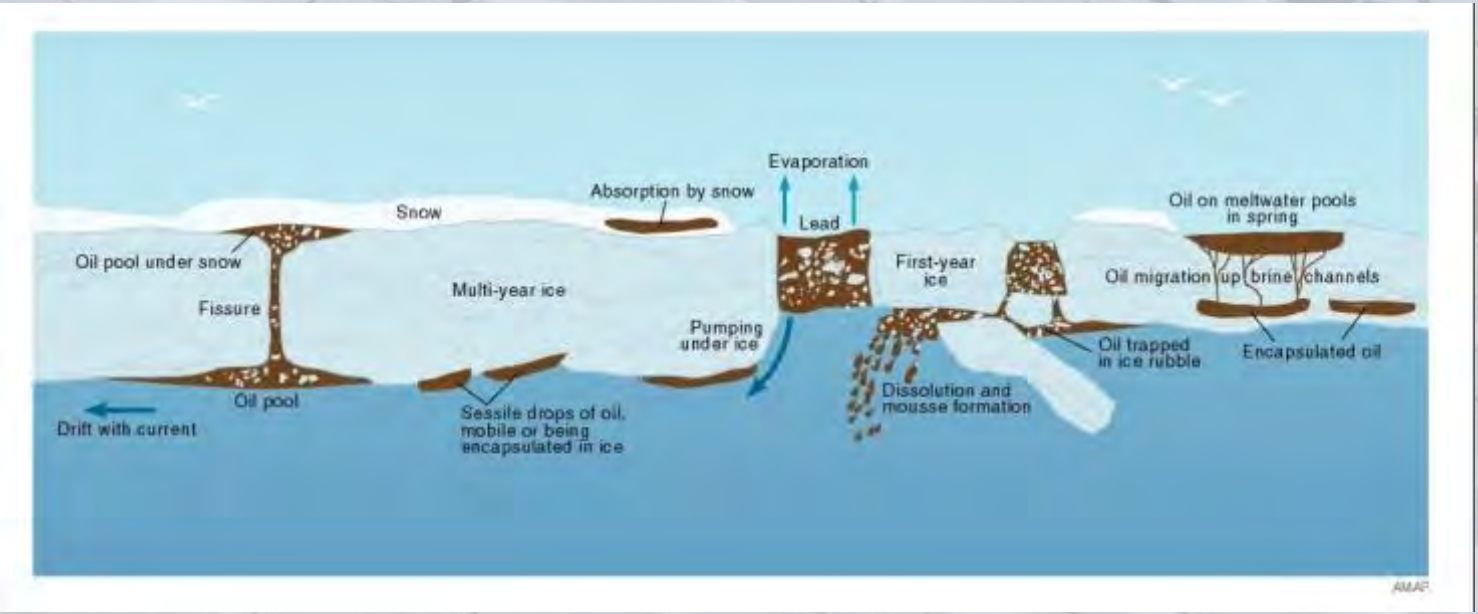
Preliminary report: State-of-Science Workshops for Dispersant Use in Arctic waters:



Doug Helton
NOAA | National Ocean Service | Office of Response and Restoration

Alaska RRT, January 28, 2015

SONS 2013

- An outcome of the December, 2013 SONS senior leadership exercise
- Attendees called for
  - An evaluation of the state of the science of dispersants and dispersed oil
  - A clear delineation of the remaining uncertainties

Coordinated by CRRC, with NOAA support

- NOAA
- USCG
- EPA
- DOI
- State of Alaska
- Cook Inlet RCAC
- PWS RCAC
- Alaska Clean Seas

Experts

- **Agencies:** NOAA, EPA, BSEE, USCG, NIH, Alaska, California, North Slope Bureau
- **Universities**: Alabama, Alaska, Calgary, California, Colorado, Florida, Georgia, Louisiana, Maine, Queen's University, Tennessee, Texas, UNH, WHOI,
- **Companies:** ExxonMobil, BP, Shell
- **Countries**: USA, Canada, Australia, Norway, Netherlands
- **NGOs:** Alaska Native Health Consortium, OSRI
- **Consultants**: Payne, ASA, RPI, Fingas, Sl Ross, Environ, PESA

Full day sessions on:

- Dispersant efficacy and effectiveness

  (will they work in Arctic conditions?)
- Physical transport and chemical behavior

  (where will the dispersed oil go?)
- Degradation and fates

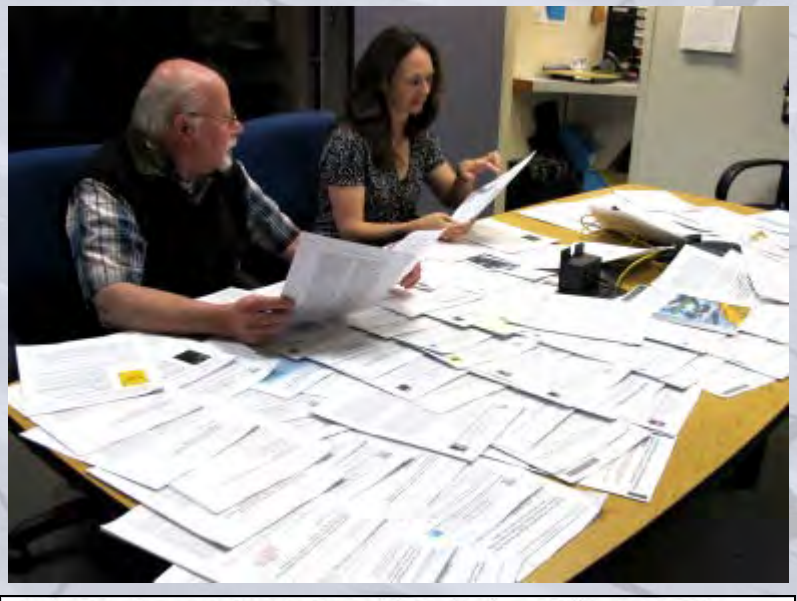
  (will the oil and dispersants degrade and how long will it take?)
- Toxicity and sub-lethal impacts

  (what are the impacts on food webs and animals?)
- Public health and food security

  (what are the risks for workers, public, and subsistence users?)

Caveats

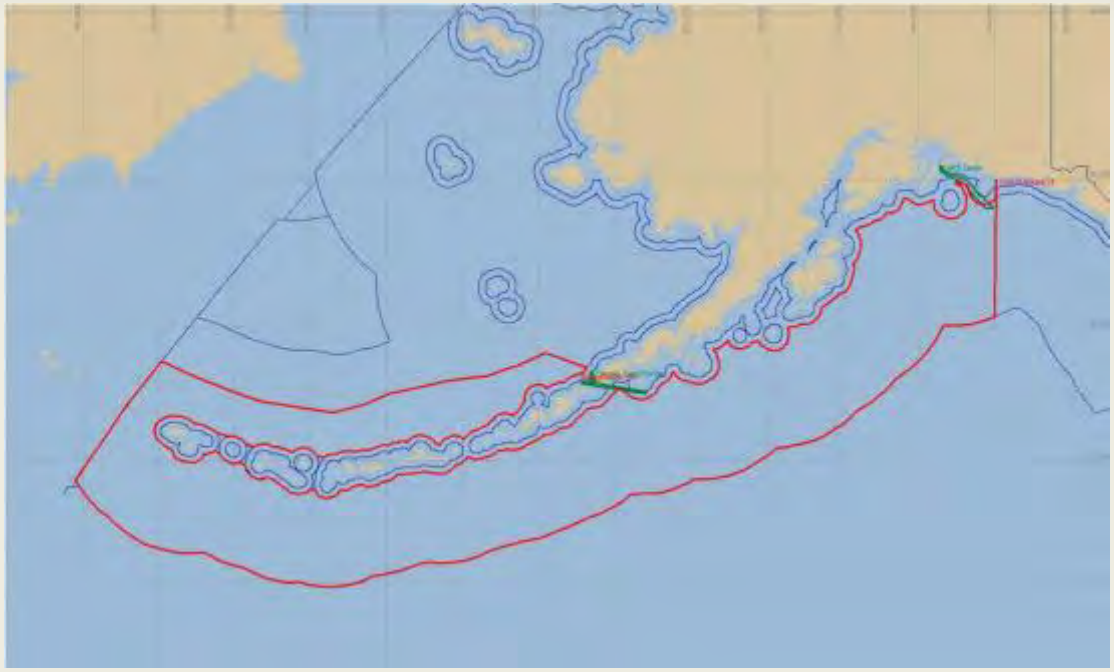
- Status based on peer reviewed literature
- Not focused on logistical or operational considerations
- Not focused on future research priorities
- Broad definition of the Arctic
- Preliminary conclusions are mine….



Draft proposal for dispersant pre-authorization zone in Alaska.

The proposal would establish a dispersant pre-authorization zone for vessels navigating in/out of Prince William Sound, Cook Inlet, and on the Great Circle Route through Unimak Pass and Aleutians. Once established, this zone would trigger existing federal regulatory requirements for vessel response plans to include a dispersant capability.

The establishment of pre-authorization areas and processes allows the Federal On-Scene Coordinator to rapidly approve the use of dispersants in these designated offshore waters.



- Offshore boundaries are the 200 NM mile EEZ in North Pacific and a 100 NM mile boundary in Bering Sea
- The near shore boundary is 24 NM miles
- The boundary touches shore to prevent a regulated vessel from trying to skirt the rule by traveling close to shore.
- The green lines are existing traffic lanes

Dispersant efficacy and effectiveness:

(will they work in Arctic conditions?)

- Temperature affects the physical properties of oils which in turn affects their dispersability.
- Viscosity is only one factor
- However, oils that disperse in temperate conditions will generally disperse in cold water if they remain fluid

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Large-scale cold water dispersant effectiveness experiments with Alaskan crude oils and Corexit 9500 and 9527 dispersants

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ABSTRACT

There continues to be reluctance in some jurisdictions to use chemical dispersants as a viable countermeasure for accidental oil spills. One argument used by some opponents to dispersant use is that "chemical dispersants do not work effectively in cold water". To address this issue, the U.S. Minerals Management Service (MMS) funded and conducted two series of large-scale dispersant experiments in very cold water at Ohmsett – The National Oil Spill Response Test Facility, located in Leonardo, New Jersey in February–March 2006 and January–March 2007. Alaska North Slope, Endicott, Northstar and Pt. McIntyre crude oils and Corexit 9500 and Corexit 9527 dispersants were used in the two test series. The crude oils were tested both when fresh and after weathering. Results demonstrated that both Corexit 9500 and Corexit 9527 dispersants were 85–95% effective in dispersing the fresh and weathered crude oils tested at cold temperatures. The MMS expects that results from these test series will assist government regulators and responders in making science based decisions on the use of dispersants as a response tool for oil spills in the Arctic.

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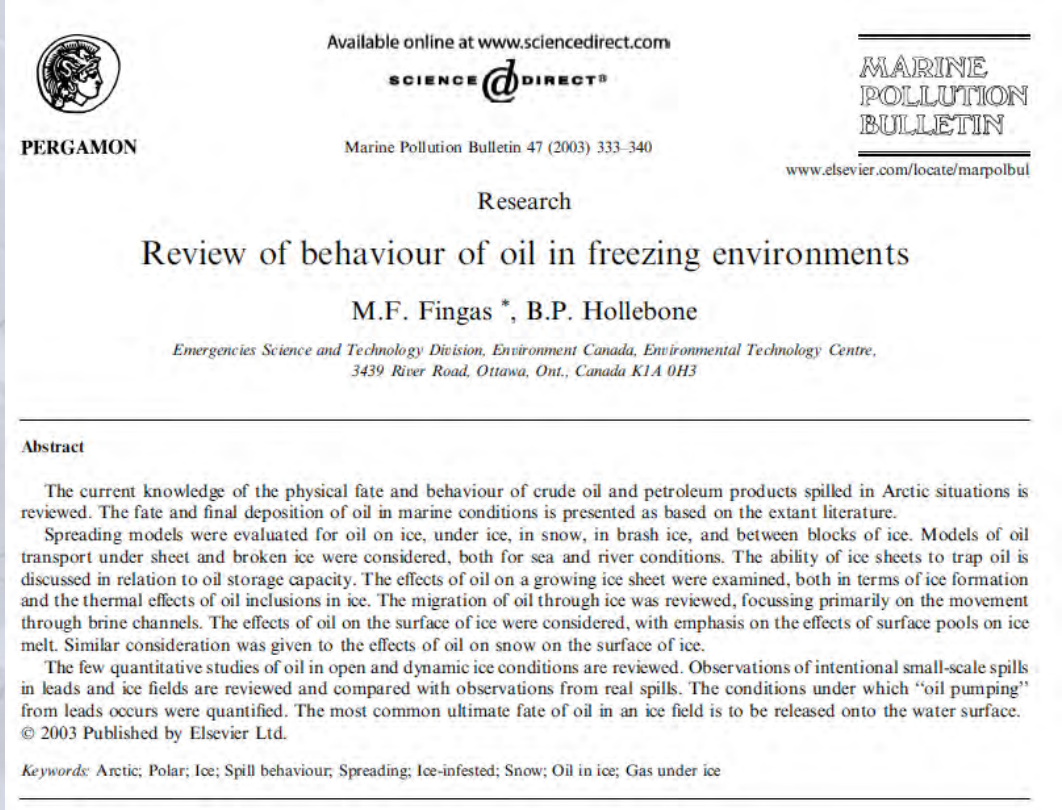
Physical transport and chemical behavior:

(where will the dispersed oil go?)

- Oil can be transported with and within ice.
- Presence of ice dampens wave energy but shearing effect of ice can increase mixing
- During ice formation, exuded brine creates a transport mechanism for moving dissolved constituents to the bottom.



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Research

Review of behaviour of oil in freezing environments

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Abstract

The current knowledge of the physical fate and behaviour of crude oil and petroleum products spilled in Arctic situations is reviewed. The fate and final deposition of oil in marine conditions is presented as based on the extant literature.

Spreading models were evaluated for oil on ice, under ice, in snow, in brash ice, and between blocks of ice. Models of oil transport under sheet and broken ice were considered, both for sea and river conditions. The ability of ice sheets to trap oil is discussed in relation to oil storage capacity. The effects of oil on a growing ice sheet were examined, both in terms of ice formation and the thermal effects of oil inclusions in ice. The migration of oil through ice was reviewed, focussing primarily on the movement through brine channels. The effects of oil on the surface of ice were considered, with emphasis on the effects of surface pools on ice melt. Similar consideration was given to the effects of oil on snow on the surface of ice.

The few quantitative studies of oil in open and dynamic ice conditions are reviewed. Observations of intentional small-scale spills in leads and ice fields are reviewed and compared with observations from real spills. The conditions under which "oil pumping" from leads occurs were quantified. The most common ultimate fate of oil in an ice field is to be released onto the water surface.
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Keywords: Arctic; Polar; Ice; Spill behaviour; Spreading; Ice-infested; Snow; Oil in ice; Gas under ice

Degradation and fates

(will the oil and dispersants degrade and how long will it take?)

- Hydrocarbon degrading microbes are ubiquitous and will actively degrade constituents in crude oil in Arctic surface waters
- Oils are degraded by complex microbial consortia with complementary metabolic pathways. (It takes a village).

Biodegradation of Dispersed Oil in Arctic Seawater at -1°C

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Abstract

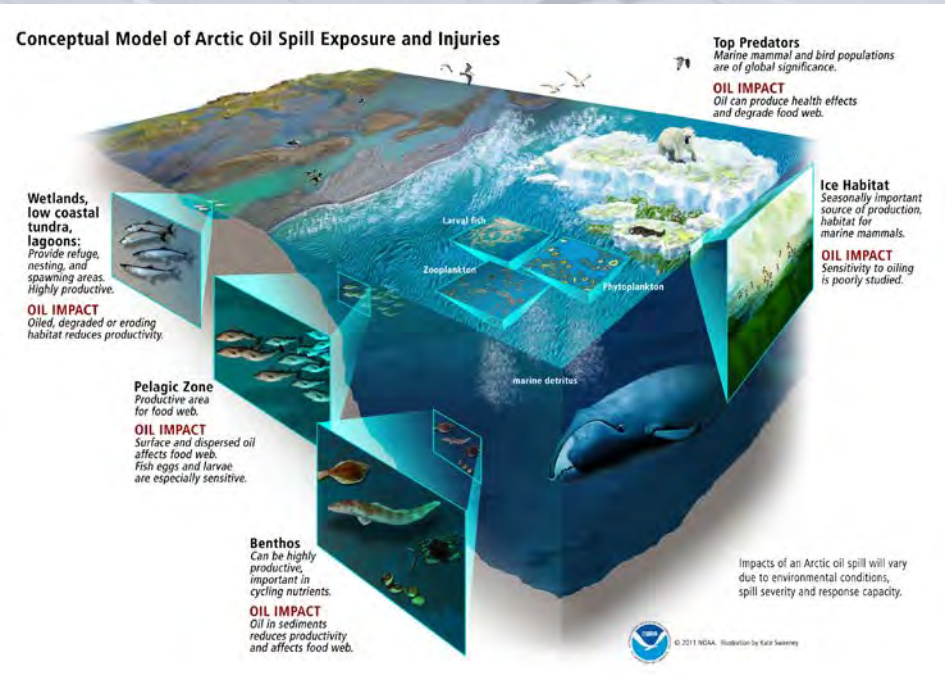
As offshore oil and gas exploration expands in the Arctic, it is important to expand the scientific understanding of arctic ecology and environmental impact to mitigate operational risks. Understanding the fate of oil in arctic seawater is a key factor for consideration. Here we report the chemical loss due to the biodegradation of Alaska North Slope (ANS) crude oil that would occur in the water column following the successful dispersion of a surface oil slick. Primary biodegradation and mineralization were measured in mesocosms containing Arctic seawater collected from the Chukchi Sea, Alaska, incubated at −1°C. Indigenous microorganisms degraded both fresh and weathered oil, in both the presence and absence of Corexit 9500, with oil losses ranging from 46−61% and up to 11% mineralization over 60 days. When tested alone, 14% of 50 ppm Corexit 9500 was mineralized within 60 days. Our study reveals that microorganisms indigenous to Arctic seawater are capable of performing extensive biodegradation of chemically and physically dispersed oil at an environmentally relevant temperature (−1°C) without any additional nutrients.

Citation: McFarlin KM, Prince RC, Perkins R, Leigh MB (2014) Biodegradation of Dispersed Oil in Arctic Seawater at -1°C. PLoS ONE 9(1): e84297. doi:10.1371/journal.pone.0084297

Toxicity and Sub lethal Impacts

(what are the impacts on food webs and animals?)

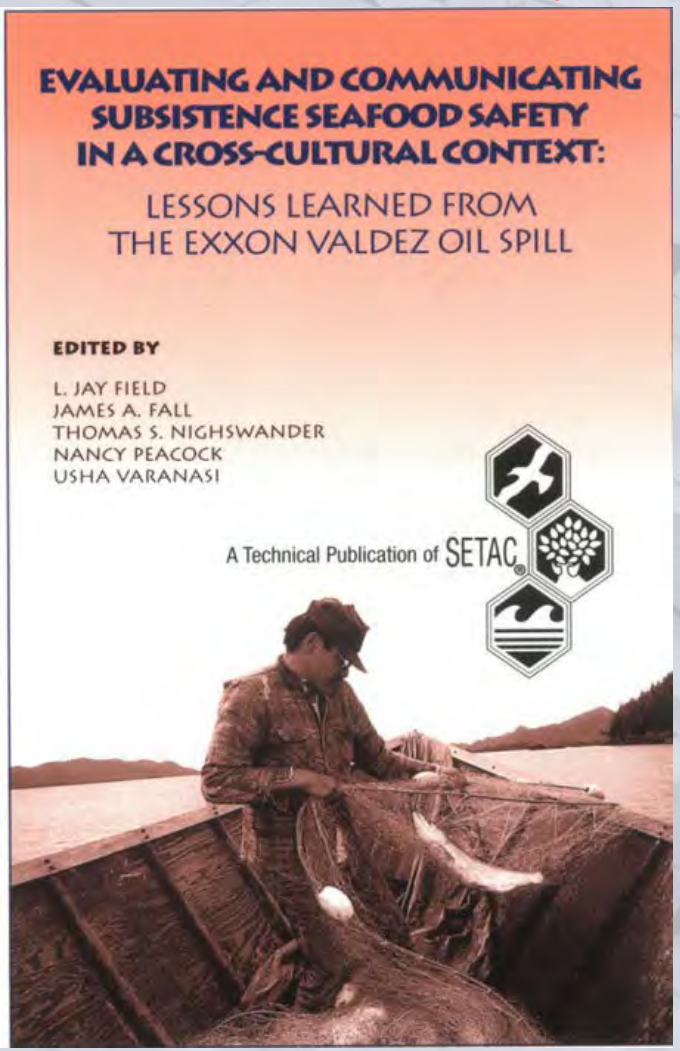
- Exposure routes include inhalation, aspiration, ingestion, and external contact
- Dispersants primarily increase the bioavailability of oil rather than its inherent toxicity.
- Data from standard toxicity tests can miss delayed mortality and other ecologically important endpoints



Public Health and Food Security

(what are the risks for workers, public, and subsistence users?)

- National seafood consumption rates, including species consumed and portions of animal consumed, are not representative of Arctic communities
- Dispersant constituents did not accumulate in edible tissues of Gulf crab and finfish following DWH
- Poor risk communication regarding seafood safety may have negative public health consequences



Preliminary Conclusions and Next Steps

- A lot of information about certain dispersants in temperate regions, but less research and information in the arctic.
- Nest steps include completing discussions,
- Holding informational sessions at GOMRE conference and via webinars.
- We anticipate drafting a detailed report and an executive summary.