

PhD Dissertation of

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“Ecosystem-Based Fishery Management”

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Abstract

Ecosystem-Based Fishery Management

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The objective of this thesis is to investigate some specific economic issues of Ecosystem-based Fishery Management (EBFM). EBFM is a new direction for fishery management that prioritizes the management of the entire ecosystem rather than the target species individually. The interaction between the living species and the nonliving environment through nutrient flows is a key process in an ecosystem. This thesis takes into account this process by incorporating it into models of EBFM. By doing so, the thesis focuses on two important ecosystem services: fish products as a provisioning service and nutrient cycling as a supporting service. Eastern Baltic cod fisheries and nitrogen enrichment in the Baltic Sea are chosen to be case studies. Different approaches and methods have been used in this thesis. Ecological production functions and bio-economic models are used to understand how ecosystem services are produced and how changes in the ecosystem conditions by human activities affect the provision of these services. The constrained optimization techniques are also used to investigate the interaction between ecological and economic systems.

The thesis comprises of six essays. The first essay is a critical literature review, and in the second essay a theoretical bio-economic model is developed to investigate the effects of nutrient enrichment on an ecosystem. The third, fourth, and fifth essays are empirical studies that investigate the effects of nutrient enrichment on the economic management of Eastern Baltic cod fisheries. The last essay explores payment schemes to reduce the negative effects of nutrient enrichment in the Baltic Sea.

The thesis reveals that the nutrient flow plays an important role in an ecosystem and that nutrients may be considered the currency in the ecological economic models for EBFM. The results show that even though EBFM prioritizes the management of the entire ecosystem, optimal management of fish stocks still plays a crucial role. In the case of the Baltic Sea, the results indicate that the nitrogen enrichment may affect the economic management of Eastern Baltic cod fisheries. Furthermore, the results show that nitrogen loadings are too high and that they need to be reduced in order to get the optimal cod stock level. If the Total Allowable Catch (TAC) of the cod fisheries is set equal to the optimal yield, with a given discount rate of 4% per year, the marginal benefit would equal the marginal cost of about 2.2% nitrogen input reduction. The results also indicate that the net benefit of a nitrogen reduction from the current level to the optimal level very much depends on the harvest policies. If the TAC is set equal to the optimal yield from the model, the net present value of the net benefit would be about 604 million DKK over a 10-year time horizon, given a discount rate of 4% per year. However, if a recovery management plan is chosen, the net present value of the net benefit would only be about 49 million DKK over a 10-year time horizon.

Department of Environmental and Business Economics

The Department of Environmental and Business Economics was founded in 1998. The Environmental and Resource Economics group is one of the strongest groups within University of Southern Denmark. It has five primary research themes: theory of regulations, pollution and resource scarcity, integrated modeling, risk management, and ecosystem-based management.

The latest theoretical development in environmental and resource economics is tied to the “ecosystem approach” which recognizes the interlink between different resources, nature and human intervention. The ecosystems produce both intermediate and final goods and services which generates human welfare in the form of benefits. The crucial aspect in the ecosystem based management approach is to recognize that all goods and services from the ecosystem should be part of the management considerations. The approach is often

broader in space and time than the traditional management approach; thus, it poses different challenges to the research since this management approach balances different use of the ecosystems towards each other.

Centre for Fisheries & Aquaculture Management & Economics (FAME)

FAME is a network and research school within resource and fisheries management and economics connecting universities, research institutions and researchers.

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