BIODIVERSITAS
Volume 25, Number 6, June 2024
Pages: 2738-2746

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d250644

Fish diversity in the Nong Leng Sai Wetland, Phayao Province, Northern Thailand, after deep-water dredging

SIRILUCK TUNCHAROEN[1,♥], KANOKPHON MANETAM[1], SITIPORN PORNPUANG[1], WARARITH CHAISAN[2], DUTRUDI PANPROMMIN[1], KANYANAT SOONTHORNPRASIT[1], SANTIWAT PITAKPOL[1,3]

[1]Division of Technology and Innovation for Fisheries, School of Agriculture and Natural Resources, University of Phayao. 19 Moo 2 Tambon Maeka Amphur, Muang 5600, Phayao, Thailand. Tel.: +66-544-66666, ♥email: siriluck.va@up.ac.th
[2]Department of National Parks Wildlife and Plant Conservation. Chatuchak, Bangkok 10900, Thailand
[3]Innovation and Technology Transfer Institute, University of Phayao. 19 Moo 2 Tambon Maeka Amphur, Muang 5600, Phayao

Manuscript received: 14 March 2024. Revision accepted: 27 June 2024.

Abstract. *Tuncharoen S, Manetam K, Pornpuang S, Chaisan W, Panprommin D, Soonthornprasit K, Pitakpol S. 2024. Fish diversity in the Nong Leng Sai Wetland, Phayao Province, Northern Thailand, after deep-water dredging. Biodiversitas 25: 2738-2746.* This study aimed to explore changes in the diversity of fish species in the Nong Leng Sai Wetland, Mae Chai District, Phayao Province, Northern Thailand, after just completed deep-water dredging while shallow-water dredging is in progress. Therefore, three different gill net mesh sizes collected fish specimens from January to July 2022. The results showed that 25 species belong to 23 genera, 13 families from 7 orders, and 21 native and 4 introduced fish species. The fish comprised of the miscellaneous group was the most composed by weight and number, accounting for 45.5% and 52%, respectively, followed by the carp, 38.6% by weight and 45.6% by number. The fish diversity after dredging has decreased, including species and quantity, compared to the diversity reported before. Physical changes in the Nong Leng Sai Wetland resulted from deep water dredging, including increasing water depth, more water storage volume, increased turbidity, and lack of fish shelter and natural food, affecting the diversity of fish species. Furthermore, dredging has stimulated the recovery of aquatic ecosystems regarding water quality, habitat of aquatic animals, and appropriate natural food, which is important for increasing the diversity of fish species and quantities.

Keywords: Fish abundance, fish composition, fish distribution, Nong Leng Sai Wetland

INTRODUCTION

Nong Leng Sai Wetland (hereafter NLSW), Mae Chai District, Phayao Province, Northern Thailand, is an important inland water source in terms of biodiversity of the aquatic ecosystem, water for consumption, irrigation, agriculture, livestock, fisheries, as well as the community lives in the area. The NLSW is the water source that joins tributaries before flowing with Kwan Phayao (the 1st largest freshwater lake in the northern region and the 4th in Thailand) and flowing into the Ing River, which is an important river of Phayao and Chiang Rai provinces in Northern Thailand. The NLSW ecosystem is mostly lentic and shallow; most areas are flooded during the rainy season, and some parts are flooded throughout the year. The NLSW is a migratory route and an important source of natural food, shelter, and refuge for wild animals such as birds, reptiles, amphibians, and fish. It is a habitat for rare plant and animal species that are likely to become endangered. It is also an important source of food, spawning ground, and nursery area for fish. It was reported that 83 wildlife animal species were found (Chanthima et al. 2019). Tuncharoen et al. (2020) reported 39 species of fish, including 36 native and 3 introduced, were found. In comparison, Soonthornprasit et al. (2019) reported 12 families and 21 fish species in this area; it has extremely important ecological value. There is quantitative and qualitative biological diversity on spatial and temporal dimensions, including its importance at the trophic level. Furthermore, a wetland ecosystem is important to human life, plant, and animal society, and the NLSW was originally a common property for public areas. Later, the Nong Leng Sai public areas in Phafaek, Charoenrat, Banlao, and Sritoy sub-districts in Mae Chai District was designated as a prohibited area for hunting wild animals, according to the Ministry of Natural Resources and Environment's announcement of the designation on 22 November 2016 (Chanthima et al. 2019).

The Mae Chai strategic sustainable development plan in 2019 by Mae Chai District has changed the physical characteristics of NLSW, resulting from dredging the deep water level to increase water storage volume, dredging the shallow water level to create the physical conditions of the littoral zone conducive to the aquatic ecosystem, and constructing spillway weirs, folding weirs, and sluice gates according to the urgent development plan from Mae Chai District water management (Chanthima et al. 2019). It directly affected the biodiversity of aquatic ecosystems, changing their habitats, nursery areas, and spawning grounds for aquatic animals. It also affected water quality in physical, chemical, and biological properties, including the abundance of natural food in the Nong Leng Sai. Landscape modification alters the condition of ecosystems and the complexity of the terrain, with consequences to aquatic animal assemblages and ecosystem functioning and negative impacts on fish distribution, composition, and abundance (Omoruwou et al. 2023). Dredging has modified processes and assemblages by favoring species with wide trophic niches, diverse habitat requirements, and tolerances to dredge-related eutrophication and sedimentation (Borland et al. 2022). Dredging can increase suspended sediment concentration, threatening fish eggs and larvae survivabilities that will reduce their quantity (Yang et al. 2019). Suspended sediment affects fish physiology and behavior (Kjelland et al. 2015). Conversely, the dredging and managing macrophytes in the reservoir benefited the fish fauna diversity through improved water quality and space expansion (Esguícero and Arcifa 2017). Dredging affects not only the aquatic ecosystem but also the livelihoods of local fishermen. Small-scale dredging activities in freshwater bodies have the potential to impact habitats and food resources that fishes depend on and ultimately impact fisheries productivity (Ward-Campbell and Valere 2018). Therefore, the study surveyed the diversity of fish after deep-water dredging was completed, and shallow-water dredging is in progress to evaluate the fish diversity change in disturbed ecosystems on species, quantities, and composition. The study will provide basic information for monitoring fish diversity changes by their time and place. This basic information is relevant to agencies to plan appropriate management and fish resource utilization.

MATERIALS AND METHODS

Study areas

The study determined six survey stations in the deep-water dredging area according to the development plan of Mae Chai District, Phayao, Thailand. Those study sites are in the Nong Leng Sai Non-Hunting Area, consisting of Station I Ban Sankhwang, Station II Ban Sansali, Station III Ban Phafaek, Station IV Ban Sankamphaeng, Station V Ban Donginta, and Station VI Ban Lao kao (Figure 1).

Fieldwork

The research team surveyed fish specimens in January, February, March, April, June, and July of 2022, a total of 6 times. Fish specimens were collected using gill nets of different mash sizes, consisting of 30, 50, and 70 millimeters, and laying the nets for at least 6 hours. Therefore, 295 fish specimens were preserved in ice to maintain freshness and will be studied at the Fishery Technology and Innovation Laboratory at the University of Phayao.

Laboratory work

Identification

Fish identification using morphological similarities and their characteristic differences, following Nagao Natural Environment Foundation (2019, 2021) and Suvarnaraksha (2023). The taxonomic arrangement follows Nelson et al. (2016). Therefore, 1-3 individual fish of each species were preserved in a 10% formalin solution to be used as reference specimens. The IUCN Red List of Threatened Species IUCN (2023) did additional checks for threatened status.

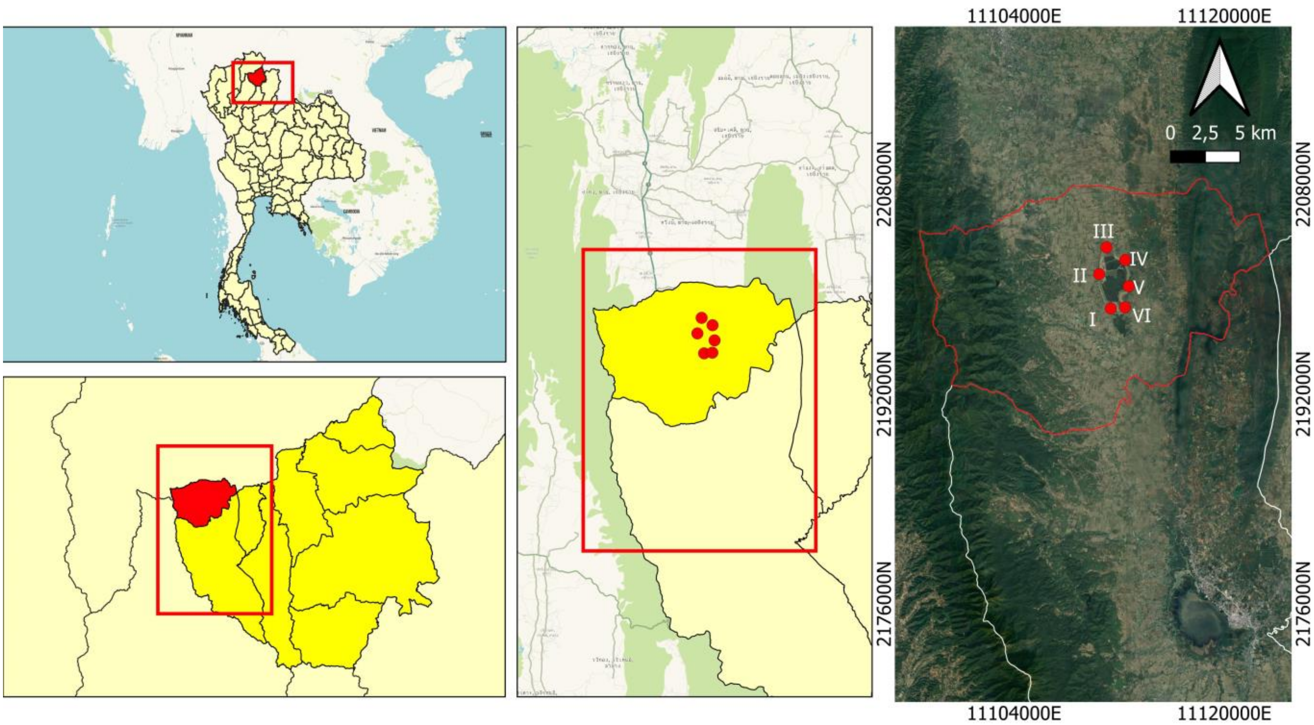

Figure 1. Station to study the diversity of fish species in the NLSW, Thailand, after deep-water dredging. I: Ban Sankhwang; II: Ban Sansali; III: Ban Phafaek; IV: Ban Sankamphaeng, V: Ban Donginta; and VI: Ban Lao kao Mae Chai, Phayao, Thailand

Species composition and quantity parameters

Percentage of Species Composition (E-value) classifies fish into 4 categories: i) Carp, a member of Cyprinidae ii) Catfish, a member of Siluriformes iii) Murrel, a member of Channidae; and iv) Miscellaneous, in addition to the 3 groups mentioned above, can be calculated from:

$$\text{E-value}_{(volume)} = \frac{\text{No. of individual fish in each category}}{\text{No. of all individual fish from the survey}} \times 100$$

$$\text{E-value}_{(weight)} = \frac{\text{Total weight of fish in each category}}{\text{Total weight of all fish from the survey}} \times 100$$

Percentages Relative Abundance (%RA) can be calculated from:

$$\%RA = \frac{\text{No. of individual fish in each species}}{\text{No. of all individual fish from the survey}} \text{ x } 100$$

Percentages Frequency of Occurrence (%OF) can be calculated from:

$$\%OF_{(period)} = \frac{\text{No. of times each species was found}}{\text{Total no. of times to survey}} \text{ x } 100$$

$$\%OF_{(station)} = \frac{\text{No. of stations where each species was found}}{\text{No. of total stations}} \text{ x } 100$$

RESULTS AND DISCUSSION

Fish species diversity

Upon fish species diversity in the NLSW, Mae Chai District, Phayao Province, Thailand, after deep-water dredging, 295 individual fish were observed, comprising 25 species belonging to 23 genera, 13 families, and 7 orders. Most fish are in Cyprinidae (10 species), followed by fish in Notopteridae, Osphronemidae, and Channidae (2 species). Regarding fish threatened status, the fish found in the survey are in two levels of IUCN Red List status: 24 species in Least Concerned (LC) and one species in Data Deficient (DD) (Table 1). The fish species diversity in the NLSW after deep water dredging just completed is different from the study of fish diversity in the NLSW before dredging, which was conducted between February 2015 to January 2016 by Tuncharoen et al. (2020) reported that 18 families of 35 genera, and 39 species of fish were found. Another January-August 2019 study by Soonthornprasit et al. (2019) reported that 12 families and 21 species were found.

The members of Cyprinidae are very diverse in terms of species, similar to Tuncharoen et al. (2020). This is because fish in this family are diverse in species and number in common freshwater (Nelson et al. (2016). However, despite the consistency in the diversity of fish species in the family Cyprinidae as well, from this survey, some members in this family were not found, as reported by Tuncharoen et al. (2020), including carplet (*Amblypharyngodon chulabhornae* Vidthayanon and Kottelat 1990), mrigal carp (*Cirrhinus cirrhosus* Bloch 1795), flying barb (*Esomus metallicus* Ahl 1923), hampala barb (*Hampala macrolepidota* Kuhl and Van Hasselt 1823), *Mystacoleucus marginatus* Kuhl and Van Hasselt 1823, *Pethia stoliczkana* Day 1871, side-striped rasbora (*Rasbora paviana* Tirant 1885) and *Thynnichthys thynnoides* Bleeker 1852. This study did not find fish in the Clariidae (air-breathing catfish), Hemiramphidae (half-beak), Synbranchidae (swamp eel), Mastacembelidae (spiny eel), and Gobiidae (goby). This is due to the differences in the study period and fish survey method. Although Soonthornprasit et al. (2019) and Tuncharoen et al. (2020) revealed similar fish survey results before dredging, they used different survey methods. Tuncharoen et al. (2020) study was in an area with various fishing gear, including gill nets, cast nets, lift nets, and fishing gear, were used by local fishermen. In comparison, Soonthornprasit et al. (2019) only used gill nets. In addition, the physical changes of the Nong Leng Sai from the recently completed deep-water dredging, changes in the depths and more water storage volume, and increased turbidity, the negative impacts were lack of fish shelter and natural food affecting the fish species diversity.

Moreover, checking the threatened status of fish found through studies according to IUCN (2023) compared with the Office of Natural Resources and Environmental Policy and Planning (2017), the database of threatened fish species in Thailand, it was found that red cheek barb *(Systomus rubripinis* Valenciennes 1842), native fish was at DD level both databases. Also, an introduced, vermiculated sailfin catfish (*Pterygoplichthys disjunctivus* Weber 1991) is classified as DD, which differs from IUCN (2023). These species must be explored further on their population biology and dynamics, human exploitation effect and other threats to clearly identify their threatened status.

Fish distribution

The study revealed that the diversity of species is similar at every station. Station I had the highest number of species, ten species, accounting for 40% of the total. This was followed by stations II, III, and IV, which found nine fish species, accounting for 36%, and stations V and VI, which found 8 fish species, accounting for 32%.

Distribution of the number of individual fish found that in stations IV and VI, the most were found throughout the study period, which was 53, accounting for 18% total number of fish, followed by station V, where 51 fish were found, accounting for 17.3%. Station II found the least amount of fish, 42 fish, accounting for 14.2 %. As for the distribution of fish weights that were surveyed, it was found that the total fish weight was 9,768.7 grams. The highest prevalence was found at station III, weighing 2,210.5 grams, or 22.6%, where giant snakehead and striped snakehead were found; these fish were larger and heavier than other fish. This is why the total fish weight in these study areas is higher than in other stations, followed by stations VI and V, where the spread by weight was 17.8% (1,737.8 g.) and 16.9% (1,655.1 g.), respectively. The lowest distribution by fish weight was found in station II; fish weighing 1,218.8 grams were found, accounting for 12.5 % (Figure 2).

Table 1. Checklist of fish in the NLSW, Thailand, after deep-water dredging, 2022, and compare the overall fish diversity before and after deep-water dredging

Order	Family / scientific name	English common name	IUCN Red List status	Origin	Soonthornprasit et al. (2019)	Tuncharoen et al. (2020)	This study
Ostoeglossiformes	Notopteridae				1	1	2
	Chitala ornata Gray 1831	Clown featherback	LC	NA		+	+
	Notopterus notopterus Pallas 1769	Bronze featherback	LC	NA	+		+
Cypriniformes	Cyprinidae				10	16	10
	Amblypharyngodon chulabhornae Vidthayanon and Kottelat 1990	-	LC	NA		+	
	Anematichthys repasson Bleeker 1853	-	LC	NA	+		
	Barbonymus gonionotus Bleeker 1849	Silver Barb, Java Barb	LC	NA	+	+	+
	Cirrhinus cirrhosus Bloch 1795	Mrigal Carp	VU	IN		+	
	Cyclocheilichthys apogon Valenciennes 1842	Beardless Barb	LC	NA	+		
	Cyclocheilichthys armatus Valenciennes 1842	Soldier River Barb	LC	NA		+	+
	Esomus metallicus Ahl 1923	-	LC	NA		+	
	Hampala macrolepidota Kuhl and Van Hasselt 1823	Transverse bar Barb	LC	NA	+	+	
	Henicorhynchus siamensis Sauvage 1881	Siamese Mud Carp	LC	NA	+	+	+
	Labeo rohita Hamilton 1822	Rohu	LC	IN			+
	Labiobarbus leptocheilus Valenciennes 1842	-	LC	NA	+		
	Labiobarbus siamensis Sauvage 1881	Siam Longfin Barb	LC	NA		+	+
	Lobocheilos rhabdoura Fowler 1934	Double Lip Barb	LC	NA			+
	Mystacoleucus marginatus Valenciennes 1842	-	LC	NA	+	+	
	Parachela siamensis Günther 1868	Glassfish	LC	NA		+	+
	Pethia stoliczkana Day 1871	-	LC	NA		+	
	Puntioplites proctozysron Bleeker 1865	Smith's Barb	LC	NA		+	+
	Puntius brevis Bleeker 1849	Golden Little Barb	LC	NA	+	+	+
	Rasbora paviana Tirantl 1885	Sidestripe Rasbora	LC	NA		+	
	Rasbora tornieri Ahl 1922	Yellowtail Rasbora	LC	NA	+		
	Systomus rubripinis Valenciennes 1842	Red Cheek Barb	DD	NA	+	+	+
	Thynnichthys thynnoides Bleeker 1852		LC	NA		+	
Siluriformes	Loricariidae				1	1	1
	Hypostomus plecostomus Linnaeus 1758	Suckermouth catfish	LC	IN	+	+	
	Pterygoplichthys disjunctivus Weber 1991	Vermiculated sailfin catfish	LC	IN			+
	Siluridae				1	2	1
	Kryptopterus cheveyi Durand, 1940	-	DD	NA	+		
	Kryptopterus geminus Ng 2003	-	LC	NA			+
	Ompok siluroides Lacepède 1803	-	LC	NA		+	
	Wallago attu Bloch and Schneider 1801	Wallago	VU	NA		+	
	Bagridae				1	1	1
	Hemibagrus filamentus Fang and Chaux 1949	-	DD	NA	+	+	
	Hemibagrus spilopterus Ng and Rainboth 1999	Yellow Bagrid	LC	NA			+

	Clariidae				1	2	0
	Clarias batrachus Linnaeus 1846	Philippine catfish	LC	NA	+	+	
	Clarias macrocephalus Günther 1864	Bighead catfish	DD	NA		+	
Gobiiformes	Gobiidae				0	1	0
	Gobiopterus lacrustris Herre 1927	Lacustrine goby	DD	NA		+	
	Eleotridae				1	1	1
	Oxyeleotris marmorata Bleeker 1852	Marble Goby	LC	NA	+	+	+
	Ambassidae				1	1	1
	Parambassis siamensis Fowler 1937	Glassfish	LC	NA	+	+	+
Cichliformes	Cichlidae				0	1	1
	Oreochromis niloticus Linnaeus 1758	Nile Tilapia	LC	IN		+	+
Beloniformes	Belonidae				0	1	1
	Xenentodon cancila Hamilton 1822	Freshwater Garfish	LC	NA		+	+
	Hemiramphidae				0	1	0
	Dermogenys pusilla Kuhl van Hasselt 1823	Wrestling halfbeak	DD	NA		+	
Synbranchiformes	Synbranchidae				0	1	0
	Monopterus albus Zuiew 1793	Swamp eel	LC	NA		+	
	Mastacembelidae				0	1	0
	Macrognathus siamensis Günther 1861	Spotted spiny eel	LC	NA		+	
Anabantiformes	Anabantidae				1	1	1
	Anabas testudineus Bloch 1792	Climbing Perch	LC	NA	+	+	+
	Osphronemidae				1	4	2
	Trichopsis vittata Cuvier 1831	Croaking gourami	LC	NA		+	
	Trichopodus microlepis Günther 1861	Moonlight gourami	LC	NA		+	
	Trichopodus pectoralis Regan 1910	Snake Skin Gourami	LC	NA		+	+
	Trichopodus trichopterus Pallas 1770	Three Spotted Gourami	LC	NA	+	+	+
	Channidae				1	2	2
	Channa micropeltes Cuvier 1831	Giant Snakehead	LC	IN		+	+
	Channa striata Bloch 1793	Striped Snakehead	LC	NA	+	+	+
	Pristolepididae				1	1	1
	Pristolepis fasciata Bleeker 1851	Leaffish	LC	NA	+	+	+
Total families (species)	18 (50)				12 (21)	18 (39)	13 (25)

Note: LC=Least Concerned; VU=Vulnerable; DD=Data Deficient; NA=Native; IN=Introduced

Species composition and quantity parameters

Percentage of species composition (E-value)

Percentage of fish species composition based on number and weight. A total of 295 individual fish were found, with a total weight of 9,768.7 grams. Differently, Tuncharoen et al. (2020), surveying fish diversity before the dredging of Nong Leng Sai, reported the findings of 3,645 fish with a total weight of 22,150.38 grams. Although the number of fish indicates that the quantity of fish has greatly decreased, when considering the size of the fish, it is found from this study that the fish had a higher average body weight (average weight 33.1 grams per fish vs. 6.1 grams per fish).

Fish in the Miscellaneous group were found in the largest number and weight, 156 individual fish, accounting for 52%, and a total weight of 4,459.12 grams, accounting for 45.5%, respectively. Followed by fish in the Carp group, 132 were found, accounting for 45.6%, and a total weight of 3,752 grams, accounting for 38.5% (Table 2).

The fish composition from this survey was miscellaneous, the highest in number and weight, followed by carp, with a similar percentage of fish composition to Tuncharoen et al. (2020). The carp are most sensitive to changes in the aquatic environment. The existence of this group of fish at an appropriate level is beneficial in terms of fish composition. Most catfish feed on the bottom of the water. The diversity of this group reflects the abundance of natural food at the bottom, including the toxicity and excessive accumulation of organic substances at the bottom of water sources. The murrel group is a fish with a feeding habit as a carnivore; most of these fish in the sub-adult to adult phase consume fish as their main food (piscivorous). According to the ecological pyramid, aquatic ecosystems should have low quantities of piscivorous because they are the top consumer. The miscellaneous group should have many species and quantities in the aquatic ecosystem. Analysis of fish species composition can be applied as an indicator of aquatic ecosystem quality (Petriki et al. 2017; Souza and Vianna 2020). This survey found the lowest percentage composition of the catfish group by number and weight. This may be because fish in this group are the most benthic fauna, and the water bottom changes are directly affected by dredging. Dredging disturbs the aquatic ecosystem and water bottom sediments; the benthic aquatic animals and demersal fish are clearly affected. Therefore, in the first phase, when the dredging was just completed, fewer fish were observed in this group.

The relationship between weight and quantity of fish composition is shown in Figure 3. Carp and miscellaneous have a similar relationship in terms of number and weight. It was found that the fish had an average body weight of 28.4 grams and 28.6 grams, respectively. The number of fish in the murrel group was smaller but bigger in weight; its average body weight was 5.342 grams, the highest compared to the other three fish groups. This group includes members of the snakehead (Channidae), which are freshwater predatory fish whose adults have larger bodies; the giant snakehead is among the largest species in the family Channidae, capable of growing to 1.3 meters length and weight of 20 kilograms (Froese and Pauly 2024), resulting in a high percentage of composition by weight. Catfish have the fewest components, both by number and by weight. However, its average body weight is 62.5 grams, second only to the murrel.

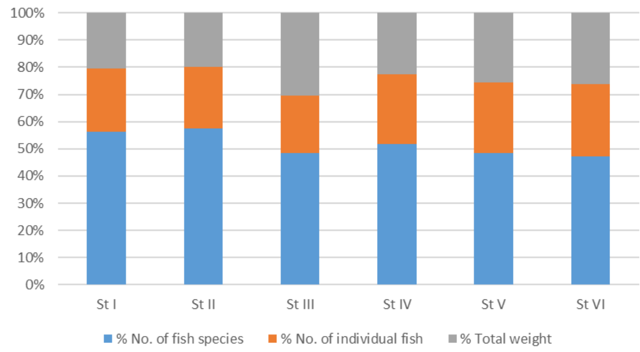

Figure 2. Spatial distribution of fish in study areas

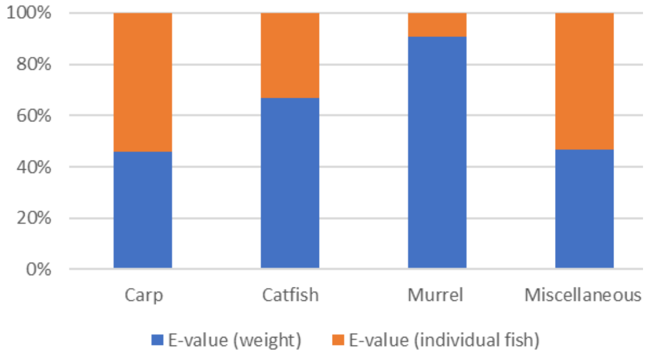

Figure 3. The relationship between weight and quantity of fish composition in the NLSW, Thailand, after deep-water dredging, 2022

Table 2. Percentage of fish composition in the NLSW, Thailand, after deep-water dredging, 2022

Fish categories	Total individual fish	E-value (individual fish)	Total weight (g)	E-value (weight)
Carp	132	45.6	3,752.0	38.5
Catfish	3	1	187.6	2
Murrel	4	1.4	1,370.0	14
Miscellaneous	156	52	4,459.1	45.5
Total	295	100	9,768.7	100

This study shows 2 species of invasive alien species were found: armored catfish (*P. disjunctivus*) and giant snakehead (*C. micropeltes*). Several studies (Thaiso et al. 2019; Lai et al. 2020; Tuncharoen et al. 2020; Parvez et al. 2023) show these two fish were reported to impact the biodiversity of native species in aquatic ecosystems negatively. Armored catfish are highly resistant to environmental changes and have a variety of dietary adaptations, affecting competition for food and habitat among native fish species. The giant snakehead is a top consumer and a strong largest predator. In addition to having an accessory breathing organ, it is highly resistant to water quality changes. Therefore, this fish group (murrel) can be found in water bodies where the ecosystem has been disturbed. The distribution of these two species should be monitored according to changes in time and area.

Percentages Relative Abundance (%RA)

This study revealed 295 individual fish; the relative abundance percentage was calculated based on the number of fish. Glassfish (*Parambassis siamensis*) was found the most, with a total of 98 individual fish, accounting for 33.2%, followed by soldier river barb (*C. armatus*), found a total of 52 individual fish, accounting for 17.6%, and siam longfin barb (*L. siamensis*) found 29 individual fish, accounting for 9.8%, respectively. Furthermore, 8 fish species were found 1 individual only fish throughout the study period (Table 3).

Percentages Frequency of Occurrence (%OF)

In terms of frequency of occurrence considering the survey period, a total 6 times, it was found that the glassfish (*Parambassis siamensis*) and the soldier river barb (*C. armatus*) were equipped with fishing gear at every survey period (100% OF); the fish with 66.7% OF are the siam longfin barb (*L. siamensis*) and the leaffish (*P. fasciata*). The red cheek barb (*S. rubripinis*), siamese mud carp (*H. siamensis*), and silver barb (*B. gonionotus*) have percentages frequency of occurrence equal to 50%.

Considering the percentage of frequencies found at all 6 survey stations, it was found that the glassfish (*P. siamensis*) and the soldier river barb (*C. armatus*) are distributed at all stations, calculated as 100%, followed by the siam longfin barb (*L. siamensis*) and the leaffish (*P. fasciata*), which are distributed at 4 stations, accounting for 66.7%. As for fish that were found in only 1 station, there were 12 species (Table 3).

Percentage abundance based on the number of individuals, glassfish was found the most, followed by soldier rive barb, consistent with studies by Soonthornprasit et al. (2019) and Tuncharoen et al. (2020). Glassfish is a by-catch fish, not economically important, but caught in many fishing nets. Due to its oval shape body and numerous spines on the dorsal and anal fins, it is easy to get caught by a gill net. Valunpion et al. (2017) reported on the feeding habits of *P. siamensis* in the Nong Leng Sai Wetland that the main food was freshwater prawns, and up to 5 individual freshwater prawns can be found in their full stomachs. Fish of the genus *Parambasis* are carnivorous, and there are groups of insects, crustaceans, zooplankton, and fish larvae in their digestive system (Gupta 2016; Ibungo et al. 2023). Therefore, the distribution of glassfish should be monitored, including management of its utilization if this fish returns to abundant to reduce the future impact on the freshwater prawn population.

Table 3. Percentages relative abundance (%RA) and Percentages frequency of occurrence (%OF)

Scientific name	Relative abundance		Frequency of occurrence			
	No. of fish	%RA	Freq. (period)	%OF	Freq. (site)	%OF
Chitala ornata	1	0.3	1	16.7	1	16.7
Notopterus notopterus	1	0.3	1	16.7	1	16.7
Barbonymus gonionotus	4	1.3	3	50	3	50
Cyclocheilichthys armatus	52	17.6	6	100	6	100
Henicorhynchus siamensis	16	5.4	3	50	3	50
Labeo rohita	1	0.3	1	16.7	1	16.7
Labiobarbus siamensis	29	9.8	4	66.7	4	66.7
Lobocheilos rhabdoura	1	0.3	1	16.7	1	16.7
Parachela siamensis	1	0.3	1	16.7	1	16.7
Puntioplites proctozysron	4	1.3	1	16.7	1	16.7
Puntius brevis	3	1	1	16.7	1	16.7
Systomus rubripinis	21	7.1	3	50	3	50
Pterygoplichthys disjunctivus	1	0.3	1	16.7	1	16.7
Kryptopterus geminus	3	1	1	16.7	1	16.7
Hemibagrus spiloptera	2	0.6	2	33.33	2	33.33
Oxyeleotris marmorata	1	0.3	1	16.7	1	16.7
Parambassis siamensis	98	33.2	6	100	6	100
Oreochromis niloticus	4	1.3	2	33.33	2	33.33
Xenentodon cancila	1	0.3	1	16.7	1	16.7
Anabas testudineus	6	2	2	33.33	2	33.33
Trichopodus pectoralis	2	0.6	2	33.33	2	33.33
Trichopodus trichopterus	21	7.1	2	33.33	2	33.33
Channa micropeltes	2	0.6	1	16.7	1	16.7
Channa striata	2	0.6	2	33.33	2	33.33
Pristolepis fasciata	18	6.1	4	66.7	4	66.7
Total	295	100	6		6	

Although dredging water sources increases the amount of water stored to solve drought and water shortage problems, especially in areas with repeated droughts, to have sufficient water for use in irrigation, consumption, water for agriculture, and livestock, as well as maintaining water levels to maintain the balance of the aquatic ecosystem. However, even though dredging has long-term benefits, it will directly impact immediately, changing the landscape of the water body, increasing its depth, and destroying soil in the riverbank and bottom. It directly affects both benthic animals and aquatic plants, which are fish the natural food, and destroys habitats, nursery areas, and spawning grounds for aquatic animals. Soil erosion on both the shoreline and bottom causes the dispersion of large quantities of sediment particles. Turbidity in water sources is much higher than normal, disrupting the breathing of fish and other aquatic animals, including reducing the amount of light reaching the water column. The environment during this time conflicts with the normal well-being of aquatic animals. The NLSW is a lentic water source connected to the Ing River, so it is possible for fish to migrate away to the Ing River. This does not have a clear pattern but is an evacuation to escape danger. However, over a long enough period, the aquatic ecosystem will recover to its natural balance, during which aquatic life will adapt to survive and become abundant again. At that time, the diversity of fish species and quantities will likely be greater than what has been reported before the dredging which will require continued monitoring of fish diversity in NLSW.

This survey was conducted after recently completed deep-water and shallow-water dredging is in progress. The objective is to observe the diversity change in fish species and quantities if the ecosystem is disturbed. Compare this with research that has been reported before the NLSW dredging. The study shows that fish diversity has decreased in terms of species and quantity; the percentage of fish in the murrel group is quite high, and the most abundant fish are miscellaneous fish with no economic value. Therefore, the recovery of aquatic ecosystems, water quality, shelter, fish habitats, and natural food for aquatic animals, including the balance of fish species and quantities and trophic composition, should be stimulated promptly to increase the diversity of fish, leading to restoration of fish resources use according to the fishery community lifestyle in the Nong Leng Sai Wetland as before.

ACKNOWLEDGMENTS

This research was supported by the Thailand Science Research and Innovation Fund and the University of Phayao, Thailand 208/2567 (Unit of Excellence 2024 on the Integrative Diversity Assessment of Aquatic Animals from Thailand). The researcher would like to thank the Nong Leng Sai Non-Hunting Area, Department of National Parks Wildlife and Plant Conservation, for supporting fish surveying in the field. Thank Mr. Phitsanunath Khantee (University of Phayao) for his assistance in collecting fish specimens. This research was conducted under Ethics for the Use of Animals for Scientific Work, Code 04 01 56 001, by the Animal Use Ethics Committee, the University of Phayao, Thailand.

REFERENCES

Borland HP, Gilby BL, Henderson CJ, Connolly RM, Gorissen B, Ortodossi NL, Rummel AJ, Pittman SJ, Sheaves M, Olds AD. 2022. Dredging transforms the seafloor and enhances functional diversity in urban seascapes. Sci Tot Environ 831: 154811. DOI: 10.1016/j.scitotenv.2022.154811.

Chanthima P, Phayuyong S, Sakulna K. 2019. Mae Chai Strategic Sustainable Plan. Mae Chai District Office, Phayao.

Esguícero ALH, Arcifa MS. 2017. Effects of dredging and macrophyte management on the fish species composition in an old Neotropical reservoir. Acta Limnol Brasiliensia 29 (00): e4. DOI: 10.1590/S2179-975X3415.

Froese R, Pauly D. 2024. Fish Base. World Wide Web electronic Publication. www.fishbase.org

Gupta S. 2016. An overview on Indian Glassy Fish, *Parambassis ranga* (Hamilton, 1822). Biosci Discover 7 (1) :63-66.

Ibungo N, Motilan Y, Bhattachary A, Sarkar P, Lokeshwor Y. 2023. Feeding habits and reproductive biology of newly discovered endemic Glassfish, *Parambassis waikhomi* Geetakumari & Basudha, 2012 of Manipur. Uttar Pradesh J Zool 44 (24): 151-158. DOI: 10.56557/UPJOZ/2023/v44i243822.

IUCN. 2023. The IUCN Red List of Threatened Species. Version 2023-1. www.iucnredlist.org

Kjelland ME, Woodley CM, Swannack T, Smith DL. 2015. A review of the potential effects of suspended sediment on fishes: Potential dredging-related physiological, behavioral and transgenerational implications. Environ Syst Decis 35: 334-350. DOI: 10.1007/s10669-015-9557-2.

Lai QT, Orfinger AB, Tran TT, Nguyen K, LE NK. 2020. Distribution of suckermouth armored catfishes (Siluriformes, Loricariidae) across the salinity gradient of the Mekong Delta, Vietnam. Asian Fish Sci 33: 300-306. DOI: 10.33997/j.afs.2020.33.3.011.

Nagao Natural Environment Foundation. 2019. Field Guide to Fishes of the Cambodian Freshwater Bodies. Nagao Natural Environment Foundation, Tokyo, Japan.

Nagao Natural Environment Foundation. 2021. Fishes of the Indochinese Mekong. Nagao Natural Environment Foundation, Tokyo.

Nelson JS, Grande TC, Wilson MVH. 2016. Fishes of the world. 5thed. John Wiley and Sons Inc., New Jersey. DOI: 10.1002/9781119174844.

Office of Natural Resources and Environmental Policy and Planning. 2017. Thailand Red Data: Vertebrate. Ministry of Natural Resources and Environment, Bangkok.

Omoruwou PE, Meye JA, Nwadiolu R. 2023. The effect of dredging on the fish distribution of Agbura River, an influent of the Nun River. Direct Res J Biol 9 (4): 31-38. DOI: 10.26765/DRJBB11987305.

Parvez MT, Lucas MC, Hossain Md I, Chaki N, Mohsin A, Sun J, Galib SM. 2023. Invasive vermiculated sailfn catfsh (*Pterygoplichthys disjunctivus*) has an impact on highly valued native fish species. Biol Invasions 25: 1795-1809. DOI: 10.1007/s10530-023-03012-8.

Petriki O, Lazaridou M, Bobori DC. 2017. A fish-based index for the assessment of the ecological quality of temperate lakes. Ecol Indic 78: 556-565. DOI: 10.1016/j.ecolind.2017.03.029.

Soonthornprasit K, Wongkunpilat K, Thammawanta H, Sudrakam S, Sansupa I. 2019. Fish communities structure and catch efficiency from Gillnets in the Nong Leng Sai Wetland, Phayao Province. Khon Kaen Agric J 47 (6): 1183-1194. DOI: 10.14456/kaj.2019.108.

Souza GBG, Vianna M. 2017. Fish-based indices for assessing ecological quality and biotic integrity in transitional waters: A systematic review. Ecol Indic 109: 105665. DOI: 10.1016/j.ecolind.2019.105665.

Suvarnaraksha A. 2023. A Field Guide to the Northern Thai Fishes. Faculty of Fisheries Technologi and Aquatic Resources, Maejo University, and Nagao Natural Environment Foundation.

Thaiso K, Yuangsoi B, Wongmaneeprateep S, Wiriyapattanasub P, Tola S, Charoenwattanasak S. 2019. A study on some biological aspect of Giant Snakehead (*Channa micropeltes*) in Huai Suea Ten Wetland Site in Thailand. Asian J Fish Aquatic Res 3 (3): 1-10. DOI: 10.9734/AJFAR/2019/v3133D033.

Tuncharoen S, Uppapong S, Soonthornprasit K. 2020. Diversity of fishes in Nong Leng Sai Wetland, Phayao Province. Khon Kaen Agric J 48 (2): 283-292. DOI: 10.14456/kaj.2020.25.

Valunpion S, Um-amphai J, Takaew P, Uppapong S. 2017. Spawning season and feeding habit of glass fish (*Parambassis siamensis*) in the Nong Leng Sai Wetland, Phayao Province. Khon Kaen Agric J 45 (SUPPL 1): 839- 844.

Ward-Campbell BMS, Valere B. 2018. What are the impacts of small-scale dredging activities on inland fisheries productivity? A systematic review protocol. Environ Evid 7: 9. DOI: 10.1186/s13750-018-0119-1.

Yang ZF, Chen D, Xiao BP. 2019. Impact assessment of dredging on fish eggs and larvae: A case study in Caotan, South China. IOP Conf Ser: Earth Environ Sci 351 (1): 012035. DOI: 10.1088/1755-1315/351/1/012035.