

What are the functional relationships between fish and their habitats?

Levels for defining Essential Fish Habitat:

- I. Presence/Absence
- II. Relative abundance data
- III. Habitat-specific growth, survival, and reproduction rates
- IV. Habitat-specific production rates

We need level 3 and 4 data to incorporate habitat into models of fish population dynamics.



Hypotheses: survival

- Whereas juvenile fish of many species depend on structural epifauna for protection from predators;
- Bottom fishing reduces this cover and increases predation mortality.

Support:

- Habitat use by different ages of juvenile cod (Gregory & Anderson)
- Predation experiments on juvenile cod with different habitat complexity (Lindholm & Auster)



Hypotheses: feeding

- Whereas diet composition of demersal fish is linked to the species composition of benthic habitats;
- In disturbed areas, demersal fish have reduced diet choice and feeding opportunities.

Support:

- Diet composition differed between disturbed and undisturbed areas (Smith et al. 2013).
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Hypotheses: scavenging

- Bottom fishing increases the availability of certain prey types to demersal fish;
- This is thought to be a response to low levels of bottom fishing that does not persist with chronic disturbance.

Support:

- Rijnsdorp and van Leeuwen (1996).
- Shifts in stable isotope ratios that imply feeding on lower trophic levels in disturbed areas



Hypotheses: feeding rate

- Whereas bottom fishing reduces benthic biomass and productivity;
- Feeding rates are lower in disturbed areas.

Support:

- Lower biomass and production in disturbed areas (Jennings et al. 2001, Hermsen et al. 2003).
- No evidence for differences in stomach-content fullness (Link et al. 2005, Smith et al. 2013).



Hypotheses: growth

- Whereas bottom fishing affects food availability to demersal fish;
- Growth rate and condition differ between disturbed and undisturbed areas.

Support:

- Plaice growth rates in Celtic Sea (Shephard et al. 2010). - on gravel; + on sand.
- Plaice condition in the Irish Sea negatively related to trawling frequency (Hiddink et al. 2011).



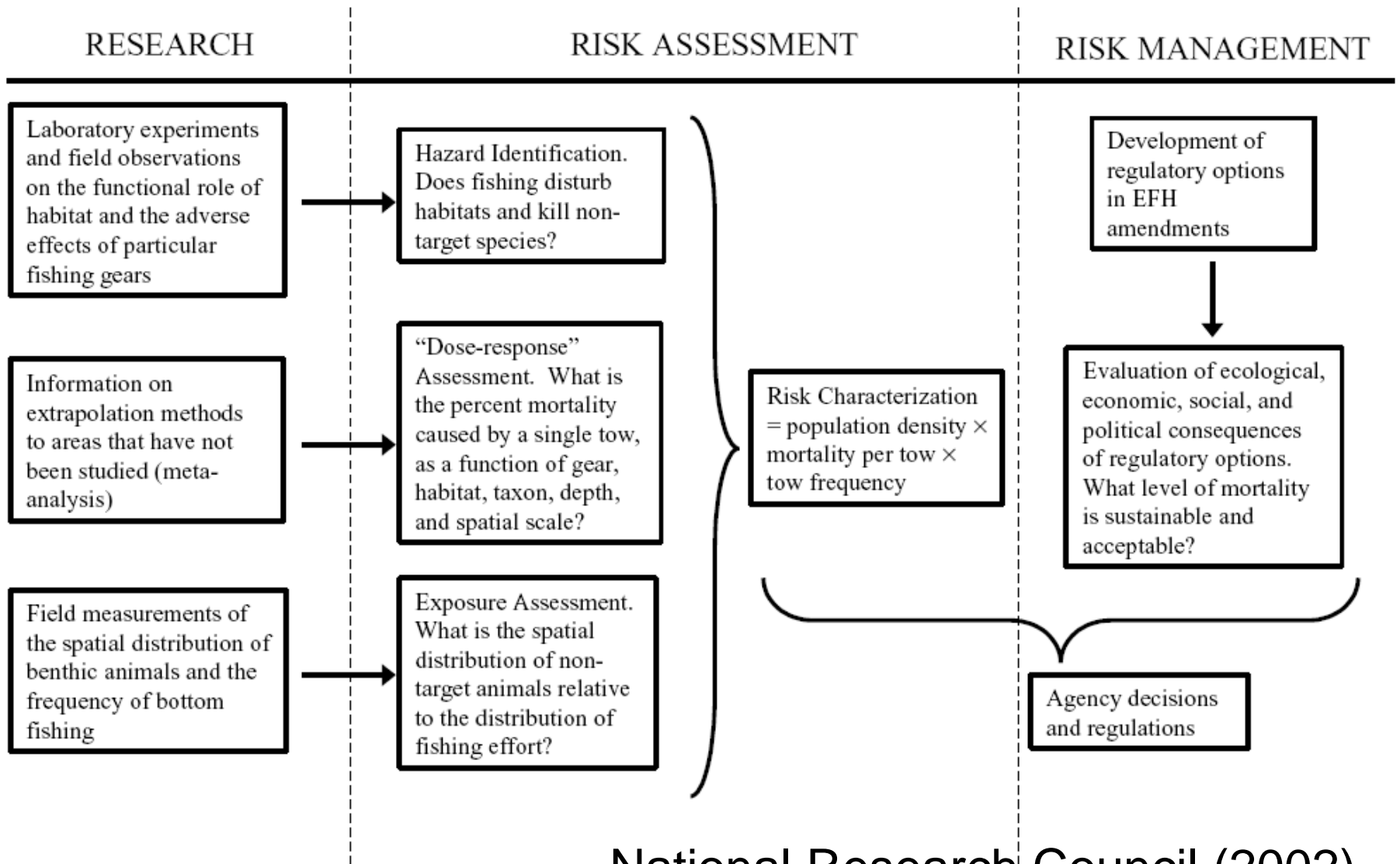
Hypotheses: reproduction

- Whereas many fish species have demersal eggs;
- Bottom fishing disrupts reproduction and causes direct mortality of eggs.

Support:

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Risk-assessment framework



National Research Council (2002)



Integrating to the population level

- Coupled fish-benthos-habitat models (Fogarty 2005);
- Size-spectrum models (Duplisea et al. Blanchard & Jennings);
- Predation models (Lindholm & Auster);
- Incorporate impacts into a basic population dynamics model (a la B-H) to scale the indirect effects to the direct effects of fisheries and bycatch;
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