The Role of Science in The Management of Biodiversity: a Case of Stingrays (Dasyatidae) Research to Provide Basic Data for Aquatic Fauna Conservation in South Sumatra

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Abstract. The study of fish diversity had been reported across the South Sumatran waters, but the study focus on stingrays (family Dasyatidae) were very limited. In general, many stingrays species face high level of direct exploitation. A recent study to provide valid checklist of stingrays in South Sumatran waters found 14 species: \textit{Brevitrygon heterura}, \textit{Fluvitrygon kittipongi}, \textit{Fluvitrygon oxyrhyncha}, \textit{Fluvitrygon signifier}, \textit{Fluvitrygon} sp ‘musi’ 1, \textit{Fluvitrygon} sp ‘musi’ 2, \textit{Himantura undulata}, \textit{Himantura uarnak}, \textit{Maculabatis gerrardi}, \textit{Pateobatis fai}, \textit{Pateobatis uarnacoides}, \textit{Pastinachus ater}, \textit{Telatrygon biasa} and \textit{Urogymnus polylepis}. Following IUCN (The International Union for Conservation of Nature) Red List status 2018, ten species of stingrays are threatened, with four species as Endangered, five species as Vulnerable and one species as Data Deficient. These findings suggest the South Sumatran waters are important habitat for stingrays in Indonesia, and immediate conservation actions plan is needed. In this paper, we demonstrate the role of science in biodiversity management with stingrays (Dasyatidae, an iconic group of rare and threatened fishes) as study case.

1 Introduction

Few species of stingrays are occur in Southeast Asia, particularly in Indonesian waters \cite{1,2,3}. In Indonesia, there are at least 40 valid species of stingrays where wide spread within main seven faunal regions. South Sumatra province is the largest province in Sumatra where located in the southeastern portion of the island. The study of fish diversity had been reported across the South Sumatran waters \cite{4}, but the study focus on stingrays were very limited \cite{5-7}. Study on stingrays diversity had been done in in South Sumatran waters, revealed relatively rich number of stingrays diversity\cite{8}. Further review on biodiversity management is required to ensure population survive in the wild. This paper
provide review the role of science to provide basic data for aquatic fauna conservation in south Sumatra

2 Materials and Methods

Records of stingrays in South Sumatran waters were obtained from local social media (mainly Facebook group of local anglers in South Sumatra province) and internet supported with photographs or other evidence (e.g. location, habitat type, morphology and description from anglers) during January 2016 to June 2018; provide an extension to the known distribution of this species and from unpublished data collected by first author. All specimens recorded were mainly from Musi River drainage (the largest and major drainage in South Sumatra) and east coast of Banyuasin. All records included herein were verified; and unconfirmed or ambiguous records were rejected. In addition, three field surveys were conducted in April 2018.

Systematically reviewed what potential solutions are needed to identify and what consensus and direction it provides to support management biodiversity to ensure population of the stingrays survive in the wild. For this reason, we adopt and modify conservation actions plan of stingrays proposed by [9] as reccomendation for management of biodiversity of rare and protected aquatic fauna in South Sumatran waters.

3 Results and Discussions

3.1 Stingrays Diversity in South Sumatran Waters

This study found 14 species of stingrays in South Sumatran waters. The species checklist and localities are presented in Table 1. Taxonomy and scientific name follow recent update revision of family Dasyatidae by [2].

Table 1. Annotated checklist, status and habitat of stingrays found in South Sumatran waters, Indonesia

| No | Species                      | IUCN Status   | Protected by Indonesian law | Habitat                                |
|----|------------------------------|---------------|-----------------------------|----------------------------------------|
| 1  | Brevitrygon heterura         | Data Deficient|                             | Estuarine and continental shelf        |
| 2  | Fluvitrygon kittipongi       | Endangered    |                             | Freshwater                             |
| 3  | Fluvitrygon oxyrhyncha       | Endangered    | Protected                   | Freshwater                             |
| 4  | Fluvitrygon signifier        | Endangered    | Protected                   | Freshwater                             |
| 5  | Fluvitrygon sp ‘musi’ 1      | -             |                             | Freshwater                             |
| 6  | Fluvitrygon sp ‘musi’ 2      | -             |                             | Freshwater                             |
| 7  | Himantura undulata           | Vulnerable    |                             | Estuarine and continental shelf        |
| 8  | Himantura warnak             | Vulnerable    |                             | Estuarine and continental shelf        |
| 9  | Maculabatis gerrardi         | Vulnerable    |                             | Freshwater and continental shelf       |
| 10 | Pateobatis fai               | Vulnerable    |                             | Estuarine and continental shelf        |
| 11 | Pateobatis uarnacoides       | Vulnerable    |                             | Estuarine and continental shelf        |
| 12 | Pastinachus ater             | Least concern |                             | Freshwater and brackish                |
| 13 | Telatrygon biasa             | Least concern |                             | Estuarine and continental shelf        |
| 14 | Urogymnus polyepis           | Endangered    | Protected                   | Estuarine and continental shelf        |

Stingrays in South Sumatran waters are recorded from of up to more 100 km inland to the coastal zone area (Figure 1). Eight genera of stingrays are recorded in South Sumatran
waters: *Brevitrygon*, *Fluvitrygon*, *Himantura*, *Maculabatis*, *Pateobatis*, *Pastinachus*, *Telatrygon* and *Urogymnus*. Five species of *Fluvitrygon* are recorded (*Fluvitrygon kittipongi, Fluvitrygon oxyrhyncha, Fluvitrygon signifer, Fluvitrygon sp ‘musi’ 1 and Fluvitrygon sp ‘musi’ 2*), consisting largest genus of this family in the area.

The occurrence of 14 species indicate that South Sumatran waters are important habitat for stingrays of family Dasyatidae. Following IUCN Red List status, the status of stingrays in South Sumatran status covering from *Endangered, Vulnerable, Data Deficient, Least Concern* and not evaluated [9]. Two unidentified of *Fluvitrygon* from Musi River, tentatively identified as *Fluvitrygon* sp ‘musi’ 1 and *Fluvitrygon* sp ‘musi’ 2, probably represent new undescribed species. Recently, four species of singrays are protected by Indonesian law under decree of the Ministry of Environment and Forestry Number P.20/MENLHK/SETJEN/KUM.1/6/2018 about protected species in Indonesia, and three of them recorded in South Sumatran waters (*Fluvitrygon oxyrhyncha, Fluvitrygon signifer* and *Urogymnus polylepis*) (Table 1).

![Map of distributional records of stingrays found in South Sumatran waters](https://doi.org/10.1051/e3sconf/20186804010)

**Fig. 1.** Map of distributional records of stingrays found in South Sumatran waters
3.2 Recommendation for Conservation Action Plan

Conservation action plan is a powerful guide conservation to develop focused strategies and measures of success. Proposed conservation action plan for each species of stingrays recorded in South Sumatran waters are proposed in table 2. This recommendation adopt and modify conservation actions plan of stingrays proposed by [9].

In the case of other parts of many countries, many stingray species in South Sumatran waters also face high level of direct exploitation, mainly for their skin or low-value meat. As reported by [2], there is considerable number of threatened stingrays in South-East Asia where catches are very high but declining, with fishers having to travel much further from port to maintain catches. Net and trawl fisheries in Indonesia and elsewhere are very extensive and, as a result, many shallow-water ray species are heavily exploited. The general lack of management measures based on scientific research and stock assessment is hindering the sustainable utilisation of these resources. Furthermore, the extensive loss and degradation of habitat such as coastal mangroves and embayments are other key threats to these coastal and inshore species.

| No | Species                        | Conservation Actions                                                                                     | Source                      |
|----|--------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------|
| 1  | Brevitrygon heterura          | Further research is required on data abundance and/or distribution, as well as assessing the interactions of the species with commercial fisheries, which will allow a more accurate monitoring of population trends | White et al., 2016a         |
| 2  | Fluvitrygon kittipongi        | Monitoring of quality of its habitat and the number of mature individuals is inferred as a result of habitat destruction and pollution, and bycatch in freshwater fisheries | Vidthayanon, & Manjaji-Matsumoto, 2016 |
| 3  | Fluvitrygon oxyrhyncha       | Monitoring of intensive threat from fisheries, pollution, logging in the catchment areas and river engineering projects and is a desirable aquarium species | Compagno, 2016a            |
| 4  | Fluvitrygon signifer          | Monitoring of freshwater habitats that are under intensive threat from fisheries, pollution, logging in the catchment areas and river engineering projects | Compagno, 2016a            |
| 5  | Fluvitrygon sp 'musi' 1     | Specimen collection and examination of the study skin and DNA are needed for confirmation of the proper identification as well as to ensure taxonomic status | Our recommendation         |
| 6  | Fluvitrygon sp 'musi' 2     | Specimen collection and examination of the study skin and DNA are needed for confirmation of the proper identification as well as to ensure taxonomic status | Our recommendation         |
| 7  | Himantura undulata           | Research is required to assess catches of Bleeker's Variegated Whipray throughout its range, and to examine its habitat, ecology and life history parameters including confirmation of its distributional range. The fisheries that | Rigby, 2012                |
| 8 | Himantura uarnak | Further research is required on the speciebiology, as is assessment of catches throughout its range | Manjanji-Matsumoto et al., 2016c |
| 9 | Maculabatis gerrardi | Monitoring surveys should to ascertain the status and possible threats to this species here, as well as in other portions of its range (New Guinea and Indonesia), efforts in further research should be directed to also obtain the population, habitat and ecology and life history parameters | Manjanji-Matsumoto et al., 2016c |
| 10 | Pateobatis fai | Further research is required to defined its range throughout the Indo-West Pacific where it is frequently misidentified as P. jenkinsii, which can complicate species-specific catch data, and monitoring high levels of exploitation throughout its range in Southeast Asia where the species is commonly caught in multiple types of fisheries | Manjanji-Matsumoto et al., 2016c |
| 11 | Pateobatis uarnacoides | Further survey regarding specific information on catches in other parts of the species' range, monitoring population declines elsewhere from Indonesia, and monitoring coastal degradation that impacted to this species | White et al., 2016a |
| 12 | Pastinachus ater | Further research is required on the species' life-history, as well as assessing the interactions of the species with commercial fisheries, which will allow a more accurate monitoring of population trends | Morgan et al., 2016 |
| 13 | Telatrygon biasa | Further research is required on the species' life-history, as well as assessing the interactions of the species with commercial fisheries, which will allow a more accurate monitoring of population trends | Our recommendation |
| 14 | Urogymnus polylepis | Further research and survey are required to confirm the presence, population trend, and taxonomic status of populations of the species from all parts of its range, especially India, Bangladesh, Myanmar, Viet Nam, parts of Indonesia and Malaysia, and Papua New Guinea | Vidthayanon, et al., 2016 |

### 4 Conclusion

When regional priorities have been set, conservation action planning is used to determine the plan of action for these priorities. The conservation action plans above would have not been possible without information on basic data information of each stingrays species. Providing basic data of stingrays diversity and distribution in South Sumatra
demonstrate the role of science in management of rare, globally threatened and protected aquatic biodiversity. As actions are taken and outcomes are measured, conservation action plans are revised to incorporate new knowledge. It is hope that the proposed conservation action above will beguideline for stake holders authority in the development of conservation of rare and protected aquatic species in South Sumatran waters.

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