Oil development in the Arctic:
What are the science needs to protect resources?

Stanley Rice, NOAA (Retired)
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

% survival of returning adults

Exposure to Eggs (ppB PAH)
CYP1A response in Embryo = decreased survival of adults
Oil was dispersed - little reached the shore
But, did dispersants do that?
From DWH, Exxon Valdez, and other spills

Removal of oil - skimming, burning = about 10%

(Even with the armada of skimmers in the Gulf)
What can we transfer to the Arctic?

August 2006

June 2007

August 2008
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

August 2008
What do we know about Arctic

Physical dominating features are extreme

Temperature
Ice
Wind
Light/ dark
(& remote)
# USGS Arctic Report: Environmental Factors

<table>
<thead>
<tr>
<th></th>
<th>Summer (Jul-Sep)</th>
<th>Fall (Oct-Dec)</th>
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<tbody>
<tr>
<td><strong>Open Ice Conditions</strong></td>
<td>40%</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Days of Peak Gust (&gt;30 MPH)</strong></td>
<td>21%</td>
<td>34%</td>
</tr>
<tr>
<td><strong>Days of Fog</strong></td>
<td>49%</td>
<td>57%</td>
</tr>
<tr>
<td><strong>Avg. Minimum Temperature</strong></td>
<td>-7 C</td>
<td>-36 C</td>
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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 vulnerability:

Air Breathers are most vulnerable.
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

Length frequency of Arctic cod

Quantitative

But—ONLY one year
Ice Condition Matters!

Bottom trawl

2008

2007

Barrow

Chukchi Sea

2007 - warm
2008 - cold
Total fish catch

Chukchi Sea

Bottom trawl

Beach seine

Barrow

2007 - warm

2008 - cold
Oil in the Arctic--
What do we need?
For planning; for damage assessment

- Baselines - chemical and population (Repeat on periodically)
- Can’t do all species - have to prioritize
- 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)

* Quantitative assessment of habitat productivity; multiple sites