# A possible method to control populations of the highly invasive *Pterygoplichthys* species in Sri Lankan Reservoirs

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## ABSTRACT

The view of reservoir fishers is that *Pterygoplichthys* species (commonly known as Tank Cleaner (TC) also called 'Sail Fin Catfish') is an annoyance as they get entangled in commercial gillnets thus making them less effective for getting target type of Cichlids. Tank Cleaner is very common in the ornamental fish trade and it was accidently released into natural water bodies by aquarists. This study investigated a possible method to control TC in Sri Lankan water bodies. A large reservoir, 'Kalawewa', in the North Central Province of Sri Lanka which is critically affected by this invasion was selected for this study. Different types of fishing gears were tested in selected areas of the reservoir from September 2016 to January 2017 to test the efficacy of nets for catching TC. Experimental submerged gill net showed better performance, giving a catch ratio of 5:1 (TC: other fishes) during afternoon (3:00 -6:00 p.m.), and 9:1 (TC: other fishes) during night time (6:00 p.m. - 5:00 a.m.). The average catch ratio of fish ranged from 2:1 to 1:1 (TC: other fishes) during the dry season, and 3:4 (TC: other fishes) during the rainy season. *P. pardalis* accounted for 70 % of the catch while *P. disjunctivus* accounted for nearly 10% with 20% intermediate type specimens unidentified. A method to produce fish meal (FM) from TC was developed using TC caught from the reservoir. The recovery percentage of fish meal was 16% and the purchasing price of TC at the FM plant was decided as 10.00 Sri Lankan Rupee (LKR)/kg. The whole body proximate data including Protein, ash, lipid and moisture content of TCFM was 49%, 25.3%, 7.7% and 11.7% respectively. The main limiting factor of this process is the reluctance of fishermen to stock TC without adequate compensation. However it may be impossible to eradicate TC, but it may be possible to control the fish populations by the investigated method which could be extended to other affected inland water bodies as well.

Key Words: *Pterygoplichthys* species, Tank cleaner, fish meal, control method, Sri Lankan reservoirs

## INTRODUCTION

Amazon Sail Fin Catfish (*Pterygoplichthys pardalis*) and Vermiculated Sail Fin Catfish (*P.disjunctivus*) otherwise called the Tank Cleaner (TC) are common in the ornamental fish industry and were released into Asian water bodies by aquarists (Page and Robins 2006). *Pterygoplichthys* species are herbivores, and massive stocks can remarkably change the

environment of a water body by reducing the energy which accessible to different herbivores, for example, aquatic insects and other arthropods. Decrease in populations of arthropods will result in diminished populations of different animals that feed on arthropods, including numerous local fishes of Southeastern Asia (Page and Robins 2006).

The Sail Fin Catfish thrive in nearly unpolluted conditions like perennial reservoirs in the Eastern, North central, North western and Central provinces. It has also become common in exceedingly contaminated waterways like HaliEla (Central province), and more urban Bellanwila-Attidiya marshes in the Western region. The fish have also invaded the Dutch Canal (Western Province) which is a brackish water body connected to the Negombo Estuary (Epa 2014). Sumanasinghe and Amarasinghe (2013) stated that there is a population of *Pterigoplichthys pardalis* which has a noteworthy negative effect on the commercial fishery of exotic Cichlid species fishery in Polgolla reservoir (Central Province) as well as in numerous inland tanks of Sri Lanka such as Kala Wewa, Balalu Wewa, Kandalama Wewa and Usgala Siyambangamuwa Wewa (all in the North Central Province) as this armored catfish gets entangled and damages gillnets. In spite of the fact that TC forms a large proportion of the total landings of TC in reservoir fisheries, they are largely discarded by fishers due to poor consumer acceptability. The view of reservoir fishers is that this species is an annoyance species as they get entangled in commercial gillnets thus making them less viable for catching target type of cichlids (Sumanasinghe and Amarasinghe 2013).

Epa (2014) mentioned that the Sail Fin catfishes that get captured in the nets are normally thrown back into the water as there is no interest in the market as a food fish. Sumanasinghe and Amarasinghe (2013) noticed when fishers attempt to remove TC from nets, their hands are harmed by solid and sharp spines. Despite the fact that intensive fishing has been proposed as an effective and feasible method for controlling population growth TC, because of the absence of consumer demand, it is difficult to establish a commercial market for this fish. To create a market interest for fish, post harvest innovations ought to be created. Mendoza-Alfaro et al. (2009) stated that in Mexico, collagen, fish paste for human consumption and fish meal is produced, using armored catfish. Pelleted animal feeds have been traditionally based on fish meal (NRC 2011) which is major dietary protein source ordinarily usually making up between 20-60% of fish diets (Watanabe 2002). For expansion of aquaculture, alternatives to fish meal are required due to strictly limited supply, steadily rising interest with increasing costs, environmental pressure to utilize more sustainable resources and restrictions on contaminants in animal feeds (NRC 2011).

In this study, we produced fish meal from TC collected from a large reservoir with the collaboration of a private fish meal producer. Comparison of the proximate composition of local fish meal with that of TC fish meal produced by the same fish meal plant was also carried out.

## MATERIALS & METHODS

### a. Fishing gear development and testing

The study was carried out in Kala Wewa, (North Central Province) a very large reservoir with a well established commercial inland fishery in Sri Lanka. Five landing sites from this reservoir were selected as follows: Kala Wewa main landing site (8° 1'16.79"N, 80°32'9.03"E); Dathusenapura Diyawara Gammanaya landing site, (8°1'32.90"N, 80°32'40.79"E); Olombeewa landing site (8° 0'41.57"N, 80°34'49.11"E); Pennuma landing site (7°59'49.93"N, 80°32'14.57"E) and Aluth Balalu Wewa landing site (7°59'30.82"N, 80°33'34.85"E) (Figure 1). Four different types of fishing gear were developed for testing.

a) One 500m long 4 ply, 3 ½ " meshed drag net
b) One 2 ply, 4 ½" meshed bottom set net of 13'x13'
c) Four small traps
d) One 1500' long 1 ply, 3 ½ " meshed gill net (2"x3" sized floaters at 300' intervals to increase sinking ability of net so as to touch the bottom)

Area with very high abundance of tank cleaners were identified based on the daily catch of fishermen and the test fishing gears were operated in three selected locations in Kalawewa (Table 1).

### b. Fish meal Production

One wooden net cage (Figure 02) and five Galvanized Iron framed plastic net cages (Figure 03) were constructed to stock the daily TC catch. These were established at each landing site. All fishermen were instructed to collect and stock TC daily in the prepared cages. One volunteer from each landing site was selected for daily stocking of TC and maintenance of the stocked fish. Within 5 days, nearly 300kg of fish from this catch were transported to a fish meal plant at the central fish market, Peliyagoda (Western Province). The TC fish meal was produced by following main steps of cooking, pressing, drying and powdering. Local fish meal (LFM) which is made by fish waste, mainly of Skip Jack Tuna (*Katsuwonus pelamis*) waste was purchased from the same fish meal factory and compared with Tank Cleaner Fish Meal (TCFM) (Table 03). The bulk transport of TC to the fish meal factory was carried out four times between November 2016 and January 2017.This also identified the key problems in transport and collection processes (figures 02, 03, 04 and 05).

### c. Sample analysis

Proximate composition analysis of both samples was performed by standard method of AOAC (1995). Samples were dried at 105°C until a constant weight to determine the moisture content by a laboratory oven (Memmert UK) following AOAC 985.14. Crude protein content was found by the Kjeltec (Velp Italy) according to AOAC 981.10 following main steps of digestion, distillation and titration. Crude fat was found by Soxtech Apparatus (Behr Germany) according

to AOAC 954.02 and ash content was determined by incineration at 550°C by a Muffle Furnace (Carbolitegero UK) following AOAC 938.08.

d. **Statistical analysis**

One-way Analysis of Variance test (ANOVA) was used to analyze proximate composition data of fish meal. The least significant difference (LSD) was used at $P<0.05$ level of significance using Statistical Analysis System (SAS Institute Inc. 2000).

## RESULTS

**Table 1**: Daily catch of tank cleaners based on fishermen's catches at two landing sites

| Date | Site | Total (kg) |
|---|---|---|
| 05.10.2016 | Dathusenapura Diyawara Gammanaya | 111.73 |
| 10.11.2016 | Olombeewa | 49.89 |

The average TC catch per fishing canoe of Kala Wewa fluctuated from 3.5 to 10 kg during the dry season. But at the start of rainy season it was below 5kg. Fish abundance is high near forested areas, rocky substrates and area close to rotting wooden trunks on the bottom of the reservoir. Average total catch of TC in a landing site was nearly 100kg during the dry period, though sometimes it can exceed 100kg. Nevertheless it was below 50kg with the onset of the rains. The average catch proportion was between 2:1 to 1:1 (TC: other fishes) during the dry season and 3:4 (TC: other fishes) at onset of the rainy season. The study revealed that *Pterygoplichthys pardalis* represented about 70% of the catch in Kala Wewa while *P. disjunctivus* represented about 10% with 20% unidentified intermediate type specimens based on catches of fishers and our catches by the experimental fishing gear (fishing gear '4'). All fish were classified according to Page & Robins (2006) and Wu et al (2011)(Figure 06 and Figure 7).

**Table 2:** Fish catch ratio of TC: other food fish (Cichlid) species by experimental gill net.

| Place | Date | Laid time | Removed time | Effective hrs | TC (kg) | Other fish (kg) |
|---|---|---|---|---|---|---|
| A | 11.11.16 | 4.30 p.m. | 7.30 a.m. | 15 hrs | 25.580 | 2.9 |
| A | 29.11.16 | 3.30 p.m. | 6.30 p.m. | 3 hrs | 5.0 | 1.0 |
| B | 05. 12.16 | 4.30 p.m. | 6.30 a.m. | 14 hrs | 4.0 | 0.8 |
| C | 06.12.16 | 4.00 p.m. | 8.00 a.m. | 16 hrs | 6.2 | 3 |

A- Dathusenapuradiyawara Gammanaya landing site;
B- Pennuma landing site;
C- Aluth BalaluWewa landing site

Among the four experimental fishing gears, only Type 'd' (submerged gillnet) fishing gear performed well. By the catch data of that gill net, it revealed that the ratio of TC to other cichlid species is 5:1 or below during evening period (3 hrs). But that ratio fluctuated between 5:1 and 9: 1 during night time (13-14 hr time period) (Table 2).

The recovery percentage of fish meal was 16%. The purchase price of 1kg of TC at the fish meal plant was decided as Sri Lankan rupees (LKR)10.00 after bulk transportation of raw fish. One kilo price of TC at the stock cages and transport cost to factory is included for this LKR 10.00.

The protein content of TCFM is nearly equal to protein content of LFM. Ash content of TCFM is significantly lower than that of LFM. Total lipid content of TCFM is significantly higher than that of LFM. Proximate composition of two fish meals (FMs) is shown in Table 03.

**Table 03:** Proximate composition of LFM and TCFM (dry basis) (means ± SD) (n=2)

| Source | Moisture | Protein | Lipid | Ash |
|---|---|---|---|---|
| LFM | 7.23±0.46[a] | 53.23±0.22[a] | 4.09±0.01[b] | 26.44±0.19[a] |
| TCFM | 8.04±0.09[a] | 55.69±0.27[a] | 7.23±0.0[a] | 17.96±0.31[b] |

## DISCUSSION

In the present study, we identified an effective fishing gear to harvest tank cleaner fish, an efficient collecting procedure of TC and a method to produce fish meal. The composition of TCFM was much better than that of LFM. Moreover TCFM can introduce as an economical viable and nutritionally acceptable protein source. Mendoza-Alfaro et al. (2009) states that production of collagen, fish paste for human consumption and fish meal was done in Mexico using armored catfishes. Also that a state government of Mexico has supported a project to crush loricariids(*Pterygoplichthys spp.*) into fish meal to be utilized as manure in agriculture and that the nutrient estimation of this fish meal shows that it is possible to be used as an ingredient in cattle feed and feeds in aquaculture.

During the study, high level of siltation was observed on the bottom of the shallow water column along the shoreline where nesting burrows of TC observed. Mendoza-Alfaro et al. (2009) also observed several dozen of nesting burrows or "spawning colony" of loricariids in very close proximity of the Infiernillo Reservoir, Mexico. It was also stated that these burrows can destroy shoreline stability, increasing erosion and suspended sediment loads. Siltation, bank failure, head-cutting, and raised turbidity can occur later. However the degree to which loricariid catfish burrowing causes bank erosion is uncertain from Sri Lanka despite the fact Hoover et al (2004) have proposed that catfish-incited erosion could diminish the shore by four meters every year. Gestring (2006) recommends that between 10 to 25 % of yearly shoreline erosion can be ascribed to this fish.

The study revealed that the average proportion of TC fish to other Cichlid species in a fishing operation varied from 2:1 to 1:1 (TC: other food fishes) during the dry season and 3:4 (TC: other fishes) during onset of the rainy season. Greene and Lee (2009) expressed that in many lakes of Florida, the haul seine fishery gets more loricariids than other fish species. They state that in 2007, 80 % of the fish Captain Wadley got in the Stockade Pit, the Reservoir, or Lake Hunter, in Central Florida were loricariid catfish, while just 10 percent were marketable tilapia.

In our study, the percent population of *P. pardalis, P. disjunctivus* and intermediate type was 70, 10 and 20% respectively. Wu et al (2011) reports that in fish collected from the wild approximately 28.3% could not be categorized into species and therefore defined as an intermediate group. They assume that *P. disjunctivus* might just be a synonym of *P. pardalis* and that the exotic populations may have originated from hybridization between the two species or that there are allopatric populations. It is possible that predominant characters of the hybrid may have helped it to become stronger and helped its invasions.

During the study, discarded TC fish were observed in remote landing sites of the Kala Wewa reservoir (Figure 08). There were existing bad odors in those areas. Mendoza et al (2009) reported that until local fishermen have an interest on loricariids, throwing them on to the shore to decompose makes it a source of public health issues.

Nets are damaged when removing entangled TC, (figures 09) and fishermen's hands are harmed by solid and sharp spines (Figure 10). Mendoza et al (2009) too reported that when attempting to detach loricariids from gillnets, fishermen often injure themselves. Recorded maximum egg count was 7000/ mature female of *P.pardalis* at the onset of rainy season (Figure 12). Hoover et al. (2004) reported fecundity ranging from 472 to 1283 mature eggs/ female. Gestring*et al.* (2006) quantified 1,983 eggs/ripe female in *P. multiradiatus*.

Some constraints to the process of making fish meal from TC were identified as follows: Hesitation of fishers to stock TC in cages without an adequate payment per kilo; decreased survival of TC in stocking cages to about 60-80% because of their wounds (Figure 11), absence of nourishment and satisfactory shade and, temperature changes in the water column; too much time spent when covering all landing sites during TC collecting process (increase of fuel cost and work hours); and it is needed to have more than one ton of fish per collection cycle for transporting in order to cover the loss.

## CONCLUSIONS AND RECOMMENDATIONS

It may be impossible, to eradicate sailfin catfishes from inland water bodies of Sri Lanka, but it might be possible to control the population below threshold level by the proposed method which could be extended to other affected inland water bodies. Additionally we recommend that fishermen should be motivated to control TC in water bodies and more attention should be paid to aware fishermen. Additionally, enforcement by government authorities is needed to collect all harvested TC without being thrown back into reservoirs. The government can encourage fishermen by giving gill nets as a subsidy and providing funds for transportation of TC and/or they can subsidize to increase purchasing price of 1kg of TC at the cage. If possible,

government or non-government organizations can facilitate for the transportation once a week from the collection site to fish meal production plant until TC level in reservoirs are brought to below threshold levels.

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**Figure 1:** Landing sites of Kalawewa



**Figure 02:** Wooden cage in Diyawaragammanaya



**Figure 03:** Olombeewa GI cage



**Figure 04:** TC collection in a 500L fiberglass tank



**Figure 05:** Transported TC at Fish meal plant

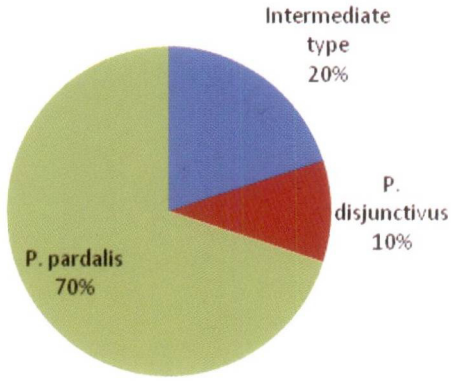



**Figure 06:** Distribution of *Pterygoplichthys spp.* in Kalawewa



**Figure 07:** Distinct characters of the two species (*P. pardalis*: unconnected dark spots on light background in ventral area and sometimes 2 or 3 darks spots jointed with a dark line; *P. disjunctivus*: dark vermiculation on light background in ventral area



**Figure 08:** Discarded TC catch in Kalawewa



**Figure 09:** TC entangled in the net



**Figure 10:** Injuries to fisherman's hand by detaching TC from nets



**Figure 11:** The lesions on TC fish resulting from trying to escape from net. These can lead to death of the fish.



**Figure 12:** Two matured ovaries of a TC fish