

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

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# Long-Term Ecosystem Response to the Exxon Valdez Oil Spill

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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

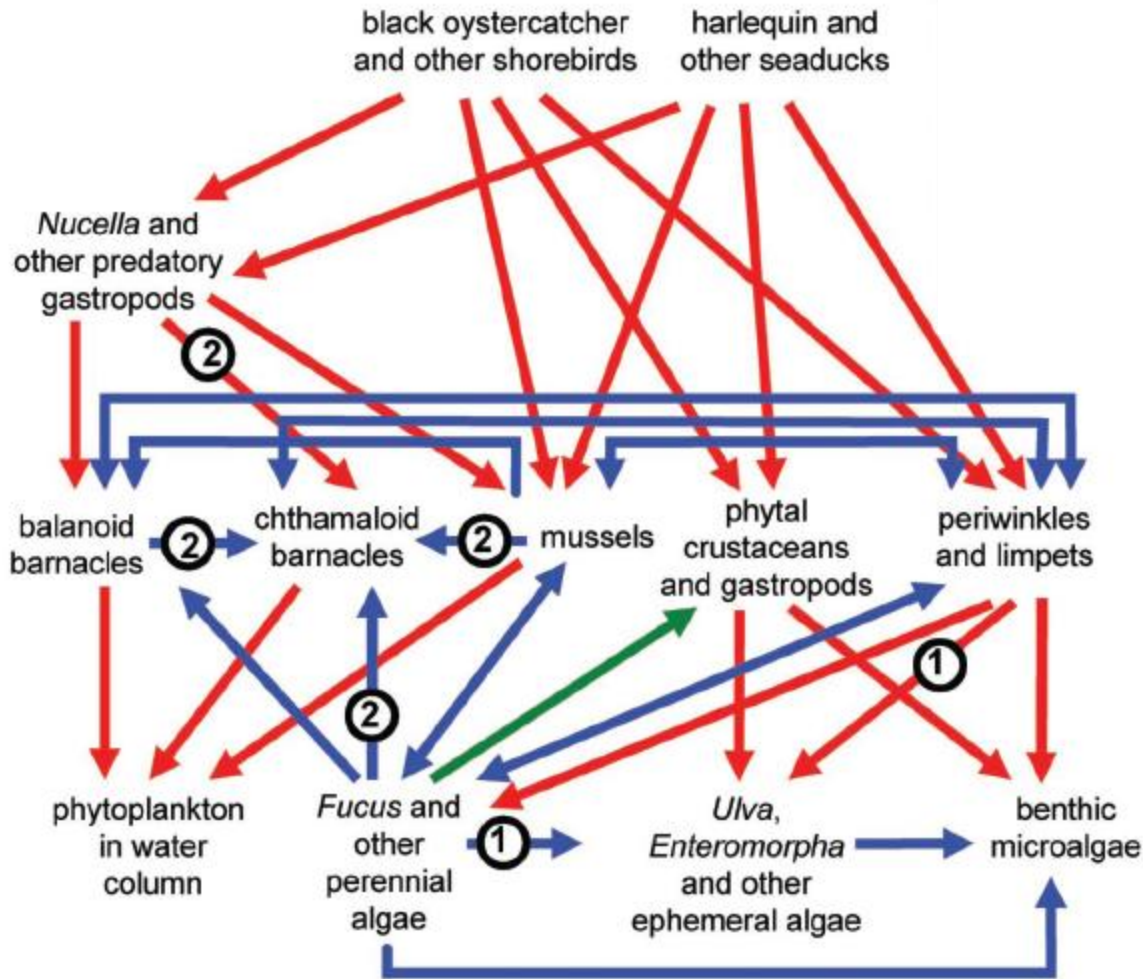
- Low levels of contaminants can be toxic to sensitive life stages
  - elevated mortality in fish embryos in oiled sediments > 4 years after Valdez spill
- Marine mammals and birds may be continuously exposed through the food chain
  - many of the toxic chemicals in oil can be sequestered in tissues (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



