Apr 5th, 11:30 AM - 1:30 PM

The challenges of moving from framework development to the real world: operationalising an oil vulnerability framework for oil spill response in the Canadian Pacific region

Lucie Hannah
Dept. of Fisheries and Oceans Canada, Canada, lucie.hannah@dfo-mpo.gc.ca

Matthias Herborg
Dept. of Fisheries and Oceans Canada, Canada, matthias.herborg@dfo-mpo.gc.ca

Candice St. Germain
Institute of Ocean Sciences, Canada, candice.st.germain@dfo-mpo.gc.ca

Sharon Jeffery
Dept. of Fisheries and Oceans Canada, Canada, Sharon.Jeffery@dfo-mpo.gc.ca

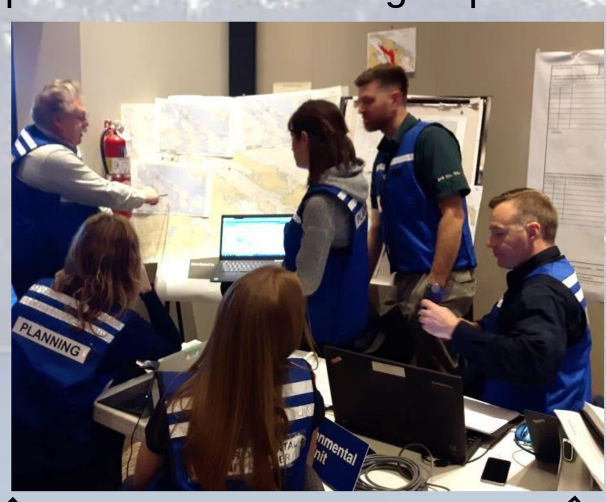
Moving from framework to the real world: operationalising an oil vulnerability framework for oil spill response in the Canadian Pacific region

Hannah, L., Herborg, L-M., St. Germain, C., Jeffery, S

Institute of Ocean Sciences, Department of Fisheries and Oceans Canada (DFO)

Background

- To support oil spill response planning, in 2016 the Pacific region of the Department of Fisheries and Oceans, Canada (DFO) developed an ecological oil vulnerability framework to focus ecological data collection within DFO. It assesses and ranks marine biota in terms of their vulnerability to oil using ten criteria (Exposure, Sensitivity and Recovery categories).
- Here we discuss how the framework outputs have been utilised by the new Environmental Incident Coordinator at DFO-Pacific (a new position as of Aug 2017) during oil spill exercises (e.g. Exercise Salish Sea , 2017) and in real incidents such as the Jake Shearer incident near Bella Bella in Nov 2017 and oil recovery operations from the WWII wreck of the MV Brigadier General Zalinski (2018).
- Operationalising the framework at the spatial scale and within the time constraints of oil spill response requires a varied approach to deal with lack of spatial data for some groups.



Environmental Unit Exercise Salish Sea

Exercise Salish Sea (Photo by Canadian Coastguard)

Crews cleaning the shoreline after a bunker oil spill (Photo: City of Vancouver)

Oil vulnerability framework

- Vulnerability criteria assess exposure, sensitivity and recovery factors of marine biota (represented by 118 sub-groups)
- A list of most vulnerable biota is produced
- The framework is adaptable and flexible. Currently it is focused on generalised impacts from a large ship based spill (not limited to spills of a particular oil type)
- Ecological only - does not assess species based on their socio-economic status (fishery and conservation status) or cultural value (this comes from other processes)

Vulnerable biota identified by the framework

Biological group	Sub-group level 1	Sub-group level 2	Sub-group level 3	Sub-group level 4	Pacific examples	Vulnerability score (0-10)
MARINE PLANTS & ALGAE	Intertidal	Vascular Plants	Low energy unconsolidated shore	Seagrasses	e.g. *Zostera marina, Z. japonica, Ruppia maritima*	9
				Salt marsh grasses	e.g. *Carex lyngbyei, Leymus mollis*	
				Salt marsh succulents	e.g. *Sarcocornia pacifica, S. pacifica, Glaux maritima*	
	Intertidal	Vascular Plants	High energy, rocky shore	Seagrasses	e.g. *Phyllospadix scouleri, P. torreyi, P. serrulatus*	8
	Subtidal	Canopy Algae	Low – moderate energy rocky habitat	N/A	e.g. *Macrocystis integrifolia*	
	Intertidal	Understory / Turf Algae	High energy, rocky shore	N/A	e.g. *Pelvetiopsis limitata, Cymathere triplicata, Postelsia palmaeformis,*	7
MARINE MAMMALS	Mustelids	N/A	N/A	N/A	e.g. Sea otter	9
	Cetaceans	Baleen	Discrete	N/A	e.g. Humpback & Grey whales	
	Cetaceans	Toothed	Discrete	N/A	e.g. Killer whales (residents (N & S) and offshore populations); Pacific white sided dolphin	7
MARINE FISHES	Estuarine	Transient	N/A	Salmon (Salmonidae)	e.g. juvenile and adult salmon & steelhead	8
	Intertidal	Benthic	Associated with unconsolidated substrates (Silt/Sand/Gravel) (inc. eelgrass environments)	Salmonidae (juvenile)	e.g. Salmon (Pink, Chum, Coho, Chinook)	
	Estuarine	Transient	N/A	Sturgeon (Acipenseridae)	e.g. Green sturgeon, White sturgeon	7
	Intertidal	Benthic	Associated with unconsolidated substrates (Silt/Sand/Gravel) (inc. eelgrass environments)	Herring (Clupeidae)	e.g. Pacific herring	
MARINE INVERTEBRATES	Intertidal	Sediment epifauna	Low mobility	Mollusca	e.g. Snails [Cl. Gastropoda]	8
				Cnidaria	e.g. Sea pens	
				Echinodermata	e.g. Sea stars	
	Intertidal	Rock and rubble dwellers	Sessile (attached to hard substrate)	Mollusca	e.g. Oysters [Bivalvia]	7
			Low mobility	Echinodermata	e.g. Sea urchins , Sea cucumbers, Sea stars	
		Sediment infauna	Low mobility	Mollusca	e.g. Clams [Bivalvia]; Snails [Gastropoda]	
				Worms	e.g. Burrowers	
				Arthropoda	e.g. Sand crabs [Emerita]	
				Lophophorates	e.g. Horseshoe worms, lampshells	
	Subtidal benthic	Rock and rubble dwellers	Sessile (attached to hard substrate)	Porifera	e.g. Glass sponges (Hexactinellida)	
			Low mobility	Echinodermata	e.g. Sea urchins, Sea stars	
		Sediment infauna	Low mobility	Mollusca	e.g. Clams	
		Sediment epifauna	Low mobility	Cnidaria	e.g. Sea pens	
				Echinodermata	e.g. Sea stars	

Results of the vulnerability framework organised by species groups. Only the top ranking (Score of 7 and higher) are listed. For more details see Hannah et al. 2017.

Challenges identified when applying the framework during oil spill response

During a spill, the Environmental Unit has to identify and prioritise specific shoreline sections for spill response operations to protect (booming, skimming, shoreline clean up)

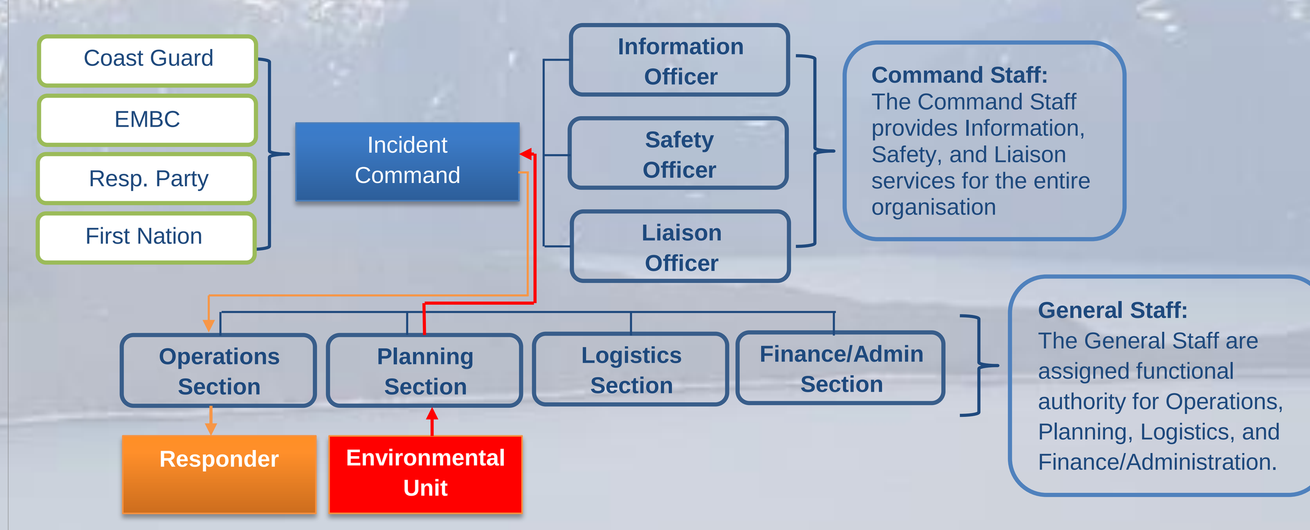
The framework was intentionally designed to assess species vulnerability without taking into account data availability. Hence, spatial distribution information at the small scale required during a spill is often lacking for some species groups.

Fisheries and Oceans Canada's Environmental Incident Coordinators using the outputs of the vulnerability framework during spill response have identified some limitations for operationalising the framework:

- Framework is general, and does not identify vulnerable biota based on specific oil types
- Absence of distribution data for many vulnerable species groups
- Lack of spatial coverage for species groups across the whole coastline
- Determining presence of highly mobile species (i.e. whales)
- Presence data does not incorporate seasonal variations in distribution or sensitive life phases

Environmental vulnerability information flow

- During a spill, the Environmental Unit, consisting of environmental experts from relevant government agencies (e.g. Environment Climate Change Canada, BC Ministry of Environment), First Nations, and the Responsible Party, identify the resources at risk.
- The proposed resources at risk are then passed to the Incident Command for review. Incident Command then tasks the on-water responders within the Operations Section



Incident Command Structure during the Environmental Response Phase of an Oil Spill in British Columbia

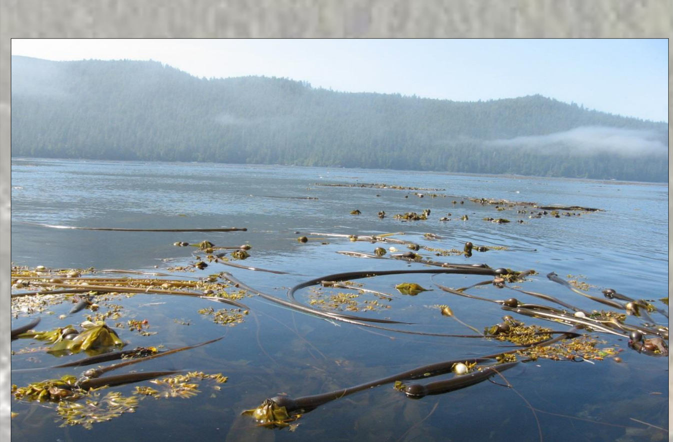
Operational approach

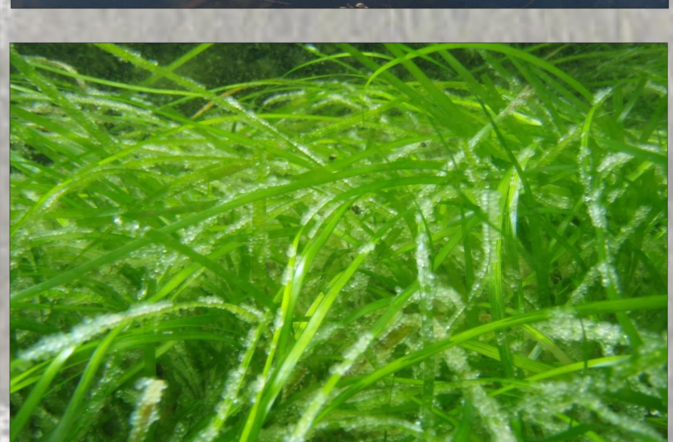
- Varied data quality among vulnerable species groups. High quality baseline data are available for some (i.e. sea otters, harvested clams, shrimp, sea urchins, herring). In other cases, there are limited data, or only older data available (e.g. seagrass, kelp), here data has to be used with a clear understanding of the uncertainties. Seasonality of some species still has to be taken into account for prioritisation
- Species lacking spatial distribution data (e.g. salt marsh plants, non-commercial invertebrates) can be combined, and the high risk areas identified by habitat type as a proxy (e.g. Intertidal soft sediment, subtidal rock and rubble)
- Highly mobile species (e.g. killer whales, Pacific white sided dolphins) have to be monitored in real time during a spill to determine their risk of exposure, through water and air based monitoring and hydrophones.
- **These priorities are part of the Environmental Units discussion to reach an overall consensus for priorities for protection that is then passed up to Incident Command**

Hannah L, et al. 2017. Application of a framework to assess vulnerability of biological components to ship-source oil spills in the marine environment in the Pacific Region. DFO Can. Sci. Advis. Sec. Res. Doc. 2017/057.

- http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm

Next steps and future work

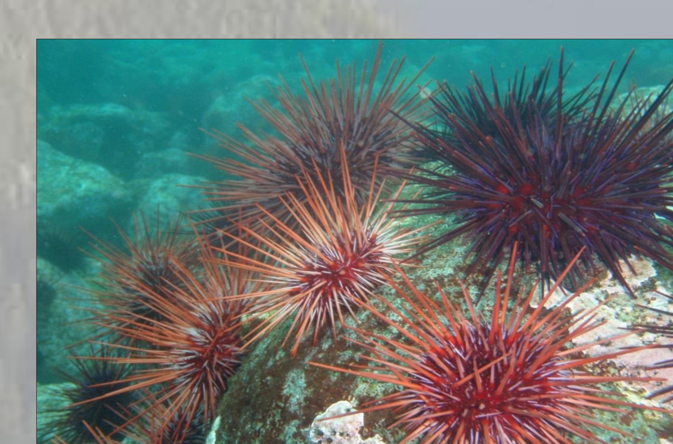




Photos by Sharon Jeffery

- The vulnerability framework is a scientifically defensible way to prioritise environmental resources during an oil spill, however other agencies are not following the same approach.
- To streamline decision making in the short timelines of spill response, using the same prioritisation framework across government would be beneficial.
- Coast-wide datasets for almost all vulnerable species groups are currently lacking, this could be improved by coast-wide shoreline mapping combined with species distribution modelling.
- Detection networks for mobile species like cetaceans need to be further improved for spills.
- Further training for responders to be able to readily identify sensitive species and habitats during the initial response phase.

- Developing the vulnerability framework to assess vulnerability to different oil types and states of weathering.
- Adding a final screening step for vulnerable species groups based on current data availability in the area may benefit responders
- While this framework allows the prioritisation by environmental factors, it does not consider socio-economic or cultural factors. The ultimate goal is to develop priority maps based on all these factors (ecological and socio-economic and cultural) for high risk areas to inform responders prior to an incident and the setting up of the Environmental Unit, as well as identifying where data collection is needed.
- **Identifying priority areas for protection during a spill, must take into account the operational limitations of spill response to enable an effective spill response strategy**.



Photos by Sharon Jeffery

Fisheries and Oceans Canada Pêches et Océans Canada