



Title	Purse seine fishery management in Malaysia : an output control for sustainable fisheries [an abstract of dissertation and a summary of dissertation review]
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学位論文内容の要旨

博士の専攻分野の名称：博士（水産科学）

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学 位 論 文 題 目

Purse seine fishery management in Malaysia : an output control for sustainable fisheries

（マレーシアにおけるまき網漁業管理：持続可能な漁業のための産出量規制）

I. Introduction

Southeast Asia (SEA) region is a promising region to provide a continuously increasing capture fishery production. Among SEA countries, Malaysia is the best practice model and a leading country for estimating best management strategies that promote sustainable fisheries practices. Purse seine fishery have played an important role in Malaysian fisheries for small, pelagic, economically important fishes, not only for food consumption, but also for supporting the livelihoods and employment of fishers. Over the past 10 years, purse seine fishing capacity has increased with minor changes in species composition for all species. However, it is still important to examine the sustainability of the Malaysian purse seine fishery as the fishing capacity has progressively increased.

To maintain sustainability, three management measures can be considered: input control, technical control, and output control. The Malaysian Government has conducted input and technical controls, but output control has not been implemented yet, although a pilot project and feasibility study began in the East Coast Peninsular Malaysia (ECPM) in 2015. Prior to starting a quota system, the fishery managers set a total allowable catch (TAC) as an annual catch limit, which is usually based on scientific advice or catch data known as allowable biological catch (ABC). It requires data of each species individually fitted and applied in single-species stock management models. However, most fisheries, including Malaysian fisheries, involve multiple stocks or multiple fleets competing for the same fish resources. Therefore, to implement a quota system in the multispecies purse seine fishery in Malaysia, information of species such as habitat and seasonal life stages is needed. It is critical to confirm whether the purse seine fishery as a multi-species fishery in Malaysia can be easily localized by areas (spatially) or by seasons (temporally) before the implementation of output control.

II. Overview of the purse seine fishery in Malaysia

To confirm the feasibility of output control, concerning on its limitations and requirements, towards Malaysian purse seine fishery, an overview of purse seine fishery in Malaysia was given by clarifying the spatial and temporal patterns of purse seine fishing areas and seasons through species diversity and cluster analysis. The analyses showed no specific seasonal and temporal pattern in the structure of the purse seine fishery fishing grounds in ECPM areas. Huge species aggregations in

catch categories lead to incapability of providing species-separated data.

Multispecies fisheries are subjected to widely distributed and homogenously mixed fish stocks which lead to non-selective exploitation. Therefore, realizing the multispecies fishery condition in Malaysian fisheries, it is impractical to manage each species individually using single-species stock assessment in multispecies fisheries. A tactical short-term management approach can be an option to respond to the demands of data-limited management, which might occur in a multispecies fishery.

III. Proposed management measure for purse seine fishery in Malaysia: an output control for sustainable fisheries

A short-term management approach that can deal with multispecies fisheries in ECPM is the feedback harvest control rule (HCR), which has been successfully applied in Japanese fisheries management, called the ABC rule 2-1 in the Japanese TAC system. This feedback HCR was previously validated to be applied in fisheries with a single-species approach. By combining management strategy evaluation with a simulation to generate mixed-species data from a multispecies fishery, the performance of this feedback HCR was evaluated and then compared with its performance using species-specific data. Also, the sensitivity of the feedback HCR's performance over several scenarios of population dynamics was also examined and compared across other modified HCRs.

The results showed that the feedback HCR is appropriate for multispecies fisheries management where only mixed-species data are available but with special monitoring for slow-growing minor species. In other words, the feedback HCR presents an initial step toward sustainably managing multispecies fisheries while contending with data-limited conditions.

IV. Concluding discussion

The Malaysian purse seine fishery management needs to commit to maintaining sustainable fisheries. It can be done by considering establishing input control through a clear and accurate adjustment of fishing capacity; strengthen capacity and capability for regional cooperation, in particular regional coordination meetings and joint surveillance with neighboring countries; and the implementation of output control.

A combination of input and output controls will be the best option for providing sustainable fisheries management for Malaysian fisheries and other multispecies fisheries in the region. The limitation of output control implementation towards multispecies fisheries condition can be solved by conducting the feedback HCR which was validated dealing with data-limited conditions. As a merit, the feedback HCR is designed to attain an optimum catch and biomass along with less catch variation which will simultaneously affect fisheries sustainability.

This research pointedly suggests that data-limited multispecies fisheries can be managed sustainably using multiple management measures, such as a combination of input, output and technical controls. Furthermore, the availability of reliable species-specific data for certain major species and mixed-species data for other species will generate substantial progress for fisheries management in SEA.