Mitigating the impacts of other sectors on the inland fishery resources

- The AMSs and relevant organizations/institutions should consider pursuing the use of appropriate designs of fishways or fish passes suitable for mitigating the impacts of cross-water obstacles on indigenous aquatic species, especially those that need upstream/downstream migration to complete their life cycles, *e.g.* anguillid eels, among others; promoting the application of fishways upon evaluating their effectiveness and investigating their cost-benefits and returns to demonstrate the benefits of fishways to fishers' incomes, food security, ecosystem services; and enhancing the awareness of policymakers, and relevant agencies and stakeholders on the ecological advantages of constructing fishways or fish passes.

- In addition to mitigating the impacts of dams and weirs on the sustainability of freshwater fishery resources, the effects of constructing other obstacles, *e.g.* roads, flood gates, that also inhibit fish movements and larval dispersal, should also be investigated. Results of such investigations should be conveyed to relevant agencies for the development of appropriate mitigation measures.

- The AMSs should enhance inter-agency coordination among their respective national agencies, *i.e.* between agencies responsible for fisheries and other agencies involved in the utilization of the inland water resources, *e.g.* irrigation, hydro-power generation. The development of measures to mitigate the impacts of cross-water infrastructures on the freshwater fishery resources is necessary and should not only be limited to the construction of fish passes but also to the proper and efficient operations of the structures, *e.g.* of irrigation weirs, hydropower dams, flood gates, to ensure that the excessive discharge of water is avoided or vice versa.

Mitigating the impacts of freshwater aquaculture on the environment

- The AMSs should promote freshwater aquaculture including culture-based fisheries with appropriate management, with due consideration given on the need to avoid factors that could possibly cause a decline in the condition of the inland fishery resources, *e.g.* environmental impacts.

- The AMSs should give due consideration to ensuring that the escape of fish from cages or other culture facilities should be prevented, as the escapees could disrupt the ecological balance of the food chain, as well as result in changes of the biodiversity and in the genetic diversity of aquatic species.

3. Aquatic Species under International Concern

3.1 Status, Issues, and Concerns

3.1.1 Sharks and Rays

The class of chondrichthyans includes the cartilaginous fishes that have skeletons primarily composed of cartilage. The chondrichthyans are divided into two subclasses: Elasmobranch (sharks and batoids (rays and skates)) and Holocephali (chimaeras). The Southeast Asian region has a rich biodiversity of elasmobranch species, and as had been recorded, there are at least 196 species of sharks, 160 species of rays, 30 species of skates, and seven chimaeras that inhabit the Southeast Asian region from freshwater environments to the deep seas (Ahmad *et al.*, 2018; SEAFDEC, 2017b; Wanchana *et al.*, 2016). New species are continuously discovered, the number of which could increase in the future, but some recorded species could turn into extinct species. The numbers of species of sharks, batoids, and chimaeras found in nine Southeast Asian countries are shown in **Figure 67**. However, several species could have been probably misidentified and still need to be confirmed. The average production of sharks and rays of Southeast Asia during 2008–2018 was approximately 62,409 mt per year and 95,265 mt per year, respectively (**Figure 68**).

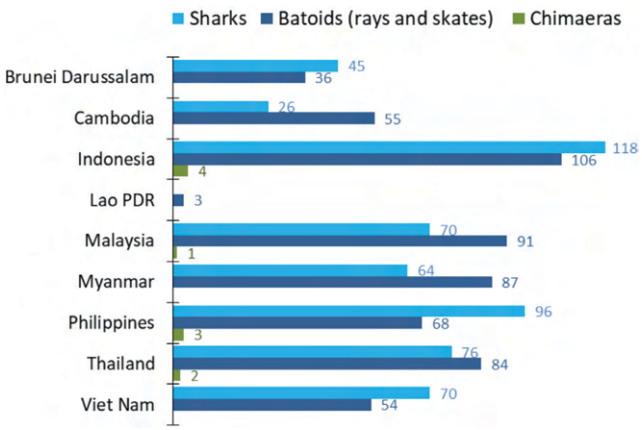

Figure 67. Number of species of sharks, batoids, and chimaeras in the Southeast Asian countries (Ahmad *et al.*, 2018, Wanchana *et al.*, 2016)

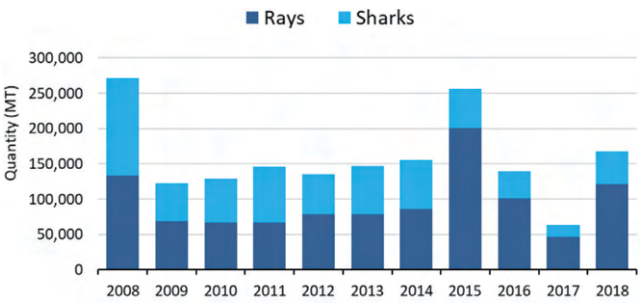

Figure 68. Production of sharks and rays of Southeast Asia from 2008 to 2018 by quantity (mt) (SEAFDEC, 2020a)

Trade of elasmobranchs

SEAFDEC/MFRDMD in collaboration with the Center for Fisheries Research of Indonesia conducted the survey on marketing and trade of sharks and rays in Java and Sumatera, Indonesia in 2018 and in Kalimantan, Indonesia in 2019. It was found that there was a high diversity of products from sharks and rays (excluding fin) such as meat, skin, cartilage, teeth, intestine, and stomach. Almost no parts of sharks and rays are wasted. The sharks and rays resources had therefore been generating livelihoods for fishers, boat owners, exporters, collectors, wholesalers, retailers, processors, and various labor workers in different levels of marketing channels including factories, ports, and transportation (Dharmadi *et al*., 2020).

In 2021, several species of sharks and rays were listed under the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Considering that some species such as the hammerhead sharks, mobula rays, and thresher sharks are common in some countries in the region, there is a need to conduct NDFs study if the products of such species are for export purposes.

Table 61. Species of sharks and rays under the CITES Appendices

Appendix I	Appendix II	Appendix III
Sawfishes • *Pristidae* spp.	Requiem sharks • *Carcharhinus falciformis* • *Carcharhinus longimanus* Hammerhead sharks • *Sphyrna lewini* • *Sphyrna mokarran* • *Sphyrna zygaena* Thresher sharks • *Alopias* spp. Basking sharks • *Cetorhinus maximus* Mackerel sharks • *Carcharodon carcharias* • *Isurus oxyrinchus* • *Isurus paucus* • *Lamna nasus* Eagle and mobulid rays • *Manta* spp. • *Mobula* spp. Whale sharks *Rhincodon typus* Guitarfishes • *Glaucostegus* spp. Wedgefishes • *Rhinidae* spp.	Freshwater stingrays • *Paratrygon aiereba* • *Potamotrygon* spp. • *Potamotrygon constellata* • *Potamotrygon magdalenae* • *Potamotrygon motoro* • *Potamotrygon orbignyi* • *Potamotrygon schroederi* • *Potamotrygon scobina* • *Potamotrygon yepezi*

Capacity building on species identification and data collection of elasmobranchs

SEAFDEC/MFRDMD in collaboration with SEAFDEC/TD had organized a series of training sessions on chondrichthyan taxonomy, biology, data collection, and report presentation in 2016, 2017, and 2019 and workshops on the identification of sharks and rays in 2017 and 2019. These capacity-building activities had been meant to enhance the knowledge and experience of the human resources responsible for collecting data and information on sharks and rays landings. Also, DNA samples had been collected from various sites throughout the region since 2013 for barcoding. A total of 145 sharks, 250 rays, and 20 skate specimens were successfully sequenced for DNA barcoding comprising 39 species of sharks, 42 species of rays, and five species of skates. Using DNA barcoding, for example, all samples identified at first as *Neotrygon kuhlii* were confirmed as *N. varidens* and *N. caeruleopunctate* according to the DNA sequence by Last *et al*. (2016). Therefore, DNA barcoding could support and verify the taxonomy of sharks and rays using morphometric and meristic data. Furthermore, some publications on the identification of sharks and rays, as well as on data collection that had been used in the capacity building activities, are listed in **Box 3** below:

Box 3. List of publications on sharks and rays identification and data collection

- Data Collection on Sharks and Rays by Species in Malaysia (August 2018–July 2019) (2021)
- Data Collection on Sharks and Rays by Species in Malaysia (August 2017–July 2018) (2021)
- Data Collection on Sharks and Rays by Species in Malaysia (August 2016–July 2017) (2020)
- Data Collection on Sharks and Rays by Species in Malaysia (August 2015–July 2016) (2017)
- Terminal Report: Regional Sharks, Rays and Skates Data Collection (2020)
- Terminal Report: Data Collection on Sharks and Rays by Species in Tawau, Sabah (Phase I) October 2018–September 2019 (2020)
- Standard Operation Procedures (SOP) for Sharks, Rays and Skates Data Collection in the Southeast Asian Waters (2017)
- Identification Guide to Sharks, Rays and Skates of the Southeast Asian Region (Volume 2) (2020)
- Identification Guide to Sharks, Rays and Skates of the Southeast Asian Region (2017)
- Guidebook to Cartilaginous Fishes of Thailand and Adjacent Waters (2019)

Stock assessment of elasmobranchs

In 2018, SEAFDEC/TD organized the "Training on Shark and Ray Stock Assessment using yield per recruit (YPR) model," and in conjunction with the regional sharks, rays, and skates data collection during 2015–2016, stock assessment of elasmobranch in Southeast Asia using yield

per recruit (YPR) and spawning per recruit (SPR) analysis was undertaken in 2021 using 32 stocks of sharks and rays from six landing sites in Cambodia, Malaysia, Myanmar, and Thailand. The growth parameter estimation showed that 27 stocks had rapid growth rates, four stocks had average growth rates, and one stock of female whitespotted whipray (*Maculabatis gerradi*), the largest stingray found in this study, had a slow growth rate. The results of both YPR and SPR showed that in 5 stocks (16 %) current fishing mortality (F_{curr}) exceeded the limit biological reference points (BRPs), while 12 stocks (37 %) were acceptably exploited with F_{curr} lower than the limit BRPs, and 15 stocks (47 %) were identified as the low exploited stock with F_{curr} lower than all BRPs. For the selected stocks, the sub-region with the lowest exploitation rate was the South China Sea, represented by only one country with a specific fishing ground. Based on the study results, three management measures suggested: fishing gear adaptation, establishment of marine protected areas, and zonation improvement to adjust either age at first capture (tc) or fishing mortality (F) or both at the same time (Pattarapongpan, 2021).

Age determination of elasmobranchs

SEAFDEC/TD organized in 2019 the Training Course on Age Determination Using the Vertebra of Sharks and Rays with support from the Japanese Trust Fund. The training included lectures on the status of elasmobranch fisheries in Southeast Asia, sensitivity of the YPR model, and estimation of the growth parameters. The training also included practical sessions in groups to practice step by step including Species Identification (Species and Sex), Measurements (total length, precaudal length, and body width and weight), Vertebra Removal (boiling and bleaching to clean vertebra, vertebra staining, embedding in epoxy), and Sectioning.

Issues and Challenges

The studies and data on sharks and rays are limited in many countries in the region such as Brunei Darussalam, Myanmar, Cambodia, and Viet Nam. Only a few countries such as Indonesia, Malaysia, and Thailand have the historical data and more comprehensive studies on this group of aquatic species. Most countries in the region still record the landing of sharks and rays by groups (sharks and rays) not up to their species level. Some countries still do not include sharks and rays landings in their national statistics. Other information such as biological data, stock structure, and spatial and temporal distribution of sharks and rays are still lacking in some countries. Furthermore, there is a lack of information on trends in species composition of shark production, while utilization of shark fins and shark meat is not recorded in international trade, global utilization of products other than shark fins and shark meat, and in trade statistics.

Way Forward

For CITES, the Animals Committee had encouraged Parties to:

- provide information on any national management measures that prohibit the commercial take or trade of sharks and rays
- provide a report in accordance with their national legislation about the assessment of stockpiles of shark parts and derivatives for CITES-listed species stored and obtained before the entry into force of their inclusion in CITES to control and monitor their trade, if applicable
- inspect, to the extent possible under their national legislations, shipments of shark parts and derivatives in transit or being transshipped, to verify the presence of CITES-listed species and verify the presence of a valid CITES permit or certificate as required under the Convention or to obtain satisfactory proof of its existence; and
- continue to support the implementation of the Convention for sharks and consider seconding staff members with expertise in fisheries and the sustainable management of aquatic resources to the Secretariat.

In the Southeast Asian region, the ongoing project "Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region" (2020–2024) under the JTF VI Phase II project is being implemented by SEADEC/MFRDMD. The planned project activities include capacity development in taxonomy, new species/record identifications, and management of major shark species; confirmation of stock structures for at least two common species of sharks/rays (*Chiloscyllium hasseltii*, *Carcharhinus sorrah*) and one CITES-listed species (*Sphyrna lewini*) in participating countries; and development of socioeconomic studies for the collection of information on marketing and trade, and channels of sharks and rays, as well as the development of NDF documents for selected CITES-listed species that are widespread in the region.

3.1.2 Anguillid Eels

Anguillid eel resources are among the highest economically important inland fishery resources in Southeast Asia. Although Anguillid eels are migratory fish species, their life cycle is mainly spent in freshwater environments. Southeast Asia is home to several tropical Anguillid eel species (Arai *et al*., 1999). Among the total 19 species/subspecies (16 species and 3 subspecies) that exist worldwide (Pacific, Atlantic, and the Indian Ocean), 13 species/subspecies are distributed in the Indo-Pacific Region, of which eight species/subspecies inhabit in Southeast Asia region (**Figure 69**). The most economically important eel species in Southeast Asia are the *Anguilla bicolor* and *Anguilla marmorata*. In this region, six countries have anguillid eel