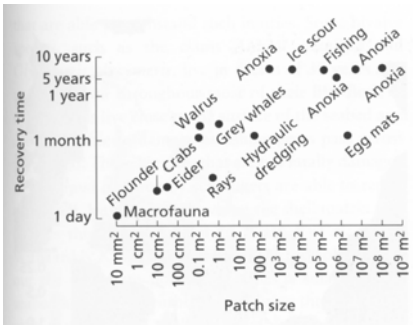
Fishing Impacts on Habitats

Ecological Consequences of Disturbance:

Anthropogenic (fishing, oil extraction, waste discharge)
vs.
Natural (hurricanes, storms, tidal action, feeding and burrowing of animals)

Physical – disturbing habitat
Biological – removing competitors and predators

Anthropogenic and natural disturbances as a function of spatial scale of impact and temporal scale of recovery

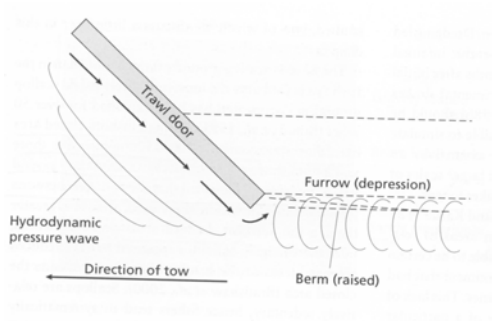


(1) Distribution of Fishing Disturbance
-- not homogenously distributed
-- concentrated where yields of commercial species have been highest
-- difficulty in looking at long-term effects of physical disturbance from fishing, especially at large spatial scales and because effects are habitat-dependent

(2) Direct Effects of Fishing Gear
-- active (towing trawls, seining, spearing, explosives
vs.
passive (pots, traps, gill nets, drift nets)

(a) Towed fishing gear has greatest potential for damage:
-- wide use, cover large areas
-- re-suspends sediments on soft bottoms
-- on rock, cobble or boulders may be moved; biogenic structures (e.g., coral) damaged
-- magnitude of damage determined by weight and dimensions of gear and towing speed
-- adversely affect infauna and epifauna, and catch a large proportion of non-target species (bycatch)

Effects of Otter trawl on sea bottom



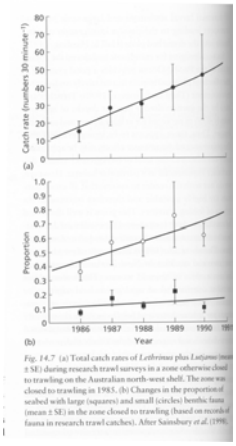


Fig. 14.7 (a) Total catch rates of *Lethrinus* plus *Lutjanus* (mean ± SE) during research trawl surveys in a zone otherwise closed to trawling on the Australian north-west shelf. The zone was closed to trawling in 1985. (b) Changes in the proportion of seabed with large (squares) and small (circles) benthic fauna (mean ± SE) in the zone closed to trawling (based on records of fauna in research trawl catches). After Sainsbury *et al.* (1998).

-- abundance of fishes tied to habitat (sponges, corals)

Sea bottom in heavily fished vs. lightly fished areas

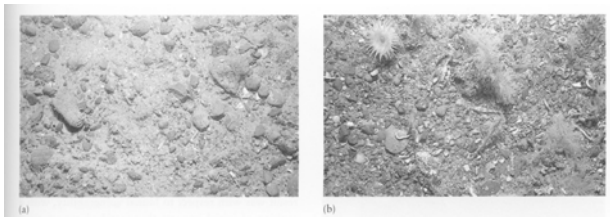


Fig. 14.8 Photographs of the seabed in (a) a heavily fished scallop ground, and (b) a similar habitat in a lightly fished area on the Georges bank. The fauna in the lightly fished area is typically dominated by foliose bryozoan and hydrozoan species that add to the structural complexity of the habitat. Photographs copyright D. Blackwood and P. Valentine.

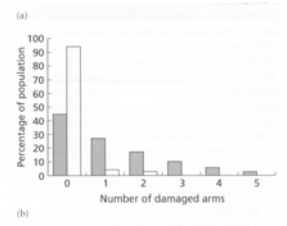


Fig. 14.4 (a) A portion of a side-scan sonar record showing pairs of 12-m-wide beam-trawl marks on muddy ground off Fleetwood, England, and pairs of 4-m-wide beam-trawl marks off the River Mersey, England. The trawl marks run in a north/south direction. Scale bar = 25 m. (b) The mean proportion of the starfish (*Astropecten irregularis*) populations with different numbers of damaged or regenerating arms at each site. Shaded bars, Fleetwood (heavily fished); open bars, Mersey (lightly fished). After Kaiser (1996).

a) Static fishing gear (gill nets, traps):

-- fish passively, anchored to the sea bottom

-- relatively little effects on seabeds, but problems with bycatch (e.g., 'ghost-fishing')

-- effects over much less area

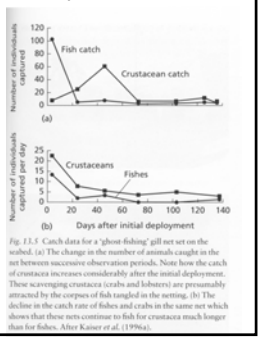


Fig. 13.5 Catch data for a "ghost-fishing" gill net set on the seabed. (a) The change in the number of animals caught in the net between successive observation periods. Note how the catch of crustacea increases considerably after the initial deployment. These scavenging crustacea (crabs and lobsters) are presumably attracted by the corpses of fish tangled in the netting. (b) The decline in the catch rate of fishes and crabs in the same net which shows that these nets continue to fish for crustacea much longer than for fishes. After Kaiser *et al.* (1996a).

Catches, bycatches, and discards:

-- catch = target species

-- incidental catch = non-target species (bycatch)

-- discards = residual organisms that are not valuable bycatch

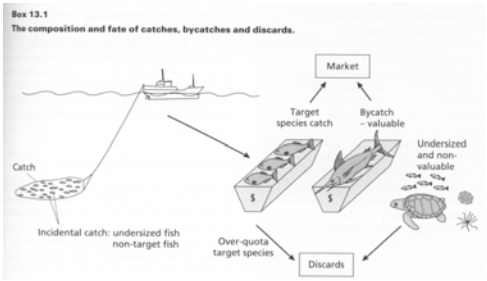
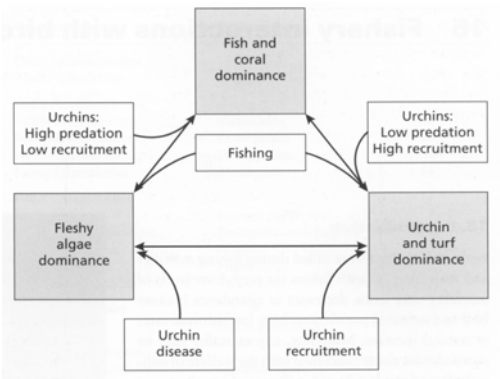


Fig. 13.1 Bycatch rates are high in groundfish fisheries that target species such as cod (a), but low in many pelagic fisheries that target species such as herring (b). Photographs copyright S. Jennings.

Why discard? Rare in artisanal fisheries, but common in commercial fisheries (limited holding capacity of vessels)

-- high-grading = target species that are above minimum size but are discarded to make room for larger, more valuable fish

-- problem when there are mixed-species quotas



Sustainability / Impacts

Concern for recent fisheries trends and the difficulties of current management

1) **overexploitation (targeted species and bycatch)**
2) **bycatch**
3) **habitat destruction**
4) **indirect (cascading) effects on rest of ecosystem**
5) **management that's ineffective at addressing all of the above concerns**

Management and Conservation

Managing Fisheries for Conservation:
Marine protected areas and no-take zones

Marine protected areas = fishing limited to locals or banned on a seasonal basis

No-take zones = all fishing is prohibited

Marine Protected Area Design Issues

- **How big ?**
- **How many ?**
- **Where ?**
- **What species ?**
- **What activities ?**

CONSERVATION APPLICATIONS OF MPA'S

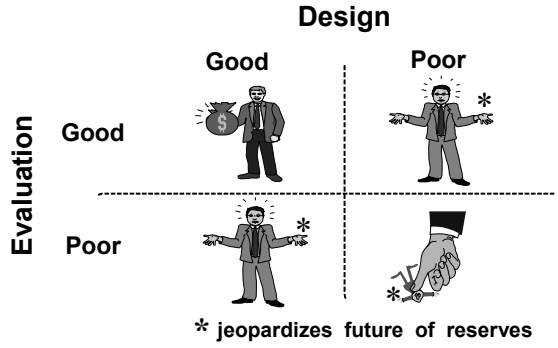
- **Protect species and habitat (i.e. ecosystem approach) *within* reserves.**
- **Create "pristine" systems as *baseline* to distinguish localized anthropogenic from natural variation.**
- **Protect spawning stock for *larval replenishment* of populations *inside and outside* reserves.**
- ***But,* "openness" of system is problematic.**

1) **transport of toxicants & invasive species into reserve**
2) **population replenishment reliant on external sources**

An Adaptive Management Approach

- Identify hypothesis relevant to management decisions (e.g., design criterion: reserve size influences sustainability)
- Design reserves with treatment levels and identify appropriate response variable(s).
- Monitor response and evaluate.
- Use evaluation to optimize design of future reserves.

Importance of Proper Design & Evaluation of MPAs



* jeopardizes future of reserves