INVESTIGATION OF CHRONIC OILING FROM MARINE OIL SEEPS IN CALIFORNIA

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Office of Spill Prevention and Response

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PURPOSE:

Quickly determine if mystery spills are anthropogenic in origin

- Document baseline level of chronic oiling of wildlife
- Develop a method to quickly identify mystery oil samples
OUTLINE

- Chronic oiling of marine birds
- Oil fingerprinting methods
- Results of fingerprinting
- Next steps
CHRONIC OILING OF MARINE BIRDS

- Seeps emit substantial amount of petroleum into the marine environment
- Very little documentation of effects on wildlife

Santa Barbara, 1923
CHRONIC OILING OF MARINE BIRDS

- January 2005 Ventura Oiled Bird Incident (VOBI)
- About 1,500 oiled birds collected
- Determined oil was from Santa Paula Creek
Oiled Wildlife Care Network (OWCN) has ~30 member orgs

Report every live oiled bird received

We assessed data from 2005-2010
CHRONIC OILING OF MARINE BIRDS

➤ Mean: 245 live oiled birds per year (not including VOBI)
➤ Seasonal trend (more birds Jan – Apr)
CHRONIC OILING OF MARINE BIRDS

- Most live oiled birds recovered in Santa Barbara County, almost none north of San Francisco Bay.
CHRONIC OILING OF MARINE BIRDS

- Number of live oiled birds varies by year
- Most birds are Western/Clark’s Grebes and Common Murres
CHRONIC OILING OF MARINE BIRDS

- South of Pt. Conception, number of live oiled birds related to wave power during previous month
SUMMARY OF EFFECTS ON MARINE BIRDS

- OWCN member orgs report about 245 misc. live oiled birds per year
- More oiled birds in the Santa Barbara Channel area than elsewhere
- Seasonal peak in late winter, may be associated with extreme wave energy
- Not sure to what extent seasonal abundance of birds at sea affects number oiled
OIL FINGERPRINTING METHODS

- Traditional fingerprinting: visually compare chromatograms from GC/MS
Biomarker Ratios

- USGS identified 18 pairs or groups of biomarkers that are relatively stable (slow to weather/biodegrade)

- By comparing height of peaks in pairs (or in some cases area under the curve), calculated 18 different ratios that could be compared among different samples (plus ratio of carbon isotopes)
### OIL FINGERPRINTING METHODS

#### MEAN RELATIVE PERCENTAGE DIFFERENCE (MRPD)

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<tbody>
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<td>A</td>
<td>-23.4</td>
<td>0.59</td>
<td>6.2</td>
<td>1.10</td>
<td>10</td>
<td>0.02</td>
<td>0.03</td>
<td>0.86</td>
<td>0.17</td>
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<td>0.63</td>
<td>0.88</td>
<td>0.32</td>
<td>0.59</td>
<td>0.83</td>
<td>0.30</td>
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<tr>
<td>B</td>
<td>-22.8</td>
<td>0.28</td>
<td>4.4</td>
<td>1.10</td>
<td>44</td>
<td>0.95</td>
<td>0.06</td>
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<td>0.14</td>
<td>0.56</td>
<td>0.40</td>
<td>0.76</td>
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<td>0.77</td>
<td>1.60</td>
<td>0.64</td>
<td>0.05</td>
<td>0.13</td>
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**RPD** = \( \frac{\text{abs}(A-B)}{\text{mean}(A,B)} \)

**MRPD** = \( \text{mean}(\text{RPD}_{1-19}) \)
Mean Relative Percentage Difference (MRPD)

- Developed MATLAB routine to quickly assess MRPD between a mystery sample and other samples
- PCL library of >160 samples with biomarker ratios
- USGS library of >780 samples w/biomarker ratios
- Still visually compare chromatograms to confirm
Out of 1,200 pairwise comparisons, less than 1% of MRPD values >0.15 had consistent chromatograms.
Group A

Possible source: Lopez Seep
USGS Family 33
OIL FINGERPRINTING RESULTS

Group B

Source: Pt. Conception Seeps
USGS Family 22

[Bar chart and map showing tarballs, otters, and birds over time]

[Legend: Tarballs, Otters, Birds]
Group C

Unknown Source
USGS Family 22

OIL FINGERPRINTING RESULTS
OIL FINGERPRINTING RESULTS

Group E
Source: Gaviota
All samples birds in March
USGS Family 212

Group H
Source: between Gaviota/COP
Bird and Otter samples in July
Tar ball sample in March
USGS Family 14
NEXT STEPS

- Continue to document and analyze seasonal and geographic patterns in chronic oiling of wildlife

- If possible, quantify seasonal abundance of marine birds in the Santa Barbara Channel

- Continue to validate use of MRPD with biomarker ratios as a tool to assess similarity

- Add more seep samples to the biomarker ratio databases

- Refine guidelines for response to mystery spills based on baseline chronic oiling
ACKNOWLEDGMENTS

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QUESTIONS?

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