

# Environmental Impacts of Oil: Shoreline Habitats and Wildlife

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National Oceanic and Atmospheric Administration • National Ocean Service • Office of Response and Restoration

*Fiscal Year 2017*

*205 Incident Responses (160 oil)*

*\$7.5M in Restoration Funds*

*Fiscal Year 2018*

*201 Incident Responses (166 oil)*

*\$34.3M in Restoration Funds*

# No Two Oil Spills Are Alike

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- *What Got Spilled?*
- *Volume Spilled?*
- *Cause and Source of Spill?*
- *Location – Where will it go and what will it hit?*
- *Shoreline Type and Sensitivity?*
- *Seasonality Differences?*
- *Resources at Risk - Natural and Public?*



# How toxic are different oil types? *noaa*



Oil Type	Group I: Very Light	Group II Light	Group III Medium	Group IV Heavy
Examples	Gasoline	Diesel, jet fuel, and light crude oil	Paraffin-based oils, most crude oils	No. 6. fuel oils, heavy crude oil
Acute toxicity to aquatic organisms	High toxicity from soluble compounds	Moderate-to-high acute toxicity from soluble compounds	Moderate to low acute toxicity; can have inhalation impacts	Low acute toxicity, but high risk of smothering
Long term environ. effects	Likely not severe because of rapid evaporation of the toxic components	May cause long-term intertidal contamination	May cause severe long-term impacts	Possible long-term sediment contamination  Can severely impact bird, fur-bearing mammals, and shoreline habitats

# Environmental Sensitivity Index (ESI) ranking

## SHORELINE HABITATS (ESI)

-  1A EXPOSED ROCKY CLIFFS  
1B EXPOSED, SOLID MAN-MADE STRUCTURES
-  2A EXPOSED WAVE-CUT PLATFORMS IN BEDROCK  
2B SCARPS AND STEEP SLOPES IN MUDDY SEDIMENTS
-  3A FINE- TO MEDIUM-GRAINED SAND BEACHES
-  4 COARSE-GRAINED SAND BEACHES
-  5 MIXED SAND AND GRAVEL BEACHES
-  6A GRAVEL BEACHES
-  6B RIPRAP
-  7 EXPOSED TIDAL FLATS
-  8A SHELTERED ROCKY SHORES
-  8B SHELTERED, SOLID MAN-MADE STRUCTURES
-  9A SHELTERED TIDAL FLATS  
9B SHELTERED VEGETATED LOW BANKS
-   10A SALT- AND BRACKISH-WATER MARSHES
-   10B FRESHWATER MARSHES
-   10C SWAMPS
-   10D MANGROVES
-  FRESHWATER SCRUB/SHRUB

# Basis for ESI Rank

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- *Relative exposure to wave and tidal energy (natural removal mechanisms\_*
- *Shoreline slope*
- *Substrate type (grain size, mobility, penetration and/or burial, and trafficability)*
- *Biological productivity and sensitivity*



# Importance of Grain Size in Controlling Penetration and Burial on Beaches



# Beach Impact and Recovery

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- Acute mortality of beach fauna from oiled sand and wrack
- Changes in species composition
- Damages from response actions
- But, recovery is often in 1-2 y except for species with:
  - *Long life cycle*
  - *Low fecundity*
  - *Limited dispersal/recruitment*



Wetlands are some of the most biologically diverse ecosystems, rivaling rainforests and coral reefs and highly sensitive



T/V *Julie N* spill  
heavy fuel oil  
September 1996  
in the Fore River,  
Portland, Maine

Sept 1996

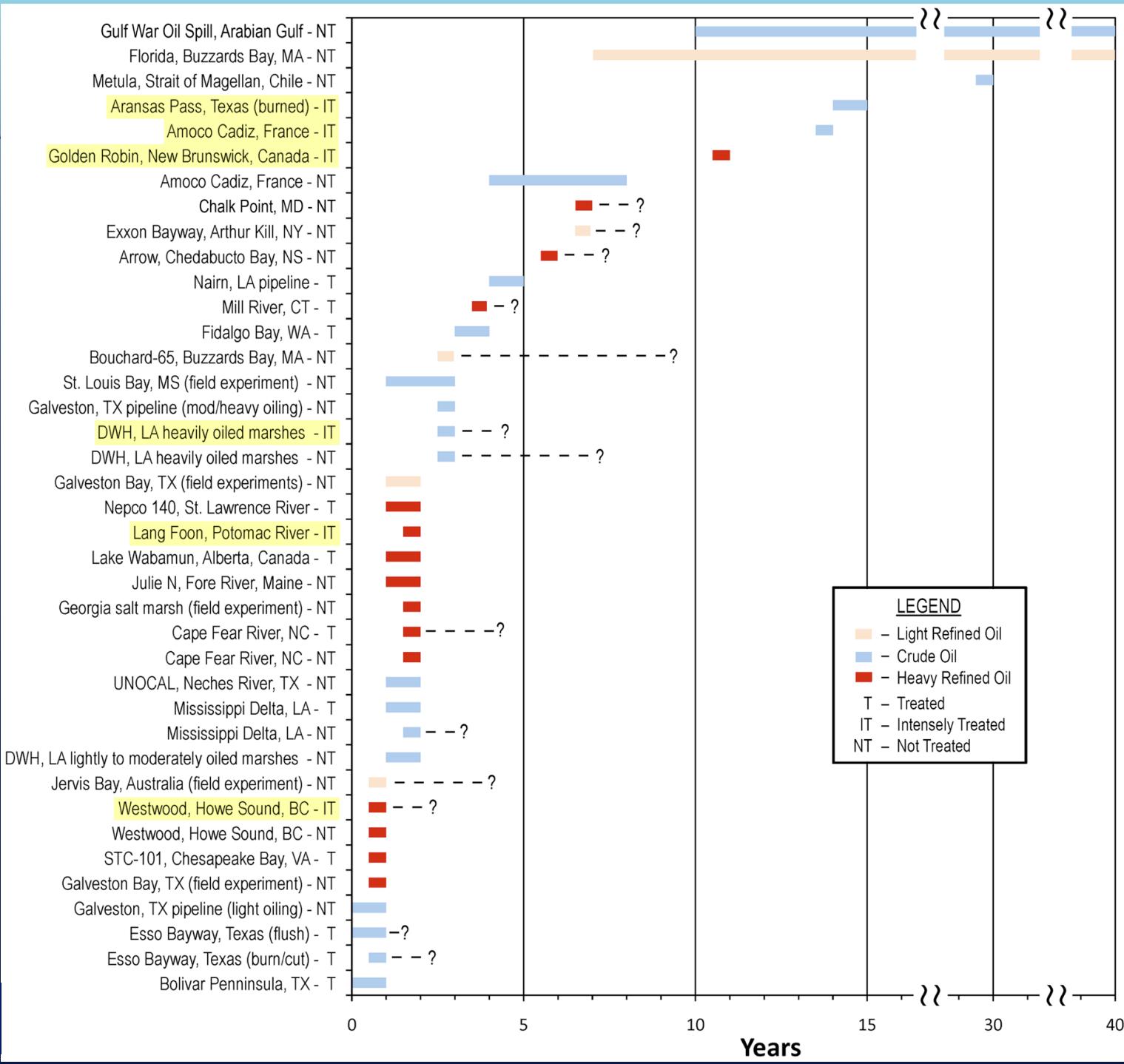


Sept 1997



# Oiled marsh vegetation recovery depends on:

*Oil type,  
oiling degree,  
penetration into marsh soils,  
treatment,  
time of year, etc.*



# Routes of Exposure

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# Birds & Oil

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- Smothering, coating feathers
  - *Reducing ability to thermoregulate*
  - *Reducing buoyancy and water proofing*
- Ingestion from preening and feeding
- Contamination of eggs and young in the nest
- Sublethal exposures can lead to reduced fitness and survival



# Turtles & Oil

- Smothering
  - *Irritation of the eyes, respiratory system, and skin*
  - *Thermal stress*
- Ingestion/fouling
- Contamination of eggs during nesting
- Disturbance of nests during response
- Emerging hatchlings can get oiled in their race to the sea



## *Pathways of Exposure:*

- *Ingestion during feeding*
- *Inhalation of volatiles*
- *Consumption of oiled prey*
- *Direct oiling*



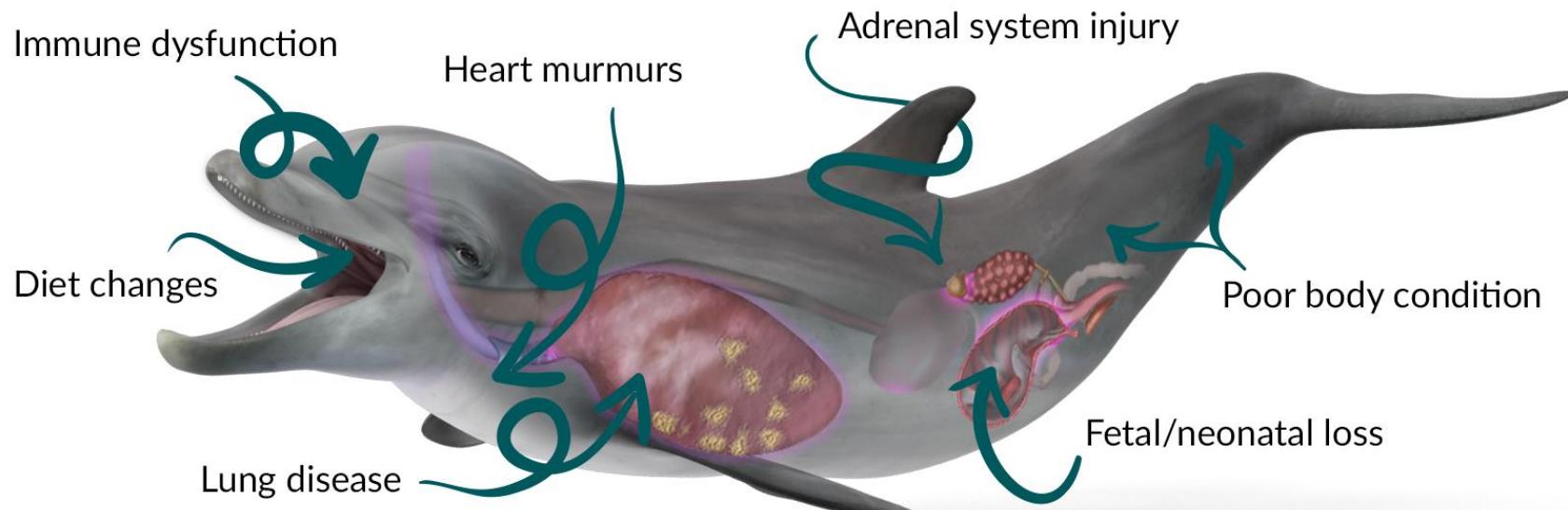
## *Acute vs Chronic impacts:*

- *Acute = Mortality*
  - (*but what oil doesn't kill you, won't make you stronger!*)
- *Reproductive effects*
- *Reduced fitness*
- *Low body weight, etc.*

## Dolphins in oil during DWH



## Deepwater Horizon Dolphin Injury Assessment Findings (Barataria Bay population)



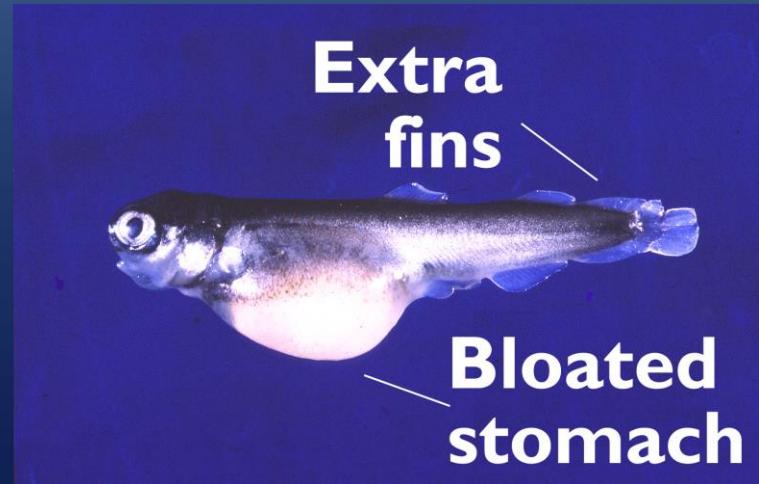
Consortium for Advanced Research on Marine Mammal Health Assessment

- Pathways of Exposure:
  - *Dissolved PAHs absorbed across membranes*
  - *Fouling of gills with particulate oil*
  - *Consumption of oiled food*
  - *Direct oiling of intertidal shellfish*
- Most spills do not have large acute impacts because of rapid dilution

- Sublethal effects can affect survival, reproduction, etc. particularly for early life stages

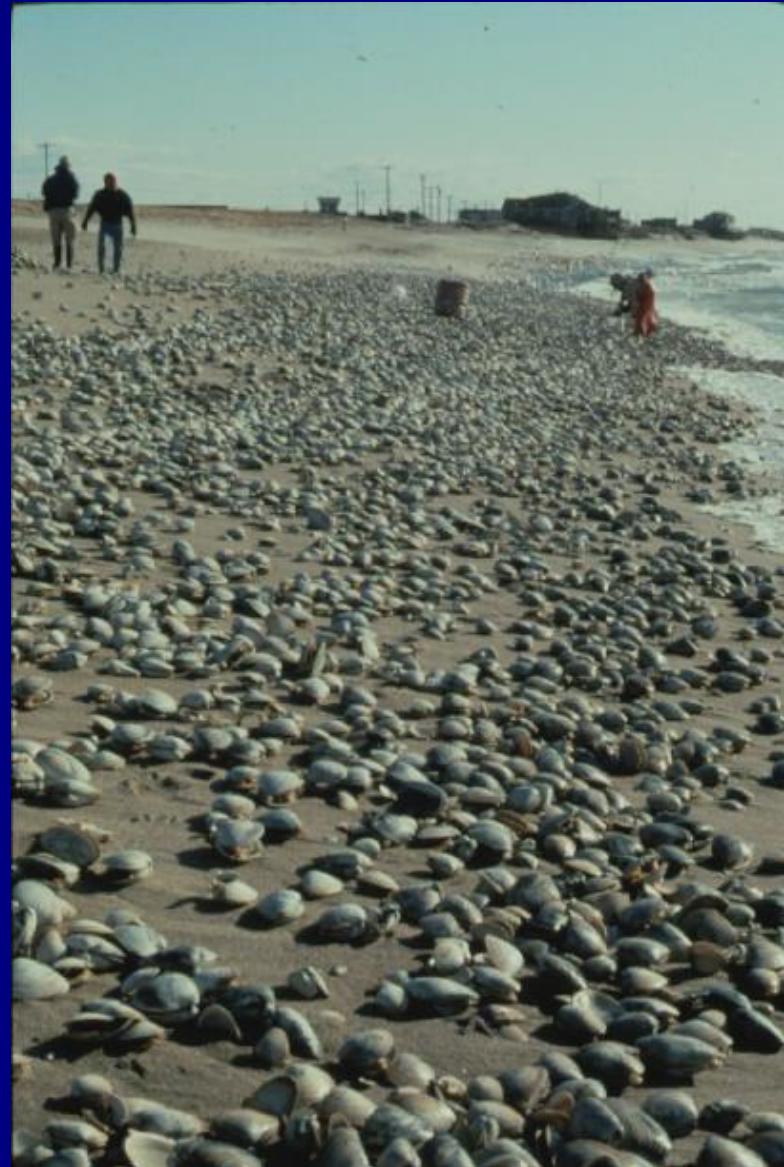


Normal larval salmon

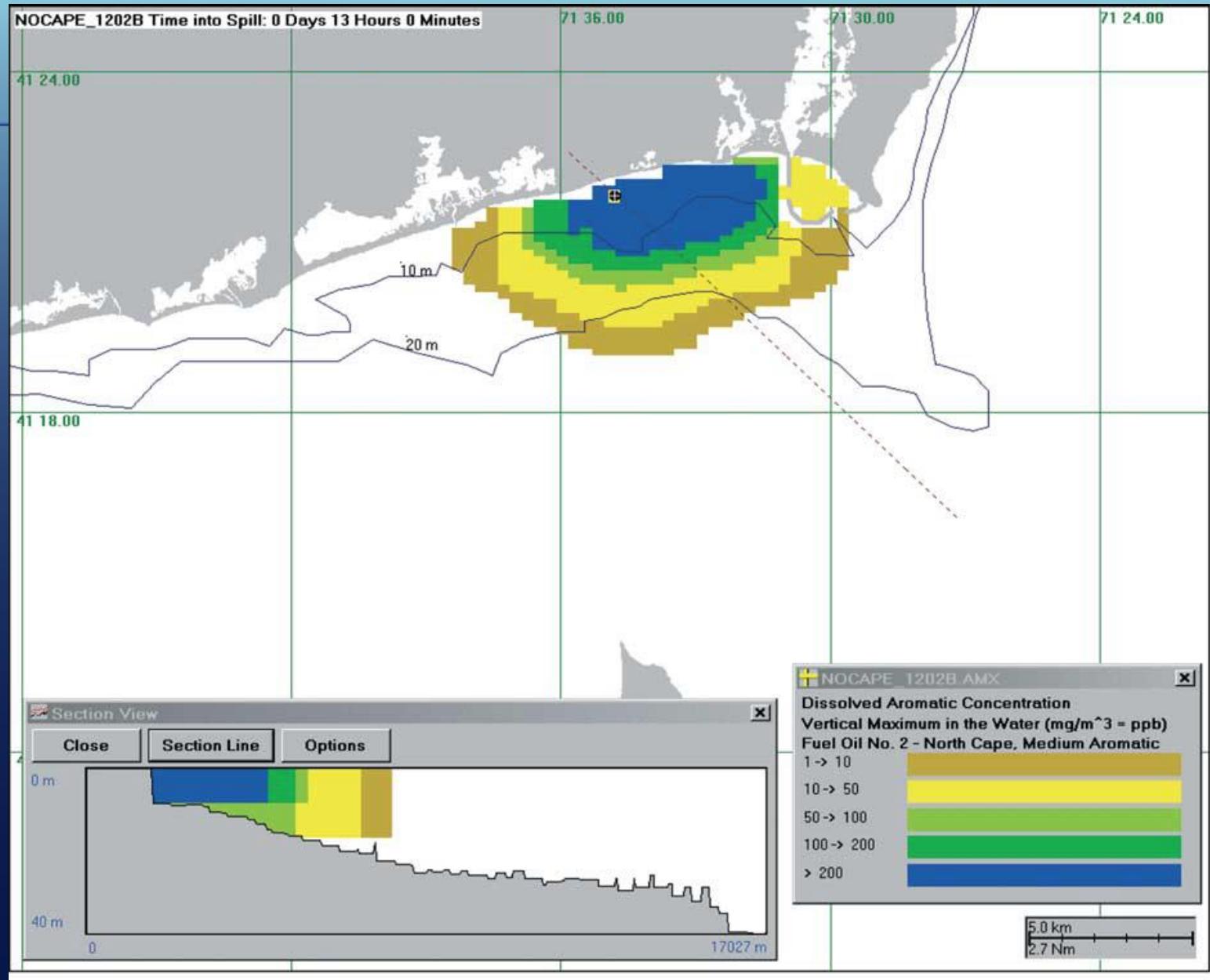


After eggs exposed to oil

- *Toxicity depends on “Dose”*
- *Dose = Concentration x Time*
- *Take 2 Aspirin 4 times/day for a week*
- *Take 8 Aspirin once/day for a week*
- *Take 56 Aspirin at once*



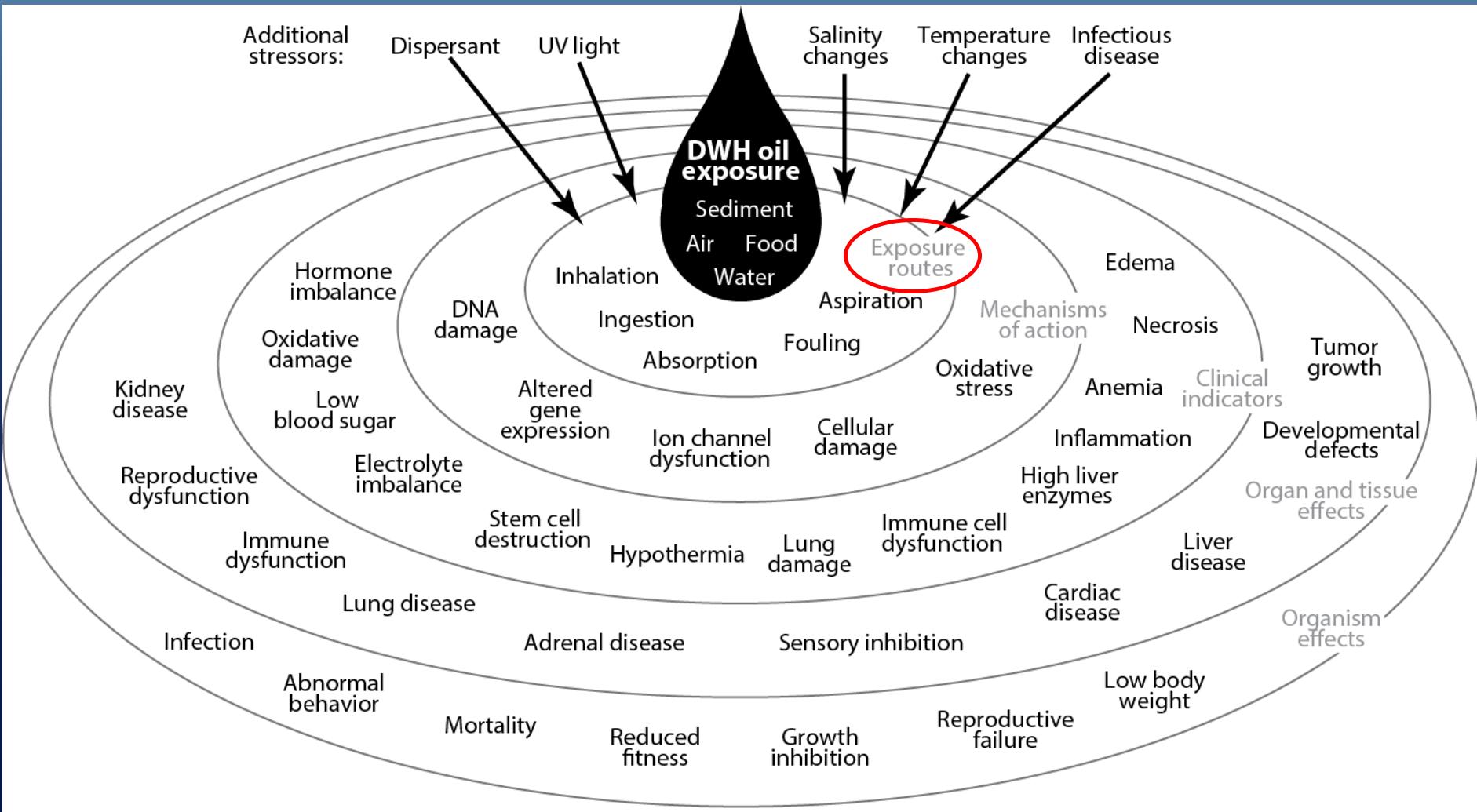
*North Cape* spill (1996): 828,000 gal home heating oil released into the surf zone during gale force winds



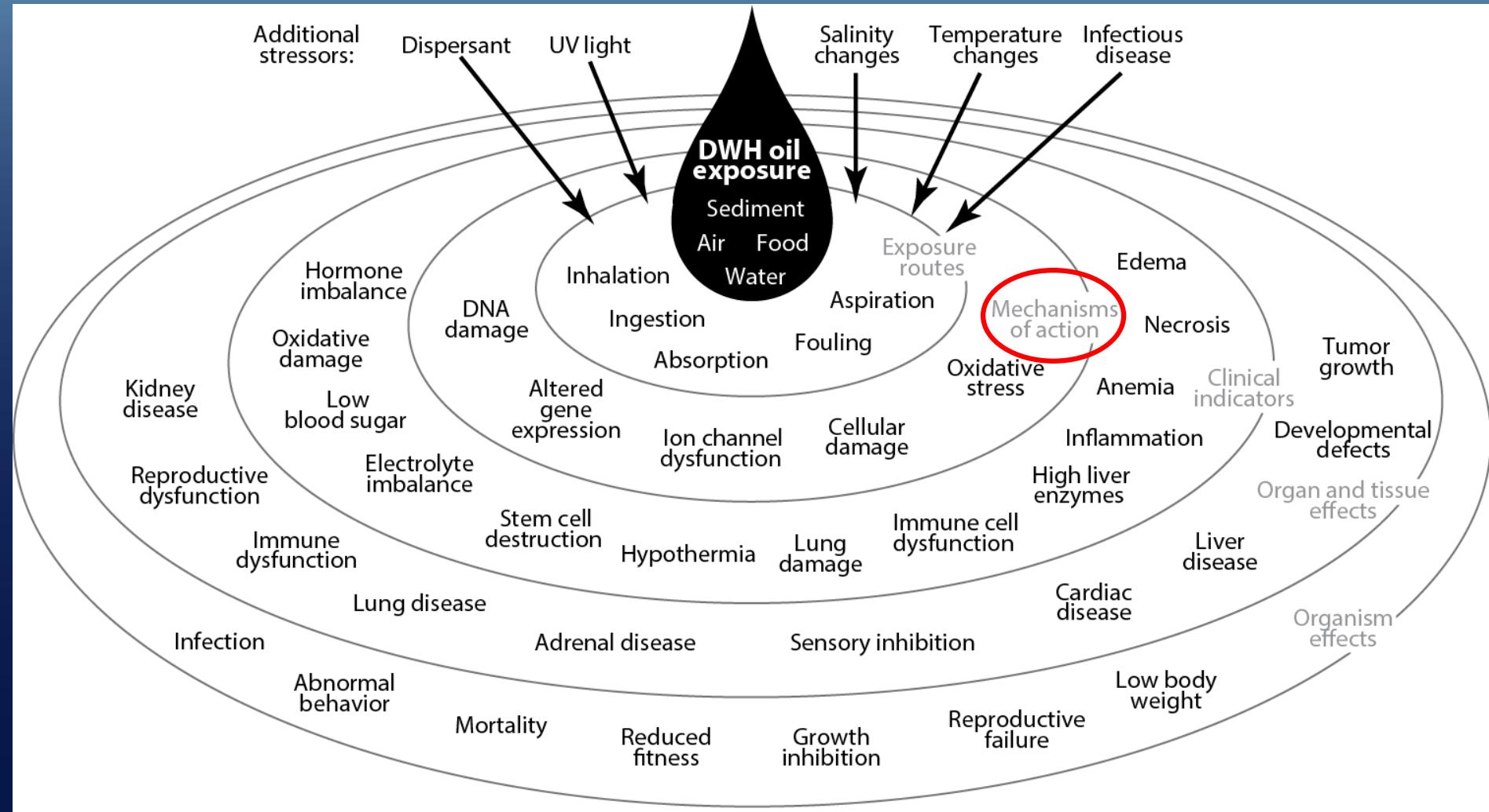
French McCay 2003, MPB

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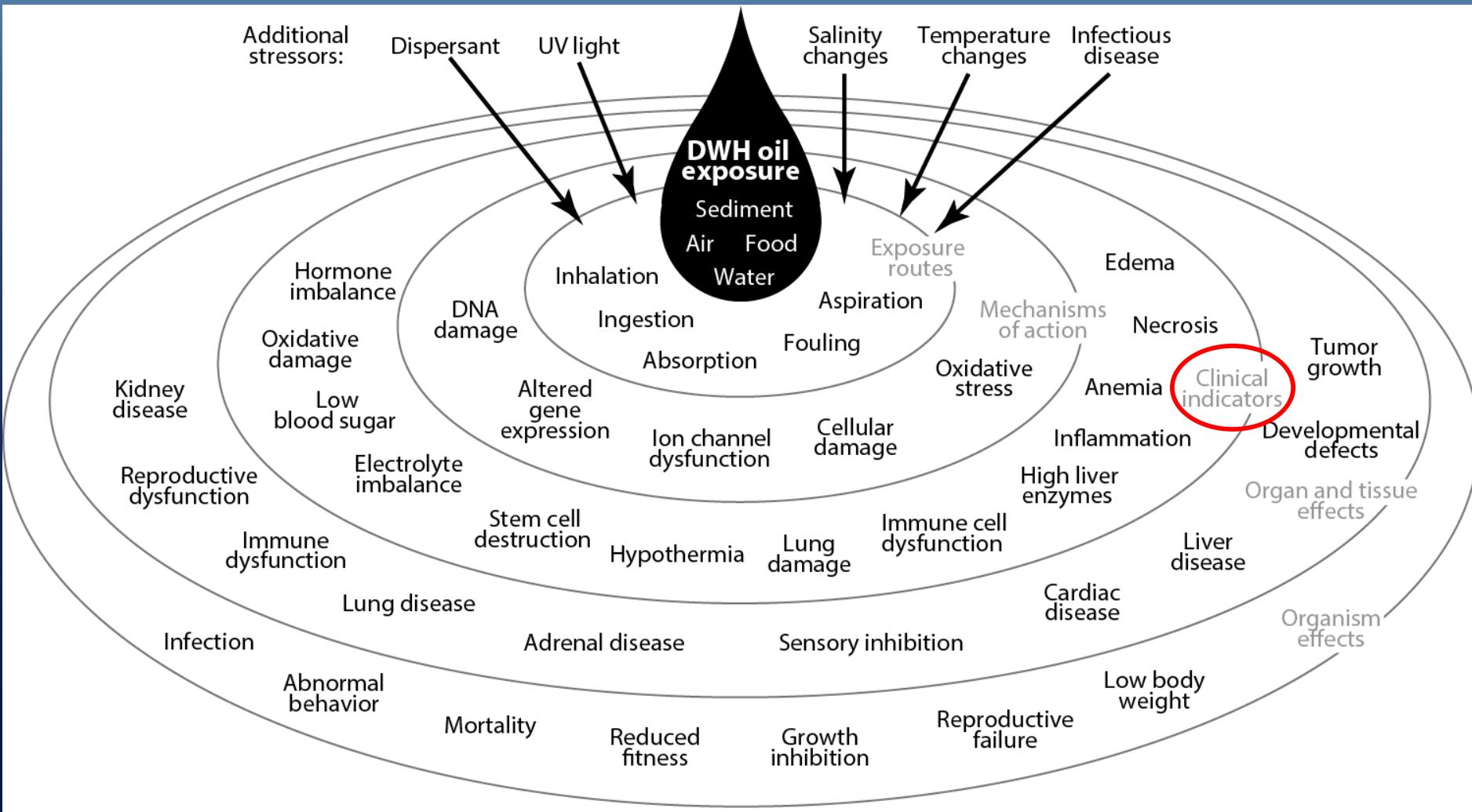
# Physiological Oil Response Constellation (DWH NRDA)



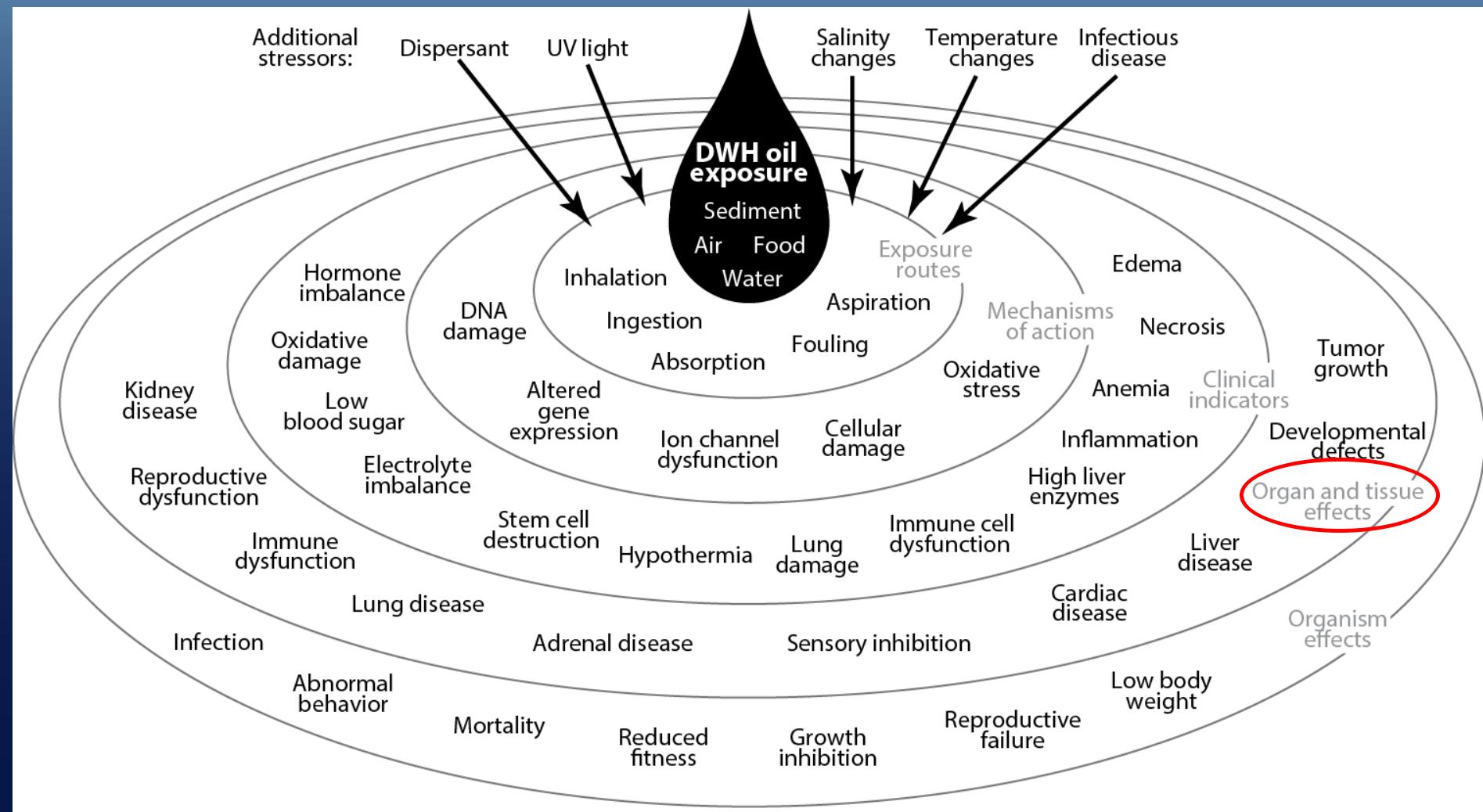
## Physiological Oil Response Constellation (DWH NRDA)



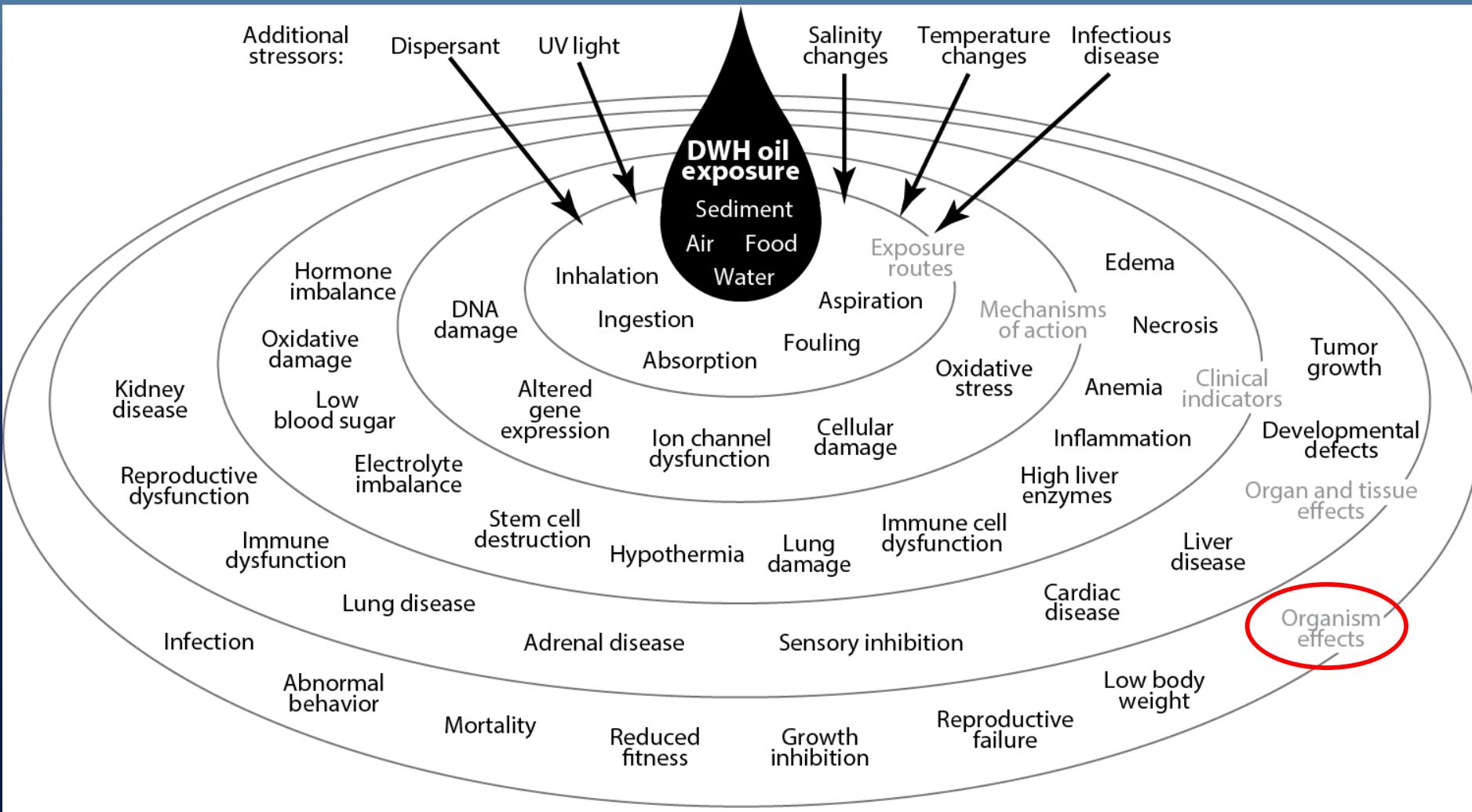
## Physiological Oil Response Constellation (DWH NRDA)



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## Physiological Oil Response Constellation (DWH NRDA)



# Summary

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- Never been to the same oil spill twice
  - Each one is different in terms of oil behavior and effects
- Smaller spills = smaller impacts, usually
- Newer tools allow us to better measure effects compared to past case studies

Thank you. Any questions?

