Digest

Feeding ecology of the genus *Pangasianodon* in a reservoir using stable isotope ratio and fatty acid analyses

（安定同位体比および脂肪酸分析を用いたダム湖におけるパンガシアノドン属の摂餌生態に関する研究）

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Chapter 1 General Introduction

Freshwater ecosystems harbor diverse organisms and provide a wide range of ecosystem services; however, wild populations of several species are declining dramatically. Releasing captive-bred animals, which is carried out worldwide for species conservation and fisheries stock enhancement, can have negative effects on the survival of enhanced species and on the communities of receiving ecosystems. Understanding the trophic niches of enhanced species is crucial for predicting the likelihood of establishment success and potential impacts on receiving ecosystems following introduction into new habitats. Freshwater megafauna (> 30 kg in body weight) are one of the most threatened groups. Nevertheless, the trophic niches of most freshwater megafauna remain unclear, and there is a particular need to increase knowledge of freshwater megafauna from Southeast Asia. The aim of this thesis was to determine the trophic niche of the genus *Pangasianodon*, the striped catfish (*Pangasianodon hypophthalmus*) and the Mekong giant catfish (*Pangasianodon gigas*), after release into a Thai reservoir.

Chapter 2 Feeding habits of *Pangasianodon gigas* and *Pangasianodon hypophthalmus* estimated by gut morphology

In this chapter, I conducted visual observations of stomach content of *P. hypophthalmus* and *P. gigas* and estimated the feeding habits of both species using gut morphometry. In visual observations, stomach content of *P. hypophthalmus* and *P. gigas* was almost digested, while fibrous material was found in a few *P. hypophthalmus*. In addition, both species did not have hard tissues, such as fish bone and otolith. In gut morphometry, I found that mean value of the relative gut length to total length (TL) were 3.8 and 3.5 in *P. hypophthalmus* and *P. gigas*, respectively. These were comparable to the values of herbivorous and/or detritivorous fish. In the Mekong River, *P. hypophthalmus* and *P. gigas* are thought to be omnivore with an herbivory and algivore, which likely consistent with my findings of feedings habits in the two species.

Chapter 3 Trophic niche of *Pangasianodon hypophthalmus* indicated by stable isotopes and fatty acids

I investigated trophic niche of *P. hypophthalmus* using stable carbon, nitrogen, and sulfur isotope ratios (δ^{13}C, δ^{15}N, and δ^{34}S) and fatty acids (FAs). Here, I analyzed *P. hypophthalmus* at the juvenile (36–50 cm in TL) and adult (80–106 cm in TL) stages. My results of stable isotopes and FAs indicated ontogenetic dietary shifts of *P. hypophthalmus*. Juveniles relied on anaerobic decomposition- as well as primary photosynthetic production-based food chains and is likely to ingest detritus. Meanwhile, it is likely that adults were a primary to secondary consumer in primary photosynthetic production-based food chain, feeding mainly on algae and partly on zooplankton. Considering the distinct trophic niche of juveniles, relying on anaerobic decomposition-based food chains, juveniles have little impacts on sympatric fish species through resource competitions but can alter energy flows in receiving ecosystems. Furthermore, there were trophic niche overlap between adults and herbivorous fish. As several commercially important and conservation species with herbivory are often released into waterbodies in Thailand, release projects should be conducted with the consideration that adult *P. hypophthalmus* can have resource competition effects on other herbivorous fish.

Chapter 4 Trophic niche of *Pangasianodon gigas* indicated by stable isotopes and fatty acids

I investigated the trophic niche of *P. gigas* using δ^{13}C, δ^{15}N and FA analyses. I analyzed *P. gigas* at the juvenile (34-41 cm TL) and subadult (148-230 cm TL) stages. I found that δ^{13}C and δ^{15}N values differed between juvenile and subadult *P. gigas*, indicating ontogenetic dietary shifts. Based on my δ^{15}N results, the trophic position of subadults was probably intermediate between herbivorous and carnivorous fish. The results of FA composition showed that zooplankton may be one of the food sources of subadults. Furthermore, isotopic niche and FA composition analyses suggested that subadults did not share a trophic niche with other sympatric fish species. Overall, subadults may have little impact on sympatric fish species through resource competition. However, considering the inconsistency between the results in this chapter and feeding habits inferred from morphological traits, *P. gigas* may change its diet depending on habitat. This highlights the need to further investigate the trophic niche of *P. gigas* in reservoirs.

Chapter 5 Niche partitioning in *Pangasianodon gigas* and *Pangasianodon hypophthalmus*

To investigate trophic niche partitioning and niche expansion trends in *P. hypophthalmus* and *P. gigas*, I performed stable isotope analysis of multiple tissues. Here, I analyzed δ^{13}C and δ^{15}N values in adult *P. hypophthalmus* and subadult *P. gigas*. There was no overlap in isotopic niche between adult *P. hypophthalmus* and subadult *P. gigas*, suggesting trophic niche partitioning in the two species. The results of δ^{15}N values indicate that trophic position was higher in subadult *P. gigas* than in adult *P. hypophthalmus*. Furthermore, I found that the trend of niche expansion was different between subadult *P. gigas* and adult *P. hypophthalmus*. Adult *P. hypophthalmus* exhibited niche expansion trends, suggesting that there was large intraspecific variation and niche partitioning among individuals. Meanwhile, subadult *P. gigas* showed niche reduction trends, suggesting that there was small intraspecific variation and that individuals shared food resources with a few categories.

Chapter 6 General Discussion

In this thesis, I investigated the feeding habits of *P. hypophthalmus* and *P. gigas* in a reservoir using morphometry and combined approaches of stable isotopes and fatty acids. I found inconsistencies in the estimates between the approaches, which were particularly evident for *P. gigas*. Given that morphological traits reflect feeding modes adapted to food resources in a habitat, *P. gigas* inhabiting the Mekong River may ingest algae. However, my results from stable isotope and FA analyses suggest that *P. gigas* shift to diet with animal materials rather than specializing in algae after being released into a reservoir. Furthermore, I show ontogenetic dietary shifts in both *P. hypophthalmus* and *P. gigas*. This highlights that the potential ecological functions and impacts of released *P. hypophthalmus* and *P. gigas* should be considered separately in juveniles and adults. Overall, I applied fatty acid and stable isotope analysis of multiple tissues, as well as carbon and nitrogen stable isotope ratio analysis, which are widely used in ecological studies. This extended the parameters that can be investigated in studies of food webs in freshwater ecosystems and the ecology of freshwater megafauna. Consequently, I proposed a dietary group of freshwater megafish that use low trophic level food resources such as detritus and plankton.