# UNDERSTANDING AND MANAGING FISHERIES ENHANCEMENT SYSTEMS

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Substantial progress has been made over the past decade in key areas of fisheries enhancement science. A consolidated body of theoretical and empirical knowledge now underpins hatchery production, release strategies, and genetic management. Understanding of population dynamics, health management, socio-economic and institutional aspects is less mature, but developing rapidly. The proof of enhancement as a fisheries management approach of course is not in the quality of the science underpinning it, but in the emergence of successful production-scale enhancements. There are now a number of such operations that have raised fisheries yields, generated economic and social benefits, and sometimes helped to create better management institutions. Such success stories are, however, rare. Many enhancement initiatives are controversial, and the overall contribution of enhancements to fisheries production has remained small. Why?

Developing successful enhancements involves far more than producing and releasing hatchery fish that survive (though that clearly is important). Enhancements enter into complex fisheries systems, and need to contribute effectively to their biological, economic, social and institutional management objectives. To do that, they need to add value to, or outperform, alternative management measures such as effort regulation or habitat restoration. Only fisheries with certain attributes in terms of ecology of the target species, its exploitation status, hatchery technology, stakeholder characteristics, market conditions, and management regimes can benefit from enhancements even in principle. Where such potential exists, careful and coordinated design of seed production, release and harvesting regimes, and supporting institutional arrangements will be required for benefits to materialize. These considerations show that successful development of enhancements requires a systems approach, placing hatchery production and release firmly into a broad fisheries management context.

Failure to engage constructively with fisheries management objectives and issues underlies many controversies surrounding enhancement initiatives, and many outright failures. It is neither necessary nor indeed helpful to put off engaging with these issues until hatchery production and release strategies have been developed. On the contrary, any initiative should be evaluated within an enhancement system framework from an early stage, well before significant resources are committed for research into hatchery production and release strategies. Understanding and managing fisheries enhancement systems requires three major components: (1) a broad-based qualitative analysis of the enhancement system, (2) quantitative assessment of biological and economic outcomes, and (3) a systematic, transparent and participatory planning process. Approaches and specific methods are now available to conduct such analyses in all stages of development.

A general framework for the integrated, qualitative analysis of enhancement systems can be derived from the Institutional Analysis and Design (AID) framework for common pool resources. The framework (Figure 1) allows analysis of how key situational variables influence the outcomes of enhancement through two pathways: direct physical-biological interactions, and those mediated by the actions of stakeholders. It can also be used to explore how the situational variables may be modified in the longer term in the light of enhancement

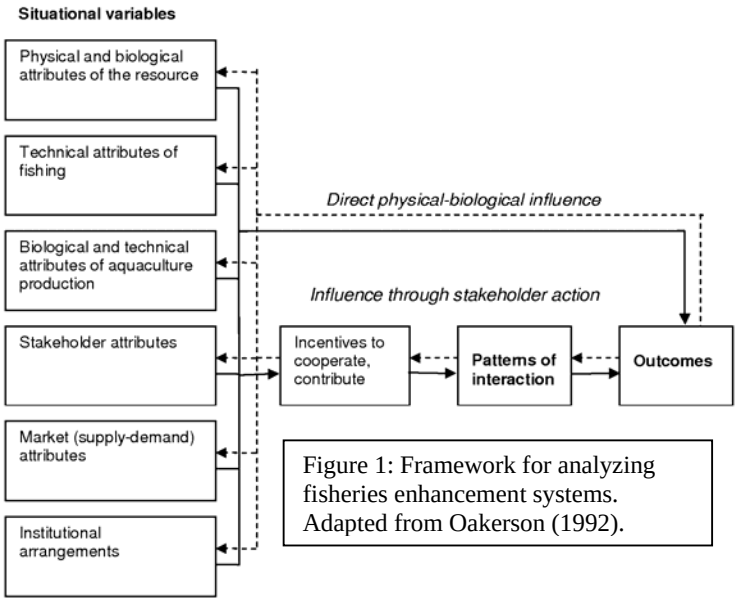


Figure 1: Framework for analyzing fisheries enhancement systems. Adapted from Oakerson (1992).

outcomes. In either case, interactions may involve simple direct linkages or complex, even cataclysmic transformations. The framework facilitates a systematic analysis of the structure and dynamics of enhancement systems by structuring information on key attributes and their potential interactions. The analysis may further draw on empirical or conceptual generalisations regarding combinations of attributes that promote particular outcomes, such as institutional transformations. In practice, the framework is best used by a multidisciplinary group of analysts, possibly within in the setting of a stakeholder workshop.

The broad-based qualitative systems analysis should be complemented by a quantitative assessment of the likely biological and economic outcomes. Stock assessment methods and bio-economic models used for natural fish stocks can be extended to allow analysis of enhancements (Lorenzen 2005). This involves unpacking the stock-recruitment relationship, incorporating density-dependence in the recruited phase of the life cycle, and accounting for differences in life history traits between hatchery and wild fish. One such model is now freely available in a user-friendly software package, the EnhanceFish decision tool (www.aquaticresources.org/enhancefish.html). Comparative data exist for most biological parameters, so that prognostic assessments can be conducted even where fisheries-specific data are limited and no release experiments have been carried out.

Constructive engagement of stakeholders (such as fishers, hatchery producers, conservation organisations, and of course scientists) is vital in all stages of the development of enhancements. Stakeholders define the objectives of management, and their actions in the light of perceived benefits and costs play a major role in determining actual outcomes. Hence the tools for systems analysis and quantitative assessment should be embedded in a transparent and participatory planning process.

The fisheries enhancement system approaches outlined provide practical tools for assessing the potential for enhancement from a fisheries management perspective, focussing initiatives on those systems where success is most likely, and guiding their further development.

**References**

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