

# Institutional Analysis of the Banggai Cardinalfish trade in Indonesia

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## 1. Part I: System Structure - Collective Action

The Banggai Cardinalfish (*Pterapogon kauderni*) is a small marine fish found in the Banggai Archipelago of Indonesia, typically in the shallow coastal waters surrounding approximately 32 different islands. Extraction of the species began in 1994, and *P. kauderni* quickly became overfished due to its popularity as an aquarium fish, causing it to be listed as “Endangered” on the IUCN Red List in 2007. There are two primary action arenas involved in the *P. kauderni* trade: 1) the extraction of the fish from Indonesian waters, carried out by local fishermen, and 2) the trading of *P. kauderni* on international markets, which involves exporting and importing parties. Successful conservation of the species depends on creating rules that harmoniously link the two action arenas, so that both are working towards the goal of reducing the *P. kauderni* trade to sustainable levels.

The case is an addition to the original Common-Pool Resource (CPR) database. Danielle Chipman at Arizona State University entered this CPR report in 2015.

### 1.1 The Commons Dilemma

The Banggai Cardinalfish is a common pool resource because it is both highly subtractable, due to its small population size and limited range; and non-excludable, due to a lack of public infrastructure limiting participation in fishing and trading activities. The system lacks proper infrastructure to prevent over-appropriation of the resource, such as enforceable licenses, catch limitations, sanctions against illegal activity, and appropriate monitoring. Additionally, the fish is caught locally and traded internationally, and there are not appropriate nested scales of management to govern the multiple levels of this system.

### 1.2 Biophysical Context (IAD)

- **Natural infrastructure:**

Banggai Cardinalfish live in the shallow coastal waters surrounding 32 islands in the Banggai Archipelago. They inhabit 3 distinct types of micro-habitats, all no deeper than 5 meters, which are defined by the primary inhabitants: *Diadema* sea urchins, sea anemones, and hard corals. *P. kauderni* uses these other species for purposes of shelter and protection. Recruits, which are fish that measure under 15 mm in size, are the most frequent in *Diadema* habitats; juveniles tend to live in the sea anemone habitats; and adults are most common among the hard corals. This means that the health of *P. kauderni* as a species is dependent on the health and habitat of at least three other species. Extraction of these cohabitating species and activities, such as seaweed harvesting, that disrupt habitats, are potentially harmful to *P. kauderni*.

A number of characteristics of *P. kauderni* make it especially vulnerable to overexploitation. It has a small population, limited range, and high site fidelity, which means that many populations are separate from one another and genetically distinct. The fish also lacks a pelagic larval phase, which means that the larvae are not able to travel long distances and colonize new territory. Additionally, the fish are male mouth-brooders, so the success of the species depends on the availability of males to carry fertilized eggs.

- **Hard human-made infrastructure:**

Fishermen require private infrastructure such as boats and nets to capture fish. Some of them use cyanide or fish bombs, which are more efficient at capturing specimens but destroy the habitat and kill marine life. The fishermen also require gas to power their boats, and the high price of gas can be a burdensome expense. Since the species is traded internationally, public transportation infrastructure in the form of roads, trucks, boats, and airplanes is necessary to transport the fish from the Banggai Islands to exporters

and buyers.

### 1.3 Attributes of the Community (IAD)

- **Social infrastructure:**

Approximately 17 villages and 230 fishermen are involved in the capture of *P. kauderni*, and most of the fishermen are poor. The fishermen are generally paid the equivalent of \$0.02 per fish, while local middlemen sell the fish for \$0.16 each and exporters sell them for \$2-5. Because fuel prices are high and fishermen earn very little money, they try to reap the biggest gains from each fishing trip, which means they tend to overfish and utilize destructive methods such as fish bombing and cyanide use.

The primary *P. kauderni* exporter stations are in Indonesia (Tumbak and Manado) and Bali (Palu). The total estimated trade between all of these exporters is between 700,000 and 900,000 fish per year, which are primarily exported to the United States, Europe, and Asia.

- **Human infrastructure:**

Currently, fishermen in the Banggai region have low awareness of sustainable fishing methods and the impacts of their actions on *P. kauderni* populations. The Banggai Cardinalfish Action Plan, introduced in 2007, created programs to build human infrastructure among these fishermen. The programs train fishermen in sustainable harvesting methods, post-harvest care, and marketing skills. There is also a movement to retrain fishermen in aquaculture, so that they can raise fish in captivity and thus reduce pressures on wild populations. There is a need for more research on the ecological, economic, and social factors influencing the health of *P. kauderni*.

The hobbyist aquarium population, who create the demand for *P. kauderni*, are generally knowledgeable about the endangered status of the species. Some have responded to this by increasing captive breeding efforts and demanding captive-bred specimens over wild specimens.

### 1.4 Rules in Use (IAD)

#### Position Rules:

- Local *fishermen* catch Banggai Cardinalfish from local waters.
- *Middlemen* buy the fish from local fishermen and sell to exporters.
- *Exporters* buy the fish from middlemen and sell to foreign buyers.
- *Buyers* from foreign countries (United States, Europe, and Asia) purchase the fish from exporters.
- *Aquarium hobbyists* in foreign countries, primarily the United States, Europe, and Asia, create demand for the fish and buy it from retailers.
- The *Indonesian government* makes regulations about the management, monitoring, and trade of the Banggai Cardinalfish.

#### Boundary Rules:

- Fishermen must obtain a license to capture ornamental species, including *P. kauderni*.

**Choice Rules:**

- Fishermen may choose to legally catch fish using nets, or illegally catch fish using fish bombs and cyanide.
- Fishermen may choose to catch fish from the wild or breed fish in captivity.

**Aggregation Rules:**

- Inadequate information on aggregation rules at this time.

**Scope Rules:**

- Inadequate information on scope rules at this time.

**Information Rules:**

- Fishermen must report their catch sizes to the Indonesian government.
- Importers of the fish must notify the European Union under the regulations of Annex D of the European Wildlife Trade Regulations.

**Payoff Rules:**

- Inadequate information on payoff rules at this time.

## 1.5 Summary

A lack of rules, and inadequate enforcement of rules that do exist, has permitted the continued overextraction of *P. kauderni*. Rules governing the trade of this species should be more specific and enforceable at all levels of the system, from local extraction to international export. Additionally, the species should be more accurately monitored at all levels. Thus far, regulations have primarily been made at the local level, and attempts at bringing international regulatory structures into the governance of *P. kauderni* have been rejected. Without properly-linked nested systems of governance, feedbacks between the health and supply of the species in the Banggai Islands and the demand for the species from abroad may be inadequate to promote conservation of *P. kauderni*.

## 2. Part II. Dynamic Analysis – Robustness Summary

The future success of *P. kauderni* depends upon the adoption of new management strategies. The first possibility is for the Indonesian government to create a management structure that incorporates proportional equivalence between benefits and costs, effective monitoring, strong sanctions against illegal activity, and nested enterprises, which would all help regulate the fishing and trade of wild specimens. Another option is for the government to invest in aquaculture of the species. If done properly, this can continue to provide Banggai region fishermen with an income, while also relieving the pressures on wild specimens. As importing countries become aware of the threats to *P. kauderni*, they are increasingly demanding captive-bred specimens, so this latter option may become increasingly viable.

In addition to stronger regulation and monitoring of *P. kauderni* extraction, conservation strategies should focus on maintaining the health of ecosystems that support these fish. Human activities can pollute coastal waters, especially activities that increase sedimentation and nitrate runoff into the ocean. Use of fishing equipment such as fish bombs, cyanide, and equipment that physically damages the seafloor may also disturb *P. kauderni* habitat. Finally, extraction of other species that live with *P. kauderni*, including *Diadema* sea urchins, sea anemones, and hard corals, can be disruptive to the cardinalfish. All of these environmental impacts must be mitigated if successful conservation of *P. kauderni* is to be achieved.

## 3. Case Contributors

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