

การอนุรักษ์ความหลากหลายทางชีวภาพของปลาน้ำจืดในระบบนิเวศแหล่งน้ำหนองหาร  
จังหวัดสกลนคร ประเทศไทย

Freshwater Fishes Biodiversity Conservation in Nong Han Aquatic Ecosystem  
Sakon Nakhon Province, Thailand

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บทคัดย่อ

ระบบนิเวศแหล่งน้ำจืดหนองหาร จังหวัดสกลนคร มีประโยชน์โดยตรงและโดยอ้อมต่อประชาชนในพื้นที่ วัตถุประสงค์ของการวิจัยในครั้งนี้คือ การศึกษาโครงสร้างทางชนิดและการแพร่กระจายของปลาน้ำจืด เครื่องมือที่ใช้ในการเก็บตัวอย่างคือ ข่ายเอ็น โดยมีความยาวรวม 2,000 เมตร และ มีความลึก 2 เมตร โดยประมาณ ทำการรวบรวมข้อมูลตั้งแต่เดือนมีนาคม ถึง เมษายน พ.ศ. 2554 จากการศึกษาพบว่า ในหนองหารมีปลาน้ำจืดอย่างน้อย 23 ชนิด (12 ครอบครัว) คณะนักวิจัยพบว่าพื้นที่ใกล้ฝั่งหนองหาร ซึ่งเป็นบริเวณที่มีพรรณไม้ขึ้นหลายชนิดและแสงแดดส่องถึงพื้นแหล่งน้ำนั้น ปลาน้ำจืดมีความหลากหลายทางชีวภาพสูงกว่าบริเวณกลางน้ำ ครอบครัว Cyprinidae เป็นครอบครัวหลักในหนองหารและพบว่าปลาตะเพียนทราย (*Puntius brevis*) และปลาไส้ตันตาแดง (*Cyclocheilichthys apogon*) เป็นปลาท้องถิ่นชนิดพันธุ์เด่นที่รวบรวมได้มากที่สุด ผลจากการศึกษาในครั้งนี้สามารถใช้เป็นประโยชน์ทางวิชาการในด้านการอนุรักษ์และจัดการความหลากหลายทางชีวภาพ

ABSTRACT

Nong Han aquatic ecosystems, Sakon Nakhon Province provide goods and services to human communities. The objectives of this study were to determine structure of freshwater fishes and their distribution. Gill nets with about 2,000 m length and 2 m depth in different mesh sizes were used to collect samples during March to April 2011. There were at least 23 species (12 families) discovered. Littoral zone revealed higher species richness than limnetic zone. Cyprinidae was the major family and *Puntius brevis* and *Cyclocheilichthys apogon* were the most common species. Moreover, the study found the prevalence of other freshwater fishes species and the diversity indices were explained. The results from this study implied various policies on aquatic biodiversity conservation and management.

Key Words: freshwater fishes, biodiversity conservation, aquatic environment, Nong Han  
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## INTRODUCTION

This article explains current species composition of freshwater fishes in Nong Han aquatic environment. Nong Han subjected to static communities due to the alterations of natural flow system by man-made dams and fragmentation of aquatic patches (DOF, 1993) which influence its biodiversity and values for mankind. Therefore, the understanding of the functioning of aquatic ecosystems and biodiversity conservation are necessary (Smith and Smith, 2004).

Nong Han dominated by many species of aquatic flora which contributes to habitat and niche for freshwater fishes. They provide a various ecosystem services, for example controlling the algae and phytoplankton bloom and assist in balancing ecosystem food web (Doydee *et al.*, 2010). This ecosystem is very important to human societies. It serves as a source of water supply, food and income for local people (Doungsawas *et al.*, 2003), however, Nong Han facing problem on over proportional loss of biodiversity. Critical threats to freshwater biodiversity include overexploitation, water pollution, degradation and habitat and invasive alien species (Geist, 2011; Doydee and Jaitrong, 2008).

Therefore, an important undertaking in biodiversity conservation of freshwater fishes is defining its species spatio - temporal structure and diversity indexes. This study aims to enumerate species composition of freshwater fishes, to investigate the dominance and rare species of native freshwater fishes in order to understand their distribution and conservation management options.

## MATERIALS AND METHODS

### Study Area

The study was conducted in Nong Han reservoir, Sakon Nakhon Province, Thailand which composed of littoral and limnetic zones (Figure 1) where high and low density of flora are presented, respectively. Their area is about 7,456 ha with 0.75 m in average depth and 158 m elevation (DOF, 1993; Srichalerntam and Koranantakul, 1993). It is located in the Northeast of Thailand within the boundary of the Great Mekong Sub-region (GMS) (Rainboth, 1996), about 614 km far from Bangkok and was suited around 17°11'56" N latitude and 104°11'9" E longitude. There are a totaled of 18 islands existed in the study area. They serve as natural habitat for various species of organisms. Two sites were selected based on characteristics of water depth and aquatic plants density, such sites were Don Chaing Ban and Don Sawan (Figure 1). Site selection was based on layout of satellite image (THEOS: Thailand Earth Observation System) (GISTDA, 2008) and field survey using Global Position System (GPS) (Doydee *et al.*, 2010).

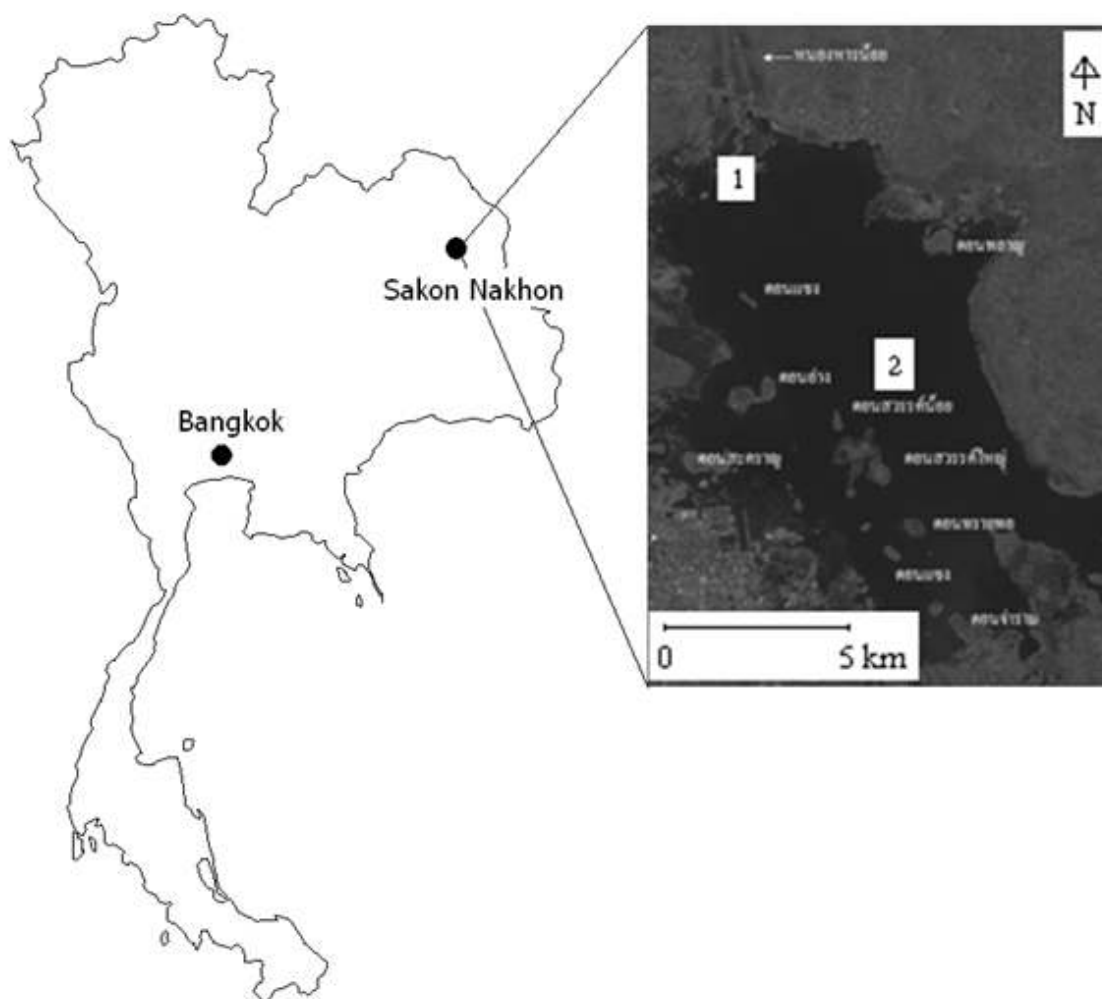


Figure 1 A study area showing image of Nong Han, Sakon Nakhon Province, Thailand: Don Chaing Ban for littoral zone (1) and Don Sawan for limnetic zone (2).

#### Data Collection and Analysis

The coordinates data of two sampling sites (Don Chaing Ban and Don Sawan) (Figure 1) and adjacent area were recorded using GPS receiver with estimated accuracy of 10 m or better (Doydee *et al.*, 2010). To validate the coordinates, geospatial method was used to display the collecting localities on thematic map. Gill nets (about 2,000 m length and 2 m depth) in different mesh sizes ( 3, 4, 6, 9, 12 cm) were used for collecting freshwater fishes (Doungsawas *et al.*, 2003; Sutteemechaikul *et al.*, 2001) during March to April 2011.

The diversity indices (Begon *et al.*, 1990) such as the Shannon Wiener index of Diversity ( $H$ ), Shannon Wiener Index of Evenness ( $J$ ) and Simpson Index of Dominance ( $C$ ) were calculated to analyst freshwater fishes biodiversity data, details as following:

### 2.1 Shannon Wiener index of Diversity ( $H$ )

$$H = -\sum_{i=1}^s pi(\ln pi)$$

where  $S$  = number of species

$pi$  = proportion of total sample belonging to each species

### 2.2 Shannon Wiener Index of Evenness ( $J$ )

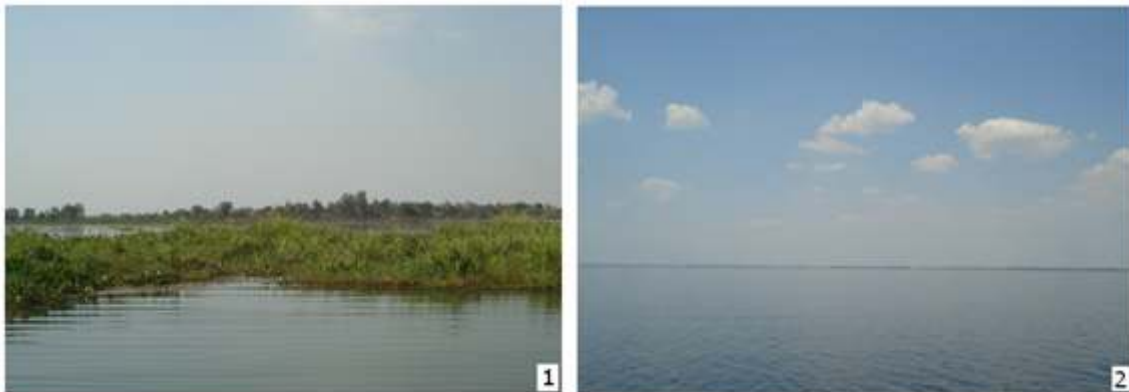
$$J = \frac{H}{H \max} = \frac{H}{\ln S}$$

### 2.3 Simpson Index of Dominance ( $C$ )

$$C = \sum_{i=1}^s pi^2$$

## RESULTS AND DISCUSSION

Figure 2 presents the general overview of the two sampling sites. There were at least 23 species (Species richness) of freshwater fishes were collected and identified (Table 1). Littoral zone had higher species richness than limnetic zone. The species richness is one of diversity index of biodiversity measurement (Krebs, 2009; Vidthayanon, 2005). The study found that there were 7 species of freshwater fishes were collected for every times namely: 1) *Hampala dispar*, 2) *Henicorhynchus siamensis*, 3) *Osteochilus hasselti*, 4) *Puntius brevis*, 5) *Oxyeleotus marmoratus*, 6) *Notopterus notopterus* and 7) *Tetraodon leiurus* (Table 1). Moreover, we revealed 4 rare species of fishes include *Trichogaster trichopterus*, *Mystus nemurus*, *Channa striata* and *Macrognathus siamensis* (Table 1).



**Figure 2** Overview of aquatic plants and water bodies in the two study sites, Sakon Nakhon Province, Thailand: Don Chaing Ban (1) and Don Sawan (2).

**Table 1** The spatial structure of freshwater fishes in Nong Han aquatic ecosystems collected using gill nets at Don Chaing Ban (1) and Don Sawan (2) during March – April, 2011.

The freshwater fishes species arranged			Sites of Collection			
Alphabetically in families	Common name	Vernacular name	March		April	
			1	2	1	2
Anabantidae						
1. <i>Anabus testudineus</i>	Common climbing perch	Pla mo thai	+	-	+	-
2. <i>Trichogaster trichopterus</i>	Three - spot gourami	Pla kradi mor	+	-	-	-
Bagridae						
3. <i>Mystus multiradiatus</i>	Iridescent mystus	Pla kyang kang lay	-	+	-	+
4. <i>Mystus nemurus</i>	Yellow mystus	Pla kod lueng	+	-	-	-
Centropomidae						
5. <i>Parambassis notatus</i>	Siamese glassfish	Pla pan kra jok	+	+	-	-
Channidae						
6. <i>Channa striata</i>	Striped snake - head fish	Pla chon	+	-	-	-
Cichlidae						
7. <i>Oreochromis melanopleura</i>	Striped tilapia	Pla mo tes kang lay	-	+	-	+
Cyprinidae						
8. <i>Barbodes gonionotus</i>	Common silver barb	Pla ta pien khao	+	-	+	-
9. <i>Cyclocheilichthys apogon</i>	Beardless barb	Pla sai tan ta dang	+	-	+	+
10. <i>Hampala dispar</i>	Eye - spot barb	Pla krasub jud	+	+	+	+
11. <i>Henicorhynchus Siamensis</i>	Jullien's mud carp	Pla soy khao	+	+	+	+
12. <i>Labiobarbus siamensis</i>	Barb	Pla sa	+	-	+	-
13. <i>Osteochilus hasselti</i>	Bonylip barb	Pla soy nok kao	+	+	+	+
14. <i>Osteochilus lini</i>	Lini barb	Pla na mong	+	-	+	-
15. <i>Puntius brevis</i>	Golden little barb	Pla ta pien say	+	+	+	+
16. <i>Puntius orphoides</i>	Red - cheek barb	Pla kam cham	+	-	+	+
Eleotridae						
17. <i>Oxyeleotris marmoratus</i>	Marbled sleepy goby	Pla bu say	+	+	+	+
Matacembelidae						
18. <i>Macrognathus siamensis</i>	Spotted spiny eel	Pla load	+	-	-	-
Nandidae						
19. <i>Nandus nebulosus</i>	Bornean leaffish	Pla seao dam	+	+	+	-
20. <i>Pristolepis fasciatus</i>	Striped tiger nandid	Pla mo chang yeap	+	-	+	-
Notopteridae						
21. <i>Notopterus notopterus</i>	Grey feather back	Pla salad	+	+	+	+
Siluridae						
22. <i>Ompok bimaculatus</i>	Butter catfish	Pla cha on	+	+	-	+
Tetraodontidae						
23. <i>Tetraodon leiurus</i>	Puffer fish	Pla pak pao	+	+	+	+
Total species in each site			21	12	15	12

Remark: + = individual species was found in each sampling site and - = vice versa

Comparing with all species (23 species), the golden little barb (*Puntius brevis*) and the beardless barb (*Cyclocheilichthys apogon*) (Figure 3 and Table 1) were the most common species in Nong Han aquatic ecosystem. The beardless barb fishes were collected in all sites except at Don Sawan during March 2011 (Table 1). This species is belong to economic freshwater fishes, the Thai people use it for making salted and fermented fishes and use as ornamental fishes as well, thus, generating income for local people who relied on Nong Han freshwater ecosystem.

Nong Han as freshwater ecosystem has functional interaction and processes of abiotic and biotic factors which presents a major challenge for researches (Geist, 2011). They have an important role in freshwater stocking for human utilization and simultaneously serving as habitat for many organisms (Doungsawas *et al.*, 2003; Sutteemechaikul *et al.*, 2001; Koranantakul and Doungsawas, 1993). The study revealed that the highest species richness of freshwater fishes was in Don Chaing Ban which belong littoral zone (Figures 1 and 2) found 21 species (Table 1). Due to various species and its distribution of aquatic plants in this zone serve as habitat and niche for many freshwater fishes particularly small and young fishes, indeed helped in species biodiversity conservation. The lowest species richness of freshwater fish was in Don Sawan (Figures 1 and 2) with presented only 12 species (Table 1). This implied that this site has less aquatic plants and niche for fishes to thrive. However, as limnetic zone is the open water where abundance of planktons is occurred thus, freshwater fishes in this site are likely bigger in terms of length and weight than littoral zone (Smith and Smith, 2004).

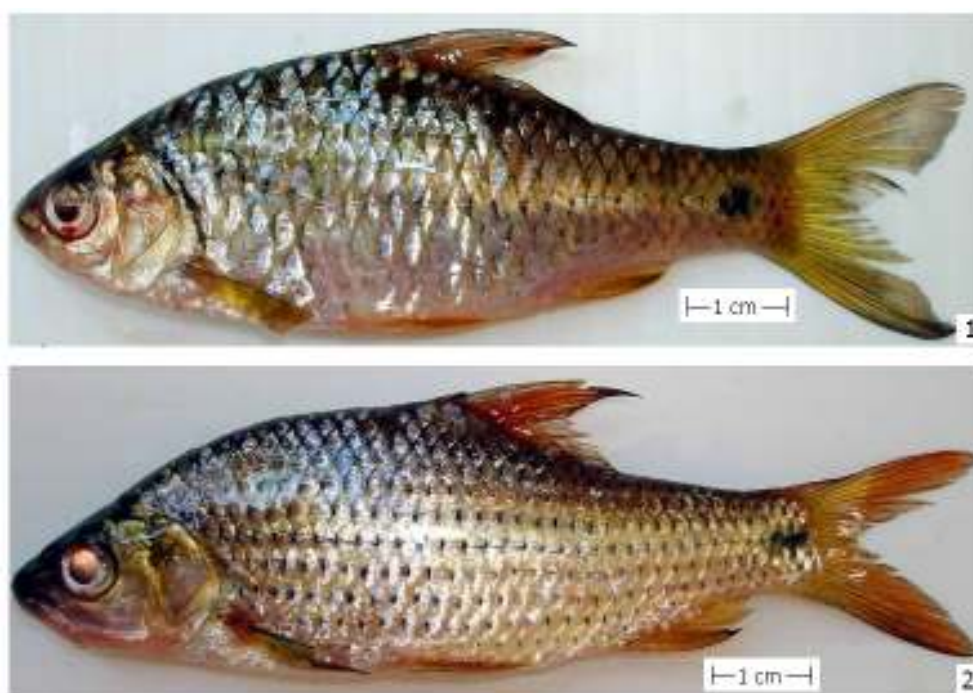


Figure 3 The common species of freshwater fishes in Nong Han aquatic ecosystem, Sakon Nakhon Province, Thailand: *Puntius brevis* (1) and *Cyclocheilichthys apogon* (2).

Shannon Wiener Index of Diversity ( $H$ ), Shannon Wiener Index of Evenness ( $J$ ) and Simpson Index of Dominance ( $C$ ) also were studied in order to understand the diversity, distribution and dominance of freshwater fish communities. The study found that Shannon Wiener Index of Diversity ( $H$ ) values in Don Chaing Ban (1.95 and 2.00) were higher than Don Sawan (1.89 and 1.76) for both March and April, respectively (Table 2) which coincided to the value of species richness (21 species) (Table 1) ; thus, confirming that freshwater fishes in littoral zone has more diverse than limnetic zone. In contrast, the Simpson Index of Dominance ( $C$ ) value in Don Sawan gave a bigger value (0.28) compared to other, meant that this zone has less diversity but it has more dominance or concentration of freshwater fishes. Moreover, it seem that in limnetic zone or Don Sawan site has better even spatial distribution of freshwater fishes due the high value of the Shannon Wiener Index of Evenness ( $J$ ) particularly during March (0.76). The implication of behind this founding was that biodiversity conservation and habitat restoration should be started at littoral zone by using native species. Native dominants from this study were *Puntius brevis* and *Cyclocheilichthys apogon* (Figure 3). The presence of these fishes implied that their food sources were readily available and served as source of livelihood for anthropogenic.

**Table 2** The biological indices values of Shannon Wiener index of Diversity ( $H$ ), Shannon Wiener Index of Evenness ( $J$ ) and Simpson Index of Dominance ( $C$ ) of freshwater fishe dataset collected in Nong Han freshwater ecosystem, Sakon Nakhon Province, Thailand during March – April, 2011.

Study sites	Months	$H$	$J$	$C$
Don Chaing Ban	March	1.95	0.64	0.24
	April	2.00	0.74	0.22
Don Sawan	March	1.89	0.76	0.22
	April	1.76	0.71	0.28

## CONCLUSION

Freshwater fishes in Nong Han aquatic environment were studied to understand their structure, species diversity and spatio - temporal distribution in shallow and open waters during March to April 2011. The fishing gear for collecting the fishes was gill nets. The study revealed the implications and contributions of native fishes species. The biodiversity conservation of fishes should be started at littoral zone by using dominant species. The habitat of fishes must be

protected associated with the awareness and cooperation from local people in a more holistic understanding of biodiversity functioning and management.

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