

Implementing Sound Policies and Regulations for the Sustainability of Eel Fisheries in Southeast Asia

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The rapid population decline of temperate eels and the listing of some anguillid eel species, *i.e.* *Anguilla anguilla* and *A. japonica* in the CITES Appendices, have led to the increase in the market value of tropical eels during the recent years. European, American, and Japanese eels are seriously threatened with extinction due to high consumption, and demand is still increasing. After the stocks and recruitment collapse in the present target eel species and areas, it has to seek other targets for replacement and compensation to continue eel consumption (Arai, 2015). Since 2009, CITES for international trade listed the European eel in Appendix II due to their decreasing population and potential extinction. In East Asia, the large consumption of the Japonica eel has led to a rapid decline in the number of glass eels. Moreover, the demand for tropical anguillid eels in Southeast Asia has increased, not only for domestic consumption but also mainly for export to East Asian countries. Since the Japanese eels and European eels are under the control of the IUCN, the development of sustainable anguillid eel fisheries could be an excellent prospect to increase the source of income of small-scale fishers in Southeast Asia.

SEAFDEC conducted the studies to obtain a better understanding of the status, biology, and life cycle of eel stocks and promote sustainable management and utilization of anguillid eel fishery resources in the region. To better understand the stock status, biology, and life cycle of eel stocks and promote sustainable management and utilization of anguillid eel fisheries resources in the region, SEAFDEC carried out two projects, namely: "Development of Stock Assessment Methods and Strengthening of Resources Management Measures for Tropical Anguillid Eel in Southeast Asia" in 2020-2022 and "Sustainable Utilization of Anguillid Eels in the Southeast Asia Region" in 2020-2024. The former Project was implemented by the SEAFDEC Secretariat in collaboration with IFRDMD with funding support from the Japan-ASEAN Integration Fund (JAIF) with the aims to collect catch data and biological/ecological information for the estimation of eel resources stocks and develop methods for estimating tropical anguillid eel resources. While the latter Project was implemented by IFRDMD with funding support from Japan Trust Fund VI (JTF) Phase 2 with the aim of keeping the sustainable management and utilization of anguillid eel fisheries resources in the Southeast Asian region through the strategic program of sustainable eel resources management. The anguillid eels are common in several ASEAN Member States (AMSs), namely: Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam. This article presents the capture fishery practices for anguillid eels in the AMSs and the national fishery management programs and regulations implemented by the respective countries to sustain the utilization of eel resources in the region.

Presently, there are 16 species and three subspecies of anguillid eels in the world (Watanabe *et al.*, 2009), which are distributed from tropic to subarctic zones except in the west coasts of the North and South American continents, the west coast of Africa, and the east coast of South America, except the north coast along the Caribbean Sea (Kuroki & Tsukamoto, 2012). They are catadromous fish species with a life cycle mainly spent in freshwater environments and migrate to the sea to spawn. Starting from eggs to leptocephalus then to glass eel, they go to the mouth of the river. After entering the river, it becomes an elver, grows into a yellow eel, then a silver eel, and becomes an adult (**Figure 1**).



Figure 1. Life stages of anguillid eels: glass eel (left), elver (top right), and yellow eel (bottom right)

However, many factors can be traced from the deteriorating eel resources, such as the conversion of their habitats into other development structures and installations, overexploitation, diseases, climate change, and water pollution. The construction of dams and weirs in many rivers to supply the water needed for crop irrigation and for running the hydroelectric power plants creates a blockage of the water flow. This river blockage hinders the migration pathways of many aquatic species. In the case of eels, this also impedes the movement of eels going upstream or undertaking reverse migration as part of their life cycle. Besides, overexploitation can be due to non-selective fishing gear and unsustainable fishing methods and practices. The lack of regulatory management on the maximum number and the distance between the gears would lead to the decreasing populations of the anguillid eels that migrate to the oceans. The damage to watersheds is also a threat that needs attention.

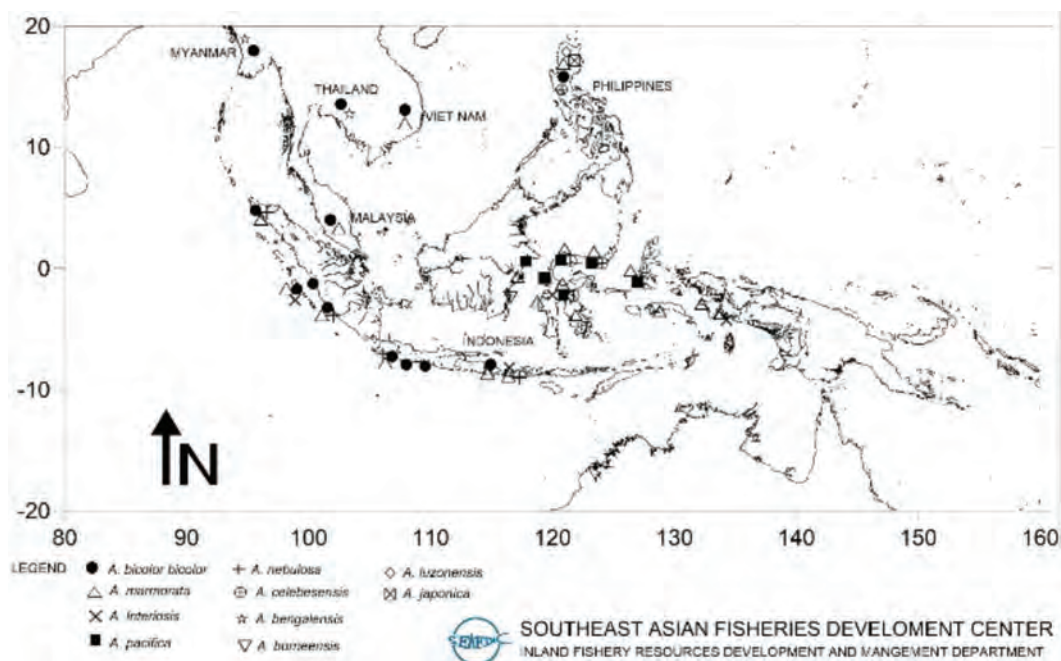


Figure 2. Distribution of *Anguilla* spp. in Southeast Asia

Eel fisheries in Southeast Asia

Southeast Asia is home to several tropical anguillid eel species, particularly in Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam (Arai *et al.*, 1999) (Figure 2). Anguillid eel resources are one of the most economically important inland fishery resources in the region as it is an important food with high nutrition. The international market for cultured eels exceeded 200,000 t in 2000 and reached 275,014 t in 2009 (FAO, 2015). The economically important eel species in the region are *Anguilla bicolor* and *A. marmorata*.

In Indonesia, fishers catch the yellow eels in the middle basin of the river using ‘bubu’ trap, while capturing the glass eels using a hand-held scoop net. In the Philippines, fishers catch the glass eels using a hand-held scoop net, fyke or fence net, or other rigid structures near the mouth of rivers. The wings

or leads guide the fish towards the entrance of the bags. In Myanmar, eel collectors or fishers use bamboo traps to collect eels using crabs or earthworms as bait and rear the catch for about one week. In Viet Nam, the main fishing gears used to catch glass eels are towing net and scoop net (Suryati *et al.*, 2017). The different types of fishing gear that are used to catch eels are shown in Figure 3.

In Indonesia and Philippines, the fishers obtain their fishing gear from the collectors to catch glass eels. The distribution channel for eels involves consolidators because of the need to transport/trade eels in their live state. Therefore, the distribution structure is concentrated around the consolidators.

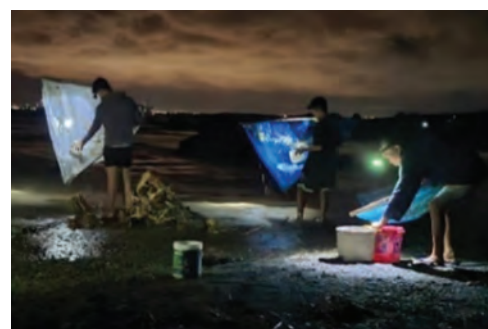


Figure 3. Types of fishing gear for catching eels: fyke net in the Philippines (top), bamboo trap in Indonesia (top right), scoop net in the Philippines (bottom right)

Anguillid eel is consumed directly fresh or as food product. The value chain in Indonesia and Philippines starts with glass eels collection from fishers, rearing the glass eels for a few days in temporary rearing tanks, then transporting the eels to eel farms. The eel farmers rear the glass eels to marketable size; then, upon reaching the size for consumption, the eels are harvested and processed into different food products. Marketing starts from the shipment of glass eels and elvers to eel farmers and the yellow eels or table-size eels to local and overseas markets.

The price of eel depends on the demand and usually, it is necessary to coordinate with collectors to ensure that a sufficient number of eels for the market are collected in Indonesia and Philippines. It can be noted that fishers of glass eels are usually temporary fishers who work only from evening to midnight. Most of them have other jobs from morning until noon. The capture activity is not done every day. Because of that, glass eel is sold at a high price (Muthmainnah *et al.*, 2021). The products are exported to Japan, Korea, and China.

Anguillid eels as an aquatic species under international concern

Strengthening the management of tropical Anguillid eels was one of the CITES Animal Committee Meeting recommendations in 2018. Moreover, the 18th Meeting Conference of the Parties to CITES (CoP18) in 2019 discussed the issues of range States of non-CITES *Anguilla* spp. in international trade particularly

A. rostrata, *A. japonica*, *A. marmorata* and *A. bicolor*. In view of the sustainable development of eel stocks in the Southeast Asian region, the AMSs were encouraged to a) where appropriate, implement conservation and management measures, such as adaptive eel management plans, enhanced collaboration within countries, between authorities and other stakeholders with responsibilities for eel management, and related legislation to ensure the sustainability of harvests and international trade of *Anguilla* spp. and make these widely available; b) collaborate and cooperate with other range States on shared stocks to develop shared objectives for these stocks and their management, improve the understanding of the biology of the species, conduct joint programs of work and share knowledge and experience; c) establish monitoring programs and develop abundance indices in range States where none exist. For ongoing programs, identifying opportunities for expanding to new locations and/or live stages would be favorable; improve traceability of *Anguilla* spp. in trade (both live and dead); and e) provide information to the Secretariat on the implementation of this Decision to allow it to report to the Animals Committee and Standing Committee, as appropriate. Six of the 10 ASEAN Member States, namely: Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam are range States for tropical anguillid eels. The respective AMSs developed their own national fishery management programs (**Box**) and agreed to collaborate with the vision of developing effective management practices for sustainable use and conservation of tropical anguillid eel resources in the region.

Box. Policies and regulations of the ASEAN Member States for sustainable development of anguillid eel resources in the Southeast Asian region

Cambodia

- On 6 July 2016, the Ministry of Agriculture, Forestry and Fisheries established the aquaculture of aquatic animals specifically on the number of eels to be cultured. The Fisheries Administration (FiA) of Cambodia obtained > 1,000 individuals for culture, while 600-1,000 individuals required permission from FiA at the provincial level.

Indonesia

- The policy regarding eel management started in 1973 through a Ministerial Decree of Agriculture KepMentan No. 214/Kpts/Um/V/1973 prohibiting the export of some species of fish seeds including eels. The decree was revised in 2009 to prohibit the export of eel seeds except for research purposes and improve the management of anguillid eel resources.
- In 2012 as indicated in the Ministerial Decree of the Ministry of Marine Affairs and Fisheries (MMAF) No. 19/2012, the export of eels below 150 g per individual was prohibited. In this decree, the National Plan of Action (NPOA) for eel conservation for the 1st period of 2016-2020 was established.
- As a commitment of the Government of Indonesia to protect the country's eel resources, the Ministry of Marine Affairs and Fisheries issued the decree 80/KEPMEN-KP/2020 on 17 July 2020 concerning the protection of anguillid eels (*Anguilla* spp.) by limiting their capture. Since then, the government implemented a quota system that limits the transfer and receiving of anguillid eels to those who have a certificate (SIPJI) within different areas in Indonesia.
- The established protection scheme limits the capture of eels in certain time periods and a certain size for protecting eel resources include:
 - Seeds of anguillid eels at the glass eel stage should not be caught every new moon on 27-28 Hijriah (Arabic calendar)
 - Adults of *Anguilla bicolor* and *A. interioris* weighing more than 2 kg should not be caught at any time
 - Adults of *A. marmorata* and *A. celebesensis* weighing more than 5 kg should not be caught at any time
- MMAF established the Eel Management plan through Ministerial Decree No. 118 in 2021 as guidelines for the MMAF, local government, related agencies, and eel stakeholders in implementing the management of eel fishery in Indonesia.
- Regarding the eel restocking, as well as catching and handling the glass eel, Indonesia issued the Decree of the Director General of Capture Fisheries No. 7 of 2022 on Technical Guidelines for Restocking Eel, and Decree of the Director General of Capture Fisheries No. 8 of 2022 concerning Technical Guidelines for Catching and Handling Glass Eel.
- Management policies on anguillid eels within Indonesia
 - Poso Regent Regulation No. 26 of 2017 concerning the management of Anguillid eels
 - Sukabumi Regent Regulation No. 25 of 2018 concerning the management and protection of anguillid eel resources
 - Decree of the Sukabumi Regent No. 523/Kep 643.1-Dislutkan/2018 concerning the cultivation of plasma core system fish
 - Sukabumi Regent Circular No. 523/2090/Dislutkan concerning the restocking of the prospective broodstocks of Anguillid eels

Box. Policies and regulations of the ASEAN Member States for sustainable development of anguillid eel resources in the Southeast Asian region (Cont'd)

Myanmar

- Closed season to promote eel recruitment, support the silver eel migrating to the ocean for spawning, and allow glass eel to enter the mouth of the river for growing
- Closed season and no collection period for eel from 1 June to 31 August every year.
- So far, the government has not yet implemented the closed area for eel management. The reason is closed-season approach is more appropriate than the closed area based on experience.

Philippines

- The export of eel seeds with lengths less than 15 cm is prohibited by virtue of Fisheries Administrative Order (FAO) No. 242 in 2014. Under this law, imprisonment of eight years, confiscation of the same or a fine equivalent to double the export value of the same upon the discretion of the court, and revocation of the fishing and/or export accreditation/permit shall be imposed on offenders.
- Fishermen registration under the “Fish R” program of the Bureau of Fisheries and Aquatic Resources is being implemented to protect the preferential rights of fishermen and for efficient delivery of government programs for the fisherfolk. This was backed up with the registration of boats and fishing gear to fast track and complete the nationwide registration of municipal fishing boats 3 GT and below and municipal fishing gear as required under “Boat and gear R” of Executive Order No. 305 s. 2004 and Section 19 of RA 10654 (formerly RA 8550) or the Philippine Fisheries Code of 1998.
- FAO 233 on aquatic wildlife conservation which includes eels
- FAO 319 on the requirements for exporting live food fish and crustaceans
- Philippine General Memorandum Circular Order No 2 S 2009 on the requirements for the export of live animals.

Viet Nam

- Regulation to manage the eel fisheries in Viet Nam is included in the enacted Fisheries Law of 2003 (amended in 2017).
- Red Book Viet Nam for *Anguilla japonica*.
- Ministry Decision No. 57/2008/QD-BNN for eel aquaculture
- Ministry Decision No.82/2008/QD-BNN for regulation of the trading of rare and endangered aquatic species.
- The Ministry of Agriculture and Rural Department (MARD) published Circular 19/2018 regarding the fishing close areas for protecting the *A. japonica* and *A. marmorata*. MARD through this Circular updated the data on fisheries and aquaculture on the National Fisheries Database.
- Government Decree 26/2019 in articles 7, 9, 39, 40, 41, 67,68, and 69 (Binh, 2019)
 - Article 7 is for aquatic endangered species
 - o List I - (including *A. japonica* and *A. bicolor*) only permitted to be caught for the following purposes: conservation, scientific research, initial seed research, and international cooperation (fishing).
 - o List II: similar to List I and with specific conditions specified in Part II of Annex II: *A. marmorata* and *A. borneensis*: catch permitted from 1 March to 30 April.
 - Article 9 indicates the procedures for issuing the permission for fishing aquatic endangered species with the Directorate of Fisheries as the competent authority
 - Articles 39, 40, and 41 deal with the detail regulation on the management and catch certification, aquaculture establishments of aquatic endangered species.
 - Articles 67, 68, and 69 showed detail regulations on the export, import, re-export, import from sea, transit of aquatic endangered species.

Way Forward

Several issues on the conservation and management of tropical eels have been identified by many Southeast Asian countries that need to be addressed. These include inadequate statistical data on the utilization of the eel resources such as catch data as well as a systematic data collection scheme, limited information on eel aquaculture, insufficient data on the geographic range of the anguillid eels, limited stock assessment studies, inadequate effective conservation and management measures, and mixed statistical data on international trade of eel species. Therefore, the suggested strategic measures to sustain the anguillid eel resources as a source of livelihood or food for the AMSs countries include data collection, biodiversity monitoring, stock enhancement, and establishment of the closed season and involve the stakeholder.

Data collection

The collection of information and statistical data on the utilization of anguillid eel resources is the most important and urgent activity to be pursued. Catch data should be collected from the enumerators and/or collectors or consolidators of glass eels, elvers, yellow eels, and silver eels to be able to derive information useful for policy formulation. The data should include species, life stages, and fishing gear. Long-term data collection should be also undertaken to generate the resource status and trends based on the catch per unit effort data. Fishing effort data includes the duration of fishing operations, number of fishing gear, and number of fishers. The data could facilitate the understanding of the current status of the fisheries for carrying out a stock assessment. In addition, it is also necessary to collect biological data such as length, weight, age of elvers/yellow eels, among others. The data for collection could also be based on the trading profiles that had been compiled from the national trade data and statistics on exports and imports (Muthmainnah *et al.*, 2016).

Biodiversity monitoring

The establishment of biodiversity monitoring sites and fish sanctuaries should be undertaken based on the following criteria: habitats and ecosystems are being degraded, species population is threatened and declining, management interventions are lacking, local communities should gain the most benefit from the resources, and restoration of habitats should obtain the intended impacts.

Stock enhancement and establishment of a closed season

To conserve the eel stocks, restocking activities could be an option. This activity aims to replenish depleted stocks as a result of overfishing. Resource enhancement could also be promoted through the enforcement of closed season during certain periods which should be considered more appropriate than closed areas. The involvement of the community is very important in this aspect to ensure effective collective efforts and outcomes.

Involvement of stakeholders

In the management of eel fisheries, the stakeholders should be involved from the planning process until the implementation of the management policies. The stakeholders are the institutions in charge of fisheries affairs in the province/district/city, which include higher educational institutions, research institutes, fishers, and collectors. The exploitation activities in the inland waters that interfere with the sustainable management of the eel resources can be monitored by such groups. For instance, dams or canalization that can cut off the migration of eels, and the construction of hydropower that discharges wastewater that can kill the eel seeds can be impeded. The institutions in charge could facilitate the establishment of a network of fishers, collectors, cultivators, and exporters that will serve as management bodies that will oversee the conservation and sustainable utilization of anguillid eels. Besides, the conduct of regular meetings and establishing Eel Cooperatives are equally important for the realization of the goals of promoting anguillid eels towards sustainability.

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