INTRODUCTION TO AQUATIC SCIENCES

14. Week	Introduction to Fisheries and Aquaculture Management

Introduction to Aquatic Sciences

WEEKLY TOPICS (CONTENT)

Week	Topics
1. Week	Aquaculture in Turkey and world
2. Week	The role of fish in human consumption
3. Week	What is fish? Taxonomy of fish
4. Week	Aquatic Crustacean
5. Week	Water quality for aquaculture
6. Week	Introduction to marine fish
7. Week	Introduction to freshwater fish
8. Week	Live foods (microalgae, zooplankton and *Artemia*)
9. Week	Introduction to fishing techniques
10. Week	Fish transport
11. Week	Introduction to fish disease
12. Week	Introduction to fisheries economy
13. Week	Processing and marketing of fish
14. Week	Introduction to fisheries and aquaculture management

Technological Development and Fisheries Management

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Abstract

Many marine fish stocks are overexploited and considerable overcapacity exists in fishing fleets worldwide. One of the reasons for the imbalance between resource availability and fishing capacity is technological development, which continuously increases the efficiency of the vessels—a mechanism referred to as "technological creep." We review how the introduction of new and more efficient electronic equipment, gear design, engines, deck equipment, and catch-handling procedures influences the capture efficiency (catchability) of commercial fishing vessels. On average, we estimate that catchability increases by 3.2% per year due to technological developments, an increase often ignored in fisheries management. The documentation and quantification of technological creep improves the basis for successfully integrating the effects of technological development (and catchability changes) in fisheries management regulations and policies. Ways of counteracting the undesired effects of technological creep are discussed as are the potential management benefits from improved fishing technology. Specific suggestions are given on the selection, application, and tuning of fisheries management tools that can be used to improve the balance between harvesting capacity and resource availability.

Keywords: catchability, fishing mortality, fishing power, fisheries management, fleet capacity, technological development

Global production of farmed fish and shellfish has more than doubled in the past 15 years. Many people believe that such growth relieves pressure on ocean fisheries, but the opposite is true for some types of aquaculture. Farming carnivorous species requires large inputs of wild fish for feed. Some aquaculture systems also reduce wild fish supplies through habitat modification, wild seedstock collection and other ecological impacts. On balance, global aquaculture production still adds to world fish supplies; however, if the growing aquaculture industry is to sustain its contribution to world fish supplies, it must reduce wild fish inputs in feed and adopt more ecologically sound management practices (Naylor et al. 2000).

An overview of the current scientific knowledge available on climate change implications for fisheries and aquaculture is provided through three technical papers that were presented and discussed during the Expert Workshop on Climate Change Implications for Fisheries and Aquaculture (Rome, 7–9 April 2008). A summary of the workshop outcomes as well as key messages on impacts of climate change on aquatic ecosystems and on fisheries- and aquaculture-based livelihoods are provided in the introduction of this Technical Paper.

The first paper reviews the physical and ecological impacts of climate change relevant to marine and inland capture fisheries and aquaculture. The paper begins with a review of the physical impacts of climate change on marine and freshwater systems and then connects these changes with observed effects on fish production processes. It also outlines a series of scenarios of climate change impacts on fish production and ecosystems through case studies in different regions and ecosystems.

The second paper tackles the consequences of climate change impacts on fisheries and their dependent communities. It analyses the exposure, sensitivity and vulnerability of fisheries to climate change and presents examples of adaptive mechanisms currently used in the sector. The contribution of fisheries to greenhouse gas emissions is addressed and examples of mitigation strategies are given. The role of public policy and institutions in promoting climate change adaptation and mitigation is also explored.

Finally, the third paper addresses the impacts of climate change on aquaculture. It provides an overview of the current food fish and aquaculture production and a synthesis of existing studies on climate change effects on aquaculture and fisheries. The paper focuses on the direct and indirect impacts of climate change on aquaculture, in terms of biodiversity, fish disease and fishmeal. Contribution of aquaculture to climate change is addressed (carbon emission and carbon sequestration), as well as possible adaptation and mitigation measures that could be implemented.

Invited Review

Operational research models and the management of fisheries and aquaculture: A review

Trond Bjørndal [a, b], Daniel E Lane [c], Andrés Weintraub [d]

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Abstract

This paper reviews the role that the operational research (OR) discipline has played in the understanding and management of renewable resources in the areas of fisheries and aquaculture. The analysis is undertaken with two purposes. First, to assess the past performance of the OR models in this field. Second, to highlight current problems and future directions of research.

Fisheries management research used to be the domain of marine biologists. Increasingly, it has also become an area of interest to social scientists as well. Successful co-management requires a renewed examination of political, social and institutional matters. These are certainly among the areas where social scientists have expertise, so an increasing number of social researchers believe they have a mission in fisheries. During the last twenty years or so we have seen an impressive increase of contributions to the fisheries management discourse from social scientists, and their voices are being heard by managers and stakeholders more so than they used to be.

Managing fisheries for human and food security

We evaluate the current status of the global marine fisheries using the frameworks of conflict, food security and vulnerability. Existing trends suggest that there is likely to be greater food insecurity and fisheries conflicts due to issues such as: declining fishery resources; a North–South divide in investment; changing consumption patterns; increasing reliance on fishery resources for coastal communities; and inescapable poverty traps creating by low net resource productivity and few alternatives. Consequently, managing fisheries from a food security perspective will become increasingly necessary, and we therefore briefly review fisheries from the perspective of food security and evaluate it using a vulnerability framework. Specifically, we describe three key components of vulnerability (exposure, sensitivity and adaptive capacity) for selected fisheries. This is followed by proposals to build the adaptive capacity of fisheries and recommendations to avoid future conflicts. Adaptive capacity attributes include assets, social flexibility and organization attributes, and learning. We present some key ways to build these aspects of the fishery to reduce the many potential environmental and social threats that increase the vulnerability of fisheries. Recommendations include fewer subsidies, reduced capital investment, precautionary management to minimize risks of ecosystem collapse, conservation of remaining resources, diversified portfolios of production and markets, and greater equity in contracts and distribution. Further, we recommend a contextual diagnostic and environmental justice framework to assess a range of options for fishery governance.

“Aquaculture is the farming of aquatic organisms, including fishes, mollusks, crustaceans, and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as stocking, fertilizing, feeding, habitat manipulation, and protection from predators. Farming also implies individual or corporate ownership of the stock being cultivated” (FAO. 1991. Fisheries Circular 815 rev. 3).

Since the management of wild stocks of fishes taken by traditional fisheries may also involve similar enhancement techniques, the criterion of ownership is used by the Food and Agriculture Organization (FAO) to distinguish between aquaculture and fisheries harvests for statistical reporting purposes. Aquatic organisms that are harvested by an individual or corporate body who has owned them throughout their rearing period fall within the domain of aquaculture, while aquatic organisms that are exploitable by the public as a common property resource, with or without license requirements, are considered to be subject to the harvest of fisheries.

Increased competition for aquaculture from fisheries: Does improved fisheries management limit aquaculture growth?

Frank Jensen, Max Nielsen, Rasmus Nielsen

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https://doi.org/10.1016/j.fishres.2014.05.004

Abstract

The global fisheries sector has been characterized by three main trends over the last 2–3 decades; fish stocks have been overexploited and supply from wild fisheries is stagnating; fisheries management has improved slowly with the aims of achieving biological sustainability and rent maximization; and supplies from aquaculture have grown continuously. In this paper, the impact of improved fisheries management on aquaculture growth is studied assuming perfect substitution between farmed and wild fish. We find that improved fisheries management, ceteris paribus, reduces the growth potential of global aquaculture in markets where wild fisheries constitute a large share of total supply.

Seasonal forecasting for decision support in marine fisheries and aquaculture

The production of marine protein from fishing and aquaculture is influenced by environmental conditions. Ocean temperature, for example, can change the growth rate of cultured animals, or the distribution of wild stocks. In turn these impacts may require changes in fishing or farming practices. In addition to short-term environmental fluctuations, long-term climate-related trends are also resulting in new conditions, necessitating adjustment in fishing, farming and management approaches. Longer-term climate forecasts, however, are seen as less relevant by many in the seafood sector owing to more immediate concerns. Seasonal forecasts provide insight into upcoming environmental conditions, and thus allow improved decision making. Forecasts based on dynamic ocean models are now possible and offer improved performance relative to statistical forecasts, particularly given baseline shifts in the environment as a result of climate change. Seasonal forecasting is being used in marine farming and fishing operations in Australia, including wild tuna and farmed salmon and prawns, to reduce uncertainty and manage business risks. Forecast variables include water temperature, rainfall and air temperature, and are considered useful up to approximately 4 months into the future, depending on the region and season of interest. Species-specific habitat forecasts can also be made by combining these environment forecasts with biological habitat preference data. Seasonal forecasts are useful when a range of options are available for implementation in response to the forecasts. The use of seasonal forecasts in supporting effective marine management may also represent a useful stepping stone to improved decision making and industry resilience at longer timescales.

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