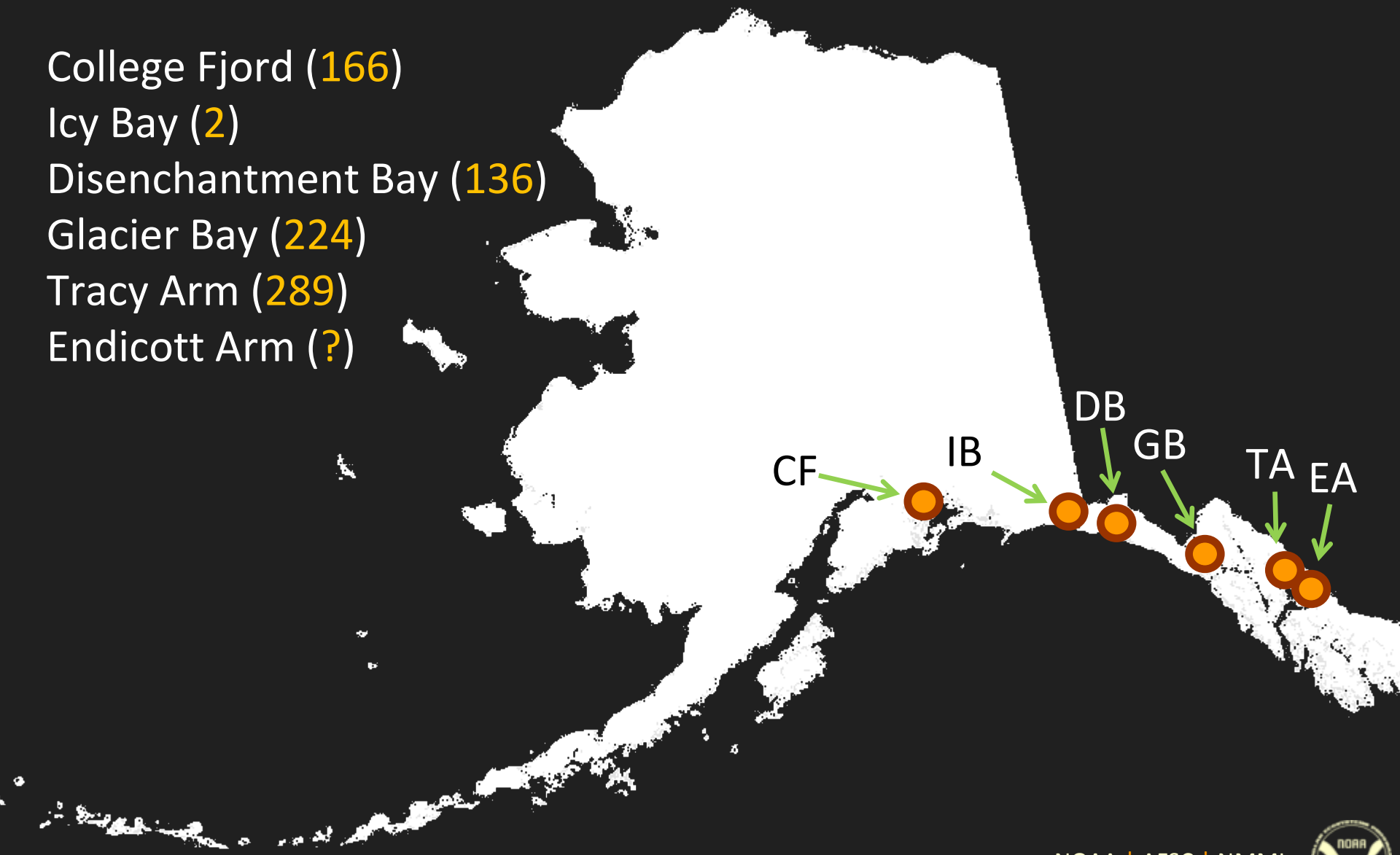
Require ships to maintain 400 m from ice habitat

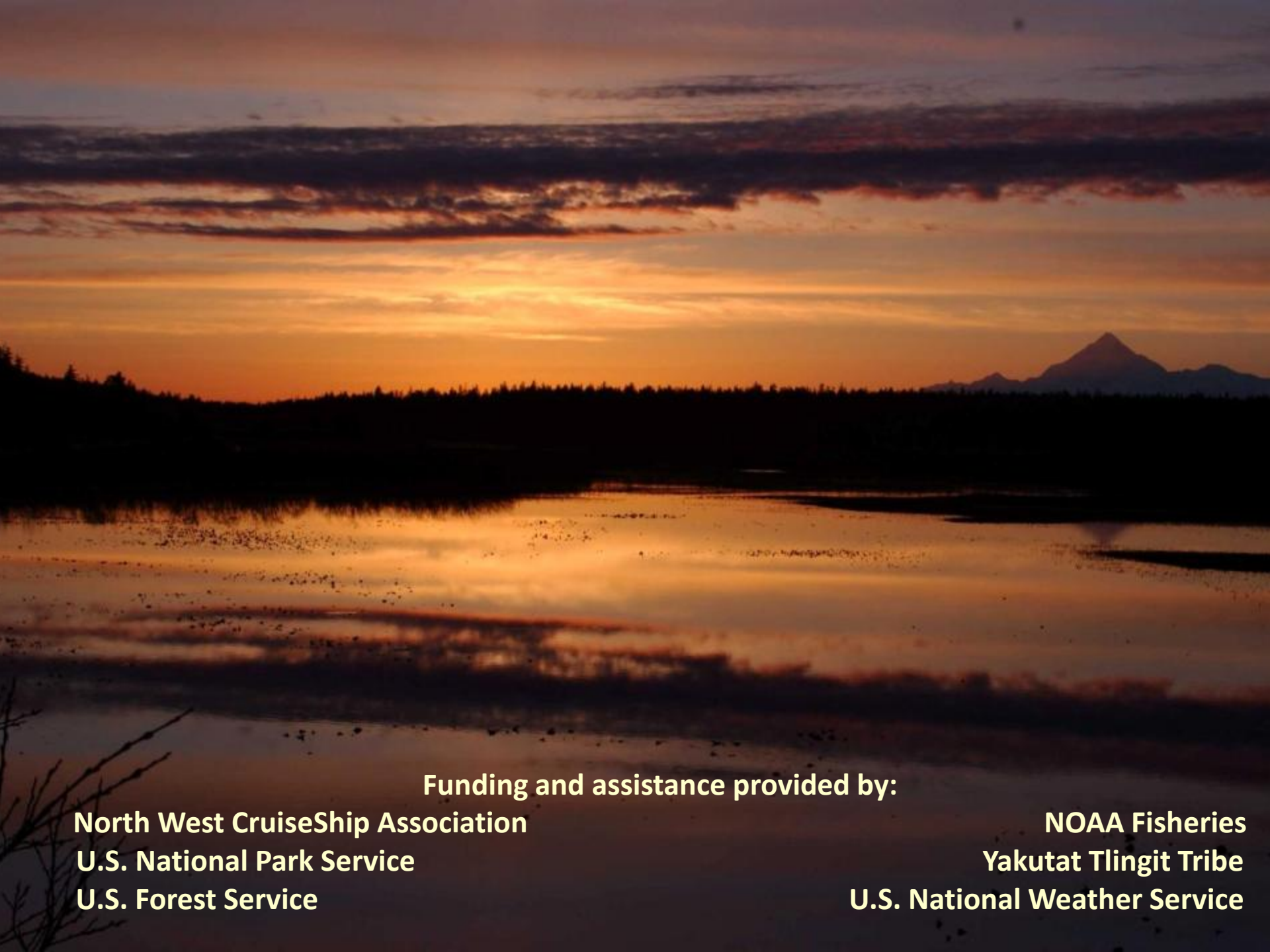
Restrict ship movement to a static corridor on the eastern shoreline away from main density of seals

Exclude ships during pupping and molting, e.g., Glacier NP

Tidewater Glacial Fjords visited by cruise ships

College Fjord (166)
Icy Bay (2)
Disenchantment Bay (136)
Glacier Bay (224)
Tracy Arm (289)
Endicott Arm (?)





Funding and assistance provided by:

North West CruiseShip Association
U.S. National Park Service
U.S. Forest Service
NOAA Fisheries
Yakutat Tlingit Tribe
U.S. National Weather Service