

Long-term population- or ecosystem-
level effects from oil spills are not only
a function of acute mortality

Andrew Whitehead

Department of Biological Sciences

Louisiana State University

Long-Term Ecosystem Response to the Exxon Valdez Oil Spill

Charles H. Peterson,^{1*} Stanley D. Rice,² Jeffrey W. Short,² Daniel Esler,³
James L. Bodkin,⁴ Brenda E. Ballachey,⁴ David B. Irons⁵

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- Unexpected persistence of oil
- Long-term exposures to sub-lethal levels of oil-associated toxins
- Sub-lethal exposures can threaten long-term resilience of species
- Recovery can be delayed because of indirect cascading effects

Acute phase mortality



Persistence of oil

Biological effects are a function of exposure.

- duration of exposure
- concentration of exposure
- chemical nature of exposure

Sediments provide refuge from degradation

- sediment-associated organisms persistently exposed
- trapping under mussel beds = enduring route of entry into food chains in Alaska
- oiled sediments = persistent source of mortality for fish embryos in Alaska

Long-term Population-level impacts

Chronic exposures from sediments

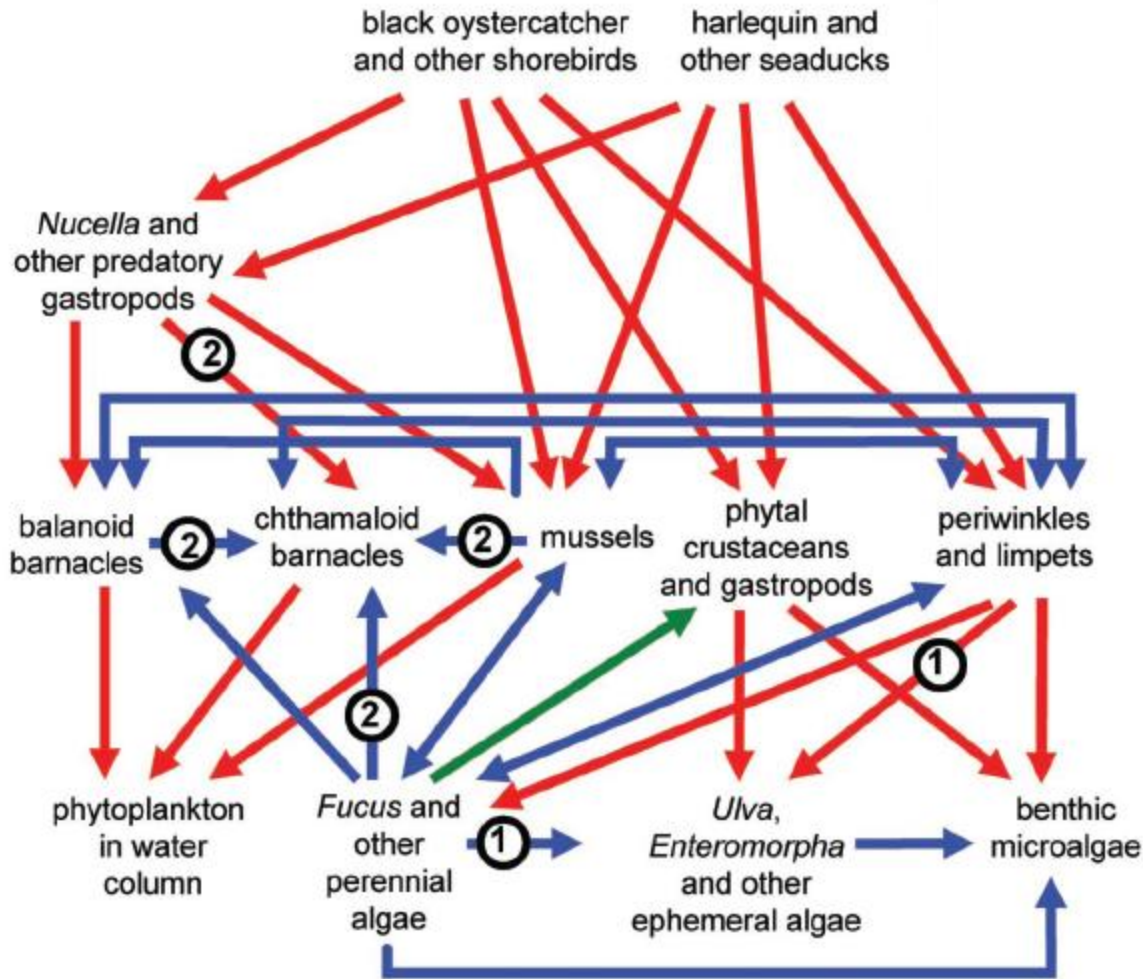
- Low levels of contaminants can be toxic to sensitive life stages
 - elevated mortality in fish embryos in oiled sediments > 4 years after Valdez spill
- Marine mammals and birds may be continuously exposed through the food chain
 - many of the toxic chemicals in oil can be sequestered in tissues (e.g., exposures to animals that eat bivalves)
 - recovery of Alaskan sea otters and Harlequin ducks much slower than anticipated

Long-term Population-level impacts

Sub-lethal exposures → indirect effects on survival

- decline from compromised health, growth, reproduction
 - salmon exposed during development: as adults, *their* embryos showed reduced survival (controlled lab studies)
 - Endocrine disruption, developmental defects
 - shorebirds: reduced breeding, smaller eggs, enhanced chick mortality

Long-term Population-level impacts



Everything is connected

Figure: Peterson *et al.*, 2003

Long-term Population-level impacts

Biological effects are a function of exposure.

- duration of exposure
- concentration of exposure
- chemical nature of exposure

Acute mortality is not predictive of long-term population-level effects

- Sub-lethal effects = harder to detect, but more insidious

Field study



