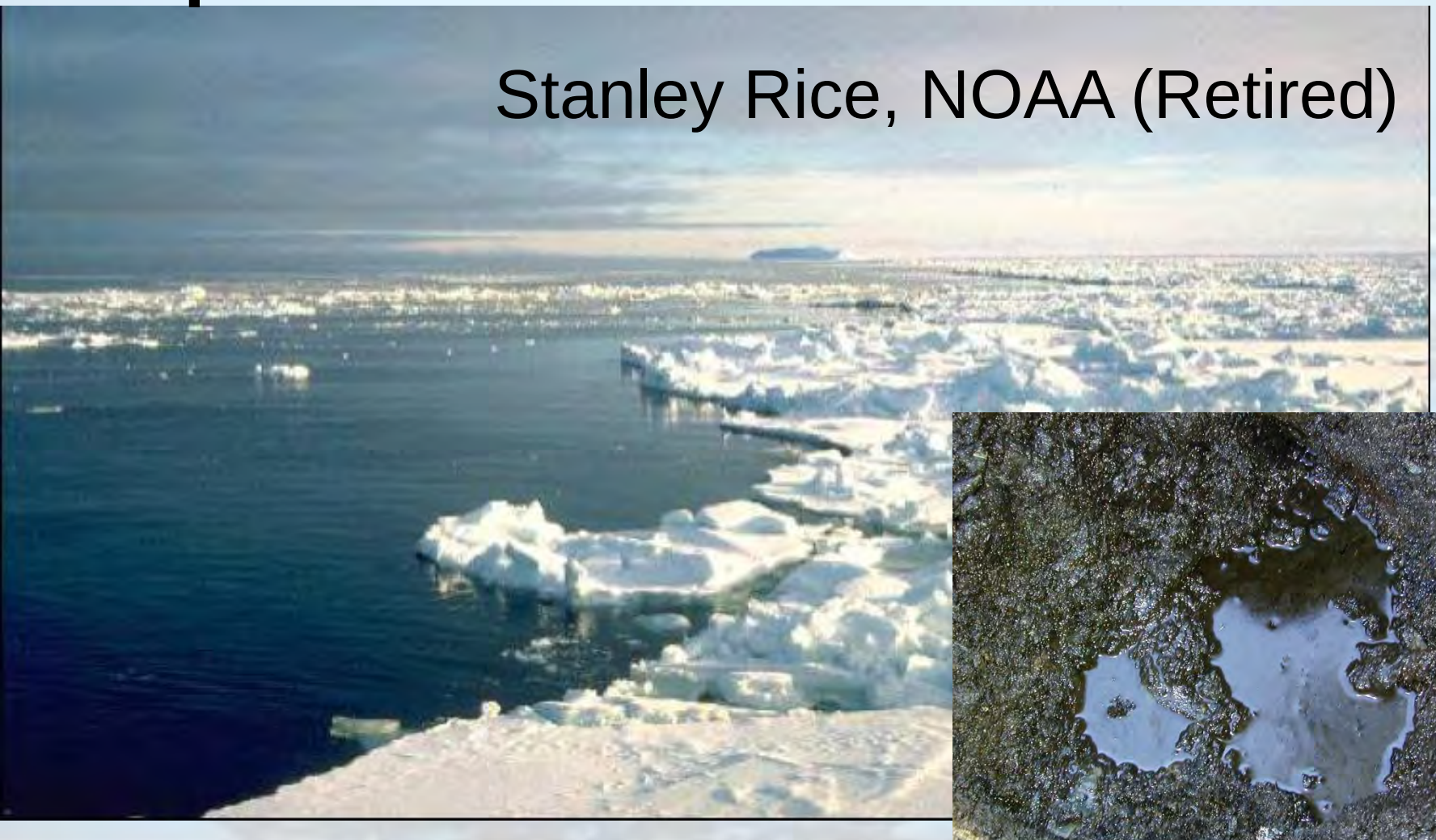
Oil development in the Arctic:

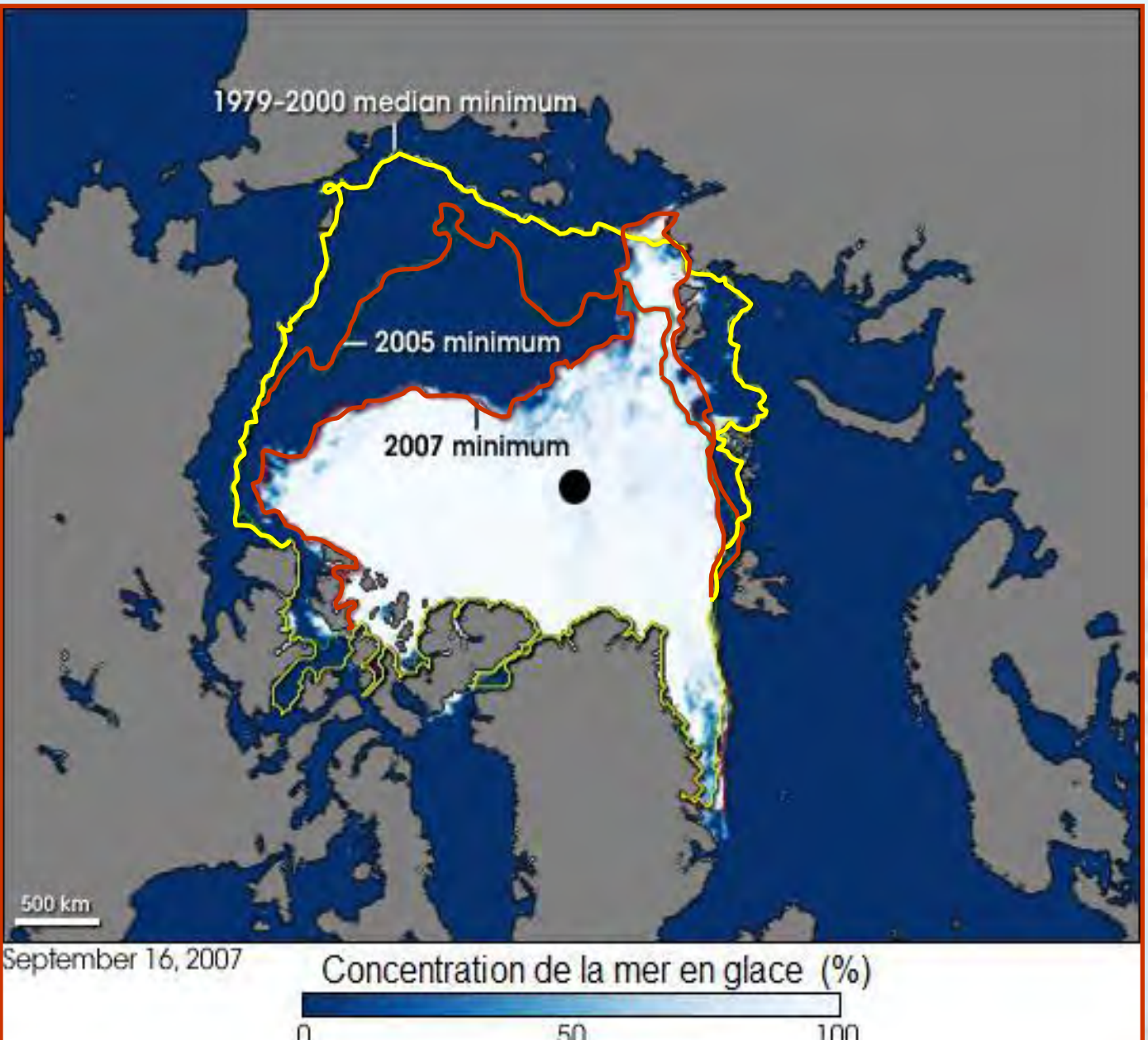
What are the science needs to protect resources?



Oil in the Arctic- --
Synthesizing Oil Effects and Arctic needs

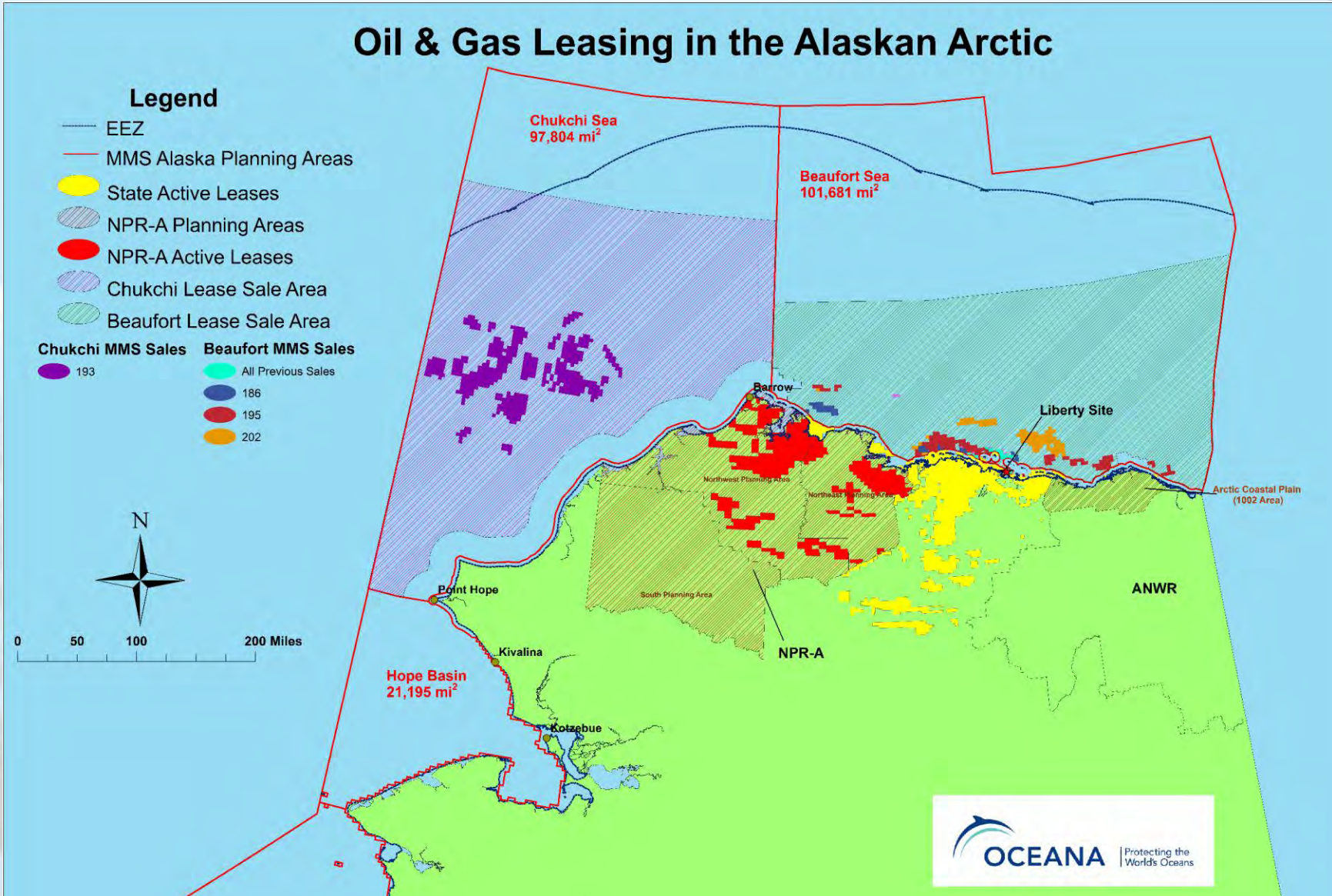
- Can we extrapolate the science learned from other spills
- What we know about the Arctic biology
- What we need to know

Oil in the Arctic - Really?



1. New frontier
2. 19 basins
3. Accessible
4. When, not if
5. Valuable

Chukchi lease sale = $2 B

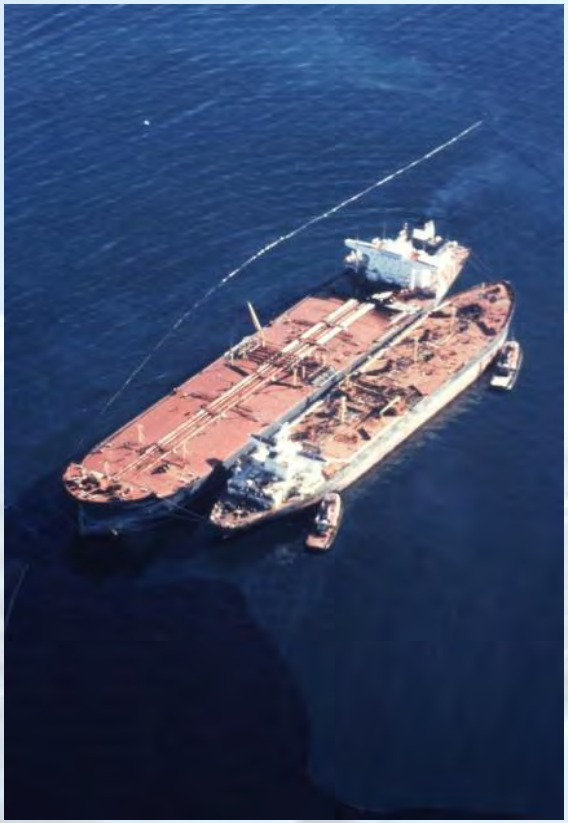


Oil Development = Challenges !

What do we need to know to protect the biological resources? Oil? Arctic?

Lessons Learned

Exxon Valdez - 1989



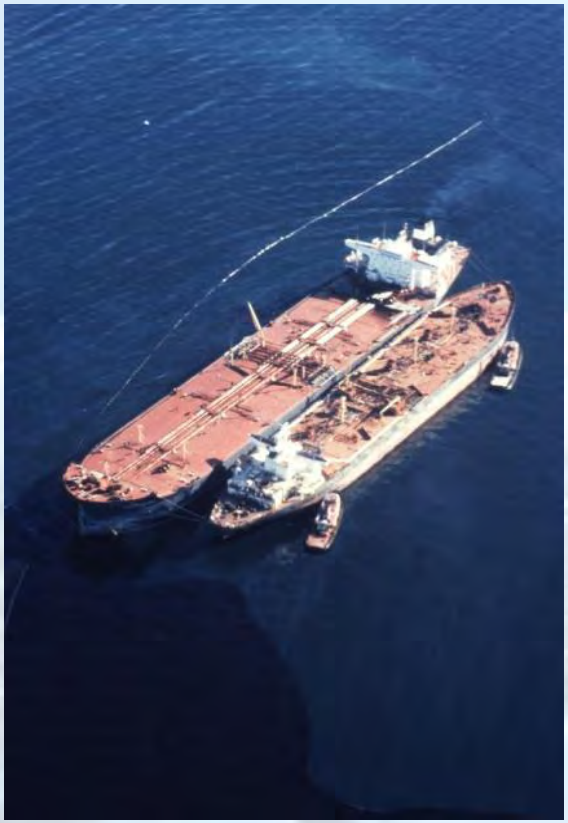
Deepwater Horizon 2010

Bottom Line:

Can we transfer this spill knowledge to the Arctic?

From the Exxon Valdez spill

Exxon Valdez - 1989



Spills last for decades!

litigation

2 law suits settled

One $100 M suit pending

From the Exxon Valdez spill

Exxon Valdez - 1989

Air breathers are vulnerable:

From the Exxon Valdez spill

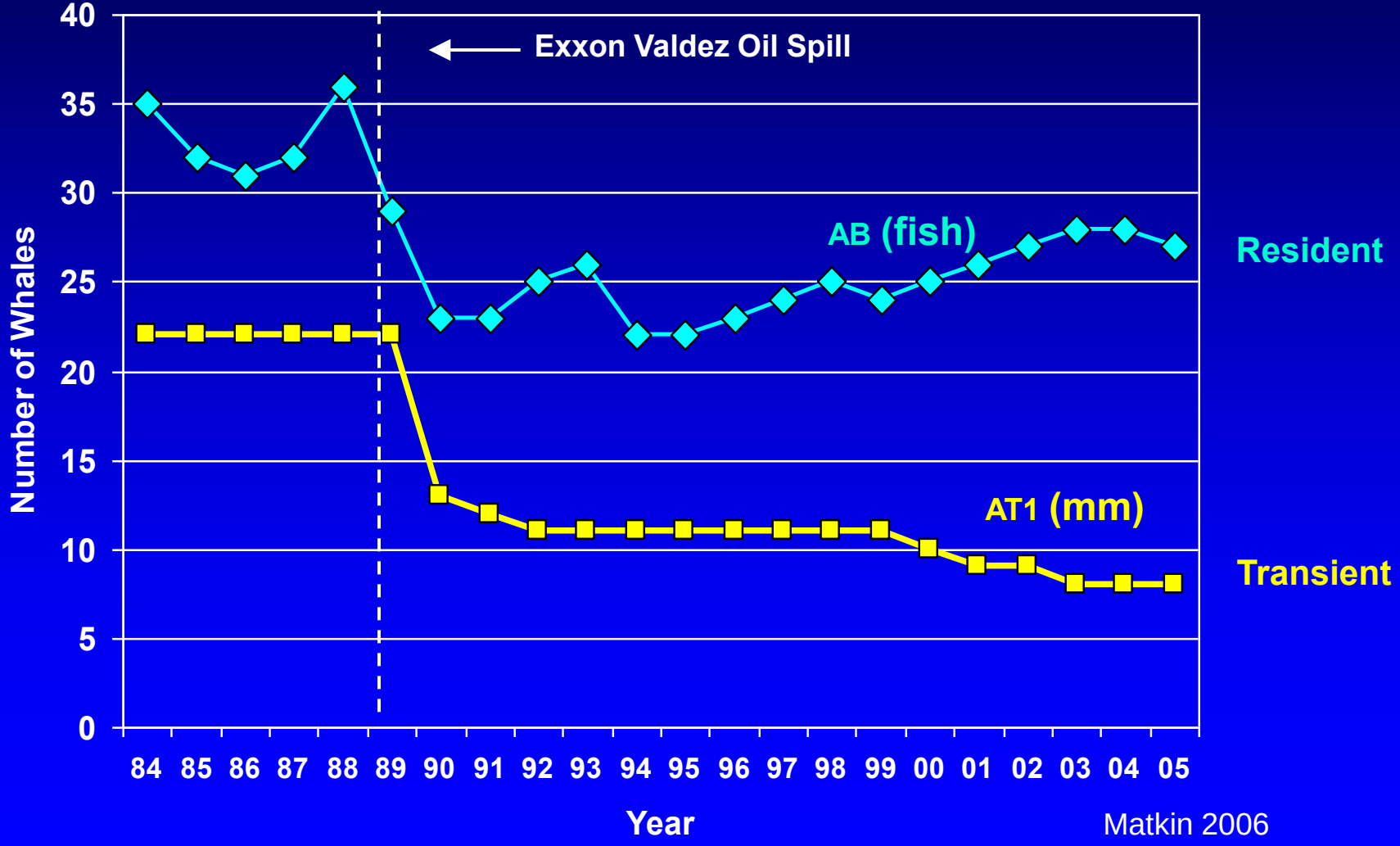
Exxon Valdez - 1989

Acute effects: can be devastating over the long term

AB pod > slow recovery
AT pod > Extinction

PWS Orca Survival After the *Exxon Valdez* Oil Spill

Residents / Transients



Matkin 2006

From the Exxon Valdez spill

Exxon Valdez - 1989

Oil Persists for decades

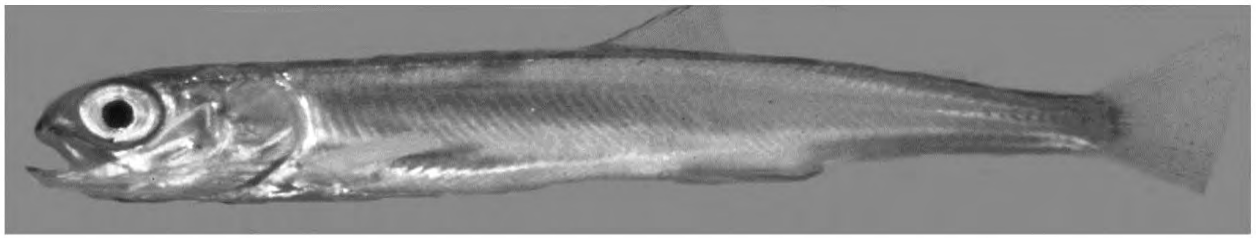
(also- 1978 Florida)

2008

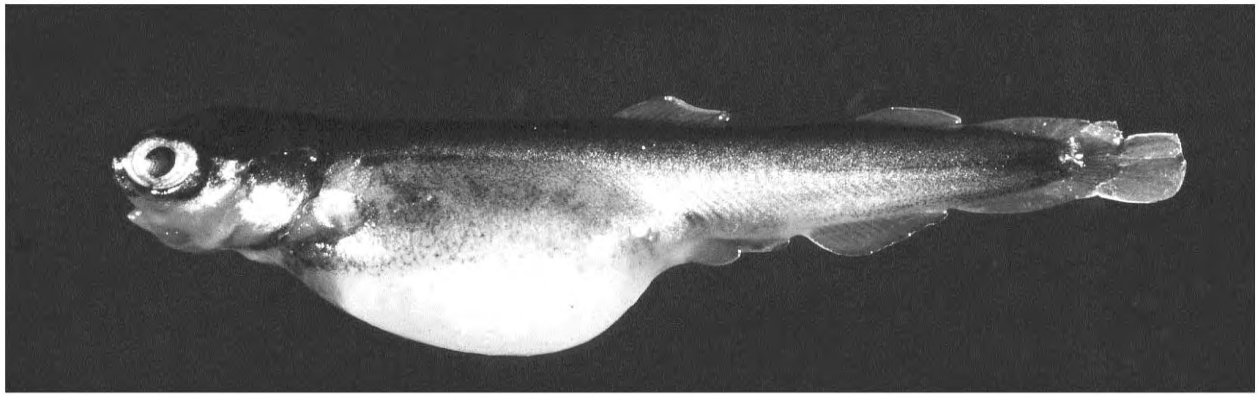
From the Exxon Valdez spill

Exxon Valdez - 1989

Embryos Sensitive at PPB
(orders of magnitude)
ADFG- Field; NOAA LAB

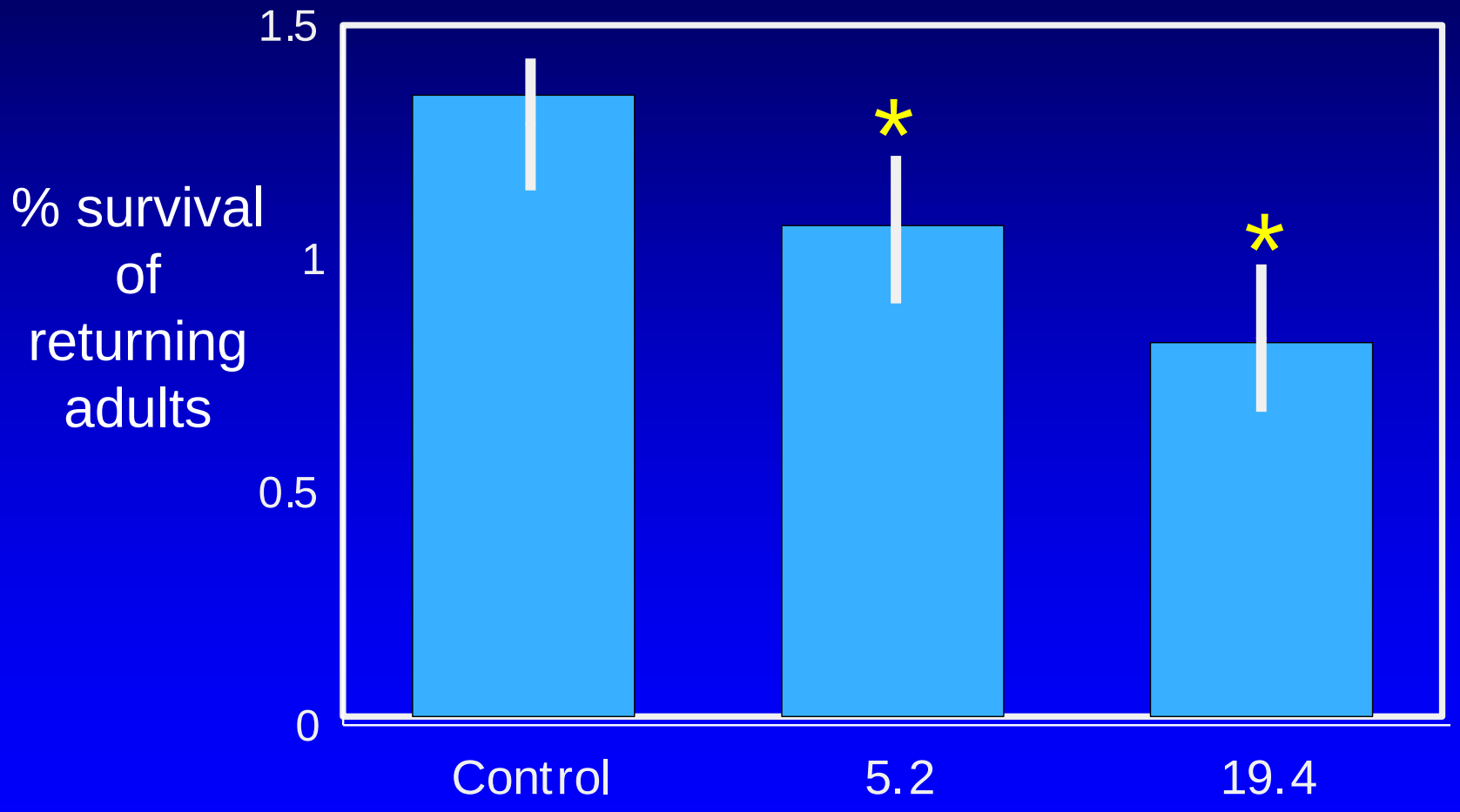


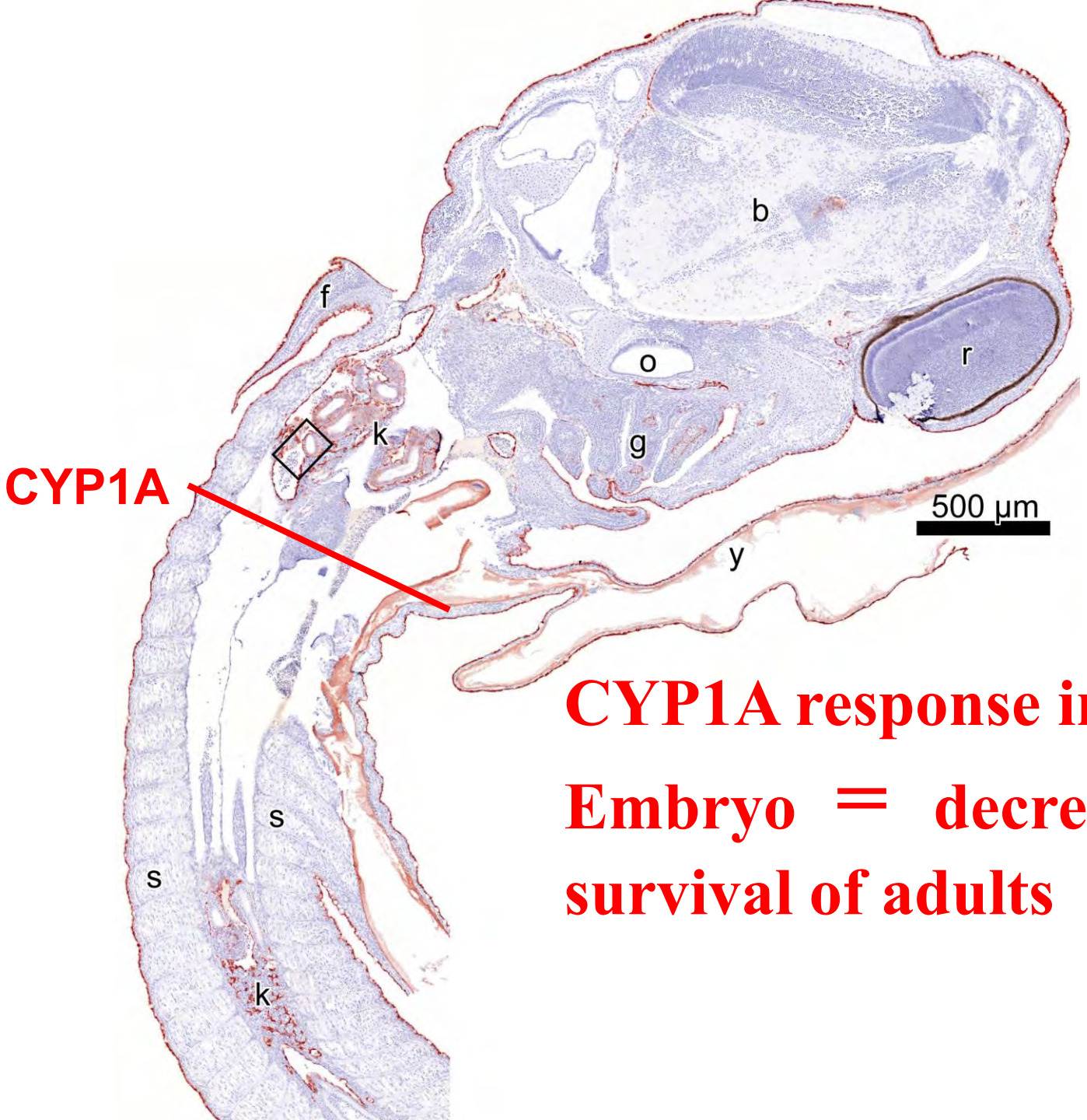
Control



18 PPB PAH

Adult Returns Reduced 20% at 5 PPB





CYP1A response in Embryo = decreased survival of adults

From DWH

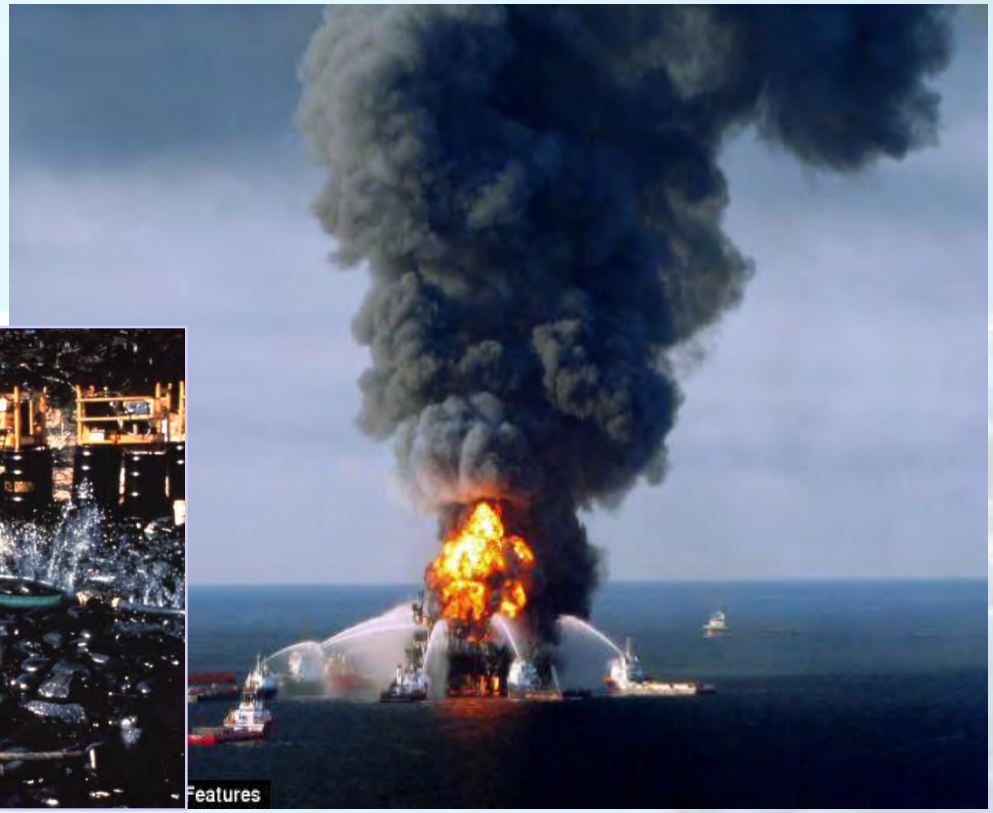
Deepwater Horizon 2010

Oil was dispersed- little reached the shore

But, did dispersants do that?

From DWH, Exxon Valdez, and other spills

Deepwater Horizon 2010



Removal of oil- skimming, burning = about 10%

(Even with the armada of skimmers in the Gulf)

What can we transfer to the Arctic?

What can we transfer to the Arctic?

Ice **will** complicate all aspects from engineering to response

Oil on ice
In Ice
Under Ice
Between ice

Affects detection
Tracking
response

What do we know about Arctic

Physical dominating features are extreme

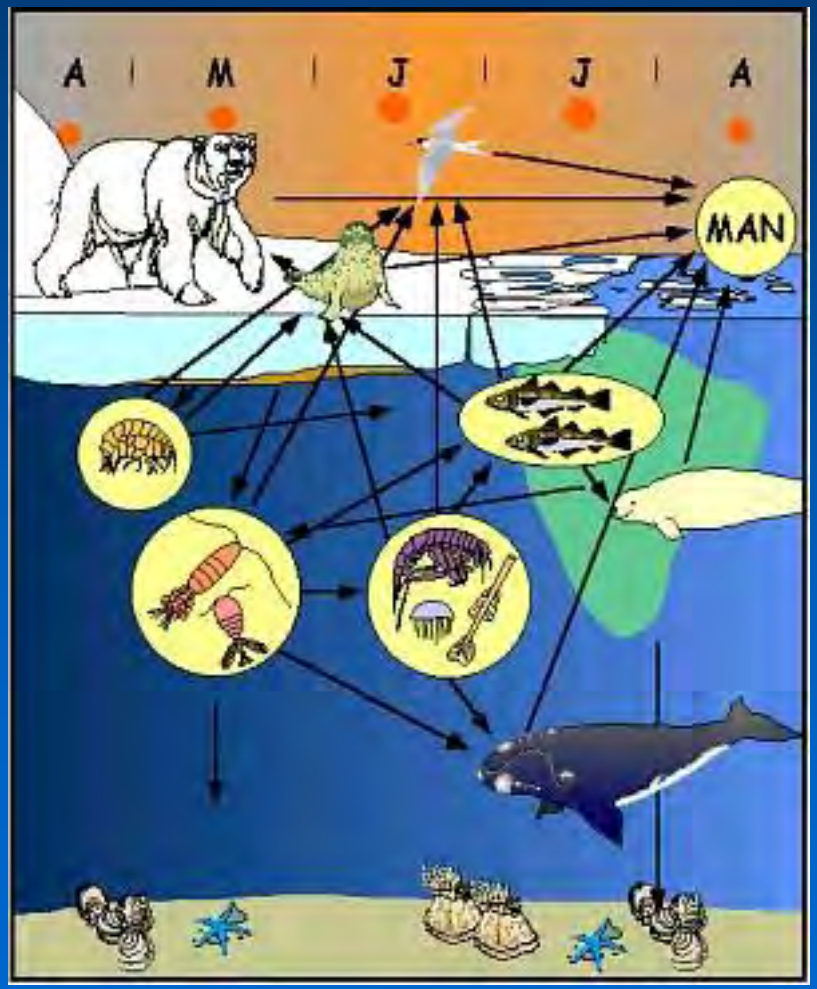
Temperature
Ice
Wind
Light/ dark
(& remote)

USGS Arctic Report: Environmental Factors

	Summer (Jul-Sep)	Fall (Oct-Dec)
Open Ice Conditions	40%	20%
Days of Peak Gust (>30 MPH)	21%	34%
Days of Fog	49%	57%
Avg. Minimum Temperature	-7 C	-36 C

Photo: Petty Officer 1st Class Sara Francis/USCG

What do we know about Arctic Biological dominating features - much less info



who is there

But How many??

Food web- short

Distributions-

S vs W ????

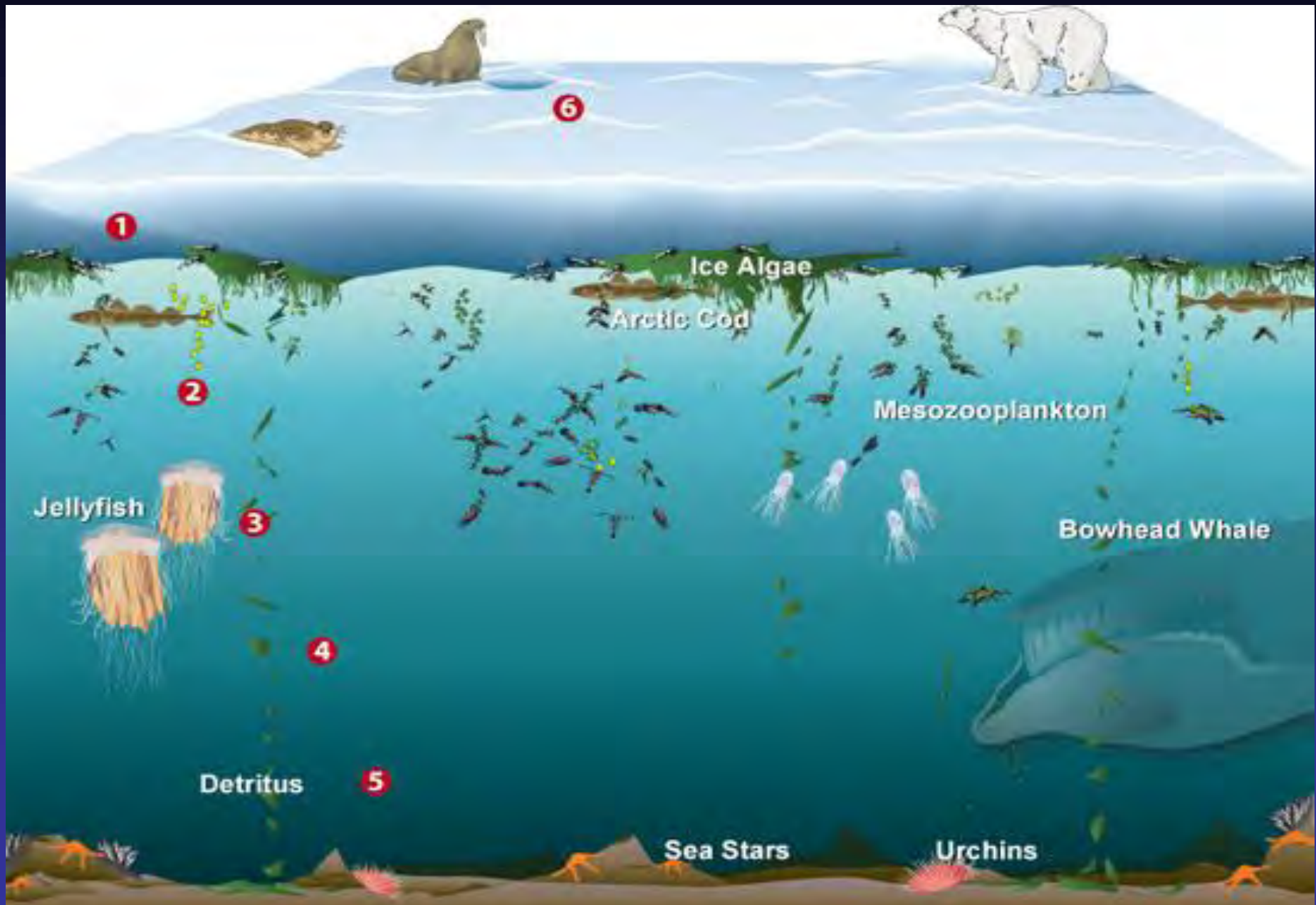
Repro details???

Species vulnerablility:

Air Breathers are most vulnerablel

What Habitats are most vulnerable?

Where is the OIL? Under the ICE?



Where is the OIL? **On the bottom?**

Will the shallow Benthic habitat be affected?

Benthic habitat over shallow shelves

Is Important

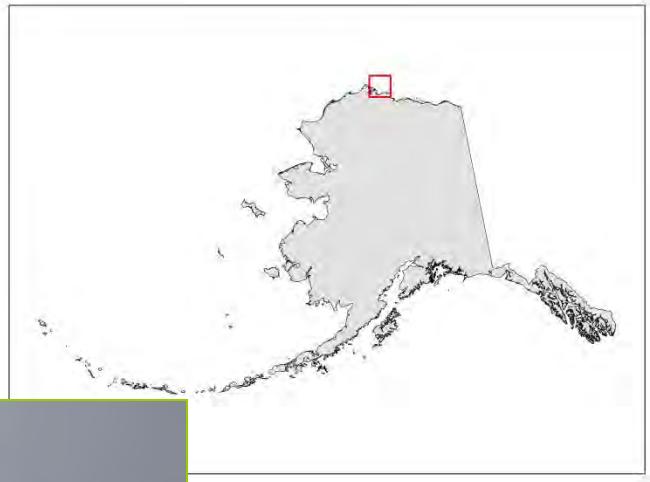
Lagoon and shorelines are low, vulnerable to Long term oiling; productive for birds and fish.

Oil in the Arctic- --
What do we need?
For planning; for damage assessment

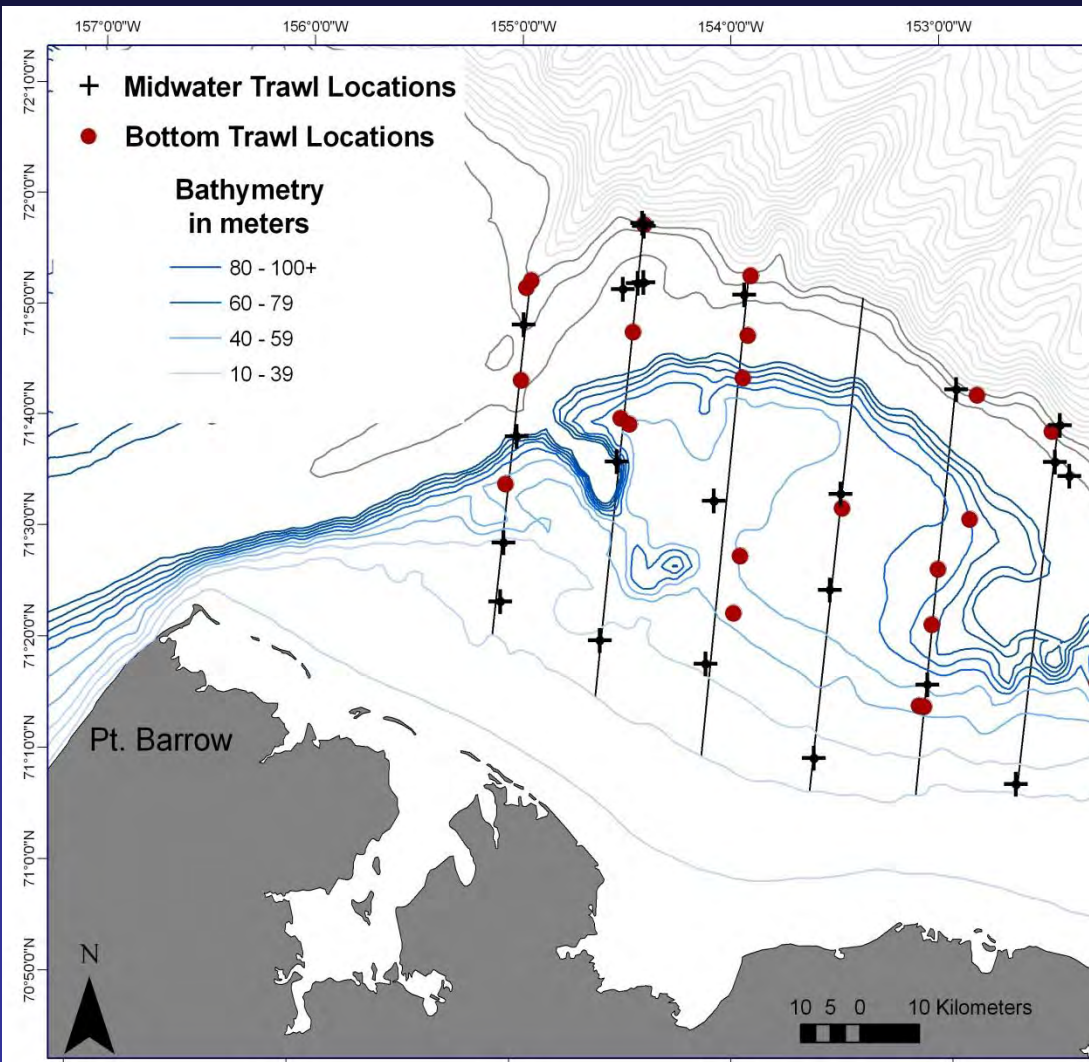
- **Baselines- chemical and population (Repeat on periodically)**

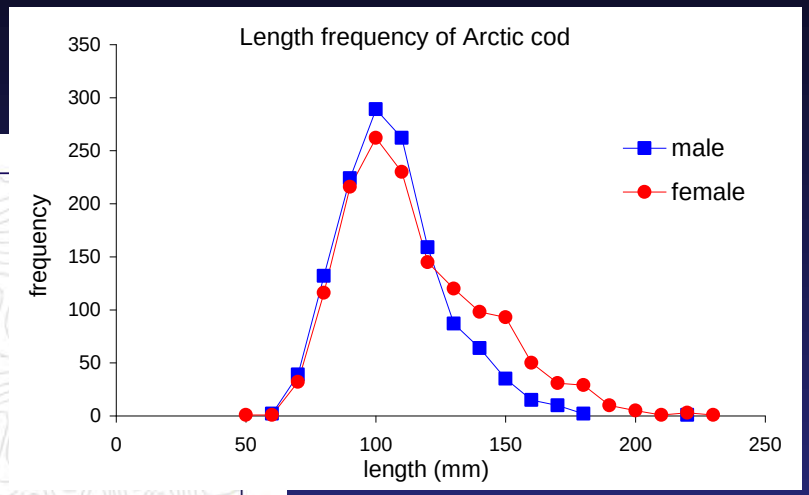
Daunting task- expensive, difficult

Beaufort Sea Survey- Aug 2008



Beaufort Sea Survey- Aug 2008

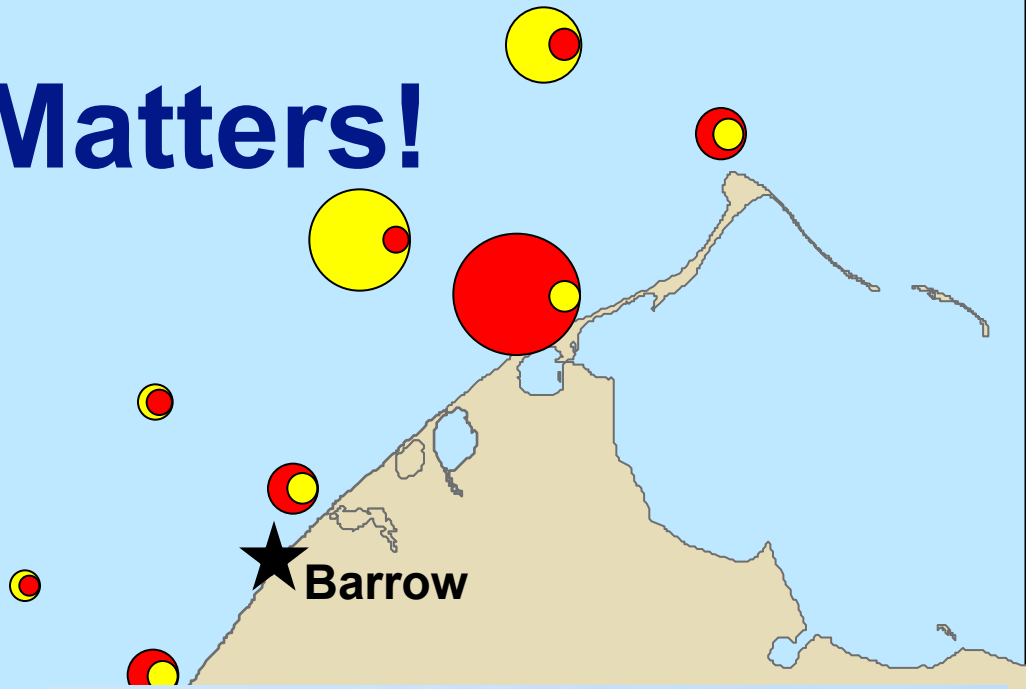




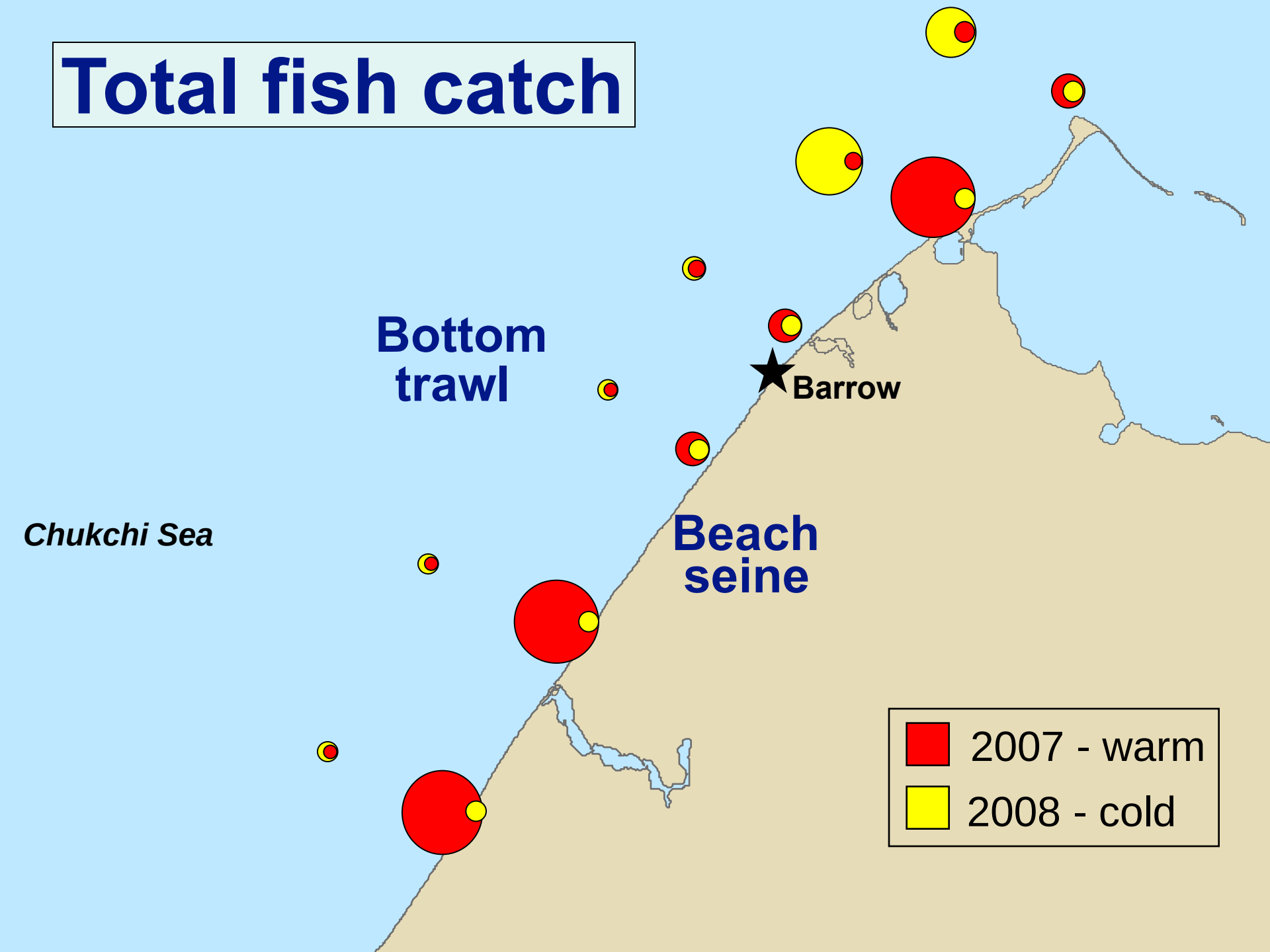
Quantitative But— ONLY one year

Ice Condition Matters!

Bottom trawl



Total fish catch



Oil in the Arctic- --
What do we need?
For planning; for damage assessment

- Baselines- chemical and population (Repeat on periodically)
- Can'd do all species- have to Priortize
- Determine seasonal distribution (Ice vs Open water)
- Determine reproductive biology (Relate to Ice/Open water)
- Determine relevant Biomarkers- (Proxies for population effect)

  Relevant = relation to population effect,

  in contrast to reflecting exposure (e.g. P450 in Pink Salmon)

* Quantiative assessment of habitat productivity; multiple sites