Chapter 13 - Fish Stock Propagation

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1. Definition

Fish stock propagation, more commonly known as fisheries enhancement, is under controlled organisms, provision of artificial h
"Fisheries" refers to the harvestin
and "natural ecosystems" are ecosy
truly natural or modified by h
intermediate position between ca
and management control (Anders
The present chapter focuses primar
organisms, the most common for

the focal ecosystem

and economic damage. Incentives for stakeholders or management agencies to engage in enhancement activities can exist even in the absence of evidence of their technical effectiveness, and once investments have been made and stakeholders have become vested, it becomes increasingly difficult to discontinue

3.4 Stock dynamics and management

Quantitative assessment of stock dynamics and the potential of enhancement as well as alternative management options, such as harvest restrictions, to contribute to stock management objectives, is important at all stages of enhancement initiatives (Caddy and Defeo, 2003; Walters and Martell, 2004; Lorenzen, 2005). Different considerations apply to ranching, stock enhancement and restocking systems (Table 2). In ranching systems where maintaining natural recruitment is not a management goal, stock structure could be manipulated to maximize biomass production in food fisheries or to maximize abundance of 'catchable' size fish in put-and-take recreational fisheries. In stock enhancements where cultured fish are released into wild populations, it would be desirable to manage stocking and harvesting activities so as to limit negative impacts on naturally recruiting stock components which may arise from compensatory ecological responses to stocking or from overfishing of the natural spawning stock (Hilborn and Eggers 2000; Lorenzen, 2005). Such effects may reduce or eliminate net benefits from enhancement and pose conservation threats to wild stocks. Impacts of enhancements on wild stocks could be reduced by separating the cultured and wild population components as far as technically possible at the point of stocking, and through differential harvesting and possibly induced sterility of cultured fish (Lorenzen, 2005; Naish et al., 2007; Mobrand et al., 2005). According to these authors, restocking is likely to be advantageous over natural recovery only for populations that have been depleted to a very low fraction of their carrying capacity and requires concomitant reductions in fishing effort (Lorenzen 2005). Fisheries models and assessment tools are now available to conduct such quantitative assessment at all stages in the development or reform of enhancements Tw 2.98 0 Td (e)T4(s)6(hi Tw -)4(e)-1(ry)4ea4(ap)-4(a(s)5.(d)-4(.1(n)-2p)]TJ 0 [i)10(l

2011). The ICES Code of Practice on the Introductions and Transfers of Marine Organisms (ICES, 2005) is widely accepted and applies to introductions carried out for the purpose of fisheries enhancement.

5. Future trends

Enhancements are likely to become more widespread as burgeoning demand for seafood and increasingly severe human impacts on the coastal oceans create greater demand for proactive management, aquaculture technologies become available for an ever-increasing number of marine species, and governance arrangements for many fisheries move towards rights-based systems that provide strong incentives for investment in resources (Lorenzen et al., 2013). Greater scientific and management attention to enhancements is required to aid the development of potentially effective initiatives and to avoid widespread investment in ineffective or damaging

Table 1. Elements of the updated "responsible approach" to fisheries enhancement (Lorenzen et al. 2010).

Stage I: Initial appraisal and goal setting
(1) Understand the role of enhancement within the fishery system
(2) Engage stakeholders and develop a rigorous and accountable decision making process
(3) Quantitatively assess contributions of enhancement to fisheries management goals
(4) Prioritize and select target species and stocks for enhancement
(5) Assess economic and social benefits and costs of enhancement
Stage II: Research and technology development including pilot studies
(6) Define enhancement system designs suitable for the fishery and management objectives
(7) Design appropriate aquaculture systems
(8) Use genetic resource management to avoid deleterious genetic effects
(9) Use disease and health management
(10) Ensure that released hatchery fish can be identified
(11) Use an empirical process for defining optimal release strategies
Stage III: Operational implementation and adaptive management
(12) Devise effective governance arrangements
(13) Define a stock management plan with clear goals, measures of success and decision rules
(14) Assess and manage ecological impacts
(15) Use adaptive management

Table 2. Design criteria for biological and technical components of marine enhancement fisheries systems serving different objectives (adapted from Lorenzen et al., 2012).

	Sea ranching	Stock enhancement	Re-stocking
Aim of enhancement	Increase fisheries catch	Increase fisheries catch while conserving or increasing naturally recruiting stock	Rebuild depleted wild stock to higher abundance
Wild population status	Absent or insignificant	Numerically large Possibly depleted relative to carrying capacity	Numerically large or small Depleted relative to carrying capacity
Aquaculture management	Production-oriented Partial domestication Conditioning for release Possibly induced sterility	Integrated programmes as for restocking Separated programmes as for sea ranching	Conservation-oriented Minimize domestication Conditioning for release
Genetic management	Maintain genetic diversity Selection for high return	Integrated programmes as for restocking Separated programmes as for sea ranching; also selection to promote separation	

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