Benthic effects of trawling and dredging and implications for Fisheries Planning

Martin Cryer
Science Manager Aquatic Environment

Overview of presentation

- What methods are we talking about?
- Over what scale do they operate?
- What are the general effects?
- What are the consequences?
- How do we deal with this?

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Northern NZ scallop dredge

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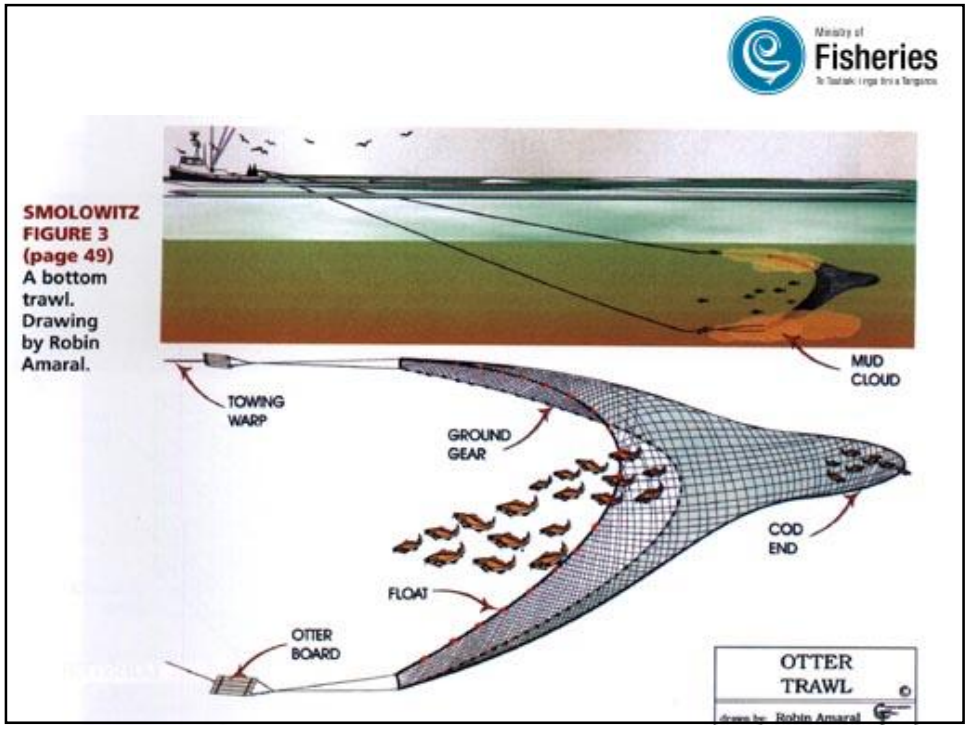
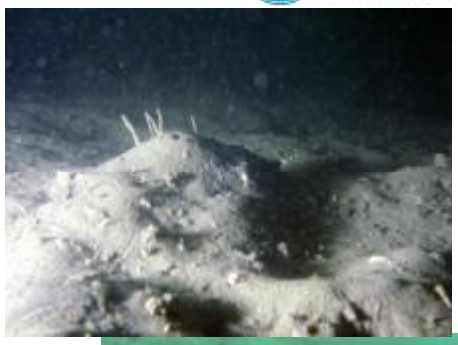
Dredges have teeth or tines; they're designed to "dig"

March 2008


Ministry of
Fisheries
SMOLOWITZ
FIGURE 3
(page 49)
A bottom
trawl.
Drawing
by Robin
Amaral.
MUD
CLOUD
TOWING
WARP
GROUND
GEAR
COD
END
FLOAT
OTTER
BOARD
OTTER
TRAWL
©
drawn by: Robin Amaral

Soft-sediment seafloor habitats are diverse and heterogeneous

Ministry of Fisheries



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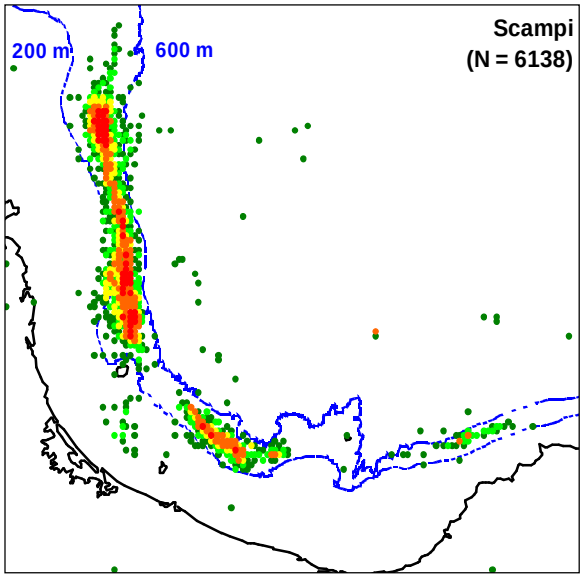

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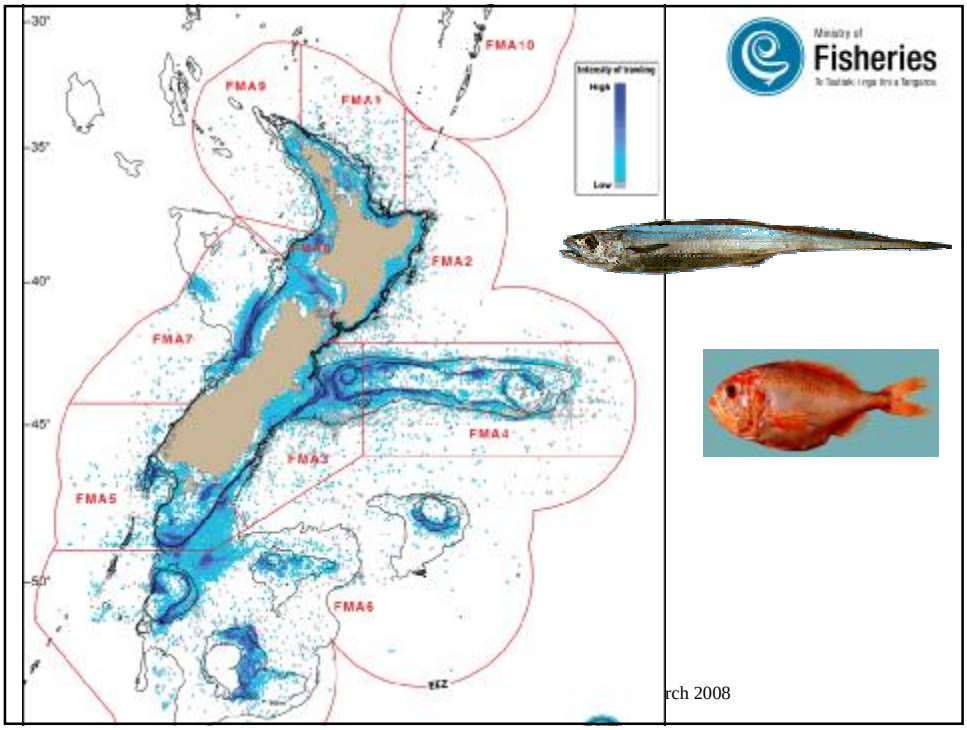

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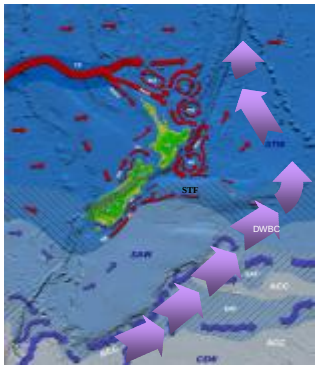
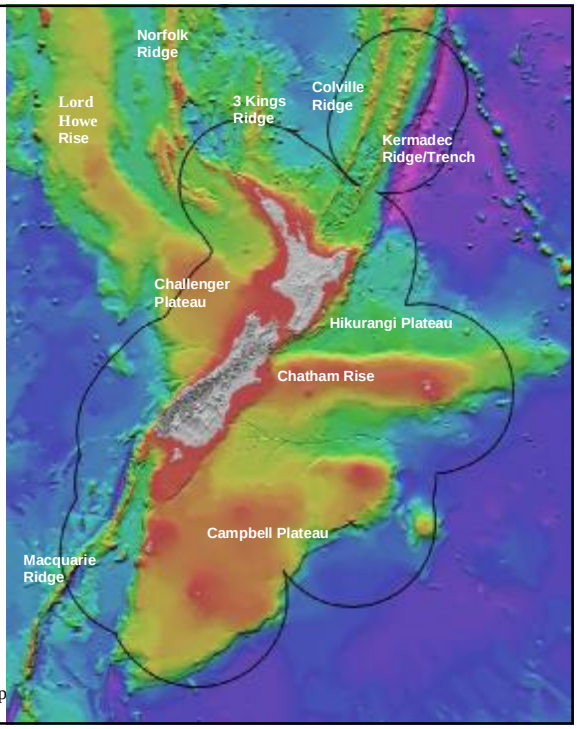
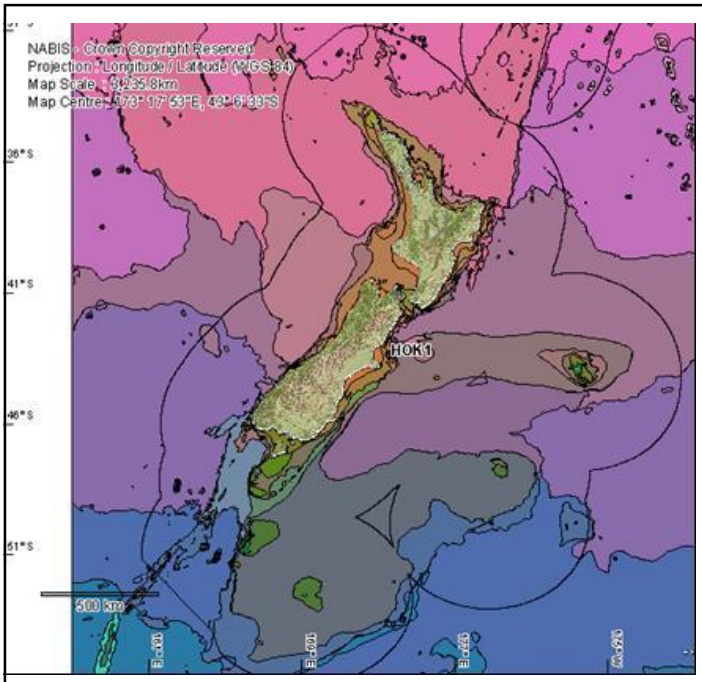
New Zealand's Exclusive Economic Zone (EEZ) is huge, and very diverse



Northland Scallop





What can we say about the distribution of seabed habitats?

(Not that much!)

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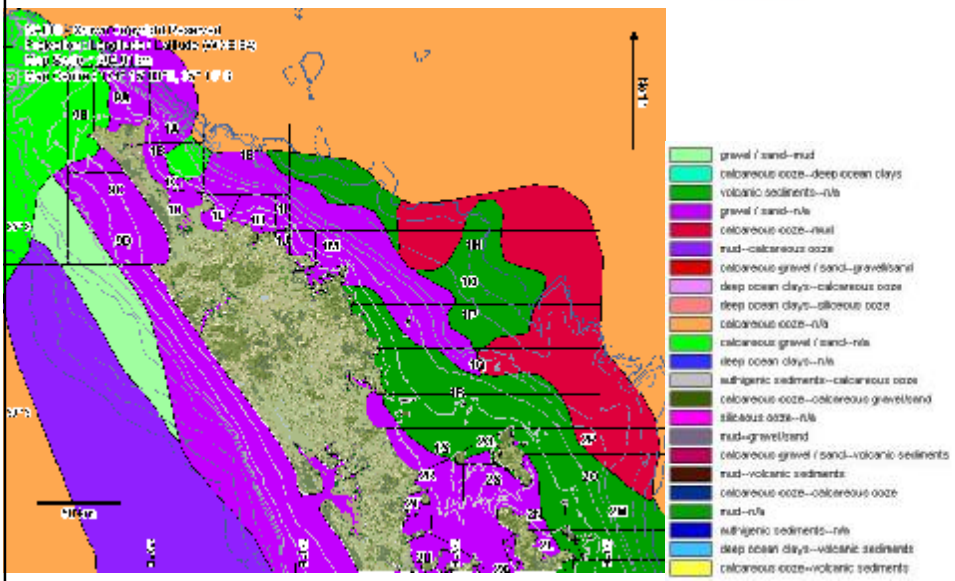
Even sediment distribution is approximately known



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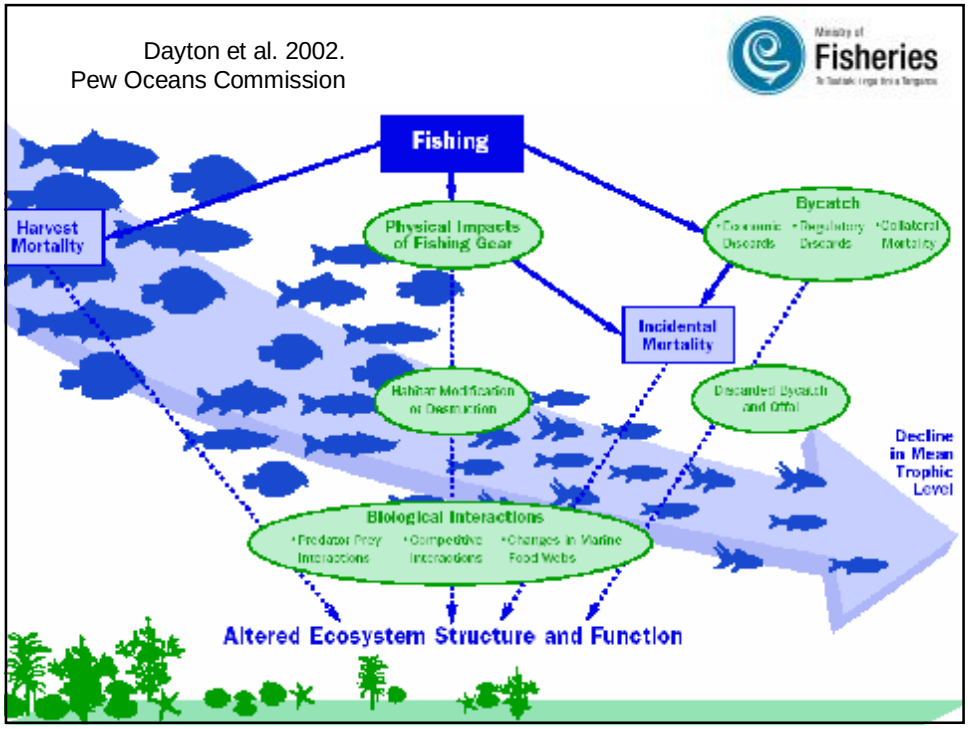
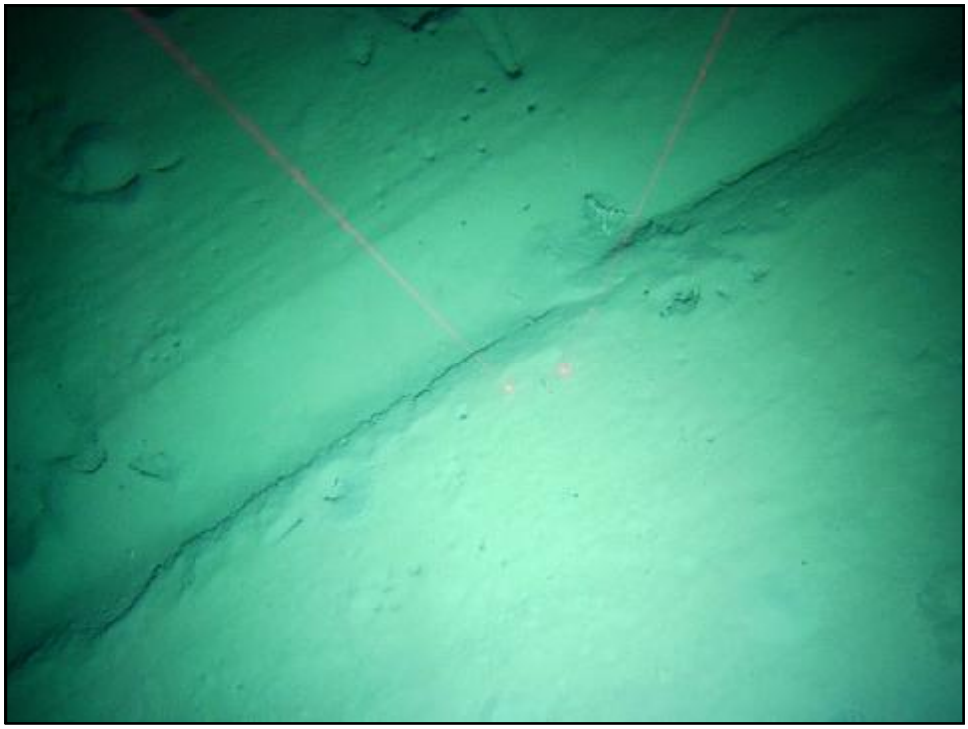
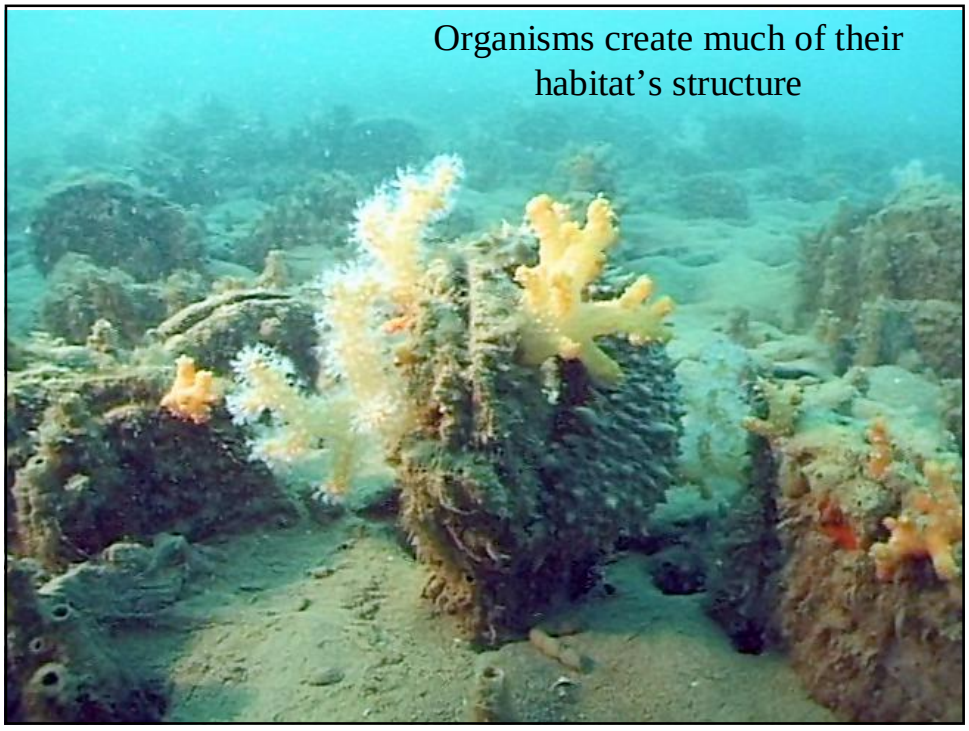
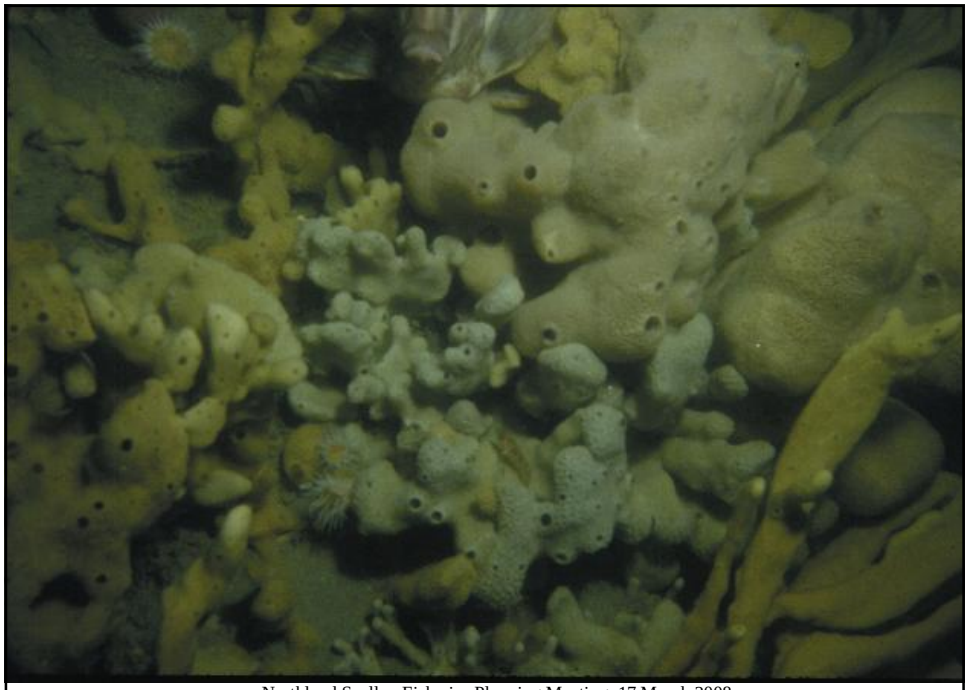

Dayton et al. 2002.
Pew Oceans Commission
Ministry of Fisheries
Fishing
Harvest Mortality
Physical Impacts of Fishing Gear
Bycatch
•Economic Discards
•Regulatory Discards
•Collateral Mortality
Incidental Mortality
Habitat Modification or Destruction
Discarded Bycatch and Offal
Decline in Mean Trophic Level
Biological Interactions
•Predator Prey Interactions
•Competitive Interactions
•Changes in Marine Food Webs
Altered Ecosystem Structure and Function




Organisms create much of their habitat’s structure



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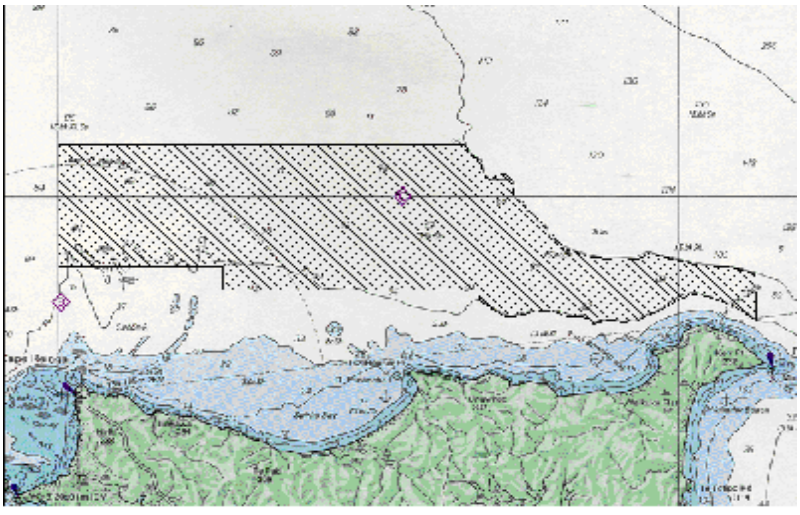
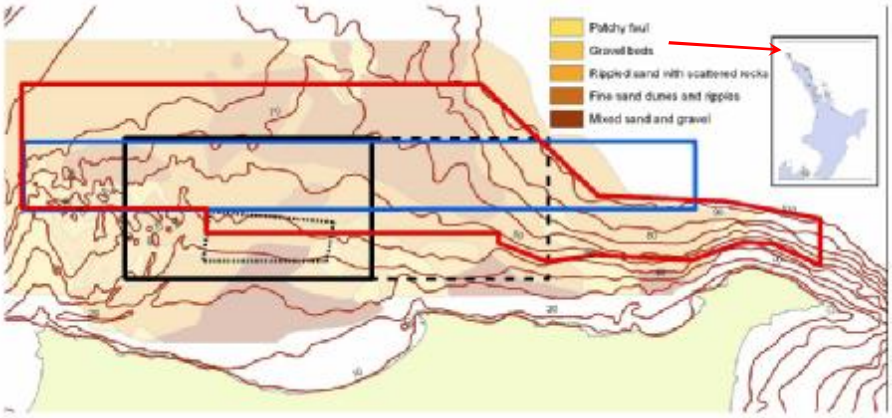
Current closure in Piwhane / Spirits Bay to protect biodiversity (sponges, bryozoans, hydroids)



Current closure in Piwhane / Spirits Bay to protect biodiversity (Project ENV2005/23)



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International review (Jake Rice, 2006)

C S A S

Canadian Science Advisory Secretariat

Research Document 2006/057

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Impacts of Mobile Bottom Gears on Seafloor Habitats, Species, and Communities: A Review and Synthesis of Selected International Reviews

S C C S

Secrétariat canadien de consultation scientifique

Document de recherche 2006/057

Ne pas citer sans autorisation des auteurs.*

Effets des engins de fond mobiles sur les habitats, les espèces et les communautés du plancher océanique – Examen et synthèse des examens internationaux choisis

Jake Rice

Canadian Science Advisory Secretariat
Science Branch, 200 Kent Street
Ottawa, Ontario K1A 0E6

International review (Jake Rice, 2006)

Impacts of Bottom Gears on habitats:

1. Mobile bottom gears can **damage/reduce structural biota** - All reviews, strong evidence or support.
2. Mobile bottom gears can **damage/reduce habitat complexity** - All reviews panel, variable evidence or support.
3. Mobile bottom gears can **reduce/remove major habitat features** (boulders etc.) – Some reviews, strong evidence or support.
4. Mobile bottom gears can **alter seafloor structure** – Some reviews, conflicting evidence for benefits or harm.

International review (Jake Rice, 2006)

Other emergent conclusions on habitat impacts included:

5. There is a gradient of impacts, with **greatest impacts on hard, complex bottoms** and least impact on sandy bottoms – All reviews, strong support (with qualifications).
6. There is a gradient of impacts, with **greatest impacts on low energy environments** and least (often negligible) impact on high-energy environments – All reviews, strong support.
7. Trawls and **mobile dredges are the most damaging** of the gears considered – Three of the reviews considered other gears, all drew this conclusion, often with qualifications.

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International review (Jake Rice, 2006)

Impacts of Bottom Gears on benthic species and communities:

8. Mobile bottom gears can **change the relative abundance of species** – All reviews, strong evidence or support.
9. Mobile bottom gears can **decrease the abundance of long-lived species** with low turnover rates – All reviews, moderate to strong evidence or support.
10. Mobile bottom gears can **increase the abundance of short-lived species with high turnover rates** – All reviews, moderate to occasionally strong evidence or support.
11. Mobile bottom gears **affect populations of surface-living species** more often and to greater extents than populations of burrowing species – All reviews, weak to occasionally strong evidence or support.

International review (Jake Rice, 2006)

Impacts of Bottom Gears on benthic species and communities (contd.):

12. Impacts of mobile bottom gears are **less in high-energy / frequent natural disturbance environments** than in low energy environments where natural disturbances are uncommon - 4 reviews (one did not address the factor) – strong evidence or support.
13. Mobile bottom gears **affect populations of structurally fragile species** more often and to greater extents than populations of "robust" species – All studies, variable evidence and support.
14. Abundance of **scavengers increases temporarily** in areas where bottom trawls have been used – 3 reviews, variable support or evidence, all argue for only transient effect.

International review (Jake Rice, 2006)

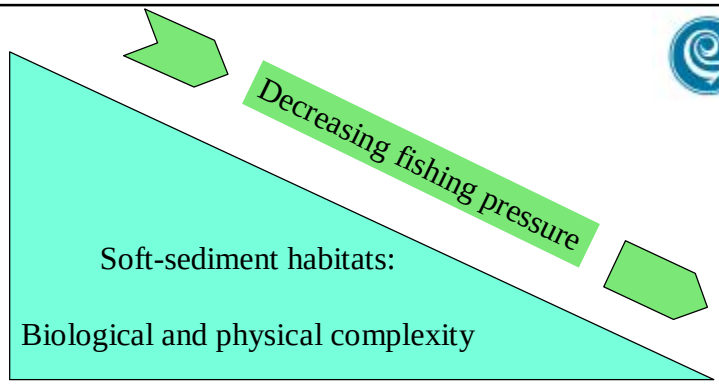
Mitigation:

22. The impact of mobile bottom gears on seafloor habitats and species can be reduced through **major reduction in effort** in fisheries using those gears – All reviews, strong support.
23. The impact of mobile bottom gears on seafloor habitats and species can be reduced through **implementation of areas where use of those gears is not permitted** – All reviews; strong support for habitat features, especially by NMFS, support for species and communities qualified in all cases to depend on the characteristics of the species of concern.
24. The impact of mobile bottom gears on seafloor habitats and species can be reduced through **substitution of another gear** or modification of the trawl gears to reduce contact with the benthos and seafloor – All studies, moderate to strong support.

International review (Jake Rice, 2006)

Summary for Northland scallop fishery:

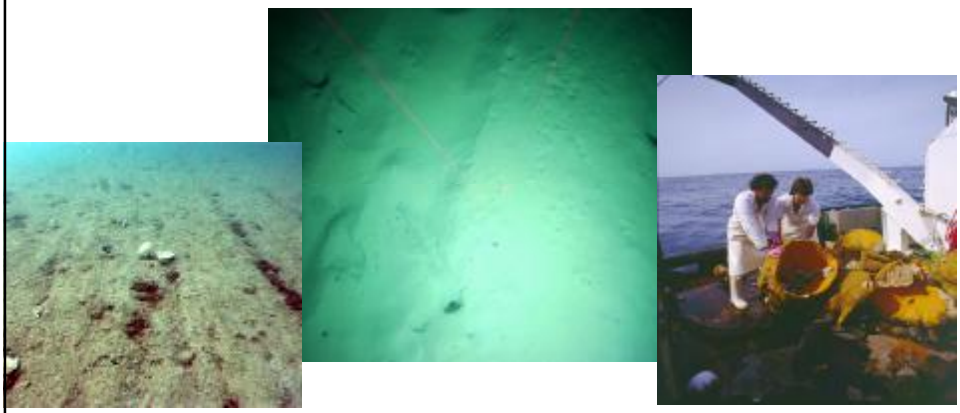
- Dredges are the most heavily impacting gear type
- Effects on foliose or emergent "structural" fauna are greatest
- Effects in sandy or high-disturbance environments are least
- Knowledge of distribution of habitats is sketchy
- Overlaps with bottom trawl fisheries are not well described



Simple, low diversity system, few large, old animals few fragile animals (e.g., echinoids), Scavengers? Lower productivity?	Complex, high diversity system, wide variety of ages, foliose, fragile or "structuring" animals. Settlement / nursery areas Higher productivity?

Dayton et al. 1995. Aquatic Conservation: Marine and Freshwater Ecosystems **5**:205-232.

Knowledge of the frequency, extent, intensity, response, and recovery are needed to identify when disturbance exceeds the capacity of nature to respond



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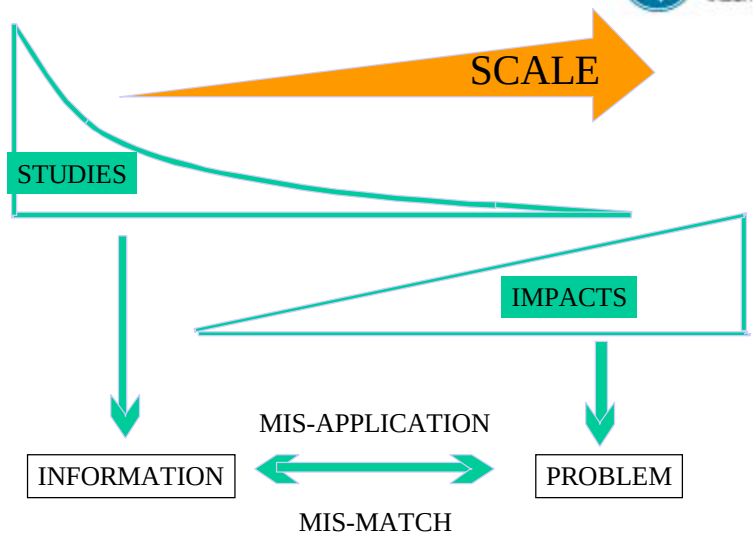
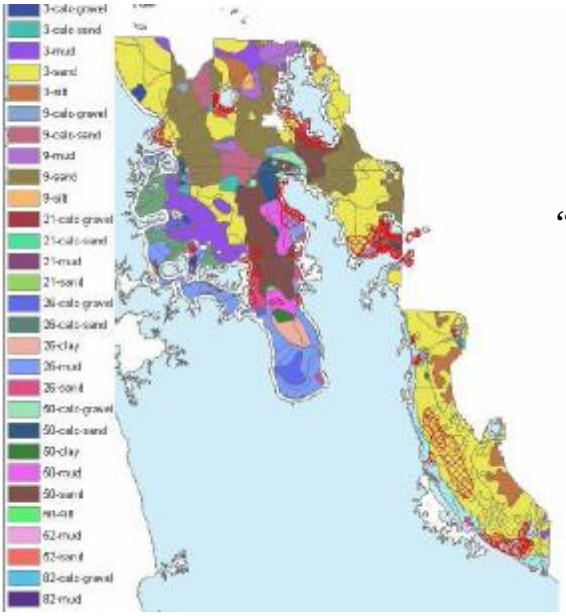
This is tricky science, though…



Do changes to seafloor habitats matter?

- Short answer is Yes.
- Biodiversity will probably decline
- Some important "structuring" species may become functionally extinct
- Productivity may be affected
- We risk affecting critical ecological processes
- Need to consider in a landscape context.



An example of the "landscape approach, Coromandel scallop fishery

Questions, comments???