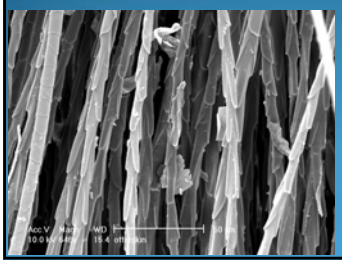
The Physical Effects of Chemically and Mechanically Dispersed Oil on Wildlife



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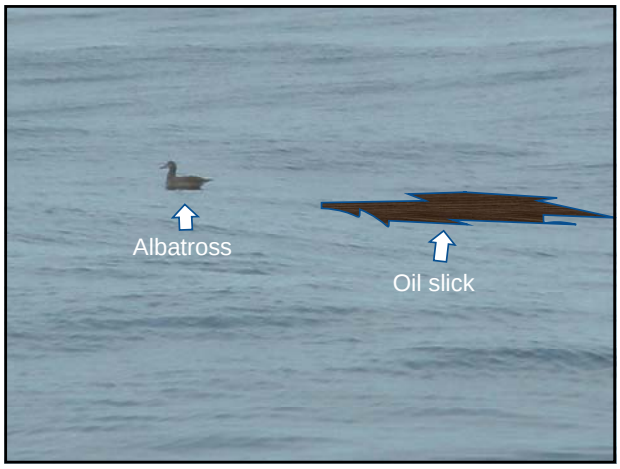
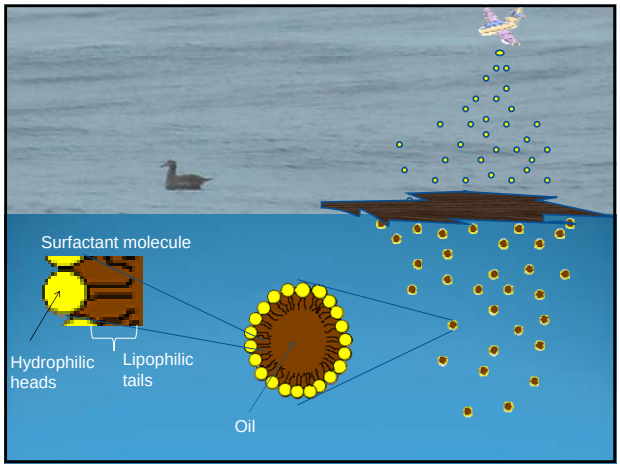




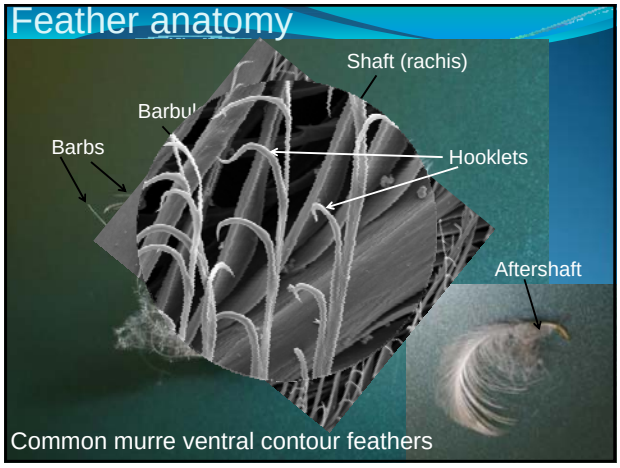
Impetus for study:

- Pre-approval due to assumed benefit
- Limited studies on vertebrates
- Inevitable direct exposure

Objectives

- Generate solutions and system for exposure
- Assess structural changes due to exposure
- Evaluate dose-response relationships

Feather anatomy



Common murre ventral contour feathers

Sea otter pelt

Methods:

Test solutions:

- Plain Instant Ocean (IO)
- IO + Prudhoe Bay crude oil (x 3)
- IO + Corexit 9500 (x 3)
- IO + both (x 3)

Solutions drawn from below surface

Methods:

Exposures:

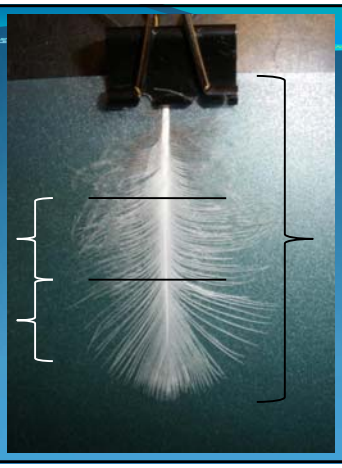
- 100 numbered feathers
- 10 pelt swatches
- 200 rpm for 60 or 90 sec

Outcomes:

- Feather geometry changes
- Blinded observer
  - Orderliness
  - Foreign material observed
- X-ray mapping

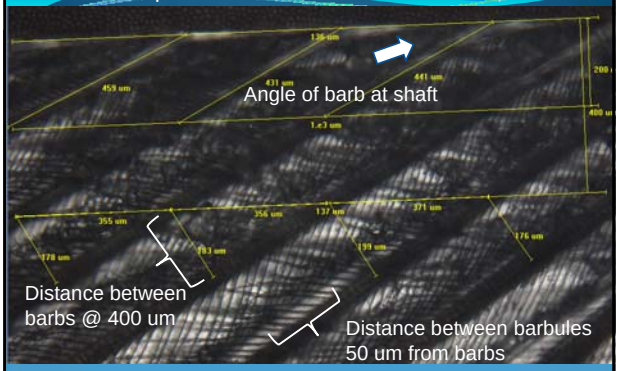
Middle 1 cm for light microscopy

Distal tip for electron microscopy

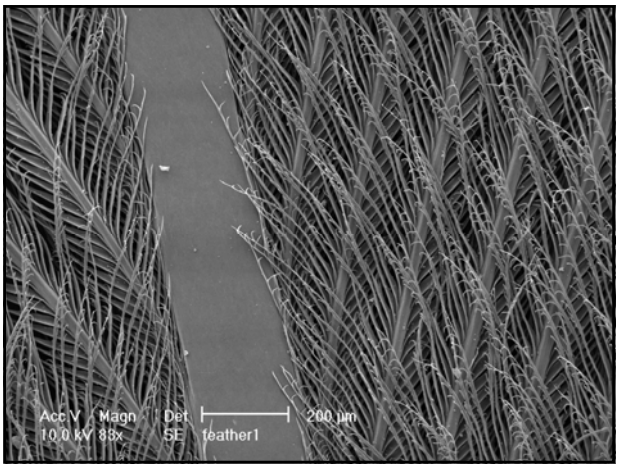


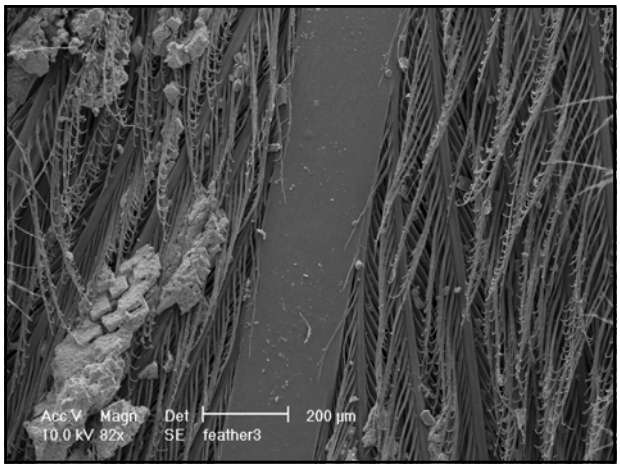
~4.0 cm total length

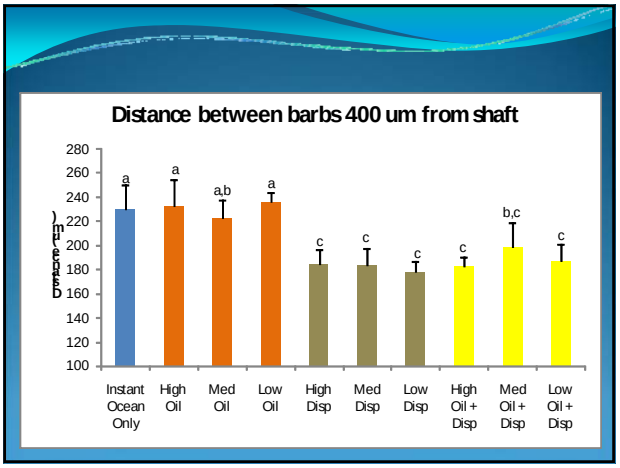
Feather morphometrics

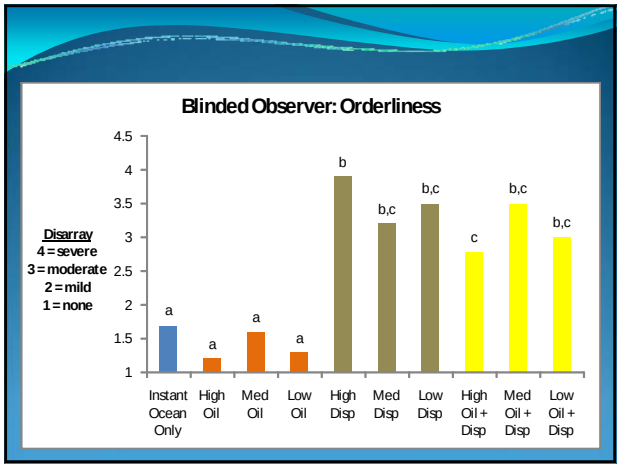


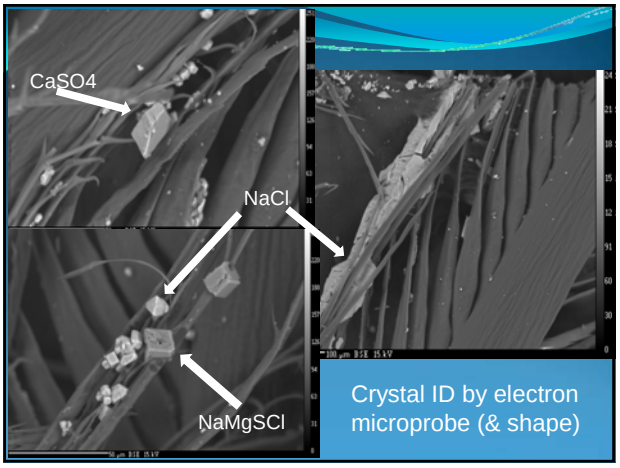
Light microscopy, high concentration of oil + dispersant

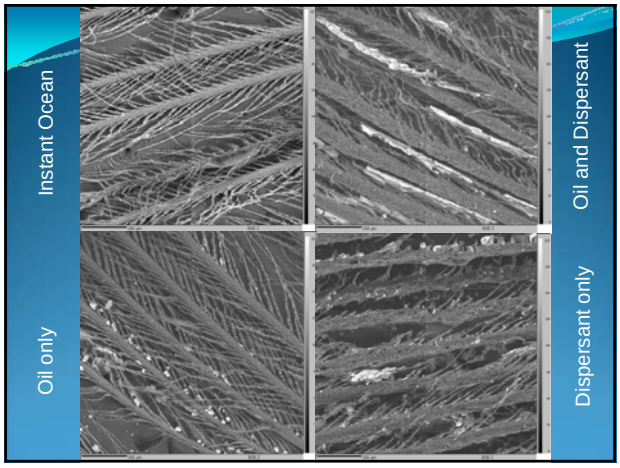

Acc.V Magn Det
10.0 kV 83x SE feather1
200 µm

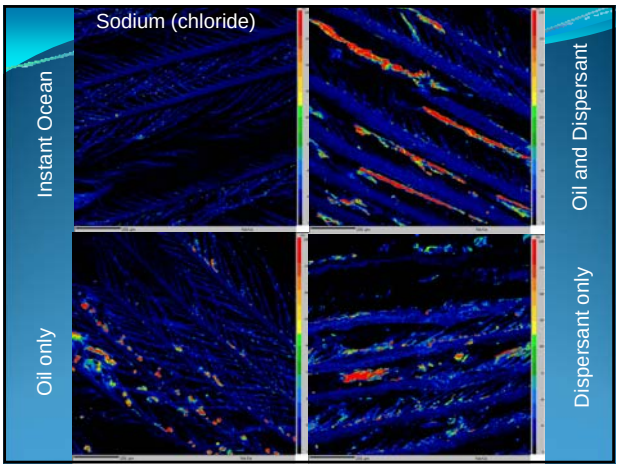

Acc.V Magn Det
10.0 kV 82x SE feather3
200 µm


Distance between barbs 400 um from shaft
280
260
240
220
200
180
160
140
120
100
a
a
a,b
a
c
c
c
c
b,c
c
Instant Ocean Only
High Oil
Med Oil
Low Oil
High Disp
Med Disp
Low Disp
High Oil + Disp
Med Oil + Disp
Low Oil + Disp


Blinded Observer: Orderliness
Disarray
4 = severe
3 = moderate
2 = mild
1 = none
4.5
4
3.5
3
2.5
2
1.5
1
a
a
a
a
b
b,c
b,c
c
b,c
b,c
Instant Ocean Only
High Oil
Med Oil
Low Oil
High Disp
Med Disp
Low Disp
High Oil + Disp
Med Oil + Disp
Low Oil + Disp


CaSO4
NaCl
NaMgSCl
Crystal ID by electron microprobe (& shape)


Instant Ocean
Oil and Dispersant
Oil only
Dispersant only



Summary of findings

- Dispersant exposure:
  - Immediate change in feather behavior
  - Significant geometric changes to feathers
  - Significant loss of orderliness
  - More foreign material observed crusted on feathers
- No dose dependent effects noted at concentrations tested
- No significant findings about otter pelt
  - Why?

Implications for dispersant use:

- Potential exposure of larger numbers of animals due to dispersion into larger volume of water
- May negatively impact waterproofing through alterations in functional geometry
- Immediate loss of plumage/pelt aeration?
  - Even if rinsed in pristine water, would require extensive preening to restore
- Further study needed to ID lower limits of concentrations where see effect

Acknowledgements

This project was funded by the CDFG OSPR Scientific Study and Evaluation Program (SSEP).

Many thanks to Ron Tjeerdema, Bryn Phillips, Don Ballard, January Bill, Yvette Hernandez, Susan Sugarman, Pat Kysar, Sarah Roeske, Dave Jessup, and Francesca Betac for helping make this study happen.