



Injury and Recovery of Sea Otters and Harlequin Ducks following the Exxon Valdez Oil Spill: a Quarter-Century Perspective

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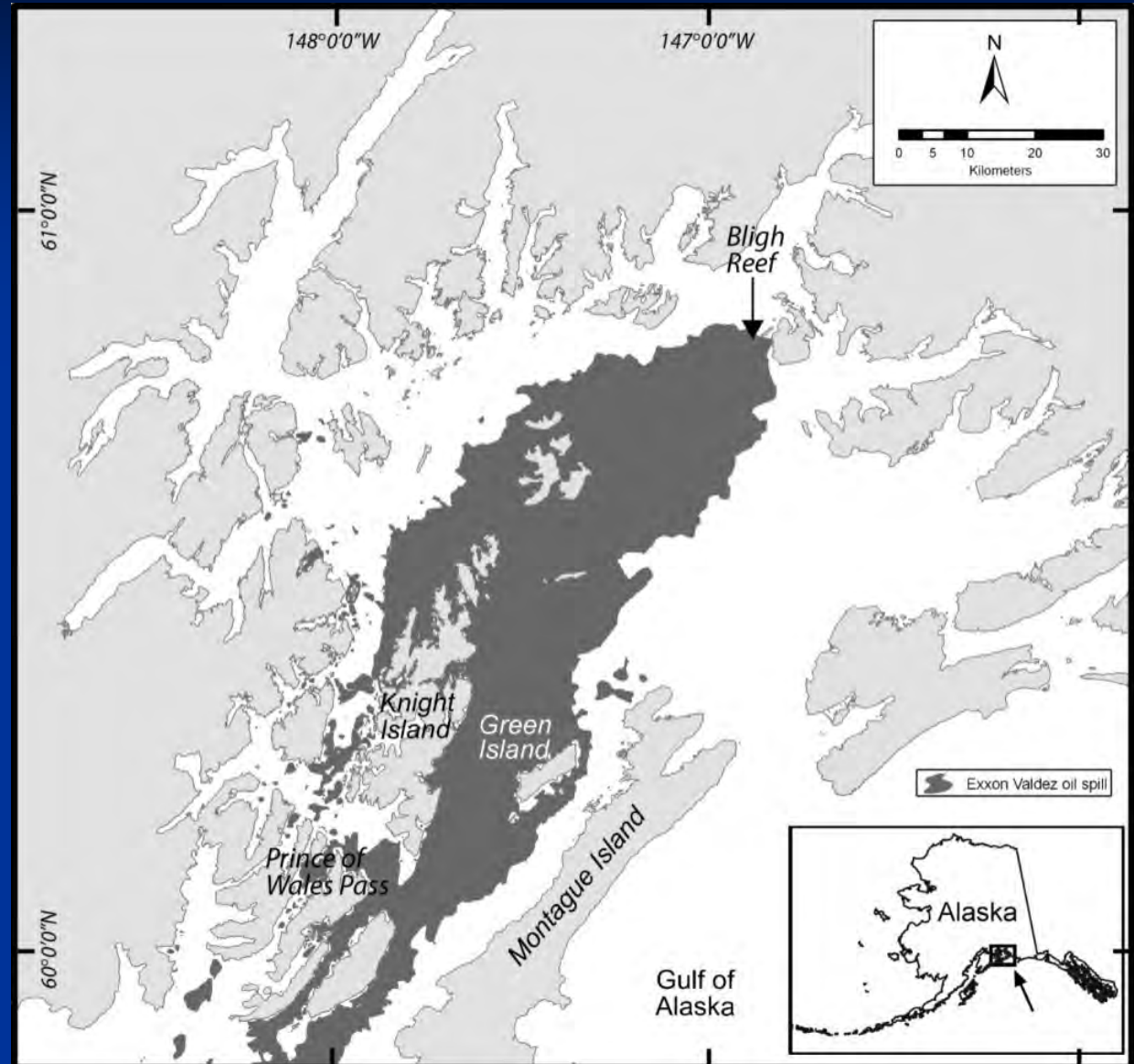
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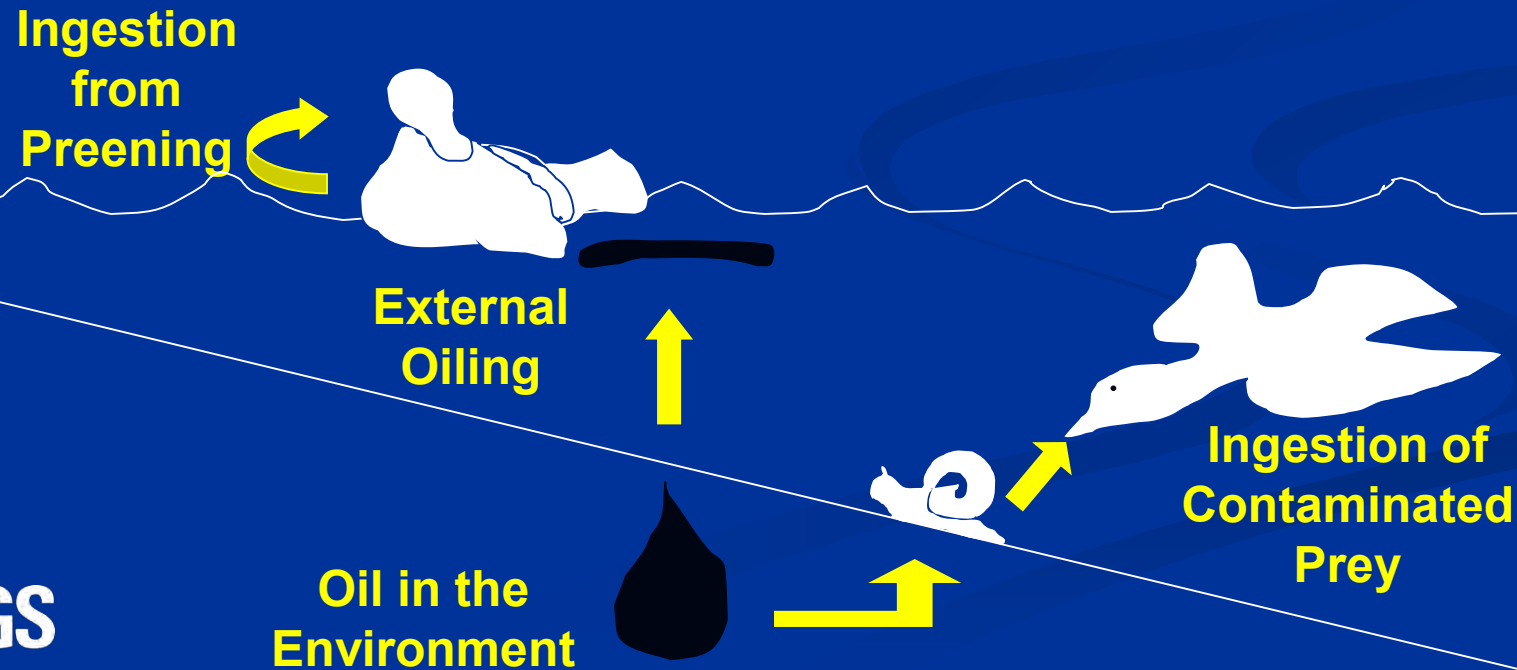
Background – The Spill

- 42 million liters spilled
- 40% landed on beaches
- Some still remains



Background - Varying Mechanisms of Spill Effects on Wildlife

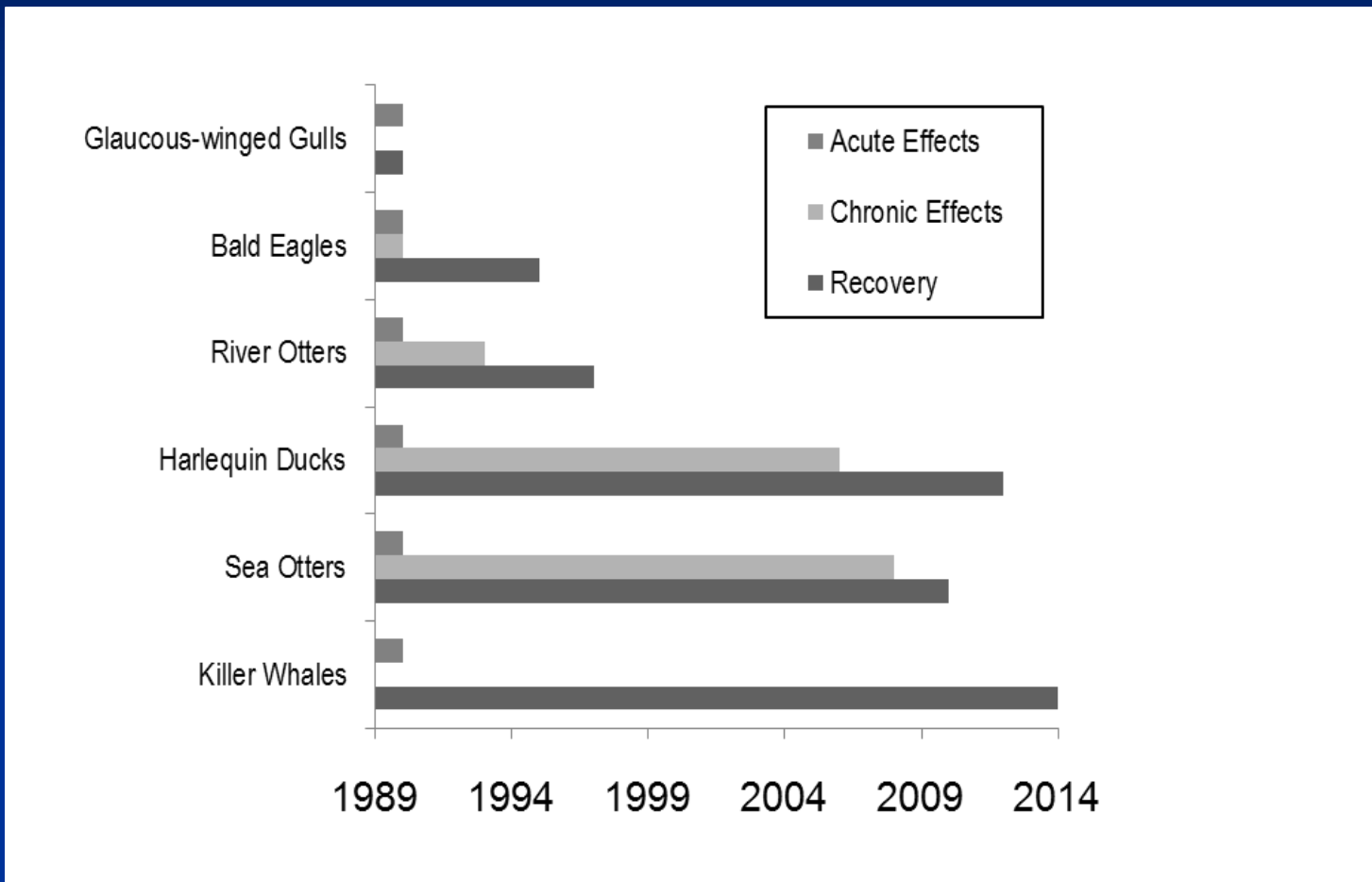
- Direct
- Indirect
- Acute
- Chronic



Background - Varying Vulnerabilities to Oil Spill Effects



Examples of Varying Timelines and Mechanisms of Population Recovery from the Exxon Valdez Oil Spill



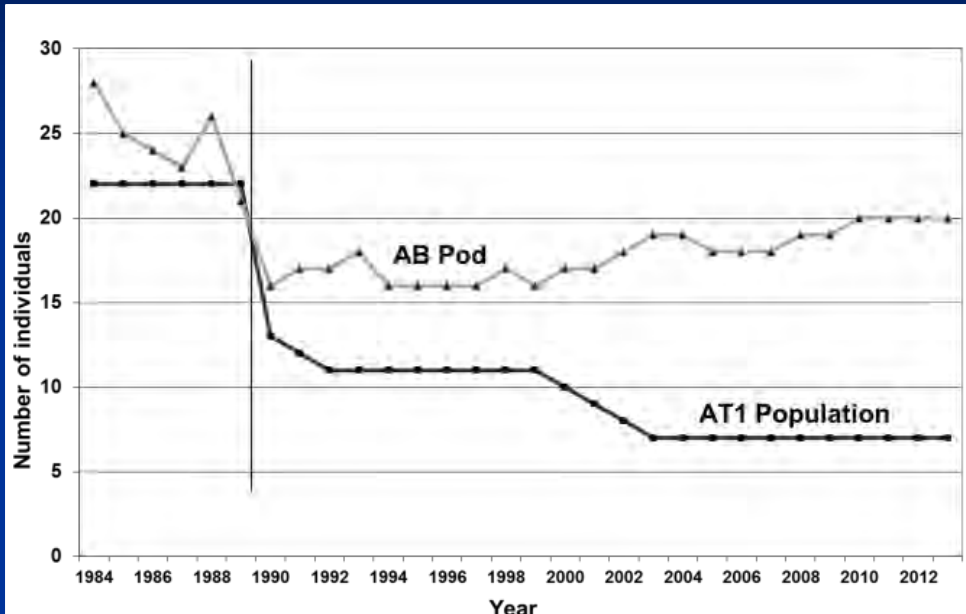
Examples of Varying Timelines and Mechanisms of Population Recovery from the Exxon Valdez Oil Spill

- Bald Eagle acute mortality observed
- Around 250 estimated to have died (about 10% of PWS population)
- Reproduction impaired for at least one year



By 1995, the Bald Eagle population had recovered and no chronic effects were observed (Bowman et al. 1997)

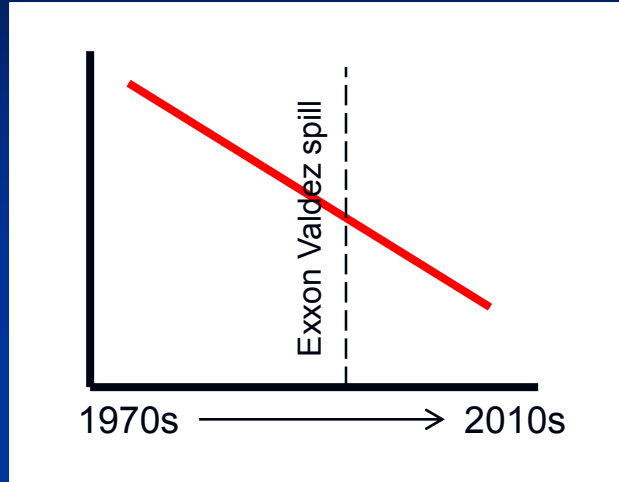
Examples of Varying Timelines and Mechanisms of Population Recovery from the Exxon Valdez Oil Spill



Killer Whale numbers, in both resident and transient pods, dropped in association with the oil spill; acute mortality

Pre-spill numbers had not been achieved by 2013; indirect effects (demographic lags) (Matkin et al. 2012)

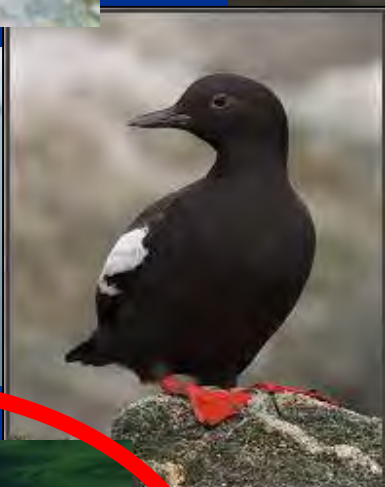
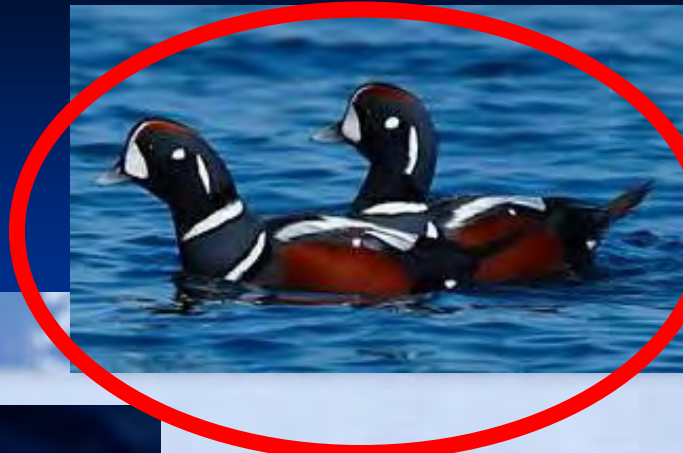
Examples of Varying Timelines and Mechanisms of Population Recovery from the Exxon Valdez Oil Spill



Marbled murrelets and pigeon guillemots have been declining since the 1970s, due to changes in ocean conditions

There were almost certainly direct and indirect effects of the spill, but these are overwhelmed by larger processes

Varying Vulnerabilities to Oil Spill Effects – Lingering Oil

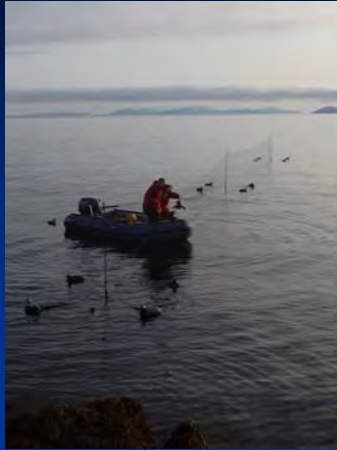


Sea Otter and Harlequin Duck Recovery Constrained by Lingering Oil



- Oil persisted in subsurface sediments
- Lightly weathered and toxic
- Lower intertidal zone affected

Population Recovery Research

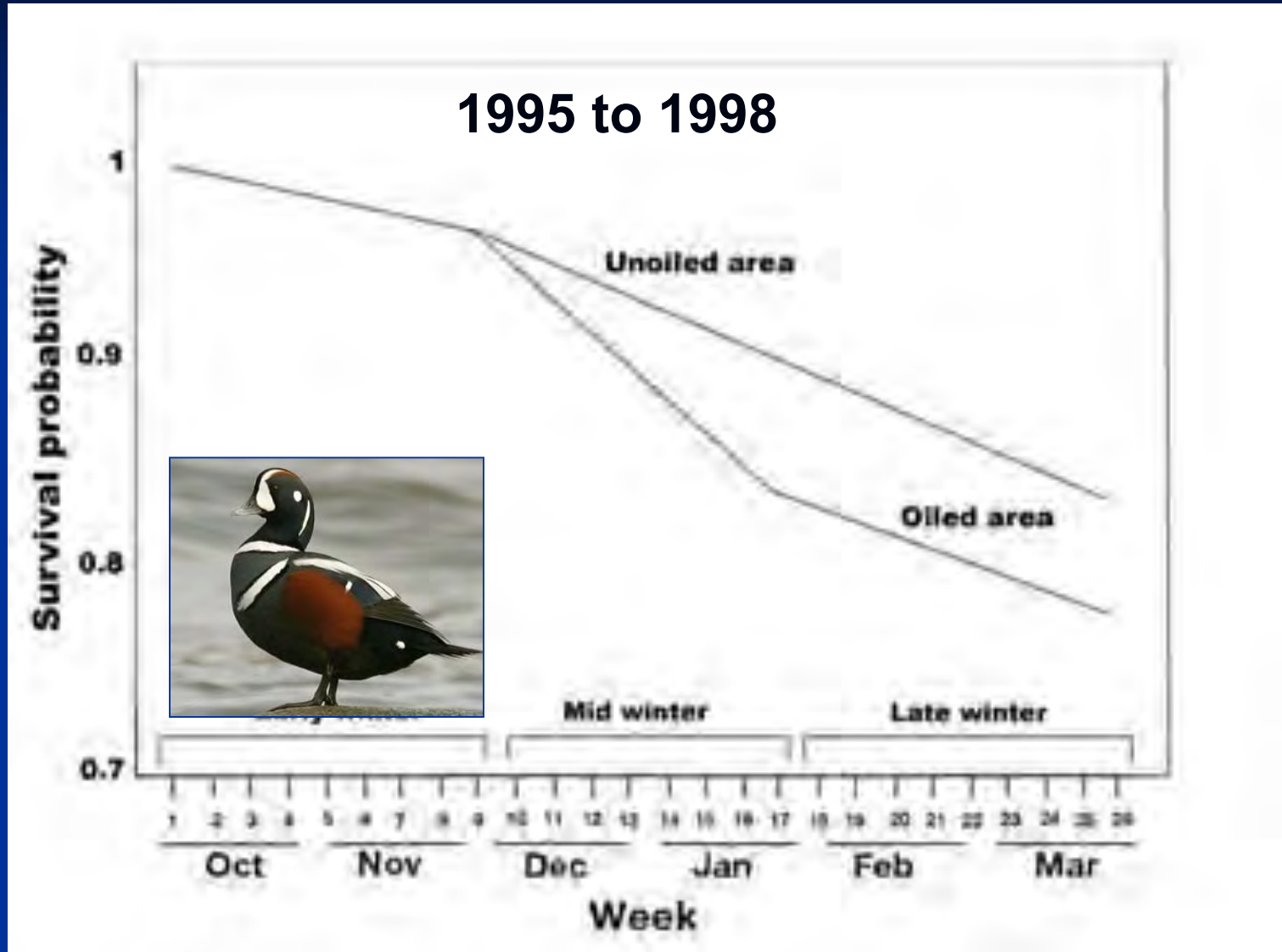


Why Harlequin Ducks?

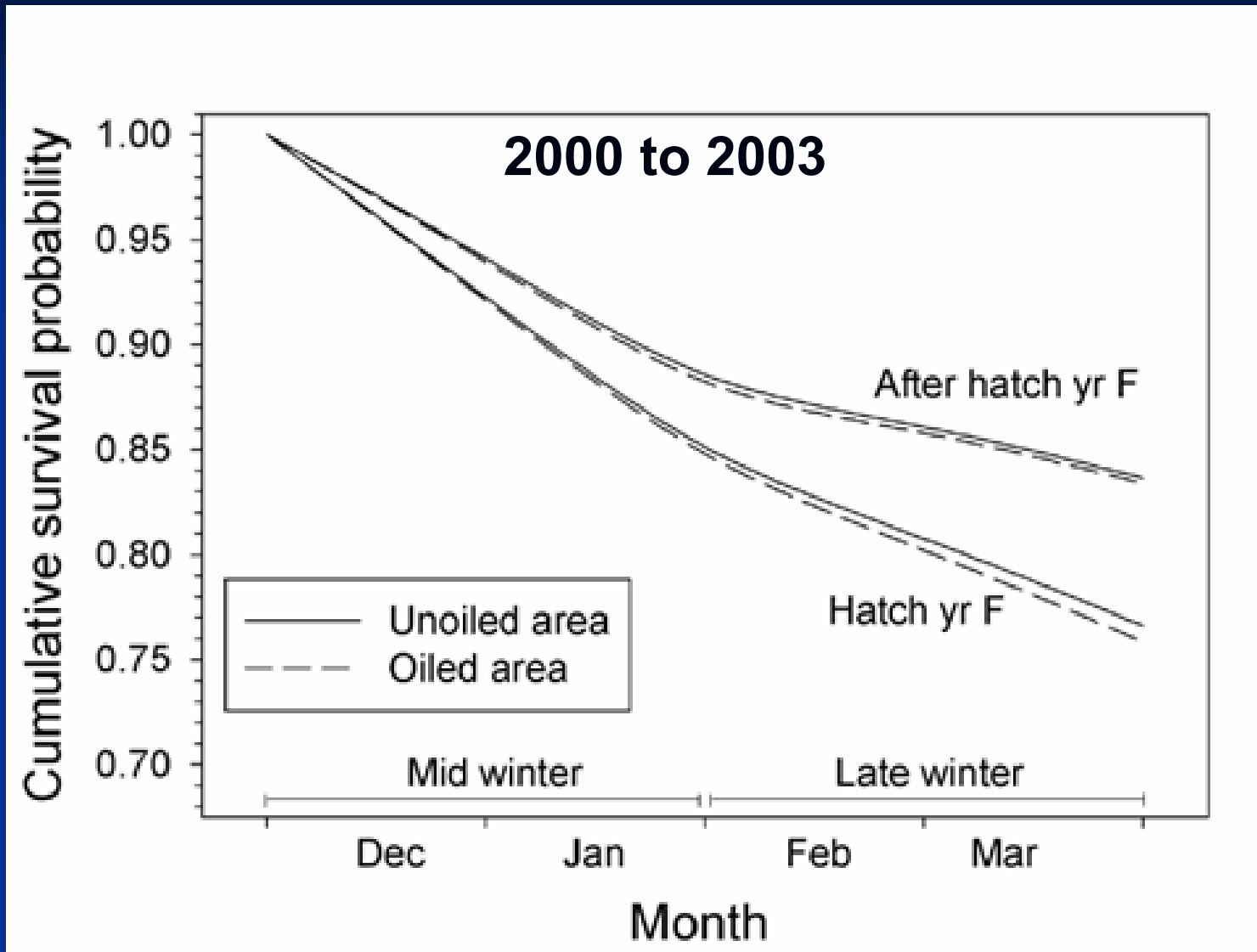
- concerns about population recovery in the immediate post-spill years
- attributes that suggest vulnerability to spill effects:
 - nearshore habitats
 - benthic invertebrate diet
 - high site fidelity
 - small body size
 - near northern range limit
 - life history



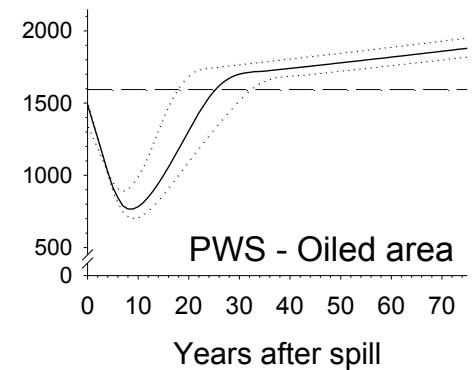
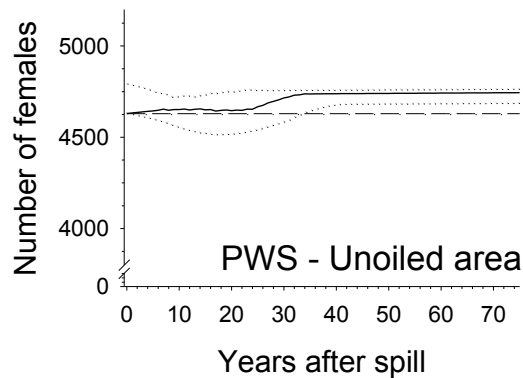
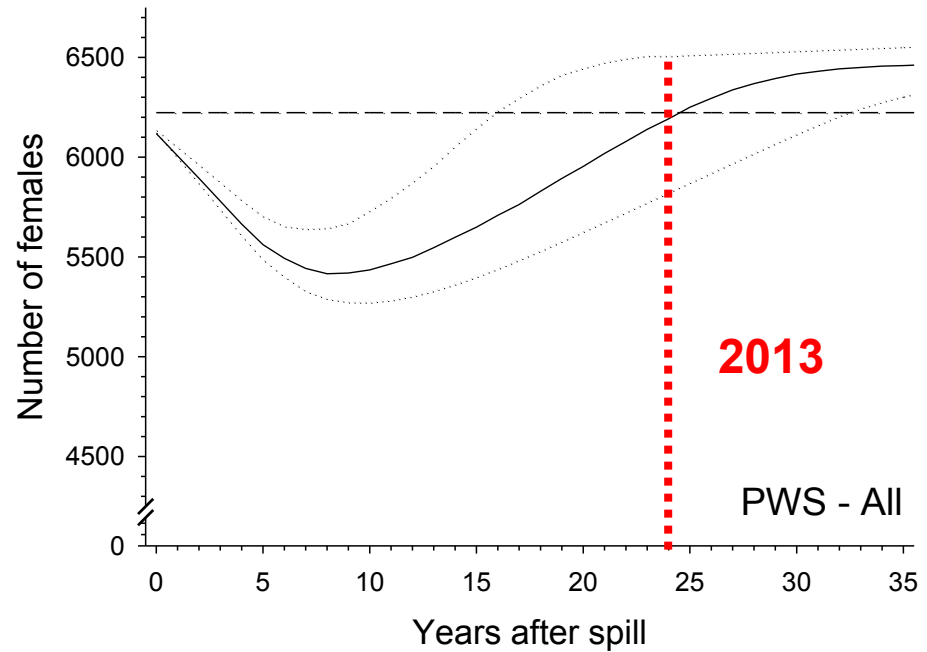
Harlequin Duck Demography



Harlequin Duck Demography



Harlequin Duck Demography



Harlequin Duck Biochemical Indicators of Exposure

Cytochrome P450 1A

- one of a family of enzymes involved in metabolism and detoxification
- Cytochrome P450 1A (CYP1A) is induced by exposure to polycyclic aromatic hydrocarbons (PAHs) and PCBs
- CYP1A is a sensitive and specific indicator of oil exposure (as PCBs are not an issue in PWS)

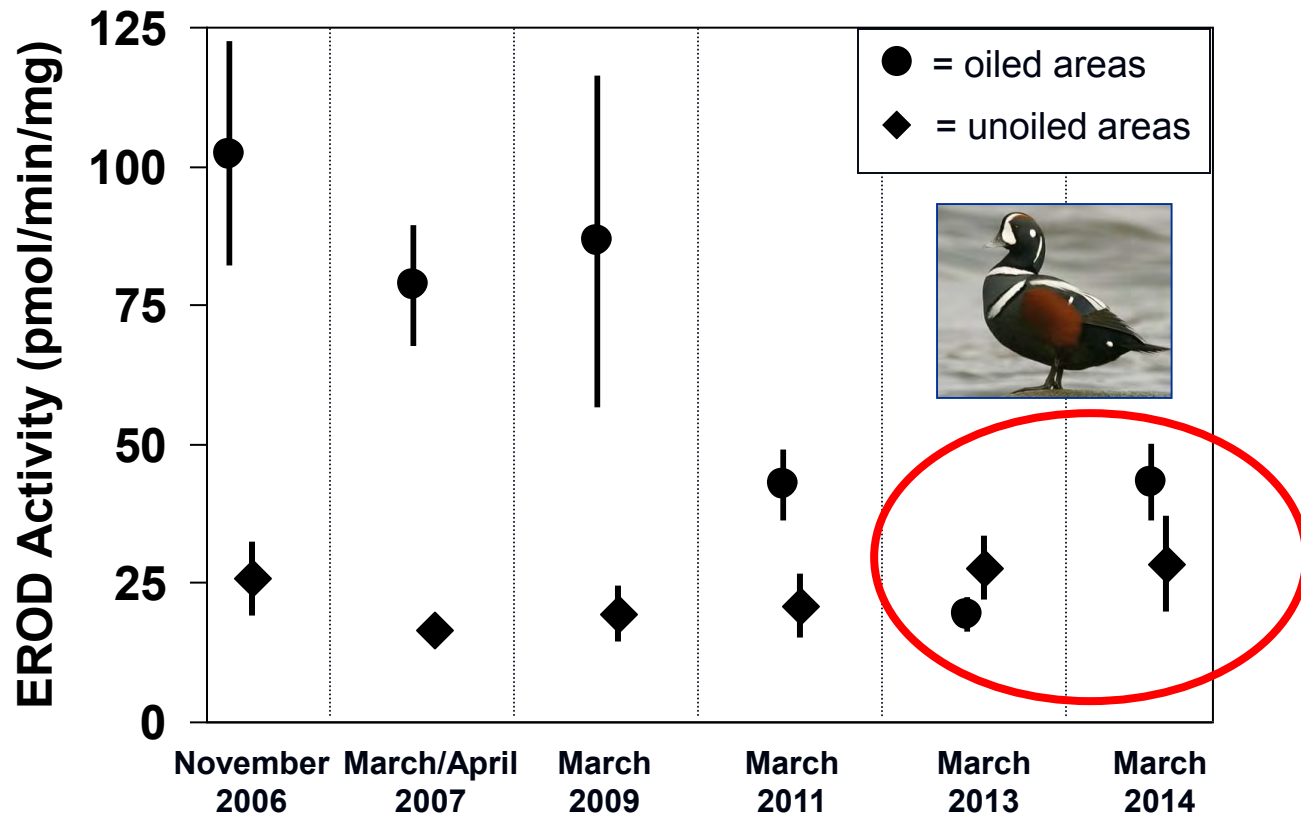


Harlequin Duck Biochemical Indicators of Exposure



Harlequin Duck Biochemical Indicators of Exposure

Average (\pm SE) EROD Activity of Harlequin Ducks



Critical Conclusions:

Results for harlequin ducks indicate:

- Population-level effects of the Exxon Valdez oil spill and lack of population recovery persisted into late 2000s
- Recent data are consistent with recovery criteria set by the EVOSTC, indicating timeline to population recovery was between 20 and 25 years



Why Sea Otters?

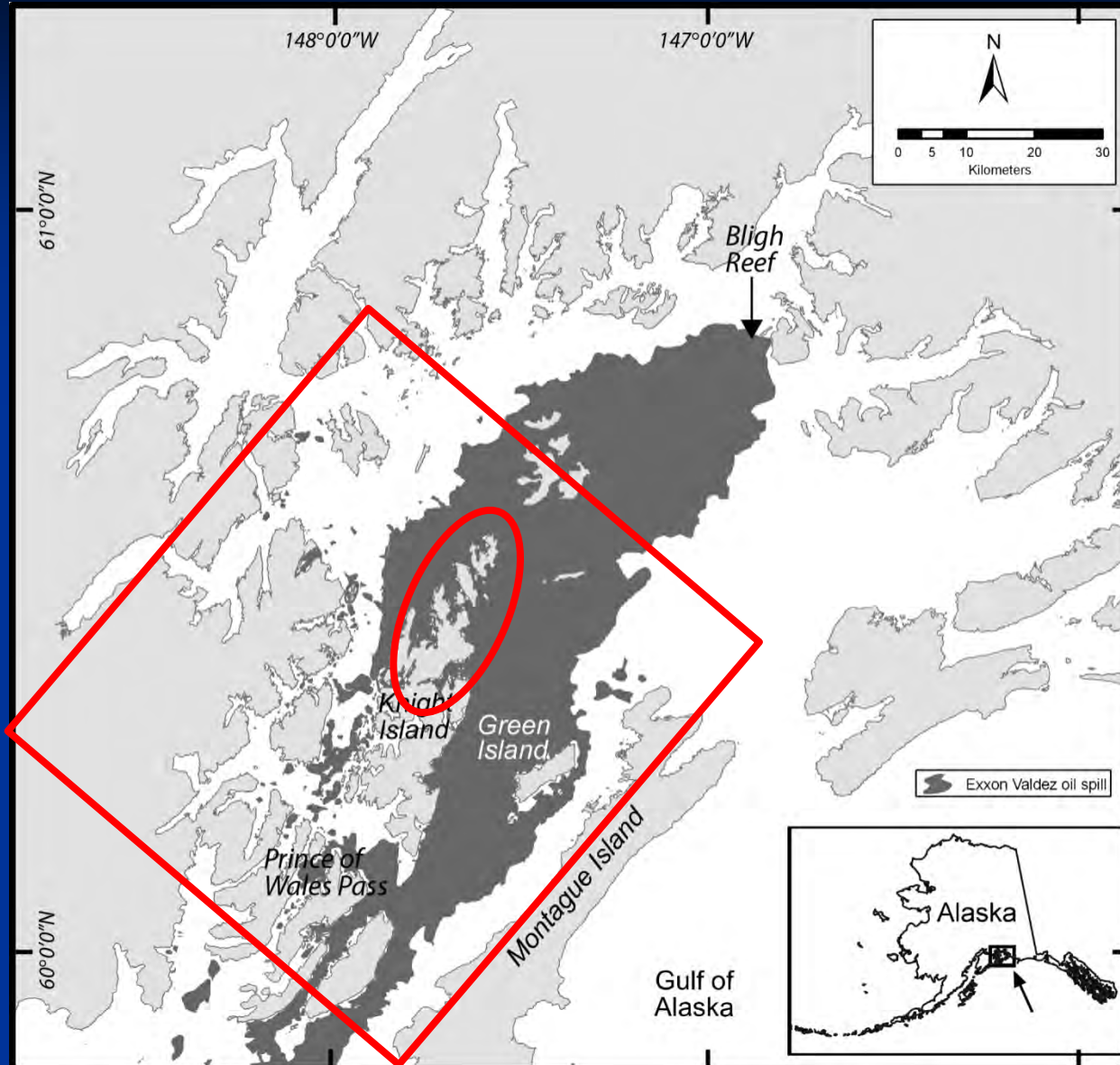
- concerns about population recovery in the immediate post-spill years
- attributes that suggest vulnerability to spill effects:
 - nearshore habitats
 - benthic invertebrate diet
 - thermoregulatory/metabolic challenges



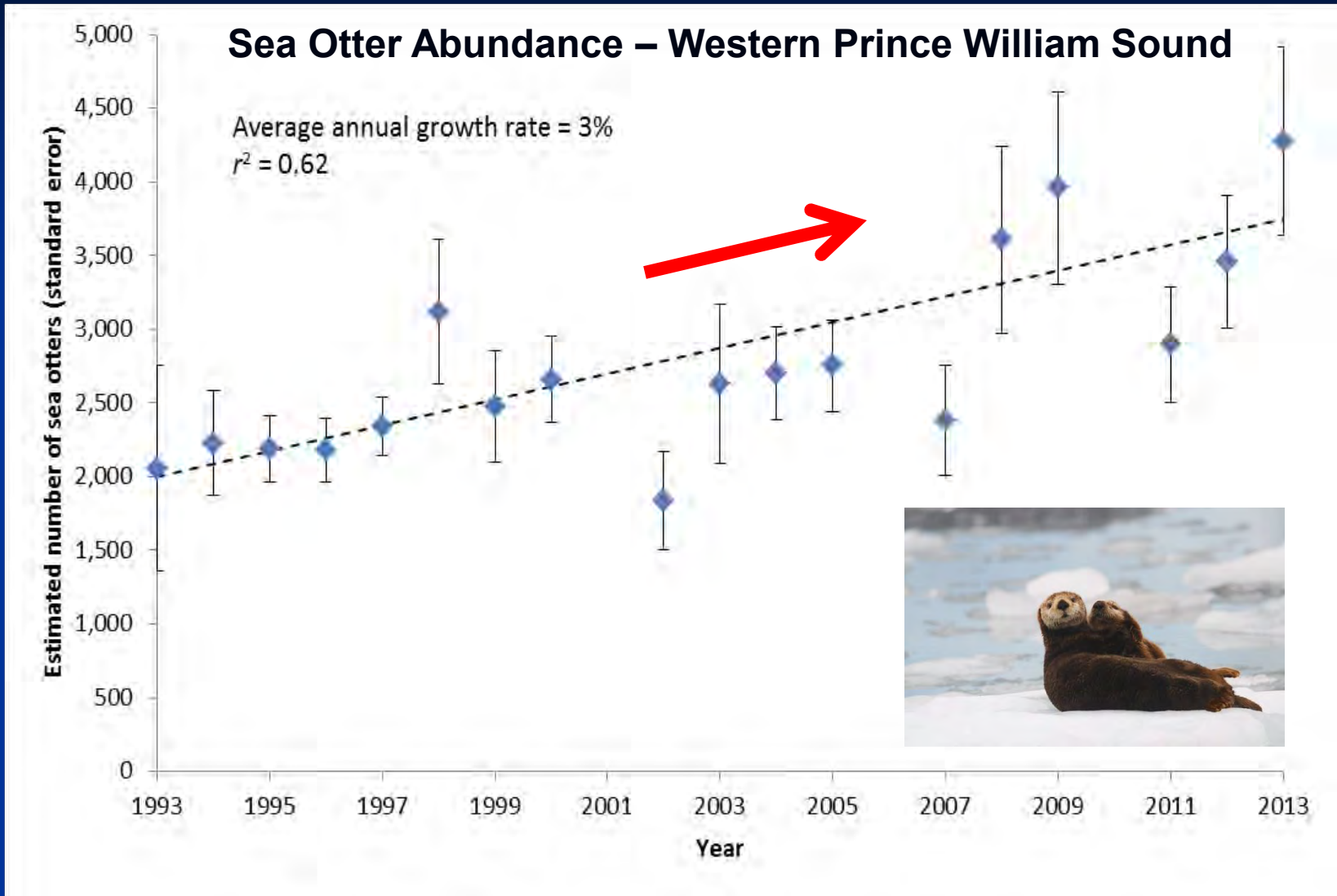
Sea Otter Demography



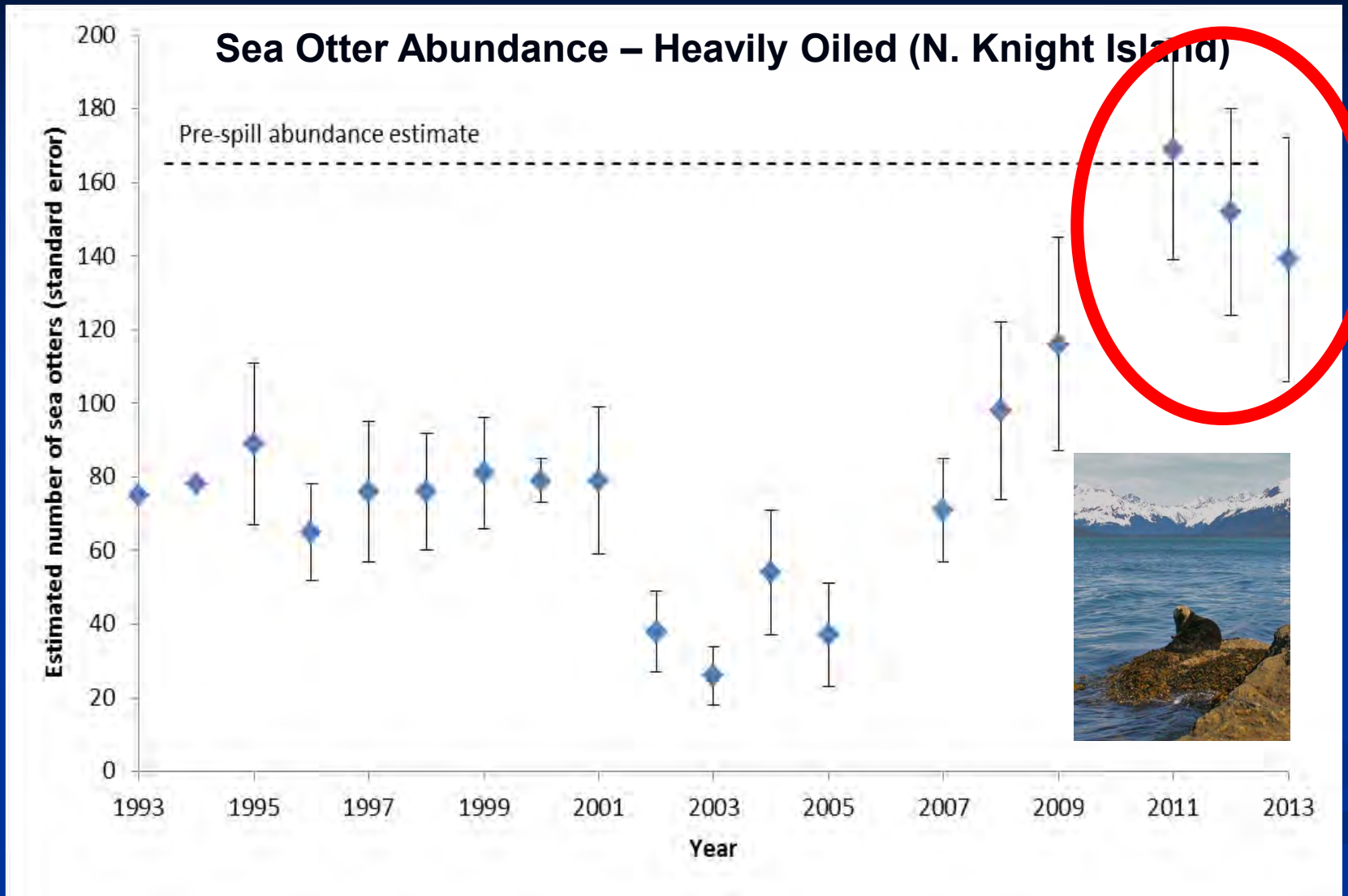
Sea Otter Demography



Sea Otter Demography



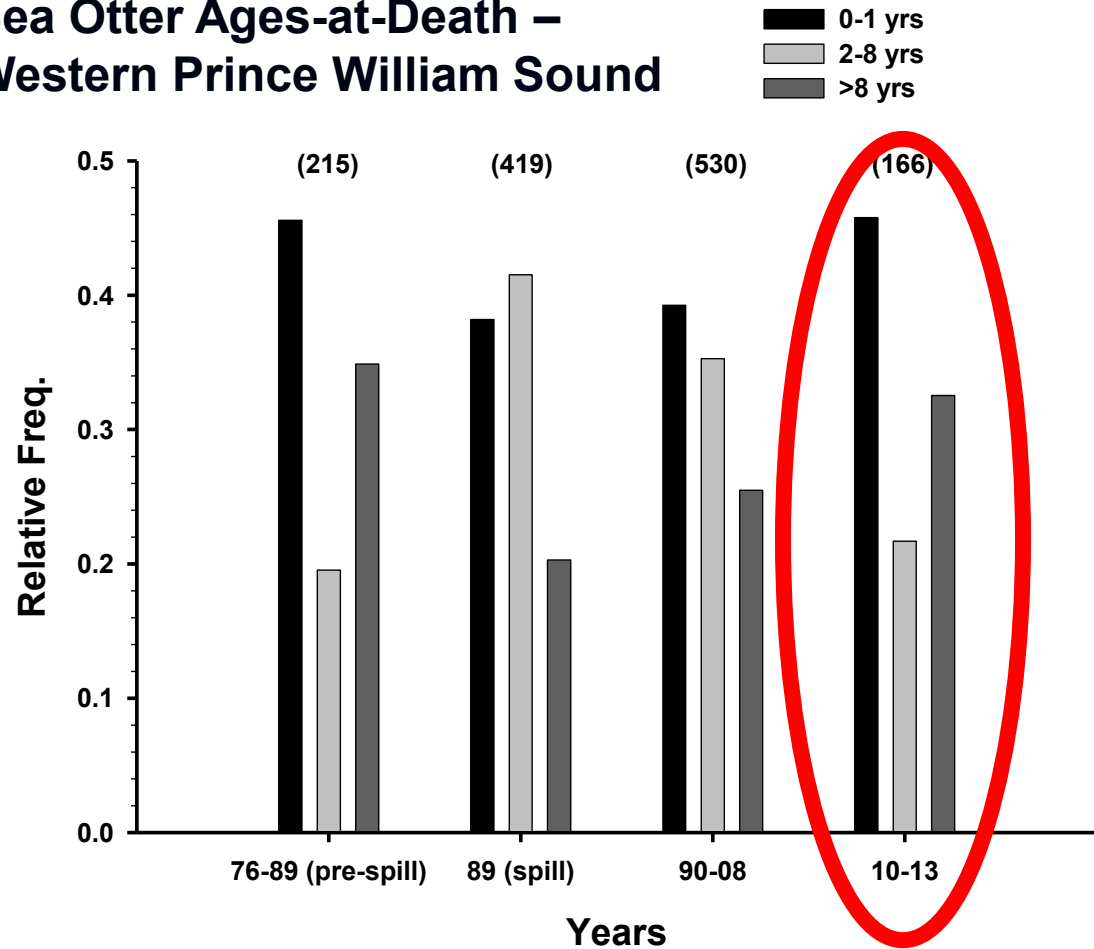
Sea Otter Demography



Sea Otter Demography



Sea Otter Ages-at-Death – Western Prince William Sound



Critical Conclusions:

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Overall Implications

- Wildlife species vary widely in vulnerability to oil spill effects
- Spill effects on wildlife can be manifested through a wide array of mechanisms, not just direct, acute
- For some species, chronic exposure to residual oil can have effects as large as direct, acute effects
- The timeline over which recovery occurs varies by species; for some, it may be measured in decades

What's Next?



<http://www.gulfwatchalaska.org/>



USGS

*Exxon Valdez
Oil Spill Trustee Council*



Southwest Alaska Network
Inventory & Monitoring Program



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