



## ความหลากหลายของมอลลัสค์ในพื้นที่ปากปักพันธุกรรมพีช เขื่อนศรีนครินทร์ อำเภอศรีสวัสดิ์ จังหวัดกาญจนบุรี

Mollusc diversity in the plant genetic protection area of Srinagarind Dam,  
Sisawat District, Kanchanaburi Province

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### บทคัดย่อ

จังหวัดกาญจนบุรีเป็นจังหวัดที่มีความหลากหลายของชนิดพันธุ์ของมอลลัสค์จำนวนมากเนื่องจากตำแหน่งทางภูมิศาสตร์ที่ตั้งอยู่ใจกลางของเขตสัตวภูมิศาสตร์สองเขตและมีภูมิอากาศแบบทุ่มเขี้ยว ในการศึกษาครั้งนี้มีการสุ่มเก็บตัวอย่างมอลลัสค์ที่อาศัยอยู่บนบก (ทั้งตัวอย่างเป็นและตัวอย่างตาย) ทุกเดือนโดยวิธีการใช้ตารางสุ่ม (quadrat sampling technique) ที่ทำจากห่อพีวีซีขนาด  $1 \times 1$  ตารางเมตร ร่วมกับเทคนิคการร่อนตัวอย่างหน้าดินและชาดใหญ่ที่เก็บได้ในตารางสุ่มตามเส้นสำรวจ 5 เส้นทาง (Trail) ทุก ๆ ระยะ 100 เมตร ส่วนตัวอย่างมอลลัสค์ที่อาศัยอยู่ในน้ำใช้วิธีการเก็บตัวอย่างในบริเวณแหล่งน้ำ 3 แห่ง (เวลาสำรวจ 20 นาทีต่อหนึ่งแห่ง) การสุ่มตัวอย่างอยู่ระหว่างเดือนพฤษจิกายน พ.ศ. 2551 ถึงเดือนตุลาคม พ.ศ. 2552 ในพื้นที่ปากปักพันธุกรรมพีชเขื่อนศรีนครินทร์ อำเภอศรีสวัสดิ์ จังหวัดกาญจนบุรี ผลการศึกษาพบตัวอย่างมอลลัสค์จำนวน 861 ตัวอย่าง จำแนกได้เป็น 11 วงศ์ 13 สกุล 14 ชนิด พันธุ์ และ 4 ชนิดพันธุ์ย่อย มอลลัสค์ที่พบจำนวนมากที่สุดสามอันดับแรกคือ *Cyclophorus siamensis* Sowerby, 1850 (17.77 %) *Cryptozona siamensis* Pfeiffer, 1856 (16.72 %) และ *Anentome Helena* Philippi, 1847 ตามลำดับ การศึกษาในครั้งนี้พบตัวอย่างความหลากหลายชนิดพันธุ์ที่ตั้งในพื้นที่ศึกษาอาจเป็นผลมาจากการที่ศึกษาอยู่ใกล้กับแหล่งชุมชนที่ได้รับการรับกวนอยู่บ่อย ๆ

## ABSTRACT

Kanchanaburi province harbours many kinds of molluscs due to its geographic location at the center of two zoogeographical zones and humid climate. In this study, land molluscs (i.e. live and dead specimens) were sampled monthly by a combination of quadrat sampling technique using PVC frame ( $1 \times 1 \text{ m}^2$ ) and leaf litter/topsoil sieving technique along five trails in every 100 meters, whereas, aquatic molluscs were collected by hands at three aquatic sites (20-minute search each). The sampling was conducted from November 2008 to October 2009 in the Plant Genetic Protection Area of Srinagarind dam, Sisawat district, Kanchanaburi province. In total, 861 individuals of molluscs representing 11 families, 13 genera, 14 species, and 4 subspecies were found. The three most abundant species were *Cyclophorus siamensis* Sowerby, 1850 (17.77 %), *Cryptozona siamensis* Pfeiffer, 1856 (16.72 %), and *Anentome helena* Philippi, 1847 (13.24 %), respectively. Our result revealed a high Shannon-Weiner diversity index ( $H' = 2.27$ ) meaning molluscs were distributed more equitably among species. Low species richness probably resulted from the proximity of the study area to the nearby human community, where disturbance frequently occurs.

**คำสำคัญ:** จังหวัดกาญจนบุรี หอยฝาเดียว หอยสองฝา มอลลัสค์ ประเทศไทย

**Keywords:** Kanchanaburi province, gastropod, bivalve, mollusc, Thailand

## INTRODUCTION

Molluscs are the second most diverse group of invertebrate organisms, with an estimated 80,000–100,000 described species and 200,000 species in total (Strong et al., 2008). Thailand is one of many countries in tropical areas that are rich in biological diversity, particularly the areas belonging to tropical rainforests. Its species estimation is as high as 8.7 % of the world (Baimai, 1995; Baimai and Brockelman, 1998). Of many diverse groups of fauna, molluscs are one of many taxa that are abundant and diverse in Thailand because of its habitat diversity, including the extensive ranges of limestone hills and outcrops. The species numbers of molluscs in the country had been increased for years in the course of previous studies such as Brandt (1974), Upatham et al. (1983), and Panha and Burch (2005). However, the actual figures are considerably lower than those many expected due to a handful of experts and a high rate of current extinction (Attaklap and Dumrongrojwattana, 2010). The recent extinction of molluscs is largely due to human activities such as

deforestation and the conversion of natural habitats for agricultural purposes (Brooks et al., 2002). Panha (2000) pointed out that the endemic species such as arboreal snails in the genus *Amphidromus* and obligate calcicole microsnails are highly vulnerable to extinction compared to other snails.

Kanchanaburi is the largest western province of Thailand that borders Myanmar to the west with the Tenasserim range as a borderline. It covers two significant zoogeographical regions ranging from Indo-Himalayan to the north and west and Malaysian to the south (Naggs et al., 2006). Geographically, its area is predominantly limestone hills with various distinct limestone landforms such as cliffs, caves, and sinkholes, where support snail abundance and diversity (Tweedie, 1961; Vermeulen and Whitten, 1999; Sutcharit and Panha, 2008). In this study, the species richness and diversity of molluscs in the Plant Genetic Protection Area of Srinagarind dam, Kanchanaburi province were investigated. This study will be useful for comparative

studies with other limestone forest habitats in the future.

## RESEARCH METHODOLOGY

### 1. Study site

This study was conducted in the Plant Genetic Protection Area of Srinagarind dam, which is a part of Srinagarind dam national park in Kanchanaburi province (Figure 1). Total area of study site is 2.4 km<sup>2</sup>. The study area was located in the southern part of the Srinagarind dam, where Chao Nen village (Baan Chao Nen) and the head office are located. The altitude is about 200 m above sea level. Generally, the area consists of a rolling plateau of granite and limestone hills covered with mixed deciduous forest and bamboo deciduous forest, recovering from extensive logging in the past. Average annual rainfall of study site is less than 1,500 mm (Elliott and Cubitt, 2005). The average low and high temperatures are 22 °C and 33 °C, respectively. Heavy rain occurs during July - October (Suksala, 2007).

### 2. Mollusc collection

The mollusc sampling was done for two consecutive days every month from November 2008 to October 2009.

**A. Land molluscs:** Land molluscs (i.e. live and dead specimens) were sampled by a combination of quadrat sampling technique and leaf litter/topsoil sieving technique along five trails in every 100 meters (Figure 1). Quadrat sampling technique involved placing a PVC frame (1 x 1 m<sup>2</sup>) on the ground consecutively in every 100 meters along five trails (each is about one kilometer long) and then collecting, identifying, and counting both live and dead molluscs present in the quadrat. The quadrat sampling required two steps – firstly collecting live and dead molluscs seen by eyes inside the quadrats and secondly collecting leaf litter and top soil samples inside the quadrats for later sieving

minute molluscs (i.e. microsnails = shell size is less than 5 millimeters). Sieving method, therefore, covers molluscs inhabiting the forest floor and arboreal dead molluscs falling from the tree.

**B. Aquatic molluscs:** Aquatic molluscs were collected by a direct search by hands at three aquatic sites – two small temporary creeks and one spot at a bank of Kwai Yai river (20-minute search at each site) (Figure 1). The bottom of Kwai Yai river, where we collected aquatic molluscs consists largely of gravels and broken concrete, which provide safe shelters for freshwater molluscs.

All specimens were identified to species level based on the morphological criteria (Brandt, 1974; Upatham et al., 1983; Sutcharit and Panha, 2008). Some gastropods, bivalves, and slugs found alive in the field were preserved in 10 % formalin solution after narcotization by menthol for future species identification.

### 3. Data analysis

To measure mollusc diversity around the study area, three aspects were evaluated:

- 1) Species richness (S) was estimated as the number of species in the study area.
- 2) Relative abundance is the percent composition of each mollusc species relative to the total number of mollusc species in the area.
- 3) Species diversity index (H') was calculated from the Shannon-Weiner index (Heip et al., 1998) as follows:

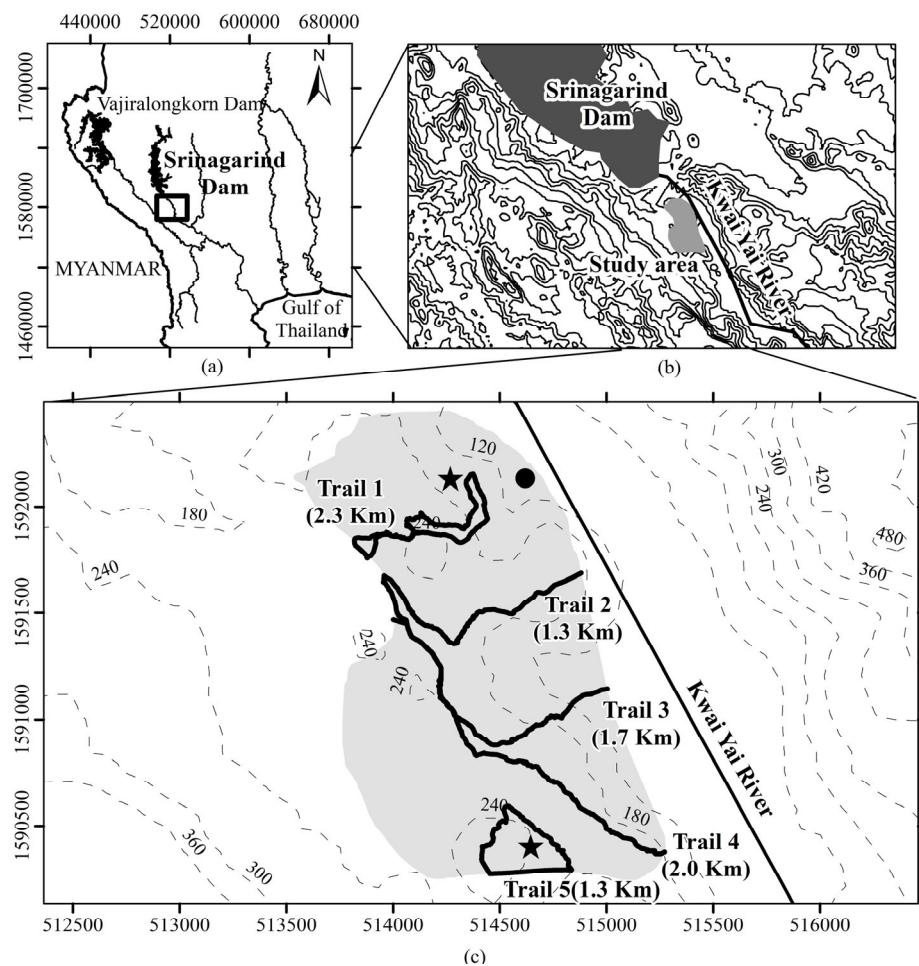
$$H' = - \sum_{i=1}^s (p_i)(\ln p_i)$$

Where

H' = Shannon-Weiner diversity index

s = Number of species

$p_i$  = Proportion of total sample belonging to *i*th species

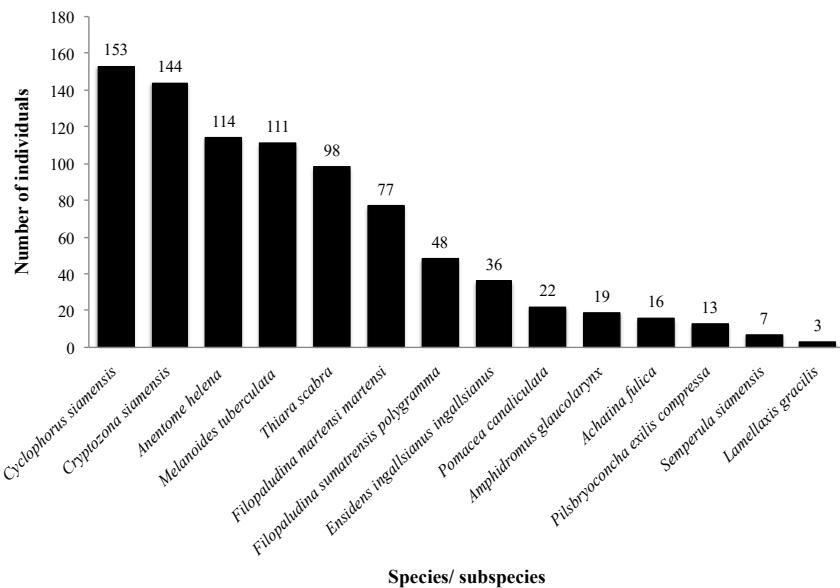


**Figure 1.** Map of the Plant Genetic Protection Area of Srinagarind dam, Kanchanaburi province where molluscs were collected (a, b). Land molluscs were collected from five trails represented by lines (c) and aquatic molluscs were collected from two temporary creeks represented by two star marks (c) and one spot at a bank of Kwai Yai river represented by a black circle (c).

## RESULTS

The total number of land and freshwater molluscs from the study area were 861 individuals, which represented 11 families, 13 genera, 14 species, and 4 subspecies. Of 14 species, eight are freshwater molluscs, five are land molluscs and one is arboreal

mollusc. The three most abundant mollusc species are *Cyclophorus siamensis* (17.77 %), *Cryptozona siamensis* (16.72 %), and *Anentome helena* (13.24 %), respectively (Table 1 and Figure 2). All relative abundance of molluscs is listed in Table 1 and the representative mollusc species are shown in Figure 3.



**Figure 2.** Absolute abundance of the 14 species/ subspecies of molluscs found in the Plant Genetic Protection Area of Srinagarind dam.

**Table 1.** The summary of species richness, relative abundance, and species diversity index of molluscs collected in the Plant Genetic Protection Area of Srinagarind dam, Kanchanaburi province from November 2008 to September 2009.

Taxon	Abundance		Habitat	
	No. of Individuals	% of total		
<b>Class: Gastropoda</b>				
<b>Subclass: Prosobranchiata</b>				
<b>Family: Ampullariidae Gray, 1824</b>				
<i>Pomacea canaliculata</i> Lamarck, 1819	22	2.56	Freshwater	
<b>Family: Nassariidae Iredale, 1916 (1835)</b>				
<i>Anentome helena</i>	114	13.24	Freshwater	
<b>Family: Cyclophoridae Gray, 1847</b>				
<i>Cyclophorus siamensis</i>	153	17.77	Land	
<b>Family: Thiaridae Gill, 1871 (1823)</b>				
<i>Melanoides tuberculata</i> Müller, 1774	111	12.89	Freshwater	
<i>Thiara scabra</i> Müller, 1774	98	11.38	Freshwater	
<b>Family: Viviparidae Gray, 1847</b>				
<i>Filopaludina sumatrensis polygramma</i> Martens, 1860	48	5.57	Freshwater	
<i>Filopaludina martensi martensi</i> Frauenfeld, 1864	77	8.94	Freshwater	
<b>Subclass: Pulmonata Cuvier, 1814</b>				
<b>Family: Achatinidae Swainson, 1840</b>				
<i>Achatina fulica</i> Bowdich, 1822	16	1.86	Land	
<b>Family: Ariophantidae Godwin-Austen, 1888</b>				
<i>Cryptozona siamensis</i>	144	16.72	Land	
<b>Family: Camaenidae Pilsbry, 1895</b>				
<i>Amphidromus glaucolarynx</i> Dohrn 1861	19	2.21	Arboreal	

**Table 1.** The summary of species richness, relative abundance, and species diversity index of molluscs collected in the Plant Genetic Protection Area of Srinagarind dam, Kanchanaburi province from November 2008 to September 2009. (continues)

Taxon	Abundance		Habitat
	No. of Individuals	% of total	
<b>Family: Subulinidae Fischer &amp; Crosse, 1877</b>			
<i>Lamellaxis gracilis</i> Hutton, 1834	3	0.35	Land
<b>Family: Veronicellidae Gray, 1840</b>			
<i>Semperula siamensis</i> Martens, 1867	7	0.81	Land
<b>Class: Bivalvia</b>			
<b>Family: Unionidae Fleming, 1828</b>			
<i>Pilsbryoconcha exilis compressa</i> Martens, 1860	13	1.51	Freshwater
<i>Ensidens ingallsianus ingallsianus</i> Lea, 1852	36	4.18	Freshwater
<b>Total</b>	<b>861</b>	<b>100.00</b>	
<b>Shannon-Weiner diversity index (H')</b>		<b>2.27</b>	

## DISCUSSION AND CONCLUSIONS

The species of freshwater and land molluscs found in the study area were common species similar to the previous studies (Brandt, 1974; Upatham et al., 1983; Sutcharit and Panha, 2008). Although Kanchanaburi province is rich in mollusc species (Sutcharit and Panha, 2008), the species richness of freshwater molluscs (i.e. 8 species) in the Srinagarind dam area was lower than those of other areas (> 10 species) such as in the Lam Ta Khong Reservoir, Nakhon Ratchasima province, Thailand (Tesana, 2002), Kalasin province, Northeast Thailand (Sri-aroon et al., 2005), and various localities in 11 provinces of Thailand during 1999-2004 (Sri-aroon et al., 2007). Likewise, the species richness of land molluscs in our study area (i.e. 5 species) was also lower than those of other limestone areas (i.e. > 40 species) in Thailand (Boon-ngam et al., 2008; Sucharit and Panha, 2008; Boon-ngam et al., 2010; Attaklap and Dumrongrojwattana, 2010; Chidchua and Dumrongroj-wattana, 2010).

Two possible reasons explain the low species richness in this study. Firstly, the concrete construction of the bank and bottom of the Kwai Yai river is not suitable for some mollusc species, such as bivalves

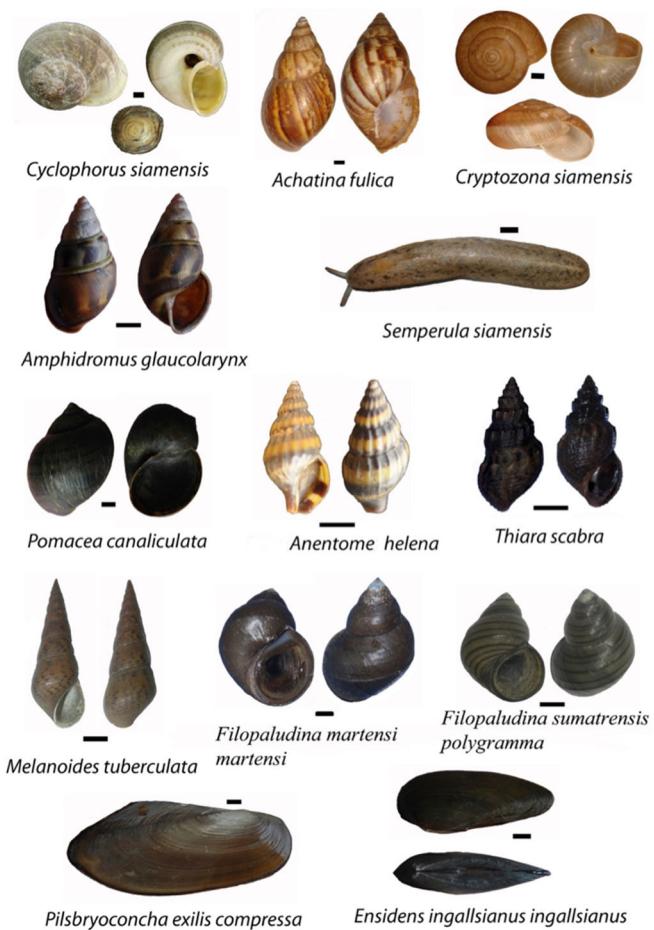
which inhabit the muddy bottom of streams and rivers. In this study, only two subspecies of bivalves e.g. *Pilsbryoconcha exilis compressa* and *Ensidens ingallsianus ingallsianus* were found in a small muddy and sandy area of the riverbank. Sri-aroon et al. (2007) suggested that aquatic molluscs living downstream of large-scale irrigation systems were ecologically affected by the strong turbulent water current and the less abundant vegetation as a shelter. Secondly, the study area was frequently disturbed by human activities from a nearby community such as the collection of non-wood forest products i.e. mushroom, bamboo shoot, local vegetable shoots (the so-called Pak Warn in Thai), fishing, hunting, and forest fire (occurred in April 2009). Human disturbance and probably dam construction reinforce the local extinction of many land and aquatic molluscs.

Kay (1995) showed that many families of molluscs are considered to be threat-prone taxa because of late maturity, relatively high longevity, low fecundity, restricted distribution, and specialized habits and habitats. Among 14 species of molluscs, the only endemic species of snails in genus *Amphidromus* was observed in the study area. The genus *Amphidromus* is

a group of arboreal snails that are highly vulnerable to extinction compared to the other taxa (Panha, 2000).

Frequent access to the area by humans since the completion of the dam in 1981 has likely affected the prosobranch land snails (gill-breathing snails) more than pulmonate snails (lung-breathing snails). Schilthuizen et al. (2005) reported recently that pulmonate snails were significantly more abundant in disturbed areas than prosobranch snails because of high tolerance to human disturbance. Our study shows that the area has a high mollusc diversity ( $H' = 2.27$ ) meaning no obvious dominant species were found but species distribution is more equitable among species (Figure 2). The two most dominant species of molluscs are

*Cyclophorus siamensis* and *Cryptozona siamensis*, respectively. *Cyclophorus siamensis* is the only one prosobranch land snail found in our study (Table 1) and its abundance was also the highest compared to another species. The abundance of *C. siamensis* in the area is because the mountainous area of the study sites acts as suitable natural habitat for *C. siamensis* (Kongim, 2005). The other five species of land snails are pulmonates i.e. *C. siamensis*, *A. glaucolarynx*, *A. fulica*, *S. siamensis*, and *L. gracilis*, respectively. These pulmonates are common agricultural pests except *A. glaucolarynx*. Particularly, *C. siamensis* is a rather common species in Thailand because it easily adapts to human settlements (Panha, 2007).



**Figure 3.** Representative mollusc species found in the Plant Genetic Protection Area of Srinagarind dam (scale bar = 5 mm).

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