論　文　要　旨 Dissertation Abstract

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論文題目 Dissertation Title	Vulnerability Assessment for Hilsa (*Tenualosa ilisha*) and its Data-limited Bycatch Stocks from Hilsa Gillnet Fishing of Bangladesh

Abstract

The sustainable management of fisheries resources is a challenging issue for fisheries managers across the world. Fisheries manager requires the accurate stock status prior to set the harvest control rules or effective management measures to protect or conserve the stock and thus to ensure the long-term sustainable use of it. However, the actual stock status for the greater portions of global fish stocks is still unknown, and they remain unmanaged or managed with insufficient scientific guidance, leading to suboptimal catch rates and adverse social and economic consequences for those who depend on fishing. The stock status compared to different biological reference points (e.g., maximum sustainable yield) can be adequately made by conventional quantitative stock assessment method, particularly in data- and capacity-rich settings. However, the majority of small-scale fisheries, which account for half of the global fishery catches, are treated as data-limited fisheries. These data-limited fisheries lack the biological and catch data, resources, and expertise required to estimate stock status using conventional quantitative stock assessment techniques. Following the increased need to address fishing’s impacts on the whole range of exploited stocks, including bycatch species, fishery scientists have sought to develop comprehensive methods to assess the potential risk of various fishing types (gillnet fishing, seine net fishing, longline fishing, etc.) in data- and capacity-constrained situations, where the fully quantitative assessment is not likely due to data scarcity. Productivity susceptibility analysis (PSA) is one such risk assessment tool that has been proven useful in fishery sciences. This semi-quantitative fisheries risk assessment tool assists the fisheries manager to evaluate the relative risk of both target and non-target fisheries stocks for a particular gear type in a data and capacity-constrained situation, thus prioritizing management and research among

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species. This tool typically compared the inherent recovery potential (i.e., productivity attributes) of species once depleted with their susceptibility to fishing activities in elucidating the overall species vulnerability.

We performed a PSA to evaluate the relative risk to bycatch stocks in gillnet fishing (gillnet shares > 95% of Hilsa catch in Bangladesh) along with target stock, Hilsa. The Hilsa (*Tenualosa ilisha*) is an iconic flagship species of Bangladesh, a south Asian country. Recent studies suggest that this geographical indication product of Bangladesh, owing to its high economic value and socio-cultural importance, is becoming increasingly threatened by excessive fishing pressure. Additionally, given the multi-species nature of Bangladeshi fisheries, it is nearly impossible to catch Hilsa selectively, with significant numbers of both riverine and marine species (Hilsa migrates both in sea and freshwater) being caught by Hilsa fishing nets. Even though many other non-target (bycatch) species are caught using Hilsa gillnet fishing, no risk assessment has been carried out to identify the relative vulnerability of bycatch stocks of Hilsa gillnets, either by Bangladesh or any other Hilsa fishing nations (e.g., India, Myanmar, Iran, Pakistan, etc). This is mainly because of the lack of information on bycatch species.

In chapter 3 of this dissertation, we have focused on the identification of the bycatch of Hilsa gillnet fishing for the first time from Bangladesh water areas, which were then subjected to a detailed relative risk assessment with PSA. By using taxonomic keys and questionnaire interview with 300 local professional Hilsa fishers across Hilsa habitats, 130 species included Hilsa as the target species were identified where 52 marine bycatch and the target stock Hilsa, and 22 inland bycatch were subjected to PSA depending on data availability and magnitude of capture. We validated our vulnerability (V) results by comparing them with two other empirically derived assessment outcomes, the IUCN Red List and the exploitation rate (E). We also compared PSA scores with the catch trend of stocks from fishers' subjective recognition. Hilsa was found to be moderately vulnerable to gillnet fishing. The majority of the bycatch were found to be highly susceptible to fishing, with 17 bycatch species found to be in the high-risk category. Five species classified as high-risk group

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were known to be threatened species listed in the national IUCN Red List. Our finding revealed 82% accordance level between the exploitation rate and PSA-derived vulnerability scores. It implies that the E associated with overfishing corresponds to the V scores. Moreover, with few exceptions, we found that species with V score over 1.8 showed decreasing catch trend. Our result also revealed that around 55% of inland bycatch and 42% of marine bycatch is associated with overfishing (V > 1.8). Data quality analysis indicated that the majority of bycatch species received low data quality scores. It emphasizes the need for the improved data collection on species-specific life-history traits.

Despite different approaches used to assign the risk scores for missing information in PSA for the selected attributes of a given species, no formal comparison has been made between scoring approaches in terms of how well they can predict species vulnerability. In chapter 4, we have evaluated the PSA findings of 21 bycatch stocks of the Hilsa gillnet fishery of Bangladesh using two different scoring approaches. Two scoring approaches we used in our PSA analysis were designated as "conservative scoring approach (CSA; assign highest risk score for missing information)" and "alternative scoring approach (ASA; inclusion of experts opinion and/or usage of the empirical relationship equation to derive missing data if the value of correlated life-history parameters is known). We assumed that the higher consistency between the pairs of outcomes (V score and E; V score and catch trends) under two different scoring approaches for PSA would be a useful method in determining the reliable scoring approach for PSA that could be able to minimize the overestimation of species vulnerability. Our analysis revealed that the V scores increased by 0.0–0.20 with a mean value of 0.09 for 21 selected bycatches when CSA was applied. The inconsistency between the V-score-suggested fishing status ($V \leq 1.8$ = underfishing, $V > 1.8$ = overfishing) and the fishing status defined by exploitation rate ($E > 0.5$ = overfishing, $E < 0.5$ = underfishing) were 38.1% and 19.0% under CSA and ASA, respectively. As we presumed that species with decreasing catch trend are undergoing overfishing problem, a consistency between V-score-suggested fishing status and fishers' perceived catch trends was found to be higher when using ASA than when using CSA. Our analysis suggests that CSA could overestimate species vulnerability. Therefore, ASA is more

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reliable than CSA in PSA, which may increase the confidence of fisheries stakeholders in PSA.

The baseline information of our PSA-derived outcomes for the Hilsa gillnet fishery of Bangladesh assists the fisheries manager in setting management measures to protect the vulnerable stocks from being collapse unless more data are available for further assessment with a quantitative risk assessment approach. Furthermore, for the treatment of the missing information for the attribute, our findings could be useful guidance for fishery managers for selecting the reliable scoring approach in their PSA, which could minimize the false estimates in specie’s vulnerability.

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