



Jan 1st, 12:00 AM - 12:00 AM

A framework to assess vulnerability of biological components to ship-source oil spills in the marine environment

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Thornborough, Kate; St. Germain, Candice; Hannah, Lucie; and O, Miriam, "A framework to assess vulnerability of biological components to ship-source oil spills in the marine environment" (2016). *Salish Sea Ecosystem Conference*. 47.

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A framework to assess vulnerability of biological components to ship-source oil spills in the marine environment

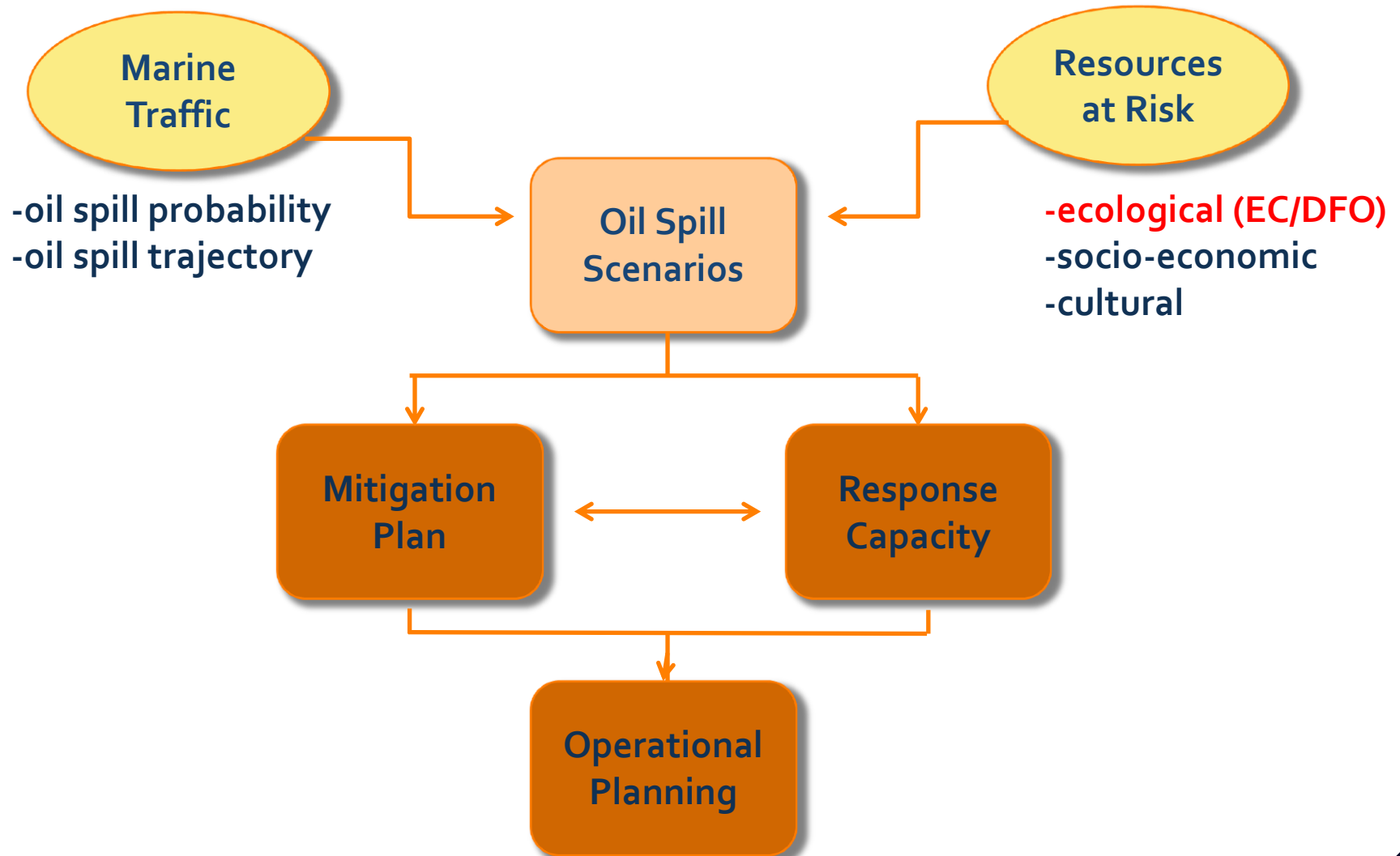


Kate Thornborough, Lucie Hannah, Candice St. Germain and Miriam O
IOS DFO Science

Purpose

- + Need for a rapid assessment of vulnerability to ship source oil spills for biological components under DFO mandate
- + Framework needed to be:
 - + Nationally consistent
 - + Regionally flexible
 - + Grounded in science
 - + Rapid and simple to implement
- + Primary outcome:
 - + Concise list of biological components most vulnerable to oil

Steps to develop an Area Response Plan for ship-sourced oil spills

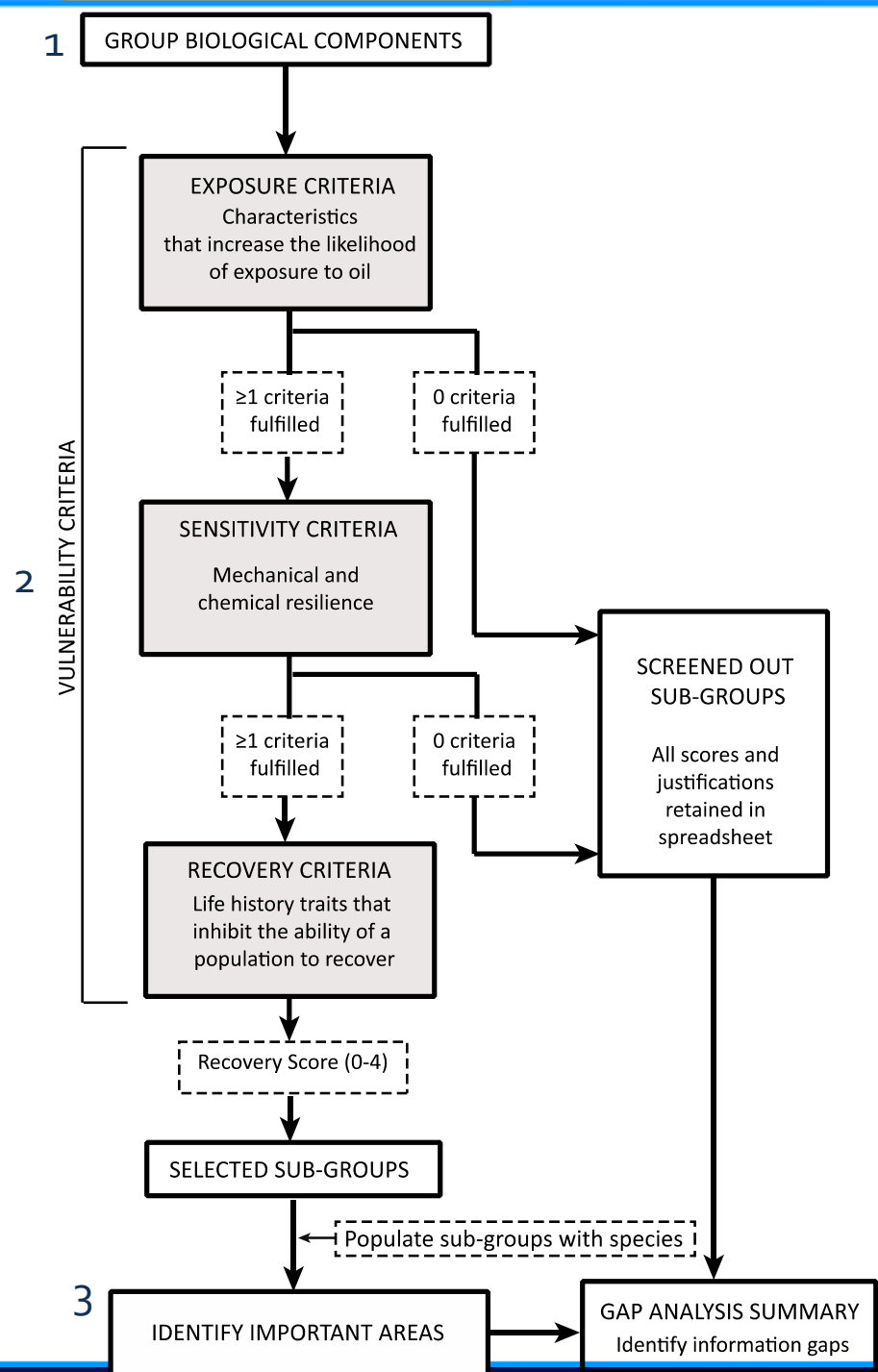


Context: Scope

- + Focus on biological components under DFO science mandate
- + Shoreline type not considered – existing EC classification system
- + Ecological only, does not consider socio-economic or cultural values
- + Focus on impacts from direct contact with oil
 - + no indirect or secondary impacts
- + Habitats:
 - + areas associated with vulnerable biological components
 - + Biogenic habitats are assessed as a species
- + MPAs and other spatial planning areas not assessed
- + Not limited to any specific oil type.
- + No mitigation measures are included.

Framework Overview

1. **Grouping** of the biological components into sub-groups
 2. **Scoring and screening** of sub-groups against vulnerability criteria (exposure, sensitivity, and recovery criteria) to identify the most vulnerable sub-groups
 3. Identification of **area specific species** and **areas of importance** for vulnerable sub-groups
- + Gap analysis built into every phase



Phase 1: Grouping of Biological Components

- + Sub-groups allow for rapid assessment
- + Sub-groups developed within:
 - + Marine Mammals
 - + Marine Reptiles
 - + Marine Fish
 - + Marine Invertebrates
 - + Marine Algae/Plants
- + Members of a sub-group should share similar characteristics with respect to factors important for vulnerability to oil



Phase 2: Scoring and Screening

Vulnerability Criteria Development

- + All biological components are vulnerable to oil to some degree
 - + Developed suite of criteria to identify the **most** vulnerable components
- + Criteria development
 - + Literature review (NOAA Environmental Sensitivity Index, vulnerability and risk assessments)
 - + Three main aspects to assess vulnerability:
 - + Potential Exposure to oil
 - + Sensitivity to oil
 - + Recovery potential
- + Criteria are developed to be applicable at the sub-group level, and relevant to all regions across Canada



Phase 2: Scoring and Screening

Exposure criteria

- + Concentration (aggregation) and/or site fidelity
- + Sessile/low mobility
- + Surface interacting
- + Sediment interacting



Phase 2: Scoring and Screening

Sensitivity Criteria

MECHANICAL SENSITIVITY

- + Loss of insulation
- + Reduction of feeding/photosynthesis

CHEMICAL SENSITIVITY

- + Impairment due to toxicity



Russ Markel

Phase 2: Scoring and Screening Recovery Criteria

- + Population status
- + Reproductive capacity
- + Endemism or isolation
- + Close association with sediments



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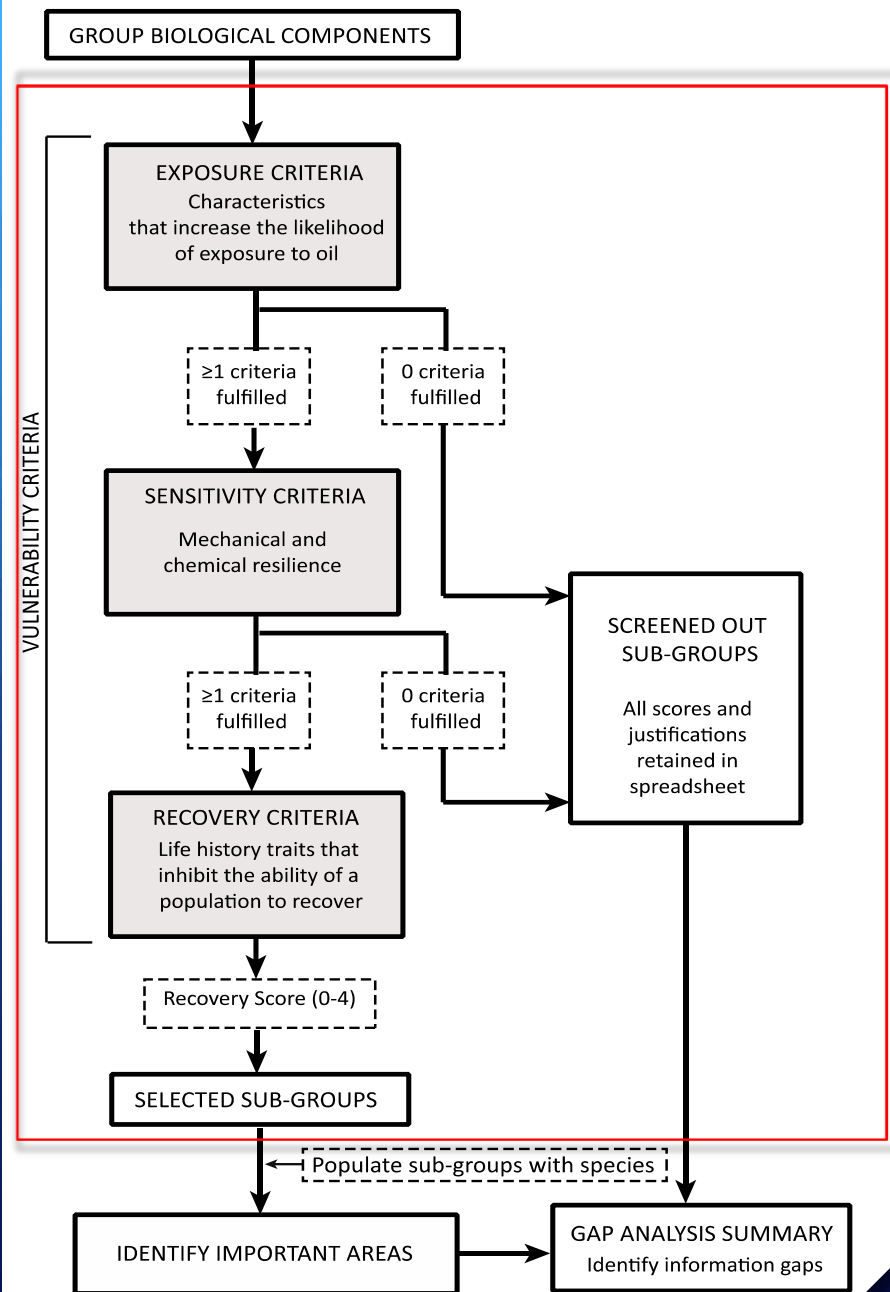
Phase 2: Scoring and Screening

Scoring Considerations

- + Scored at the sub-group level (e.g. baleen whales)
- + Criteria scored as either fulfilled/not fulfilled
- + Based on direct contact with oil
- + Scored based on life stage most likely to be impacted (e.g. fish embryos – BUT this may not be feasible for some organisms)
- + Sub-groups scored based on most sensitive member to best of available knowledge
- + Scores and screening reviewed by subject matter experts

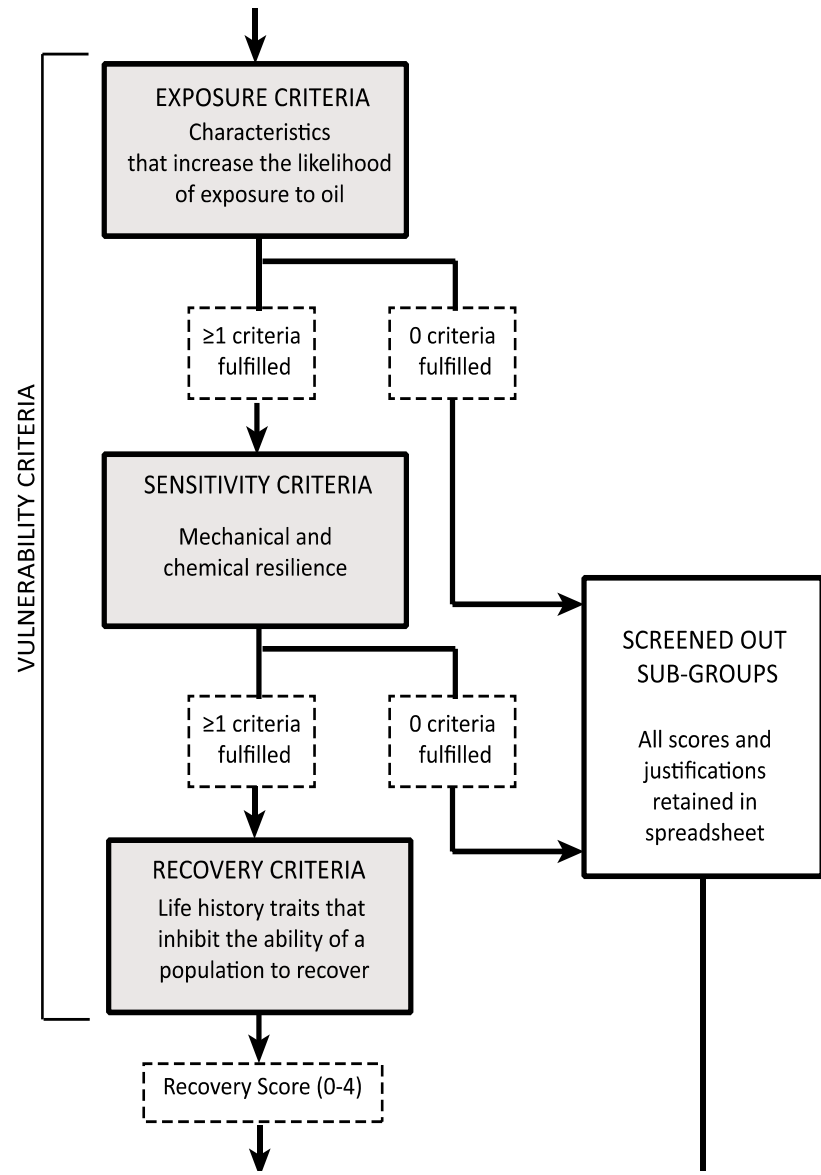
Phase 2: Scoring and Screening

Process

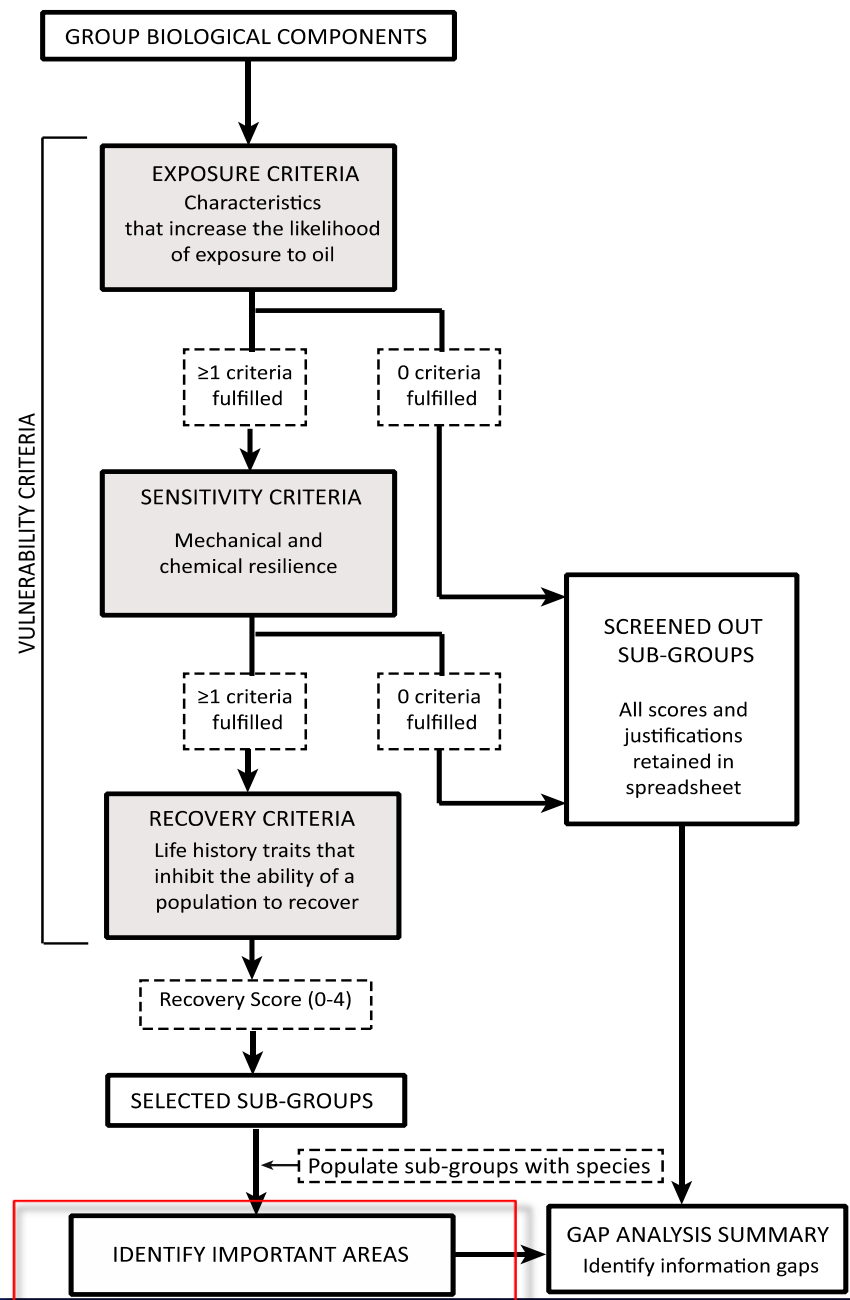


Phase 2: Scoring and Screening Process

1. Exposure Criteria
 - + Screen out sub-groups which do not fulfil any criteria
2. Sensitivity Criteria
 - + Screen out sub-groups which do not fulfil any criteria
3. Recovery Criteria
 - + Remaining sub-groups ranked by recovery score (0-4)



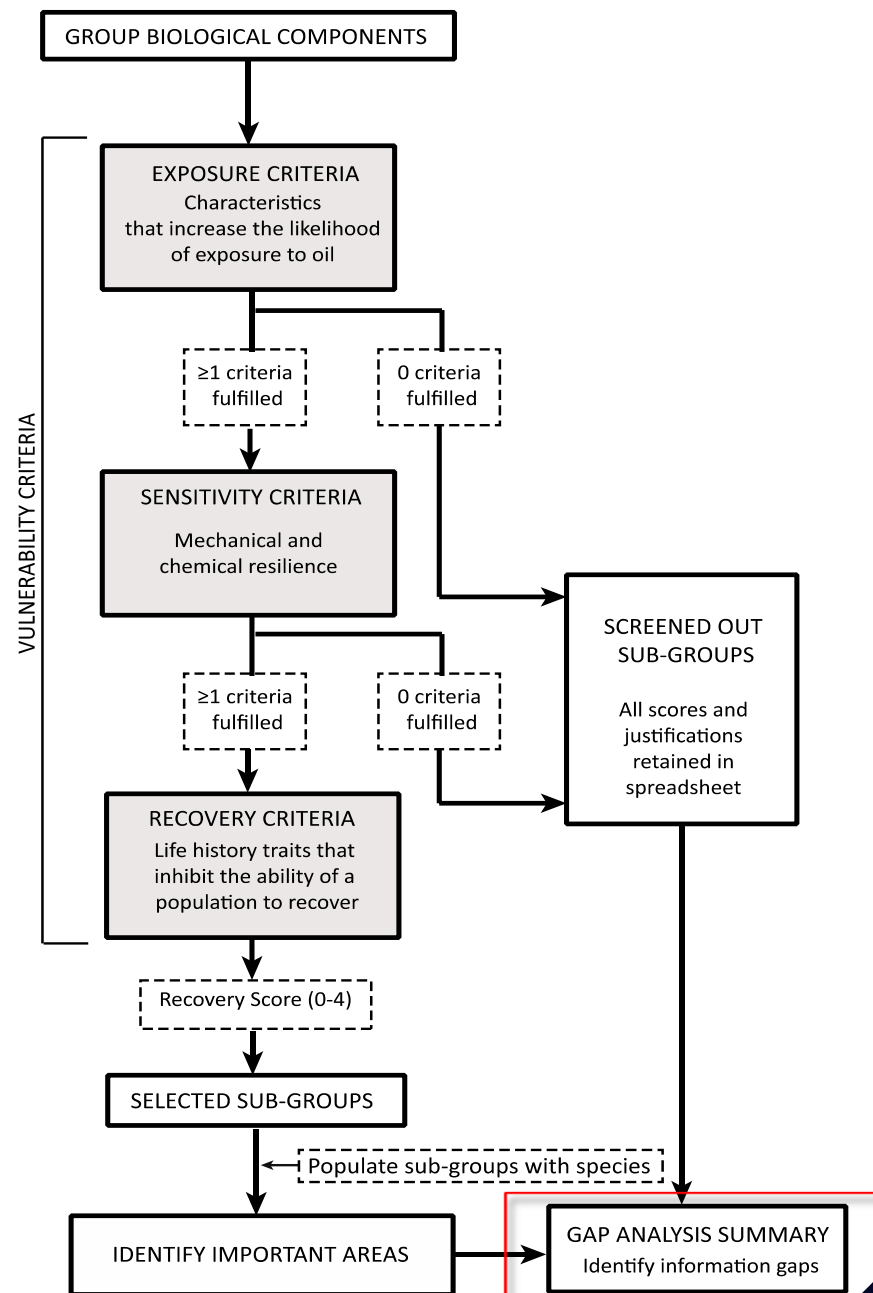
Phase 3: Identification of area specific species and areas of importance



Phase 3: Identification of area specific species and areas of importance

- + Assemble lists of local species for each vulnerable sub-group
- + Compile lists of important areas for species within vulnerable sub-groups (e.g. haul outs, spawning grounds)
- + Request and compile identified data

Gap analysis summary



Gap Analysis Summary

- + Summarize knowledge and data gaps
- + Knowledge gaps:
 - + A lack of information or conflicting information causing uncertainty in grouping or scoring
- + Data gaps:
 - + A lack of data on areas of species concentration
 - + A lack of current data
 - + Improper data format
 - + Unavailable data
- + Summary of identified gaps used to prioritize future research or streamline data management

Limitations

- + Indirect effects (e.g. food web impacts)
- + Cumulative effects (e.g. multiple stressors)
- + Compounding impacts (e.g. source-sink dynamics)
- + All important considerations for comprehensive assessment, but not possible to assess using current knowledge



Future Work and Other Applications

- + Trial applications underway in 4 Canadian regions:
 - + **Salish Sea**
 - + Bay of Fundy
 - + St. Lawrence
 - + Port Hawkesbury, NS
- + Feasibility for use by other agencies? (e.g. EC-Birds)
- + Framework can be adapted for vulnerability assessment of:
 - + Arctic and freshwater environments
 - + Other anthropogenic stressors

Questions?



Photo by Linda Tanner