



Presenter:

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INVESTIGATION OF CHRONIC OILING FROM MARINE OIL SEEPS IN CALIFORNIA

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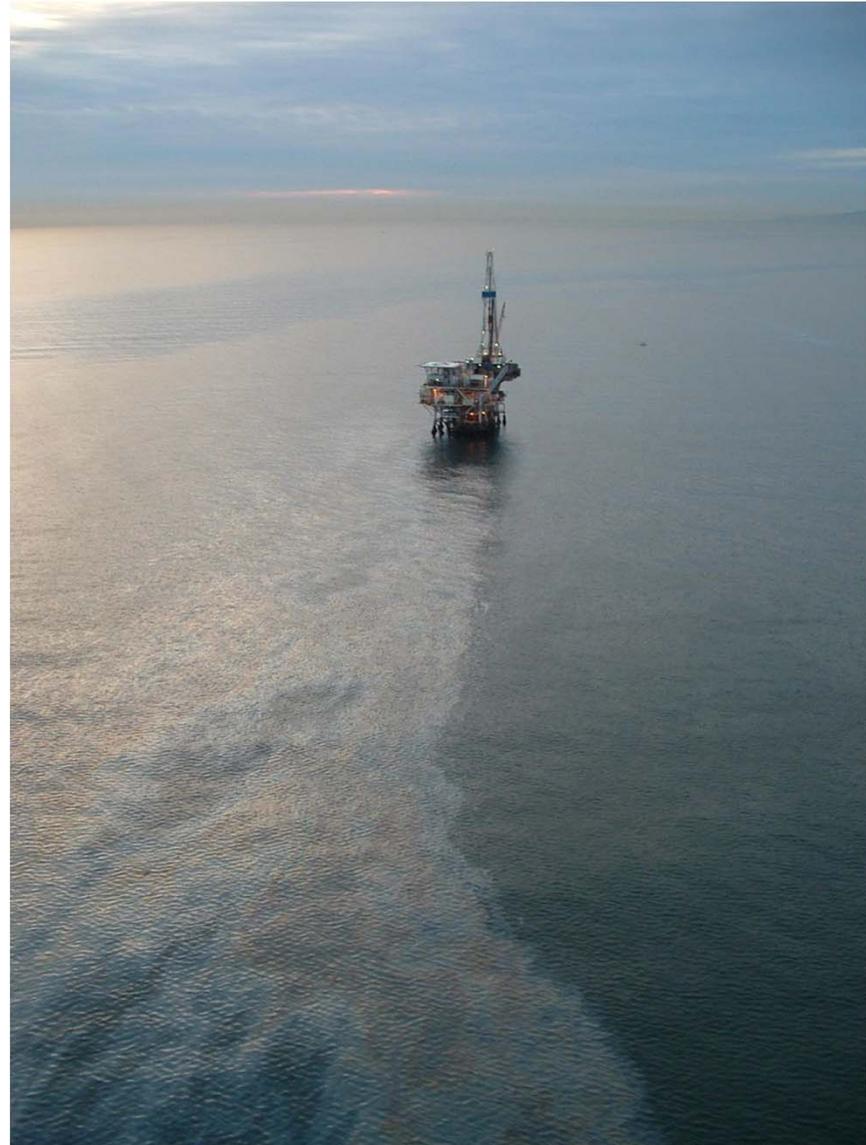
Petroleum Chemistry Laboratory
Rancho Cordova, CA



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



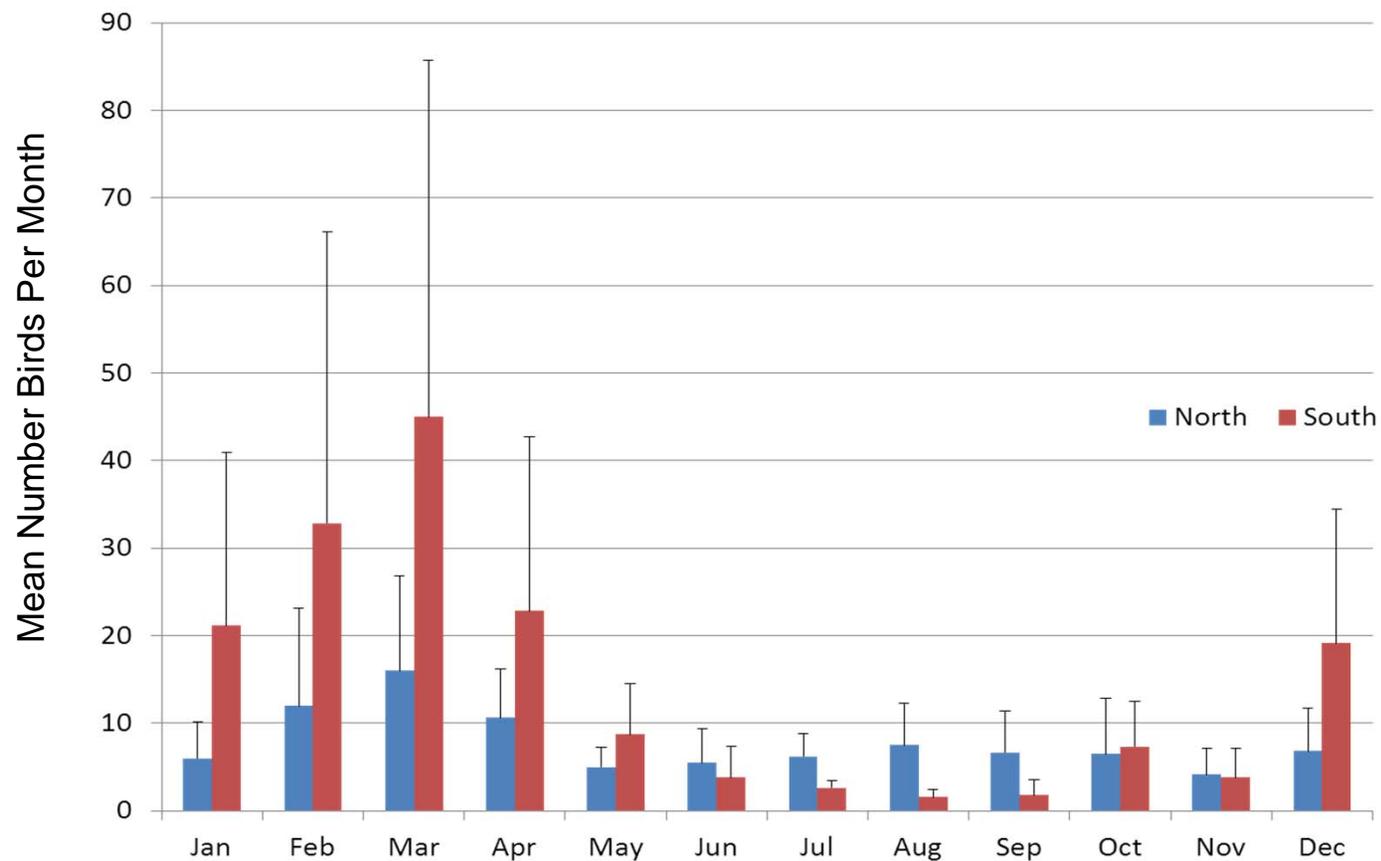
CHRONIC OILING OF MARINE BIRDS

- Oiled Wildlife Care Network (OWCN) has ~30 member orgs
- Report every live oiled bird received
- We assessed data from 2005-2010



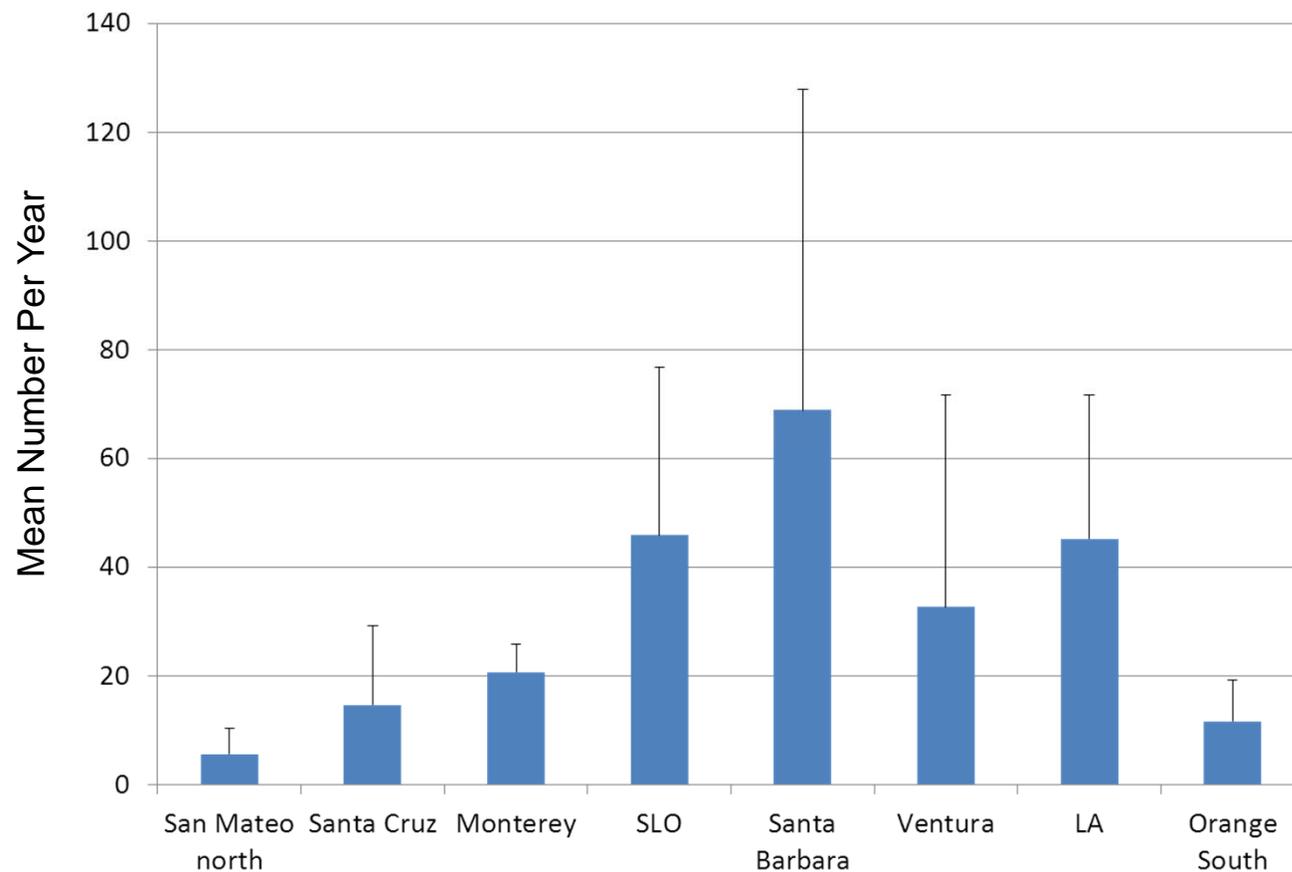
CHRONIC OILING OF MARINE BIRDS

- Mean: 245 live oiled birds per year (not including VOBI)
- Seasonal trend (more birds Jan – Apr)



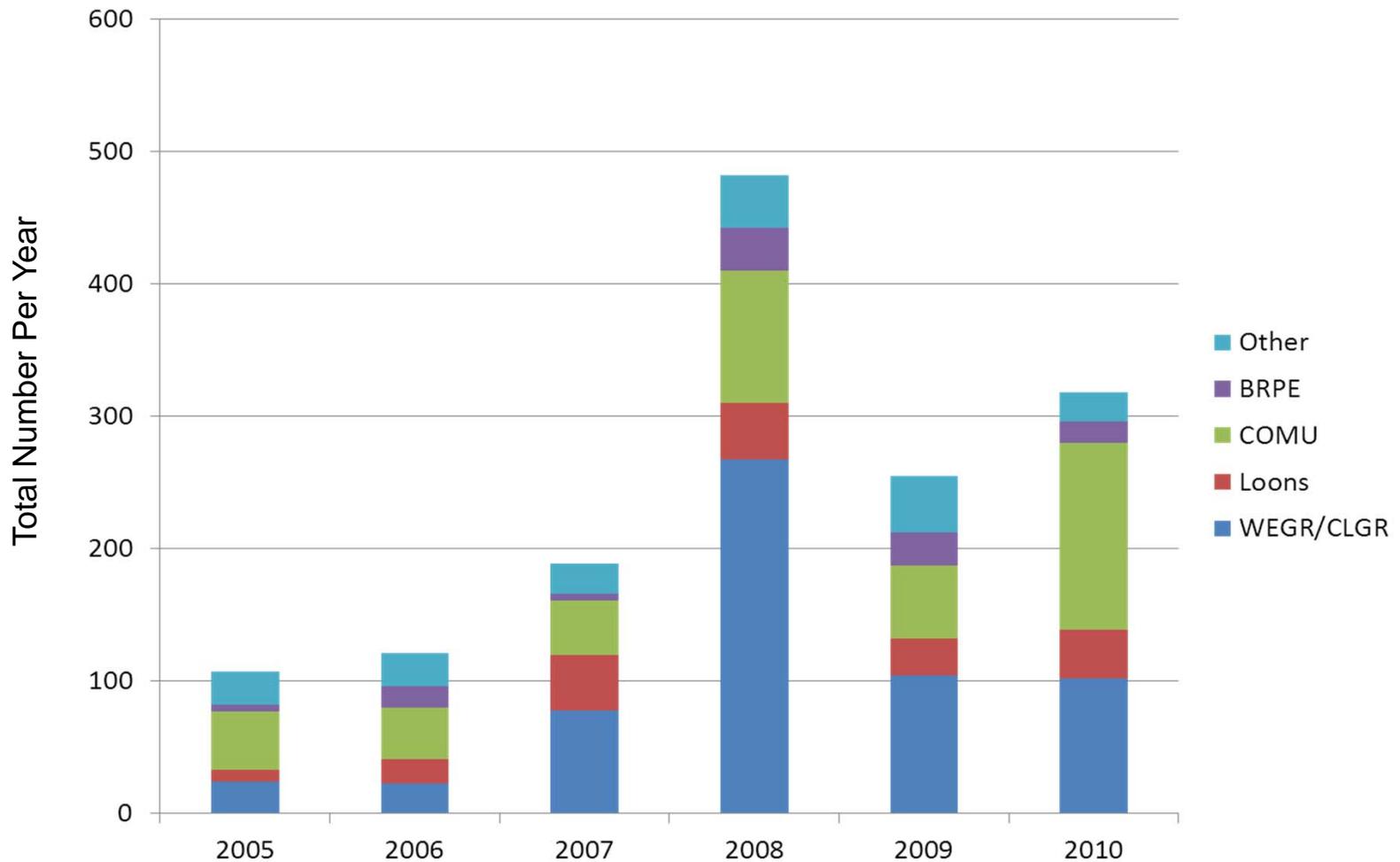
CHRONIC OILING OF MARINE BIRDS

- Most live oiled birds recovered in Santa Barbara County, almost none north of San Francisco Bay.



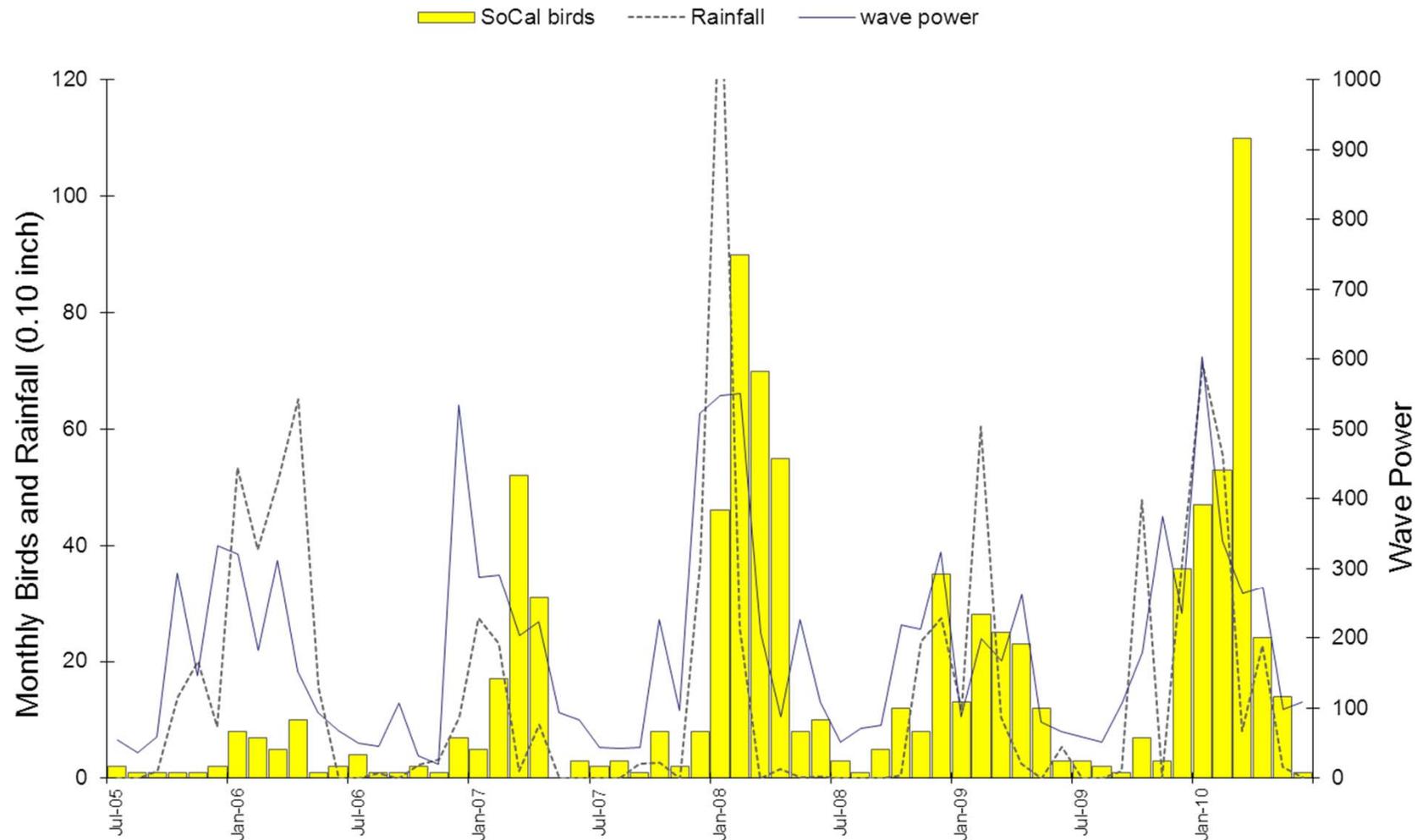
CHRONIC OILING OF MARINE BIRDS

- 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



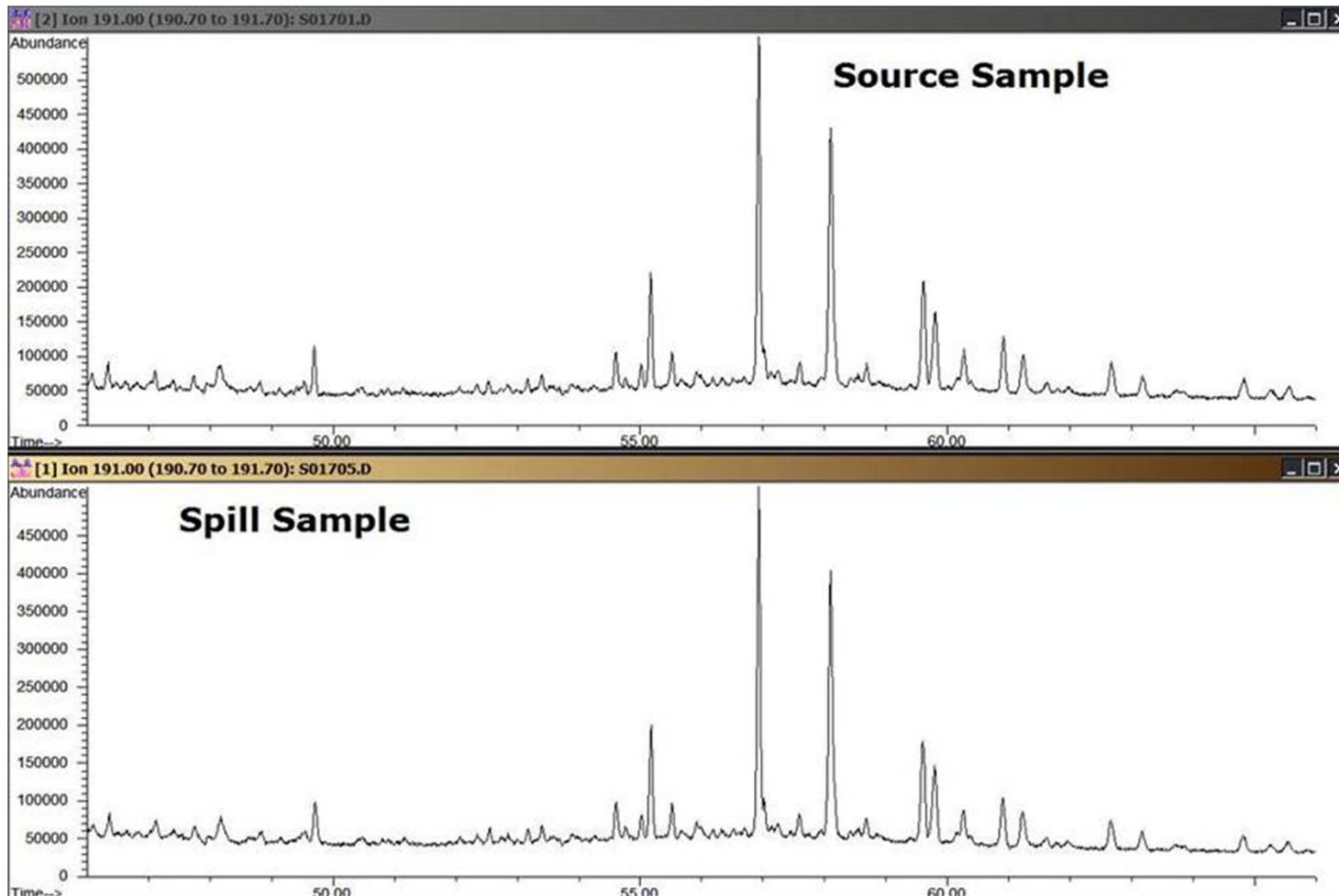
CHRONIC OILING OF MARINE BIRDS

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



OIL FINGERPRINTING METHODS

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)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	-23.4	0.59	6.2	1.10	10	0.02	0.03	0.86	0.17	0.23	0.63	0.88	0.32	0.59	0.83	0.30	0.20	0.11	0.35
B	-22.8	0.28	4.4	1.10	44	0.95	0.06	0.70	0.14	0.56	0.40	0.76	0.56	0.77	1.60	0.64	0.05	0.13	0.19

$$RPD = \text{abs}(A-B)/\text{mean}(A,B)$$

$$MRPD = \text{mean}(RPD_{1-19})$$

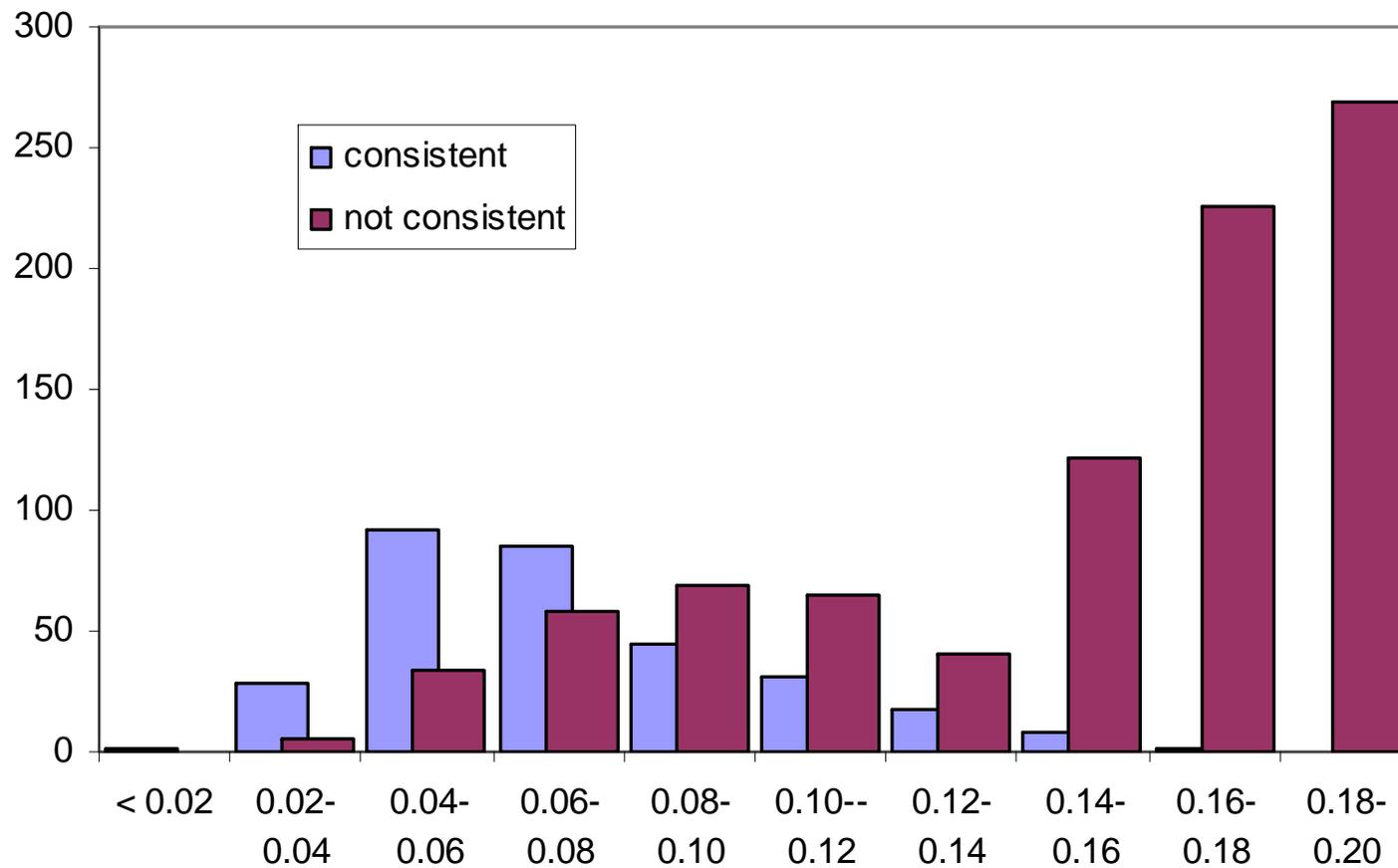
OIL FINGERPRINTING METHODS

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

OIL FINGERPRINTING METHODS

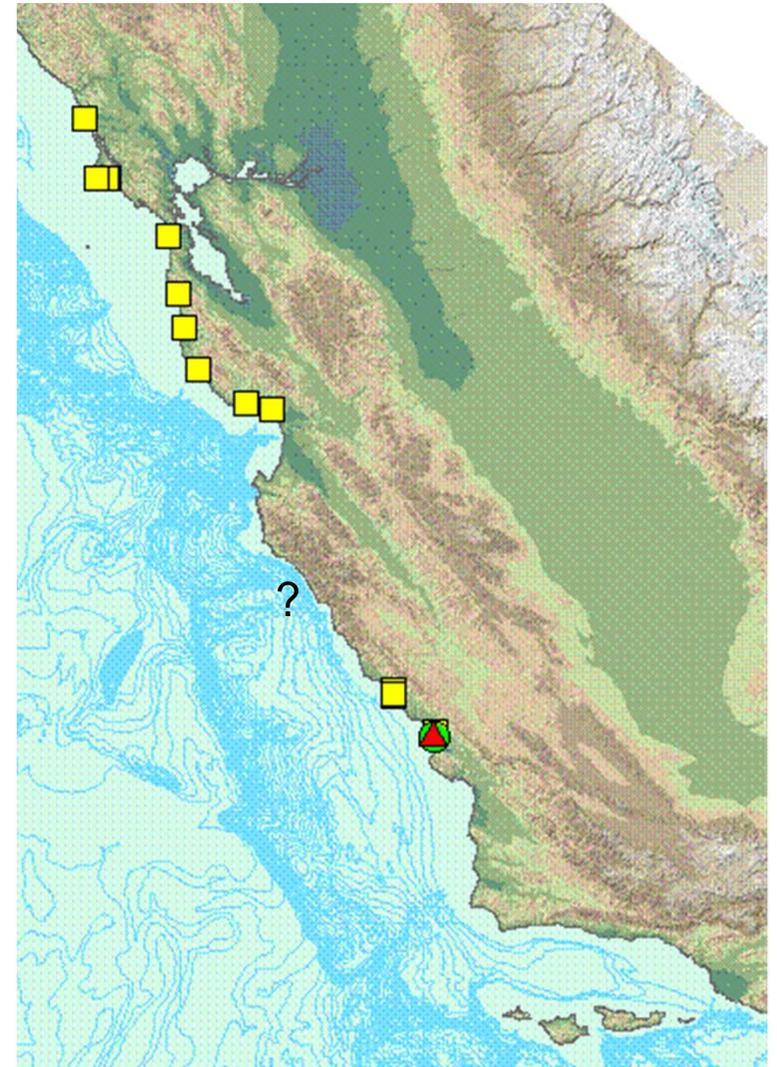
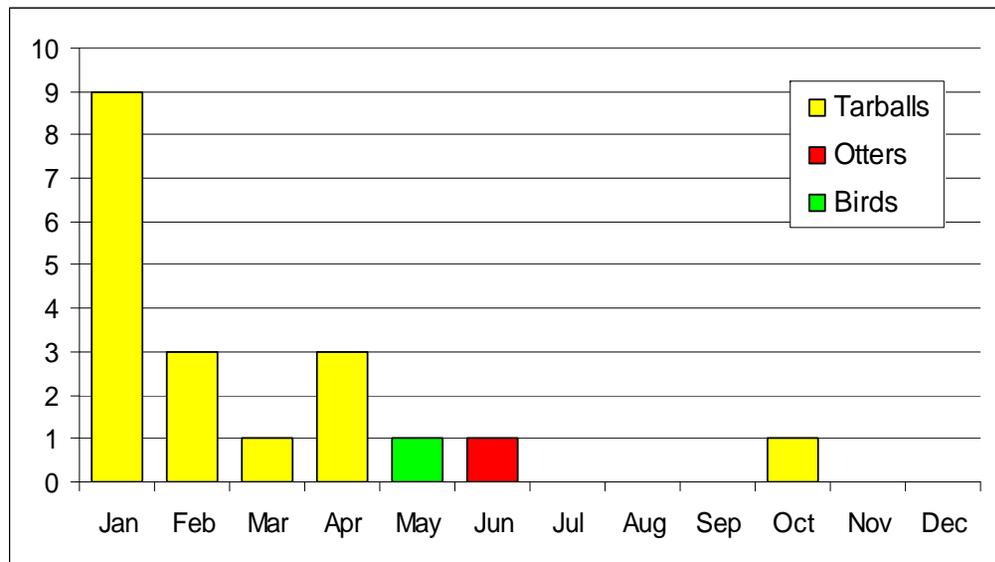
- Out of 1,200 pairwise comparisons, less than 1% of MRPD values >0.15 had consistent chromatograms



OIL FINGERPRINTING RESULTS

Group A

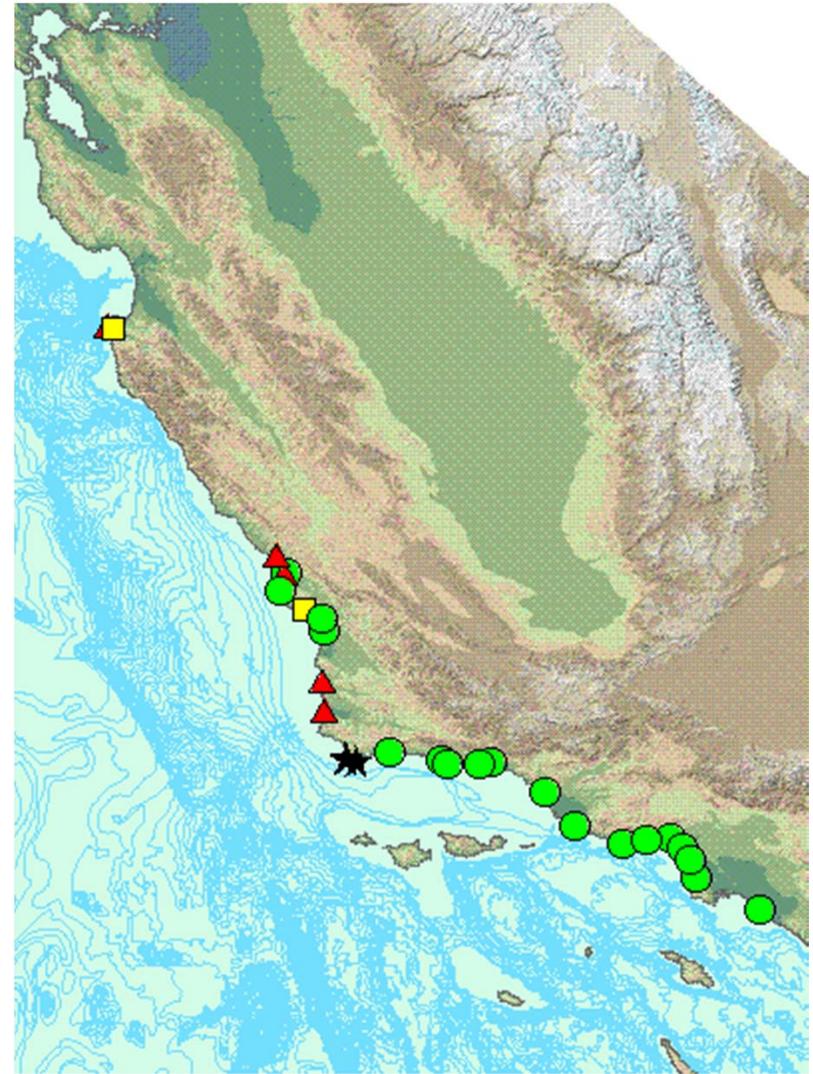
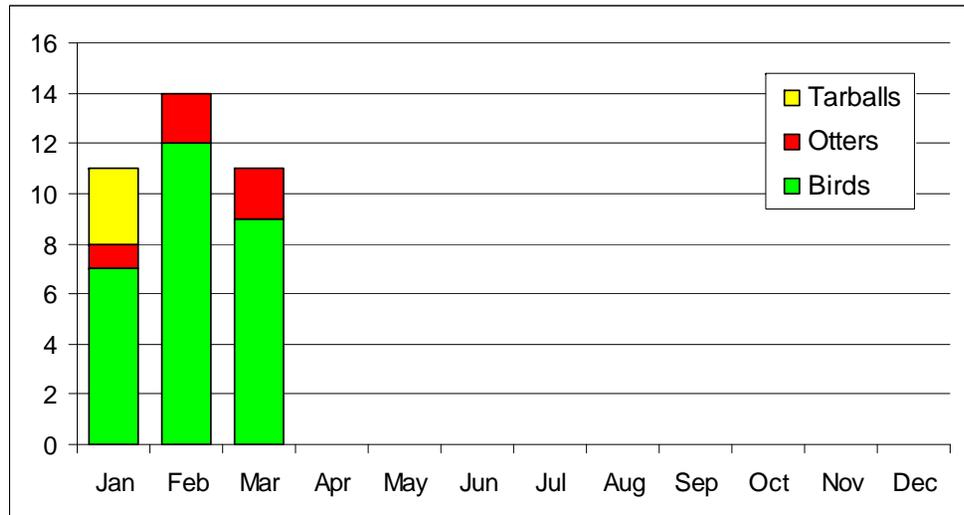
Possible source: Lopez Seep
USGS Family 33



OIL FINGERPRINTING RESULTS

Group B

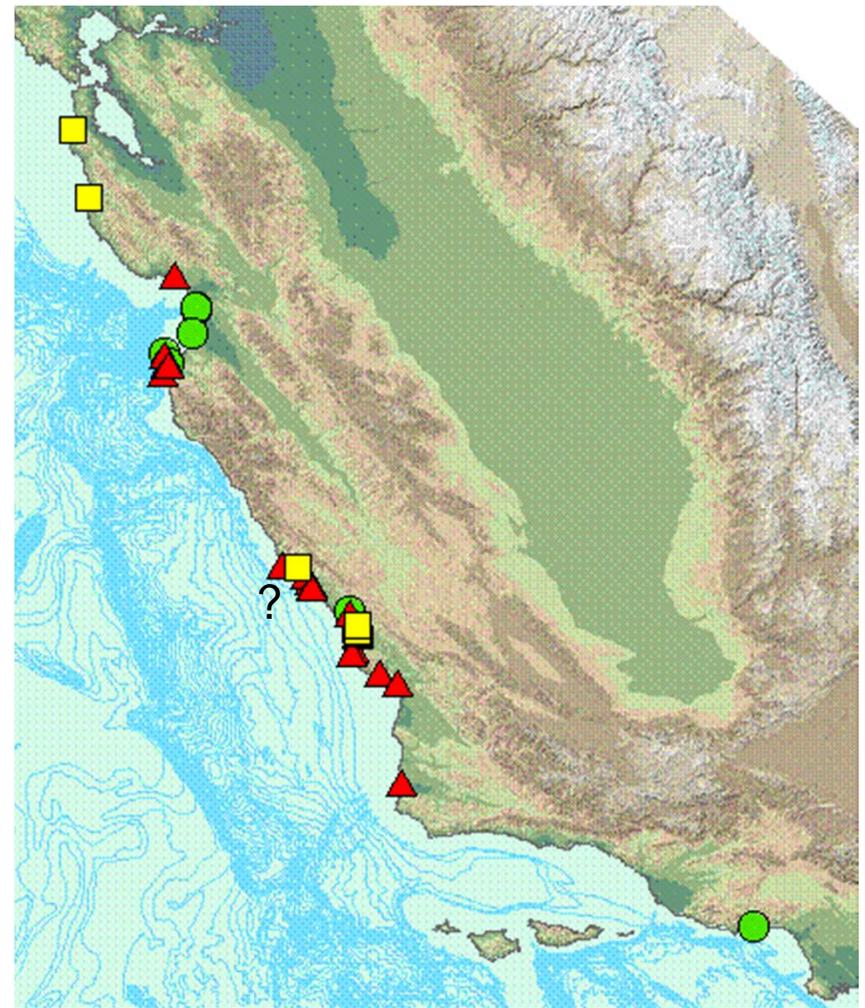
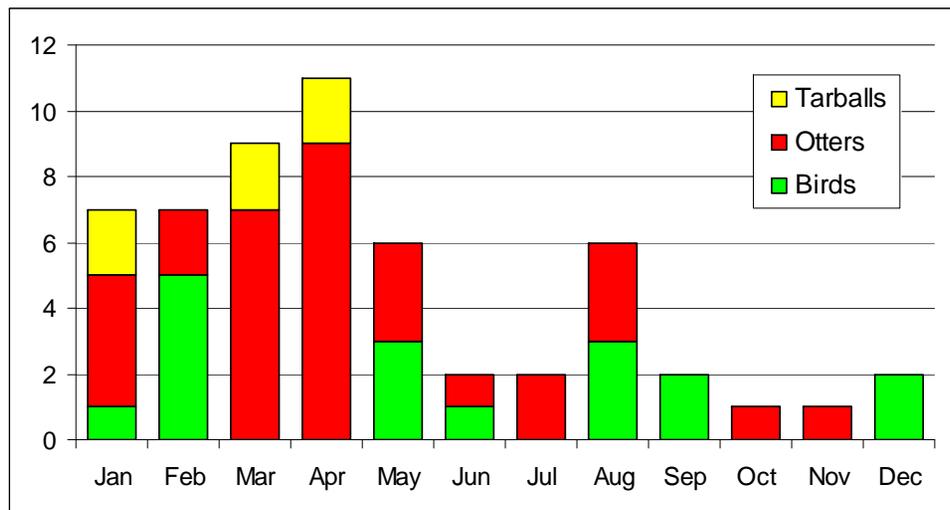
Source: Pt. Conception Seeps
USGS Family 22



OIL FINGERPRINTING RESULTS

Group C

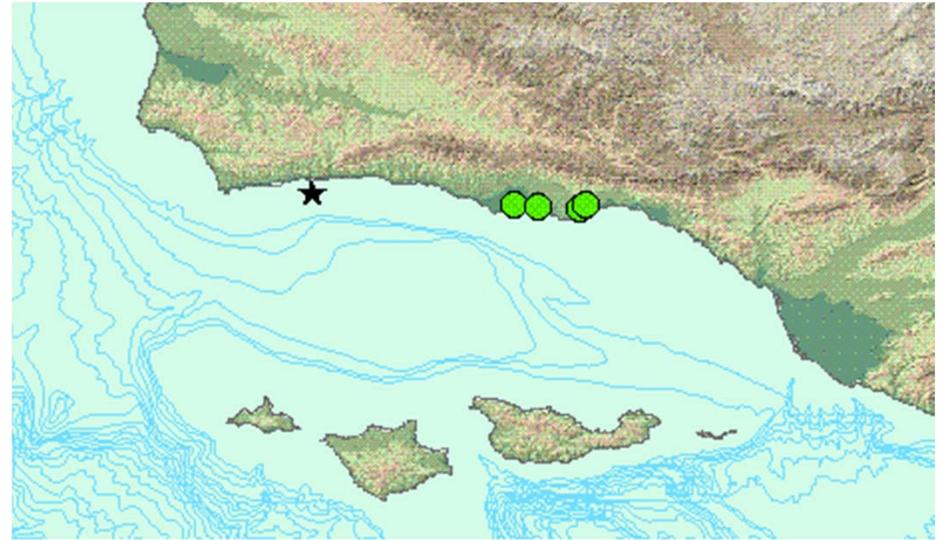
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USGS Family 22



OIL FINGERPRINTING RESULTS

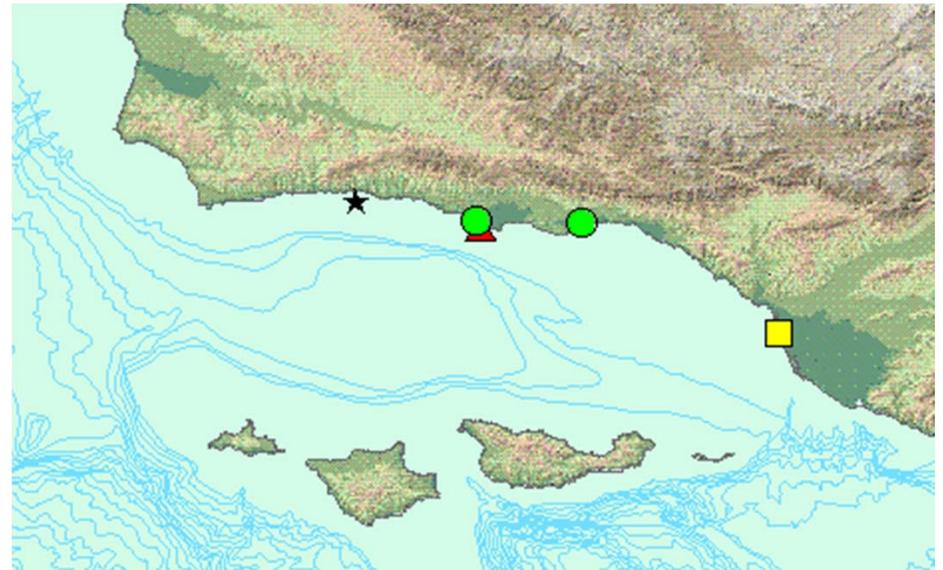
Group E

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

- Mike Ziccardi, Lavonne Hull, Hannah Nevins, and others, UCD/OWCN
- Susan Sugarman, Shane Stahl, OSPR PCL
- Tom Lorenson, Fran Hostettler, and others, USGS

QUESTIONS?

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