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Exploring fisheries strategies for multi-criteria decision making: A case study of the East China Sea

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Major problems regarding traditional fisheries management in the context of rapidly declining stocks and degrading ecosystems and an urgent need for sustainable devolvement create an impetus for a fundamental change in fisheries management. Ecosystem-based Fisheries Management (EBFM) reconsiders the orders of management priorities, starting with the ecosystem instead of target species, with the aim to maintain healthy marine ecosystems and fisheries. Potential conflicts among economy, society and ecosystem structure should be reconciled to achieve the EBFM. The module of 'fishing policy search' in the Ecopath with Ecosim (EwE) software is currently the most commonly used and tested ecosystem modeling tool for addressing problems in three aspects: economic benefits, social employment and ecosystem conservation in fisheries management. The purpose of this study was to explore optimum fisheries management strategies for the East China Sea (ECS) on economic, social and ecological criteria using the EwE model incorporating the Analytic Hierarchy Process (AHP) method. Simulations were performed for a 41-year period by changing fishing efforts for each fleet. Thirty-five alternative fisheries management options constituting 3 single criterion options, 1 compromise criterion option and 31 mixed criteria options were tested in succession. Finally, the AHP method was adopted to optimal policy configuration from the 35 options for the ECS fisheries. Optimization for single and compromise criteria led to the specialization of fishing fleets. The effort of mixed criteria options showed very complex and irregular dynamics in economic profits, landed value, trophic level of catch and diversity index. Top three optimum options were 0.4:0.2:0.2, 0.2:0.4:0.2 and 0.2:0.9:0.2 for the weights of the economic criterion, social criterion and ecological criterion, respectively. Results from the AHP analysis provided several meaningful implications for the EBFM in the ECS. It was found that compromise criterion option with same priorities for economic, social and ecological criteria and single criterion options would not achieve the primary goal of the EBFM. It is not apt to put the ecological criterion ahead of the economic and social criteria under current statuses of economy, society and ecosystem structure of the ECS. Changes in fishing efforts from three optimum options will provide guiding principles to optimize the structure of fishing efforts for the ECS fisheries, including reductions in trawl and shrimp trawl efforts, control of stow net, pure seine and drift gill net efforts, and promotion of offshore fisheries.

Palabras clave: East China Sea, Ecopath with Ecosim, Optimization, Ecosystem-based fisheries management, Criterion, AHP