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Change of fish composition in the Nong Leng Sai Wetland, Thailand, after newly completed dredging

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Abstract. *Panprommin D, Sornphui S, Tipdacho P, Chaisan W, Tuncharoen S. 2025. Change of fish composition in the Nong Leng Sai Wetland, Thailand, after newly completed dredging. Biodiversitas 26: 2611-2621.* The objective of this study was to explore changes in fish composition and fish species diversity in the Nong Leng Sai Wetland, Mae Chai District, Phayao Province, Northern Thailand, following the completion of dredging in 2023. Fish specimens were collected both in the areas of the Nong Leng Sai non-hunting area and in the Nong Leng Sai common properties area from February to December 2023. The results revealed the presence of 34 species, 31 genera, and 16 families, all belonging to 7 orders. Thirty-one native and three introduced species were found. A total of 561 individual fish were found with a total weight of 40,403.3 grams. The carp group was found in the highest numbers and with the heaviest weight: 325 individual fish, accounting for 57.9%, and a total weight of 29,462.7 grams, accounting for 72.9%, respectively. Fish were found in the miscellaneous group, where 177 fish were identified, accounting for 31.6% of the total, with a total weight of 5,876.4 grams, which represented 14.5% of the total weight. Smith's barb (*Puntioplites proctozystron*) was the dominant species in terms of numbers. In terms of threatened status, there were 28 species of Least Concern, 4 species of Data Deficient (*Systomus rubripinnis*, *Clarias macrocephalus*, *Gobiopterus lacustris* and *Dermogenys pusilla*), one species in Vulnerable (*Wallago attu*) and one species of Endangered (*Pangasianodon hypophthalmus*). The fish composition and diversity changed from what had previously been reported and were markedly different from those prior to dredging operations. It is necessary to continue monitoring fish diversity and composition after the dredging is complete, to gather information about changes in fish resources over time, leading to informed resource management based on accurate academic data.

Keywords: Completed dredging, fish abundance, fish distribution, Nong Leng Sai Wetland, Northern Thailand, species diversity

INTRODUCTION

The dredging of public freshwater sources is often performed primarily to address the issue of shallow water sources, particularly in areas repeatedly affected by drought, in order to ensure sufficient water storage for efficient management of its use. This usage can include water allocated for domestic use and local communities, water for the national water supply, water for agriculture and livestock, according to the local people's way of life, water storage necessary to balance the aquatic ecosystem, and water required to deliver the benefits of water transportation. However, even though the dredging activity is carefully considered on the basis of the merits and opinions of stakeholders from all sectors before proceeding, environmental impacts on the aquatic ecosystem persist, especially during the process itself. This includes the management of the water resources of the Nong Leng Sai Wetland (hereafter NLSW), a crucial water source in the upper northern region of Thailand. It is a freshwater ecosystem, characterized by mostly standing and shallow water, with most areas flooding during the rainy season and providing shallow floodplains throughout the year. However, some areas become parched during the dry season. This is the reason why dredging operations are necessary to manage the proper use of water resources (Janthima et al. 2019).

Sediment and suspended sediment generated from dredging activities have both direct and indirect effects on aquatic organisms and the aquatic ecosystem. Dredging leads to changes in water quality and alterations in zooplankton communities (Rehman et al. 2016), which in turn affect macrobenthos communities, particularly during periods of disturbance, but return to normal quickly after the disturbance ceases (Dauvin et al. 2022). Dredging also affects the normal life of marine mammals (Todd et al. 2015). The concentration of sediment depends on the speed of the water current and its ability to carry and circulate suspended sediment out of the system (Spearman 2015). Additionally, numerous research articles have reported that dense suspended sediment affects fish behavior and adaptations for survival, including movement and migration patterns. It also impacted the trophic level, affecting the ability of predators to hunt and the ability of prey to hide, resulting in physiological changes and stress that led to the expression of abnormal behavior (Wenger et al. 2017). Negative effects on the reproductive system, including reproductive cell abnormalities, abnormalities in DNA levels, and altered mating patterns, have been reported, along with decreased fertilization rates (Kjelland et al. 2015). These effects can impact the survival of eggs and larvae (Yang et al. 2019). Additionally, fisheries were affected in terms of species and quantity of aquatic animals caught, including their abundance and size, as well as the diversity and distribution patterns of fish (Omoruwou et al. 2023).

The NLSW is located in Phayao Province. It has an area of approximately 960 hectares, with approximately three-quarters of the area designated as a non-hunting zone. NLSW is reported to be a source of natural food and shelter and the nursery ground of local animals and migratory birds. A total of 83 species of natural animals were found. NLSW has important ecological value. Its biodiversity comprises various living organisms, including both plants and animals, in terms of both quantity and quality, varying according to time and season. The value of the way of life in the area is also important. However, the problem of insufficient water storage to allocate for use has led to the dredging of water sources, as outlined in the Mae Chai Strategic Sustainable Development Plan formulated in 2019 by Mae Chai District, Phayao Province (Janthima et al. 2019). Although NLSW dredging has brought long-term benefits in managing water resource use, it has also had negative impacts on aquatic ecosystems and aquatic animal resources, particularly in terms of species diversity and quantity, due to sudden changes in water source physical conditions (Tuncharoen et al. 2024). Therefore, the researcher surveyed the diversity of fish after the dredging in 2023 had just been completed, in order to observe the changes in diversity in terms of fish species and quantities in the event that the ecosystem had been disturbed, as well as to provide basic information for monitoring fish diversity on the basis of spatial and temporal changes. This serves as basic information for relevant agencies to plan the appropriate management of fish resource utilization in the NLSW.

MATERIALS AND METHODS

Study areas

The study area comprised 10 survey stations in NLSW, in Nong Leng Sai non-hunting area: Station I Ban Sankhwang (E 0585582, N 2141958), Station II Ban Sansali (E 0584749, N 2144029), Station III Ban Phafaek (E 0585035, N 2146314), Station IV Ban Sankamphaeng (E 0586784, N 2144901), Station V Ban Donginta (E 0586862, N 2143225), Station VI Ban Lao Kao (E 0586480, N 2141723), Station VII Sra Luang (E 0585207, N 2144394), and in the Nong Leng Sai common properties area including Station VIII Nong Leng Sai Restaurant (E 0586497, N 2141691), Station IX Ban Lao (E 0586668, N 2140745), and Station X Nong Leng Sai Waterworks (E 0586716, N 2140089) (Figure 1).

Field work

Fish specimens were surveyed every two months in February, April, June, August, October, and December of 2023, amounting to a total of six times. Fish specimens were collected using gill nets as the main fishing gear. Each set of nets consisted of four different mesh sizes: 30, 50, 70, and 90 millimeters, and the nets were laid for at least 12 hours. Fish specimens were preserved in ice to maintain their freshness before transportation to be studied in the laboratory.

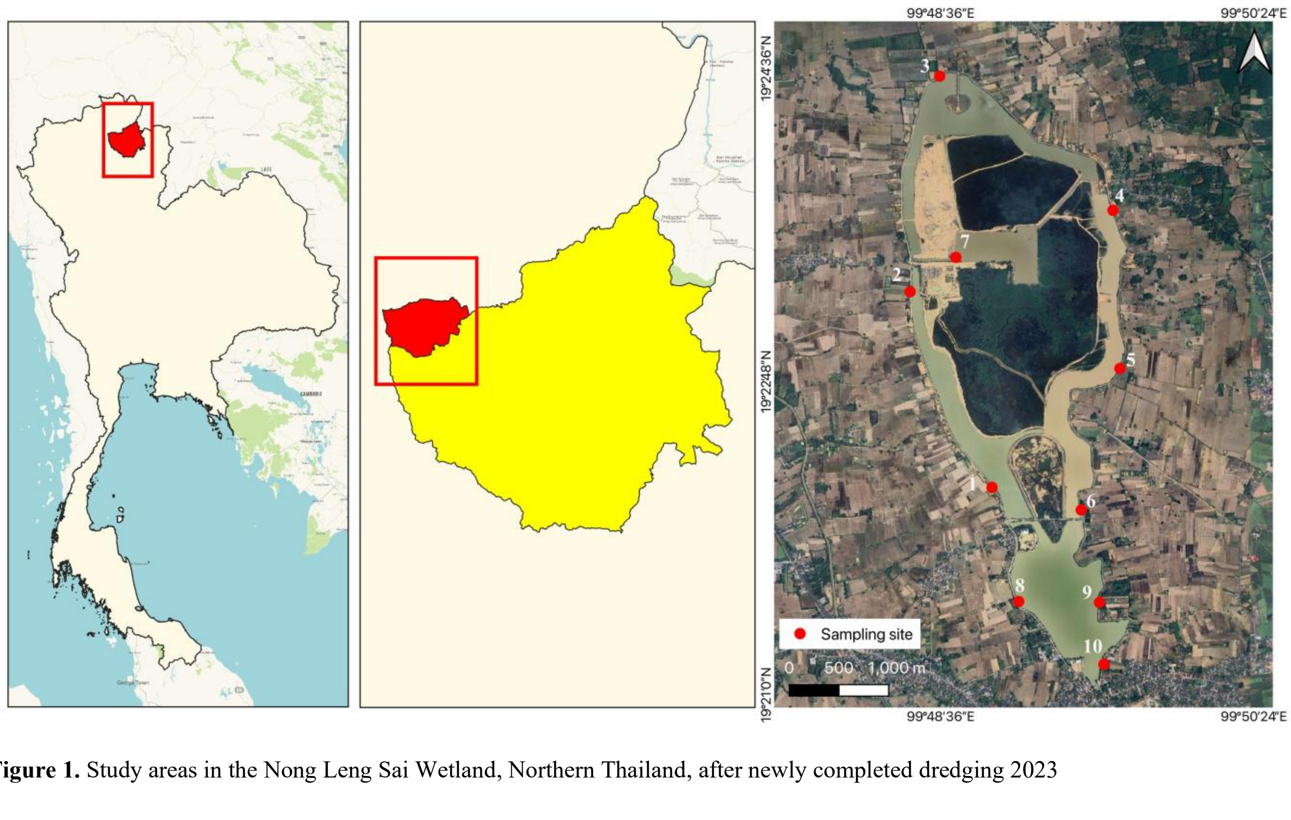

Figure 1. Study areas in the Nong Leng Sai Wetland, Northern Thailand, after newly completed dredging 2023

Laboratory work

Identification

Fish identification utilizes similarities and differences in morphological characteristics, as described by the Nagao Natural Environment Foundation (2019, 2021), Grudpan et al. (2023), and Suvarnaraksha and Utsagi (2023). The taxonomic arrangement follows Nelson et al. (2016). Up to three individual fish of each species were preserved in a 10% formalin preservative solution to serve as reference specimens. The IUCN Red List status was checked using the IUCN (2023) database.

Species composition and quantity parameters followed Tuncharoen et al. (2024)

Percentage of Species Composition (E-value) classifies fish into four categories: (i) Carp, members of Cyprinidae; (ii) Catfish, members of Siluriformes; (iii) Murrel, members of Channidae; and (iv) Miscellaneous, in addition to the three groups mentioned above. The calculations can be performed as:

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

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

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

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

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

Percentage Relative Abundance (%RA), can be calculated from:

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

RESULTS AND DISCUSSION

Fish species diversity

In the evaluation of fish species diversity in NLSW, Mae Chai District, Phayao Province, Northern Thailand, after the completion of dredging, 34 species and 31 genera from 16 families belonging to 7 orders, amounting to a total of 561 individual fish were found. Most fish were in the Cyprinidae family (13 species), followed by fish classed as Osphronemidae (3 species). Regarding fish threatened status, the fish found in the survey exhibited four levels of threatened status: 28 species in the Least Concern (LC), accounting for 82.4%; 4 species in Data Deficient (DD), accounting for 11.8%; 1 species in Vulnerable (VU) accounting for 2.9%, and 1 species in Endangered (EN) accounting for 2.9% (Table 1).

Monitoring species diversity and fish composition in NLSW after dredging was recently completed in 2023; 16 families and 34 species of fish were found. Compared to the fish diversity before dredging reported by Tuncharoen et al. (2020) and the period when deep water dredging was completed, and shallow water dredging operations were carried out, as reported by Tuncharoen et al. (2024), the diversity of carp in the Cyprinidae family was found to be the highest in all periods. This is because fish in this family have a large species composition and quantities and are common species in freshwater, with about 367 genera and about 3,006 species (Nelson et al. 2016). From the comparison, most fish were found in the period before dredging, both in terms of species and numbers (39 species and 3,654 individual fish), resulting from the low volume of water in the wetland. The shallowness of the water source results in a large catch of aquatic animals, while the variety of species and quantity of fish is minimal during the period after deep-water dredging and when dredging is in progress (25 species and 295 individual fish), as reported by Tuncharoen et al. (2024).

Table 1. Checklist of fish in the Nong Leng Sai Wetland, Northern Thailand, in the first year after completion of dredging 2023, and comparison of the overall fish diversity before and after dredging

Ordo/Family/Scientific name	English common name	IUCN Red List status	Status	Before dredging	After deep water dredging	This study Just complete dredging
Ostoeglossiformes						
Notopteridae				1	2	2
Chitala ornata	Clown featherback	LC	NA		+	+
Notopterus notopterus	Bronze featherback	LC	NA	+	+	+
Cypriniformes						
Cyprinidae				16	10	13
Amblypharyngodon chulabhornae	-	LC	NA	+		
Barbonymus gonionotus	Silver barb, Java barb	LC	NA	+	+	+
Barbonymus schwanefeldii	Tinfoil barb	LC	NA			+
Cirrhinus cirrhosus	Mrigal carp	VU	IN	+		
Cyclocheilichthys armatus	Soldier river barb	LC	NA	+	+	+
Esomus metallicus	-	LC	NA	+		+
Hampala macrolepidota	Transverse bar barb	LC	NA	+		+
Henicorhynchus siamensis	Siamese mud carp	LC	NA	+	+	+
Labeo rohita	Rohu	LC	IN		+	+
Labiobarbus siamensis	Siam longfin barb	LC	NA	+	+	+
Lobocheilos rhabdoura	Double lip barb	LC	NA		+	

Leptobarbus hoevenii	Hoven's carp	LC	NA			+
Mystacoleucus marginatus	-	LC	NA	+		
Parachela siamensis	-	LC	NA	+	+	
Pethia stoliczkana	-	LC	NA	+		
Puntioplites proctozystron	Smith's barb	LC	NA	+	+	+
Puntius brevis	Golden little barb	LC	NA	+	+	
Rasbora borapetensis	Blackline rasbora	LC	NA			+
Rasbora paviana	Sidestripe rasbora	LC	NA	+		
Systomus rubripinnis	Red cheek barb	DD	NA	+	+	+
Thynnichthys thynnoides	-	LC	NA	+		+
Siluriformes						
Loricariidae				1	1	1
Hypostomus plecostomus	Suckermouth catfish	LC	IN	+		
Pterygoplichthys disjunctivus	Vermiculated sailfin catfish	LC	IN		+	+
Siluridae				2	1	2
Kryptopterus geminus	-	LC	NA		+	+
Ompok siluroides	-	LC	NA	+		
Wallago attu	Wallago	VU	NA	+		+
Bagridae				1	1	2
Hemibagrus filamentus	-	DD	NA	+		
Hemibagrus spilopterus	Yellow bagrid	LC	NA		+	+
Mystus singaringan	-	LC	NA			+
Pangasiidae						1
Pangasianodon hypophthalmus	Striped pangasid	EN	NA			+
Clariidae				2	0	2
Clarias batrachus	Philippine catfish	LC	NA	+		+
Clarias macrocephalus	Bighead catfish	DD	NA	+		+
Gobiiformes						
Gobiidae				1	0	1
Gobiopterus lacustris	Lacustrine goby	DD	NA	+		+
Eleotridae				1	1	1
Oxyeleotris marmorata	Marble goby	LC	NA	+	+	+
Ambassidae				1	1	1
Parambassis siamensis	Glassfish	LC	NA	+	+	+
Cichliformes						
Cichlidae				1	1	1
Oreochromis niloticus	Nile tilapia	LC	IN	+	+	+
Beloniformes						
Belonidae				1	1	0
Xenentodon cancila	Freshwater garfish	LC	NA	+	+	
Zenarchopteridae				1	0	1
Dermogenys pusilla	Wrestling halfbeak	DD	NA	+		+
Synbranchiformes						
Synbranchidae				1	0	0
Monopterus albus	Swamp eel	LC	NA	+		
Mastacembelidae				1	0	0
Macrognathus siamensis	Spotted spiny eel	LC	NA	+		
Anabantiformes						
Anabantidae				1	1	1
Anabas testudineus	Climbing perch	LC	NA	+	+	+
Osphronemidae				4	2	3
Trichopodus microlepis	Moonlight gourami	LC	NA	+		
Trichopodus pectoralis	Snake Skin gourami	LC	NA	+	+	+
Trichopodus trichopterus	Three spotted gourami	LC	NA	+	+	+
Trichopsis vittata	Croaking gourami	LC	NA	+		+
Channidae				2	2	1
Channa micropeltes	Indonesian snakehead	LC	IN	+	+	
Channa striata	Striped snakehead	LC	NA	+	+	+
Pristolepididae				1	1	1
Pristolepis fasciata	Leaffish	LC	NA	+	+	+
Total families (species)	19 (50)			18 (39)	13 (25)	16 (34)
Total weight (g)				22,150.4	9,768. 7	40,403.3
No. of individual fish				3,654	295	561

Note: LC: Least Concerned; VU: Vulnerable; DD: Data Deficient; EN: Endangered; NA: Native; IN: Introduced. Before dredging (Tuncharoen et al. 2020); After deep water dredging (Tuncharoen et al. 2024)

For this survey, although more fish were found than Tuncharoen et al. (2024) in terms of fish species, 34 species and 561 individuals, when considering the number of fish, it was found that this survey found significantly less fish than before the dredging period as reported by Tuncharoen et al. (2020). When the aquatic environment is disturbed by dredging activities, the dispersion of sediment and suspended solids in the water disturbs the well-being of fish, especially in breathing, and causes physiological changes and stress, affecting the adaptive behavior for the survival of the fish (Kjelland et al. 2015).

This study is a fish survey after dredging was recently completed. Although the number of fish species was found to be nearly the same as the number in the period before dredging, none of the fish in the family Synbranchidae (Swamp eel) and Mastacembelidae (Spiny eel) were found in this survey. The dredging suddenly increased the depth and width of the water source, resulting in a significant and sudden increase in water volume, which simultaneously caused damage to aquatic plants, both of which serve as food sources and hiding places for fish. Both of these families are found only at the bottom of the water source, often in holes in shallow standing water, with hiding places such as aquatic plants, logs, rocks, and other substrates beneath the water's surface. It is, therefore, possible that these fish had migrated to the areas less influenced by the dredging. However, this study also found Striped pangasid in the family Pangasiidae, which had not been previously reported. This fish was bred by the Fisheries Department and released back into the wild. Considering the number of fish, it was found that there were many differences. The overall data of changes in fish numbers in Table 1 shows that the fish found in this study accounted for 15.4% of the fish found before dredging.

The IUCN Red List status was checked, with 28 fish species found in LC status, while there were four species of DD status, including *Systomus rubripinnis*, *Clarias macrocephalus*, *Gobiopterus lacustris* and *Dermogenys pusilla*, all lacking academic data on threats, both from human utilization, fishery biology, and natural threats, in order to be able to accurately and appropriately identify the threat status. This study found one species of VU (*Wallago attu*) and one species of EN (*Pangasianodon hypophthalmus*). This requires appropriate risk management for conservation and use.

Fish distribution

Considering the distribution of fish according to the survey locations, it was found that 561 individual fish with a total weight of 40,403.3 grams had the highest distribution by weight at Station VII, accounting for 29.2%, followed by Station VIII, accounting for 16.3%. As for the distribution by number of individual fish, it was found that Station VII had the highest number of fish throughout the survey, at 18.3%, followed by Station III and Station VIII, accounting for 13.7% and 13.4%, respectively. Distribution by number of fish species revealed Station I had the highest number of fish species (18), accounting for 52.9%, followed by Station VII, where 17 species were found, accounting for 50.0%. Stations II, III, V, VI and VIII had the same number of fish species, at 15 species, accounting for 44.1% (Table 2). From the information shown, it was indicated that the overall distribution of fish diversity, including weight, number of individuals, and number of species, was greatest at Station VII because it is a community conservation area.

In terms of the distribution of fish weight according to the mesh size of the gill net, it was found that most fish came from a 70 millimeters mesh size, at 37.0%, followed by fish caught in a 50 millimeters mesh, at 34.4%. In comparison, the mesh sizes of 30 millimeters and 90 millimeters produced 15.6% and 12.9%, respectively. For fish numbers, it was found that most fish were caught using gill nets with a mesh size of 30 millimeters (40.3%), followed by 50 millimeters, which captured 39.0% of fish, followed by nets with a mesh size of 70 millimeters (19.8%), and the lowest number of fish caught was from a mesh size of 90 millimeters, accounting for 0.9% (Figure 2).

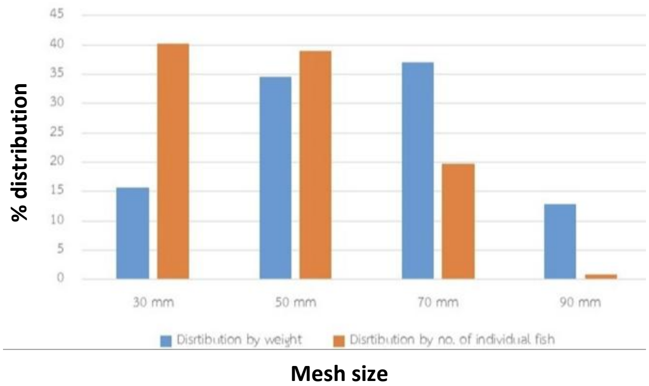

Figure 2. Distribution of fish according to the mesh size of the gill net

Table 2. Spatial distribution of fish

	St.I	St.II	St.III	St.IV	St.V	St.VI	St.VII	St.VIII	St.IX	St.X	Total
Total weight (g)	2,523.9	3,434.7	3,124.2	2,507.5	2,338.9	1,223.3	11,799.2	6,576.9	3,347.2	3,527.5	40,403.3
% by weight	6.3	8.5	7.7	6.2	5.8	3.0	29.2	16.3	8.3	8.7	100
No. of individual fish	33	37	77	62	39	41	103	75	52	42	561
% by no. of fish	5.9	6.6	13.7	11.0	7.0	7.3	18.3	13.4	9.3	7.5	100
No. of fish species	18	15	15	14	15	15	17	15	13	11	34
% by no of species	52.9	44.1	44.1	41.2	44.1	44.1	50.0	44.1	38.2	32.4	100

This can be compared to the survey conducted before dredging by Tuncharoen et al. (2020), during which the 30 millimeters mesh size had the greatest effect on catching fish, both in terms of numbers and weight. It showed that most of the fish caught were small fish. This implies that in the first period, when dredging had just been completed, medium-sized fish had adapted significantly, resulting in a higher weight of medium-sized fish being found. Meanwhile, there were a few small and large fish, which may be due to the need for natural hiding places.

Species composition and quantity parameters

Percentage of species composition (*E-value*)

Next, to determine the percentage of fish species composition based on number and weight, a total of 561 individual fish were found, with a total weight of 40,403.3 grams. Fish in the carp group were found in the largest numbers and weight: 325 individual fish, accounting for 57.9%, and with a total weight of 29,462.7 grams, accounting for 72.9%, respectively. These were followed by fish in the miscellaneous group, for which 177 fish were found, accounting for 31.6%, with a total weight of 5,876.4 grams, which represents 14.5% of the total (Table 3).

For the distribution of fish composition (by weight) according to the survey locations (Figure 3), it was clear that the carp were the main group at every Station, except for Station VI, where the carp group composition was close to the miscellaneous group. Station VII had the highest percentage of fish composition (22.3%), followed by Station VIII (18.9%), while the lowest was at Station V, where only 6.1% of fish were found. Carp were the main component in all stations and were most found in Station VIII (15.6%), followed by Station VII (14.9%). Although miscellaneous shared the second largest proportion of fish, after carp, the proportion of this group was much lower than carp, accounting for only 14.5% of all fish. They were most common in Station VII (3.0%) and Station VI (2.5%), respectively. A similarly small proportion was found in Stations IV and IX (1.7%), and the lowest amount was found in Station III (0.6%). Catfish were the fish group with the third-highest percentage component by weight. They were found mostly in Station VII (1.9%), Station VI (1.4%), Station II (1.3%) and Station VIII (1.2%), respectively. Murrel was the group with the lowest proportion of all fish found in the survey, appearing in only 4 stations (I, VI, VII, and VIII), with the highest prevalence in Station VII (2.4%).

Temporal changes in fish composition indicate that during the period after dredging was just completed, carp replaced miscellaneous fish as the dominant group, both in terms of weight and number. This differs from the pre-dredging period, as reported by Tuncharoen et al. (2020), and the period when deep-water dredging was completed but shallow-water dredging was still in progress, according to Tuncharoen et al. (2024). Although miscellaneous represents a group of fish that has a composition similar to that of carp, the percentage of composition is lower than in previously reported studies. Catfish increased in both species and quantity in this survey, with *Kryptopterus geminus* and *Hemibagrus spilopterus* being the dominant species in terms of numbers. *Wallago attu* was the larger fish, with a reported standard length of 150 centimeters, as cited by Suvarnaraksha and Utsagi (2023). It is the dominant species in terms of weight, so the proportion of catfish from this survey is higher than previously reported (Table 4). Data on changes in the composition of fish species and quantities, including species diversity, can serve as indicators of the abundance of aquatic ecosystems (Souza and Vianna 2017; Ministry for the Environment 2019; Huang et al. 2022).

This study did not find small fish of the family Cyprinidae, such as *Amblypharyngodon chulabhornae*, *Parachela siamensis*, *Pethia stoliczkana* and *Puntius brevis*, which were previously found before the dredging period (Tuncharoen et al. 2020). This may be due to the impact of lack of shelter and habitat destruction, as these fish are commonly found in areas with aquatic plants, including floating plants. In addition, these fish feed on crustaceans, insects, and zoobenthos, and dredging has a direct impact on the water bottom, which is the natural food source of these fish. Similarly, the disappearance of the Indonesian snakehead (*Channa micropeltes*), a large carnivorous fish of the family Channidae that is a top consumer, was not found in the dredged areas due to the lack of abundance of prey fish that serve as its natural food source. Hence, not only the change in fish species but also the dredging affects the overall fish stocks of the water body, especially in the areas affected by dredging, thus affecting the temporal changes in the overall fish community structure.

Table 3. Percentage of fish composition in the Nong Leng Sai Wetland, Northern Thailand, after the newly completed dredging

Fish categories	Total individual fish	E-value (individual fish)	Total weight (g)	E-value (weight)
Carp	325	57.9	29,462.7	72.9
Catfish	54	9.6	3,254.1	8.1
Murrel	5	0.9	1,810.1	4.5
Miscellaneous	177	31.6	5,876.4	14.5
Total	561	100	40,403.3	100

Table 4. Temporal changes in fish composition comparing before dredging, after deep water dredging, and in this study

Study period	E-value by weight				E-value by no. of individual fish			
	Carp	Catfish	Murrel	Miscellaneous	Carp	Catfish	Murrel	Miscellaneous
Before dredging Tuncharoen et al. (2020)	36.4	6.1	6.8	50.7	39.2	1.0	0.7	59.1
After deep water dredging Tuncharoen et al. (2024)	38.5	2.0	14.0	45.5	45.6	1.0	1.4	52.0
Just complete dredging (This study)	72.9	8.1	4.5	14.5	57.9	9.6	0.9	31.6

From this survey, three introduced species were identified: two species (Rohu and Nile tilapia) were found to be used in economic freshwater aquaculture production. In particular, tilapia is the fish with the highest production volume and value in 2023 (Department of Fisheries 2024). There was one invasive alien species, the Vermiculated sailfin catfish. The armored catfish in the Loricariidae family are highly adapted for survival, highly tolerant to environmental changes, exhibit both habitat and feeding adaptations, and have a wide variety of food sources. This species affects the competition for food and habitat among native fish. Research by Orfinger and Goodding (2018), Suresh et al. (2019), and Parvez et al. (2023) indicates that these fish have a negative impact on the biodiversity of native species in aquatic ecosystems. This survey did not find any Indonesian snakehead, in line with Soonthornprasit et al. (2019), and Tuncharoen et al. (2020, 2024). This fish has a preference for areas with dense vegetative cover along the shoreline, and they are often found in areas with abundant submerged vegetation. Therefore, it is very likely that after the completion of the NLSW dredging, there was no shoreline and submerged plant cover, and the fish temporarily migrated out of this area to live elsewhere within the NLSW in areas that were not disturbed by dredging activities.

Percentage frequency of occurrence (%OF)

For the frequency percentages found at the 10 survey stations, it was found the Silver barb (*Barbonymus gonionotus*), Siamese mud carp (*Henicorhynchus siamensis*), Smith's barb (*Puntioplites proctozystron*), *Thynnichthys thynnoides*, Yellow bagrid (*Hemibagrus spiloptera*), Glassfish (*Parambassis siamensis*), and the Leaffish (*Pristolepis fasciata*) were distributed at all stations, calculated as 100%, followed by Featherback (*Notopterus notopterus*) and Sheatfish (*K. geminus*), which were distributed at 9 stations, accounting for 90%. Regarding fish species found at only 1 station, there were 11 species (Table 5).

Table 5. Percentages frequency of occurrence (%OF) according to survey stations

Scientific name	**Distribution**										**Frequency of occurrence**	
	St.I	**St.II**	**St.III**	**St.IV**	**St.V**	**St.VI**	**St.VII**	**St.VIII**	**St.IX**	**St.X**	**Times**	**%OF**
Chitala ornata	+									+	2	20
Notopterus notopterus	+	+	+	+	+	+	+	+	+		9	90
Barbonymus gonionotus	+	+	+	+	+	+	+	+	+	+	10	100
Barbonymus schwaenfeldii				+							1	10
Cyclocheilichthys armatus	+				+		+		+		4	40
Esomus metallicus				+							1	10
Hampala macrolepidota		+							+		2	20
Henicorhynchus siamensis	+	+	+	+	+	+	+	+	+	+	10	100
Labiobarbus siamensis		+	+		+	+		+		+	6	60
Labeo rohita	+	+	+		+		+			+	6	60
Leptobarbus hoeveni									+		1	10
Puntioplites proctozystron	+	+	+	+	+	+	+	+	+	+	10	100
Rasbora borapetensis	+		+	+							3	30
Systomus rubripinnis			+								1	10
Thynnichthys thynnoides	+	+	+	+	+	+	+	+	+	+	10	100
Pterygoplichthys disjunctivus							+				1	10
Kryptopterus geminus	+	+	+	+	+	+	+	+	+		9	90
Wallago attu							+				1	10
Mystus singaringan							+				1	10
Hemibagrus spiloptera	+	+	+	+	+	+	+	+	+	+	10	100
Pangasianodon hypophthalmus	+				+						2	20
Clarias macrocephalus						+					1	10
Clarias batrachus								+			1	10
Gobiopterus lacustris	+			+							2	20
Oxyeleotris marmorata	+	+	+			+	+		+	+	7	70
Parambassis siamensis	+	+	+	+	+	+	+	+	+	+	10	100
Oreochromis niloticus								+			1	10
Dermogenys siamensis	+	+									2	20
Anabas testudineus				+	+	+					3	30
Trichopodus pectoralis						+		+			2	20
Trichopodus trichopterus		+			+		+	+			4	40
Trichopsis vittatus			+								1	10
Channa striata	+					+	+	+			4	40
Pristolepis fasciata	+	+	+	+	+	+	+	+	+	+	10	100
No. of species found (34)	18	15	15	14	15	15	17	15	13	11		
% by no. of species	52.9	44.1	44.1	41.2	44.1	44.1	50.0	44.1	38.2	32.4		

In terms of frequency of occurrence based on the survey period, covering 6 times, it was found that the Featherback (*N. notopterus*), Silver barb (*B. gonionotus*), Siamese mud carp (*H. siamensis*), Smith's barb (*P. proctozystron*), and Sheatfish (*K. geminus*) were caught with fishing gear at every survey period (100%OF), followed by Yellow bagrid (*H. spiloptera*) for 83.3%OF. Next, 15 species were found in only 1 period (Table 6).

Regarding relative abundance, considering the number of individual fish, *P. proctozystron* was found to have the highest abundance percentage (21.2%), followed by *B. gonionotus*, at 13.0%. and *H. siamensis* at 10.5% (Table 7). This study differed from previous research, which found Glassfish and Soldier River barb to be the predominant fish species in terms of numbers, as reported by Soonthornprasit et al. (2019) and Tuncharoen et al. (2020, 2024).

The impact of dredging on both water bodies and riverbanks results in physical changes to the water source, including changes in slope, width, depth, and increased water volume, along with the dispersion of suspended sediments, destruction of the riverbed, and physical, chemical, and biological alterations in water quality. There are also changes in the plant community and the structure of aquatic organisms in the water. All of these effects disrupt the life of fish, affecting population structure, food sources, habitats, and reproductive and spawning grounds, including the migration of eggs, fish larvae, and adults (Soinski et al. 2022).

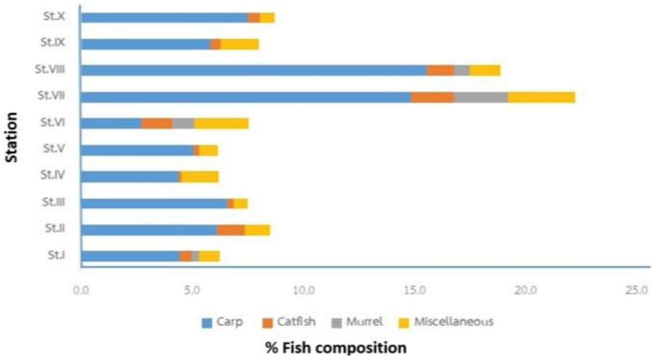

Figure 3. Distribution of fish composition (by weight) according to the survey locations

Table 6. Percentage frequency of occurrence (%OF) according to survey period

Scientific name	Distribution						Frequency of occurrence	
	Feb	Apr	Jun	Aug	Oct	Dec	Times	% OF
Chitala ornata						+	1	16.7
Notopterus notopterus	+	+	+	+	+	+	6	100
Barbonymus gonionotus	+	+	+	+	+	+	6	100
Barbonymus schwaenfeldii					+		1	16.7
Cyclocheilichthys armatus	+	+					2	33.3
Esomus metallicus	+						1	16.7
Hampala macrolepidota	+		+					33.3
Henicorhynchus siamensis	+	+	+	+				100
Labiobarbus siamensis	+	+		+			3	50
Labeo rohita					+	+	2	33.3
Leptobarbus hoeveni					+	+	2	33.3
Puntioplites proctozystron	+	+	+	+	+	+	6	100
Rasbora borapetensis	+	+					2	33.3
Systomus rubripinnis	+						1	16.7
Thynnichthys thynnoides			+	+	+	+	4	66.7
Pterygoplichthys disjunctivus				+			1	16.7
Kryptopterus geminus	+	+	+	+	+	+	6	100
Wallago attu				+			1	16.7
Mystus singaringan				+			1	16.7
Hemibagrus spiloptera	+	+		+	+	+	5	83.3
Pangasianodon hypophthalmus			+				1	16.7
Clarias macrocephalus		+					1	16.7
Clarias batrachus		+					1	16.7
Gobiopterus lacustris	+	+					2	33.3
Oxyeleotris marmorata	+	+	+	+			4	66.7
Parambassis siamensis	+	+	+				3	50.0
Oreochromis niloticus			+				1	16.7
Dermogenys siamensis		+					1	16.7
Anabas testudineus		+					1	16.7
Trichopodus pectoralis		+					1	16.7
Trichopodus trichopterus	+	+					2	33.3
Trichopsis vittatus	+						1	16.7
Channa striata	+	+			+		3	50.0
Pristolepis fasciata	+	+		+			3	50.0
No. of species found (34)	19	20	11	13	11	10		
% by no. of species	55.9	58.8	32.4	38.2	32.4	29.4		

There is also an impact on species diversity and the distribution of fish (Omoruwou et al. 2023), as well as fisheries and catch composition (Shalloof et al. 2023). Furthermore, threats to fish community diversity and structure arise due to habitat threats, especially those resulting from human intervention; soil erosion and water pollution are also significant threats (Yang et al. 2021). Preserving biodiversity is not just about preserving individual species; the key is preserving their habitats, which includes working to ensure the proper use of land and the restoration of degraded ecosystems through community participation (Bhakta and Saxena 2024).

Although changes in fish diversity and composition can be caused by natural causes such as drought, flood, imbalance of aquatic ecosystems of both biotic and abiotic environment, imbalance of trophic level. Including the spread of invasive alien species, which has an impact on predation or competition in terms of food, habitat, and mating. In addition, these species cause environmental disturbances in water sources. However, these events occur gradually, giving aquatic animals time to adapt to survive, while dredging activities have suddenly immediate effects on water sources and ecosystems. Therefore, fish must promptly adapt to survive, such as migrating to unaffected areas, especially fish groups that are less tolerant to environmental changes. Stimulating the recovery of aquatic ecosystems to increase fish resources in terms of species and quantity is necessary, especially after dredging has just been completed in order to have sufficient fish resources for the livelihoods of fishing communities in the NLSW (Tuncharoen et al. 2024). Increasing the number of fish by releasing them into natural water sources is another good way to stimulate the recovery of fish resources. However, it is necessary to carefully consider the species of fish that is suitable for releasing into water sources. This requires accurate data on the composition and diversity of fish species to make informed decisions.

Table 7. Relative abundance (%RA)

Scientific name	Distribution						Relative abundance	
	Feb	Apr	Jun	Aug	Oct	Dec	No. of fish	%RA
Chitala ornata						2	2	0.4
Notopterus notopterus	1	8	28	3	3	3	46	8.2
Barbonymus gonionotus	35	11	4	3	17	3	73	13.0
Barbonymus schwaenfeldii					1		1	0.2
Cyclocheilichthys armatus	4	5					9	1.6
Esomus metallicus	1						1	0.2
Hampala macrolepidota	1		1				2	0.4
Henicorhynchus siamensis	2	15	8	5	17	12	59	10.5
Labiobarbus siamensis	9	2		1	1	1	14	2.5
Labeo rohita						7	7	1.2
Leptobarbus hoeveni					1	1	2	0.4
Puntioplites proctozystron	14	17	8	20	32	28	119	21.2
Rasbora borapetensis	1						1	0.2
Systomus rubripinnis	1						1	0.2
Thynnichthys thynnoides			8	10	18		36	6.4
Pterygoplichthys disjunctivus				1			1	0.2
Kryptopterus geminus	2	3	5	5	7	8	30	5.3
Wallago attu				1			1	0.2
Mystus singaringan				1			1	0.2
Hemibagrus spiloptera	1	2		1	10	1	15	2.7
Pangasianodon hypophthalmus			3				3	0.5
Clarias macrocephalus		2					2	0.4
Clarias batrachus		1					1	0.2
Gobiopterus lacustris	1						1	0.2
Oxyeleotris marmorata	1	5	3	2			11	2.0
Parambassis siamensis	35	4	1	1			41	7.3
Oreochromis niloticus			1				1	0.2
Dermogenys siamensis	1						1	0.2
Anabas testudineus		29					29	5.2
Trichopodus pectoralis		4					4	0.7
Trichopodus trichopterus	6	19					25	4.5
Trichopsis vittatus	1						1	0.2
Channa striata	1	3			1		5	0.9
Pristolepis fasciata	4	11					15	2.7
No. of fish	122	141	70	54	108	66	561	100.0
%RA	21.7	25.1	12.5	9.6	19.3	11.8	100.0	

In conclusion, this survey was conducted immediately after the completion of dredging, following the implementation of the Mae Chai strategic sustainable development plan in 2019. The objective was to monitor fish composition and changes in diversity, in terms of both fish species and quantities, in the case of aquatic ecosystems being disturbed after dredging was recently completed. The results of the study show that after the recently completed dredging, the composition of fish in terms of species, quantity, and species diversity changed from what was previously reported. Dredging to increase water storage volume will have a positive effect on aquatic ecosystems and water management for appropriate use in the long term. However, it must be admitted that aquatic ecosystems were clearly damaged by dredging activities in the early stages of dredging until the ecosystem reaches a state of balance, which takes different amounts of time to adapt in each area, depending on other environmental factors in each water source. The restoration of aquatic ecosystems, water quality, fish habitats, and shelters, as well as natural food sources for aquatic animals, should be stimulated to recover fish resources in the NLSW to their previous levels. It is essential to continue monitoring fish diversity and composition after dredging is complete to gather information about changes in fish resources over time, enabling timely resource management based on accurate academic data.

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