แหล่งที่อยู่อาศัยของปลาซิวข้างขวานเล็กในลำน้ำของพื้นที่อำเภอขลุง จังหวัดจันทบุรี ประเทศไทย

Habitat Use by Lambchop Rasbora (*Trigonostigma espei*) in the Streams of Klung District, Chantaburi Province, Thailand

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บทคัดย่อ

ข้อมูลเกี่ยวกับแหล่งที่ปลาชอบอยู่อาศัยเป็นสิ่งสำคัญ สำหรับการจัดการประชากรปลา เพราะปลาแต่ละชนิดจะชอบอยู่อาศัยที่แตกต่างกันซึ่งขึ้นอยู่กับเงื่อนไขทางกายภาพของแหล่งอาศัยนั้นๆ งานวิจัยนี้ได้ศึกษาคุณลักษณะของแหล่งที่อยู่อาศัยต่างกันในลักษณะสามมิติ ได้แก่ ลักษณะของพื้นดินใต้แหล่งน้ำ ความลึกของน้ำ และความเร็วของกระแสน้ำ ที่เหมาะสมสำหรับปลาซิวข้างขวานเล็ก (*Trigonostigma espei*) โดยเก็บตัวอย่างปลาด้วยเครื่องช็อตไฟฟ้า ณ พื้นที่ที่กำหนดในลำน้ำธรรมชาติ 4 แห่ง ในบริเวณด้านตะวันออกของจังหวัดจันทบุรี จำนวน 12 สถานี ระหว่างเดือนกุมภาพันธ์ปี 2556 และมกราคม 2557 และทำการเก็บตัวอย่างดินเพื่อนำไปวิเคราะห์และตรวจวัดตัวแปรที่เกี่ยวข้องหลังจากเก็บตัวอย่างปลา ผลการวิจัยพบว่าค่าความเหมาะสมของความลึกน้ำที่ปลาซิวข้างขวานเล็กชอบอยู่อาศัย อยู่ที่ความลึกระหว่าง 40-50 ซม. และค่าความเหมาะสมนี้จะลดลงที่ระดับความลึกที่ต่ำและสูงกว่าช่วงนี้ ส่วนความเร็วของกระแสน้ำที่เหมาะสมอยู่ระหว่าง 0 และ 0.15 เมตรต่อวินาที และลักษณะพื้นน้ำที่เหมาะสมต่อการอยู่อาศัยของปลาชนิดนี้ได้แก่ทรายละเอียด ดินโคลน และดินกรวด ตามลำดับ

คำสำคัญ: ปลาซิวข้างขวานเล็ก (*Trigonostigma espei*), แหล่งที่ชอบอยู่อาศัย, ประเทศไทย

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ABSTRACT

Information on habitat preference is important for the management of fish populations, because fish species express different preferences and is differentiated according to a set of physical habitat conditions. This study investigated microhabitat preferences on the three dimensions; substrate type, water depth, current velocity for Lambchop Rasbora (*Trigonostigma espei*). Fish and habitat data were collected at 12 sites of four natural vegetated streams in Chantaburi Province, located in eastern Thailand, between February 2013 and January 2014. Fish collection was done by electrofishing in grids, whereas environmental variables in the sampled areas were measured after sampling. Results found that the highest behavioral preference of the fish for depth occurred at 40-50 cm and declined for very shallow and very deep water. *Trigonostigma espei* preferred range of velocities between 0 and 0.15 m/s. The substrate preference was highest for silt, followed by clay, sand and gravel respectively.

Key words: Lambchop Rasbora (*Trigonostigma espei*), habitat use, Thailand

INTRODUCTION

Natural streams supply a large set of favorable physical habitat conditions supporting diverse aquatic fauna. However, fish species show different preferences and segregate according to water velocity, depth and substrate types (Hued and Bisttoni, 2006). Yu and Peters (1997) indicated that habitat availability affects habitat selection by fish, while selection of habitat by fish depends on the availability of appropriate depth, velocity, substrate, and cover in a stream (Bovee, 1982). Wood and Bain (1995) has also documented the importance of these habitat features to distribution and abundance of stream fishes. Moreover, fisheries managers and researchers have increasingly used stream habitat assessment as a tool to identify, estimate, and predict the effects of habitat alteration on aquatic organisms (Wang *et al.*, 1996).

Lambchop Rasbora *(Trigonostigma espei)* is a native of Thailand. It was reported by Pongsri *et al.* (2008) as an inhabitant of streams and other water bodies that are located in peat swamp forests. The species is found in the streams of Klung District, Chantaburi Province, and Trang Province, Thailand (Kaewrith *et al.*, 2010). Although the morphology and some biological aspects of the species and fish of the same genus have been investigated (Kaewrith *et al.*, 2010; Pongsri *et al.*, 2008; Kraisurasre *et al.*, 2008), there is no quantitative information on micro-habitat requirements of the species, This study was aimed to investigate the habitat use of this species and set up its microhabitat preference based on the measurement of three principal habitat components: depth, substrate type and velocity that affect habitat use by *T. espei* for use in the conservation and management of the species.

METHODS

Study sites

Four streams; Trog-nong, Sra-bab, Kong-si-rai and E-ngaw canals in Khlung district, Chantaburi Province (Figure 1, Table 1) were surveyed for Lamchop rasbora (*T. espei*). From our primary survey, it was found that they were only the four streams to find this fish species. These streams were represented a range of stream depths, with ranging from 0.3 to 1.2 m.

Field Measurements

Field measurements were carried out

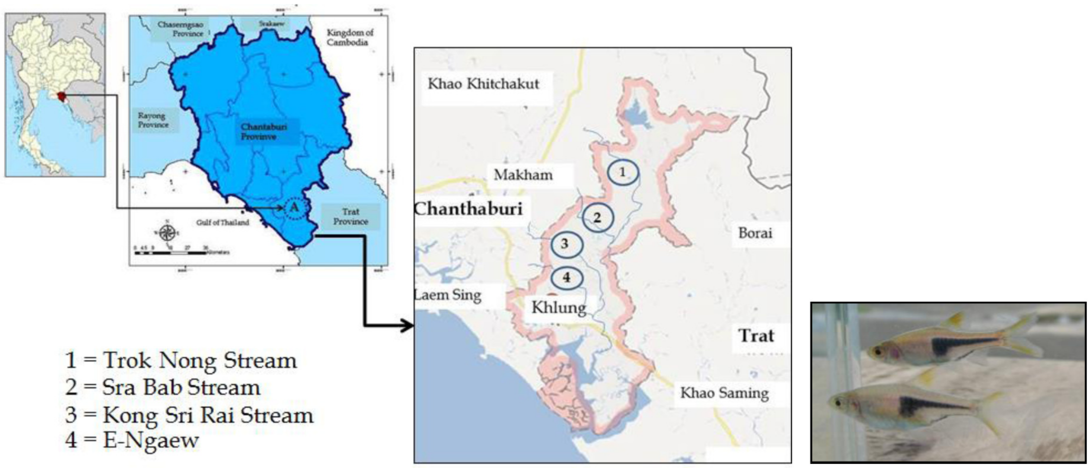

Figure 1 The River system, showing location of four streams surveyed for Lamchop rasbora (*T. espei*) (right) in Khlung District, Chantaburi Province (A), Thailand.

Table 1 Surveyed streams with location, depth, elevation and substrate types of sampling sites

Streams	Location (GPS Coordinate)	Depth range (m)	Elevation (Altitude)	Substrate type (%)			
				Gravel	Sand	Silt	Clay
1 Trog-nong	N12° 31’ 57.9” E102° 15’ 32.7”	0.3-0.8	32	20	50	0	30
2 Sra-bab	N12° 29’ 16.8” E102° 16’ 22.7”	0.3-0.8	32	0	20	20	60
3 Kong-si-rai	N12° 25’ 14.6” E102° 16’ 10.7”	0.8-1.2	32	0	10	30	60
4 E-ngaw	N12° 27’ 06.7” E102° 17’ 09.7”	0.5-1.0	32	0	10	20	70

monthly from three selected sites of each four streams, from February 2013 to January 2014. The survey procedure was to electric fish a range of depths, velocities, and habitat types within the reaches. At each location, fish were electro-fished about 1 m^2 of stream and recorded the species and numbers of fish. Following the method proposed by Barrett and Maughan (1994). Habitat variables were also measured at each location, whether or not fish were found. Conductivity (µS/cm), water temperature (°C), dissolved oxygen (mg/l) and pH were measured using a multiparameter apparatus (YSI 556). Turbidity (NTU) was measured using a portable turbidity meter. The water depth were measured using a graduated wading rod (cm), mean water column velocity was measured at ≤0.4 m of depth above the bed with a current meter (m/s). Dominant substrate type was estimated visually as percent within each sampling quadrates and, coded as clay, silt, sand, gravel, cobbles and boulder, following the protocol of Bozek and Rahel (1992).

Data Analysis

Due to our data sampling were arranged with a finite set of values for continuous random variables. Therefore, using a kernel instead of discrete probabilities will promote the continuity nature in the underlying random variable. Kernel density estimates (KDE) are closely related to histograms, but can be endowed with properties such as smoothness or continuity by using a suitable kernel. In this study, we demonstrated the process to generate kernel density estimation in Excel using NumXL's add-in functions. Frequency curves and histograms of Lambchop rasbora habitat use were displayed using histogram and kernel density plots (Bovee, 1982; Hayes and Jowett, 1994; Baker *et al.*, 2003). Frequency histograms were derived for each habitat variable to determine the number of fish that were found in each bar interval. The ordinates of the frequency histogram were then normalized by dividing by the ordinate with the highest frequency to give a relative measure of habitat use. Generally, preference and suitability are often used interchangeably (Baker *et al.*, 2003), in this study all bar intervals of a habitat variable were sampled equally, the frequency histogram shows the preference over the range of habitat values, the term suitability were used to mean a value of between 0 unsuitable habitat and 1 (optimal habitat).

RESULTS

Summarized of environmental variables values are shown in Table 2 and mean values of sampled fish and environmental variables of the study streams are presented in Table 3. The conductivity varied from 85 µS/cm to 246 µS/cm, whereas water of all streams was acid with low variation in pH (5.7-5.9 between sampling sites. It was the same for water temperature, which ranged between 23.3 °C and 27.0 °C. The lowest dissolved oxygen values were recorded in the pool of Sra-bab stream (7.15 mg/l) and the highest values were observed in stream channel of E-ngaw (8.50 mg/l). Generally, low turbidity 27 NTU) was observed in upstream areas of the streams, while high values (135 NTU) were recorded in the other sites. The upstream locations presented higher values of velocity (≤45 m/S), while low values (≥ 25 m/S) were recorded in the middle and downstream locations. In the stagnant pools, width was almost constant, while it increased from upstream to downstream (2.50 to 14.0 m) in the stream channel. The depth in the study areas varied from ≤ 0.30 m to 1.20 m.

The number of fish in water depth intervals of <15, 15-30, 30-40, 40-50, 50-60 and > 60 cm was measured at 3 locations in each depth range (Table 4). In this study, the frequency histogram of fish numbers in each

Table 2 Minimum, maximum, and mean values of sampled fish and environmental variables in the study areas

Variables	Minimum	Maximum	Mean
No. of fish/site	14	40	27.25
Elevation (m)	35	60	46.25
Width (m)	2.50	14	5.60
Depth (cm)	10.00	120.00	71.00
Velocity (m/s)	0	0.45	0.25
Substrate particle size (mm)	0.06	254	24.50
Temperature (°C)	23.30	27.02	25.13
Turbidity (NTU)	27	135	74.35
Alkalinity (mg/l as CaCO3)	34.50	64.30	43.50
Hardness (mg/l as CaCO3)	15.6	42.5	32.21
Conductivity (µS/cm)	85	246	113.53
Dissolved Oxygen (mg/l)	7.15	8.50	7.84
pH	5.73	5.96	5.80
Total Disolved Solids (mg/l)	147	243	185

Table 3 Mean values of sampled fish and environmental variables of the study streams.

Stream	Habitat variables								
	No. Fish	DO (mg/l)	pH	Alkalinity (mg/l)	Hardness (mg/l)	Water temp (°C)	Turbidity (NTU)	Velocity (m/s)	Conductivity (µS/cm)
1 Trog-nong	14	8.08	5.79	41.00	41.00	23.27	53.00	0.63	96.00
2 Sra-bab	22	7.10	5.60	45.40	40.70	25.21	68.00	0.06	112.00
3 Kong si-rai	40	7.65	5.95	63.35	42.30	25.08	73.67	0.07	124.00
4 E-ngaw	33	8.55	5.75	47.50	39.80	27.28	72.00	0.07	109.67

depth range shows the frequency of habitat use and the relative suitability of the different depths, with fish most common in depths of 40-50 cm. Depths of less than 15 cm and more than 60 cm are less suitable, depths of 15-30, 30-40 cm are almost suitable, whereas the optimum depth range of 40-50 cm.

Four streams with a total of 14 locations were sampled, giving a total of 181 fish. Most fish were found in depths from 15 cm to 60 cm (Table 4, Figure 2). Low numbers were found in depths less than 15 cm and more than 60 cm however this species exhibited a strong suitability and were abundant (suitability > 0.6) at depths of up to 30-60 cm (Figure 2). Habitat suitability as calculated from fish abundance (Figure 2), taking the number of samples collected in each depth range into consideration. Optimum depths for *T. espei* were considered to be between 30 and 50 cm.

The mean velocity of locations occupied by *T. espei* was 0.30 m/s (Table 5), with 82% of fish in velocities of less than 0.15 m/s (Figure 3) and 18% was found in velocities of 0.20, 0.25 m/s. (Figure 3). *T. espei* showed a strong preference for low water velocities with

Table 4 Sampling frequency and water depth for Lampshop rosbara (*T. espei*)

Depth Interval (cm)	Number of samples	Number of fish	Av.no.of fish per sample	Normalization	Suitability
≤15	12	6	0.5	0.5/4.5	0.11
15-≤30	12	39	3.3	3.3/4.5	0.72
30-≤40	12	45	3.8	3.8/4.5	0.83
40-≤50	12	54	4.5	4.5/4.5	1.00
50-≤60	12	30	2.5	2.5/4.5	0.56
>60	12	7	0.6	0.6/4.5	0.13

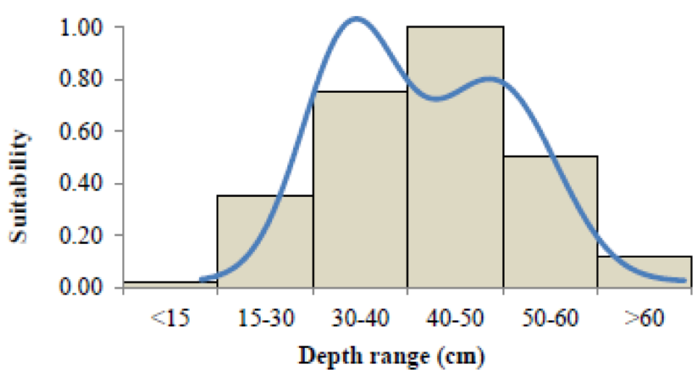

Figure 2 Normalized frequency histograms and kernel smoothed distributions (blue line) of depth used by Lamchop rasbora (*T. espei*).

relatively suitability 0.73 and 1.00 at velocities of <0.01 - 0.15 m/s. (Figure 3). These fish were probably sheltering behind or under vegetation, which the velocity measurement was taken at this location. The optimum velocity for juvenile *T. espei* was less than 0.15 m/s.

The habitat types utilized by *T. espei* were related to their velocity preferences. Adult and juvenile fish were commonly found in pools with most abundant in silt, clay, sand/silt at suitability of 1.0, 0.83 and 0.63 respectively (Table 6, Figure 4). Boulder and cobble were rare in the reaches sampled and scarcely appear to be used by either adult or juvenile fish.

DISCUSSION

Juveniles and adults of Lamchop rasbora (*T. espei*) in this study were mostly found in reach where there was low-velocity water. The streams inhabiting *T. espei* were dominated by silt or clay substrates and tended to be generally narrower and shallower than the wide alluvial streams. This finding is similar to the observations of Kaewrith *et al.* (2010) who

Table 5 Sampling frequency and water velocity for Lampshop rosbara (*T. espei*)

Velocity Interval (m/s)	Number of samples	Number of fish	Av.no.of fish per sample	Normalization	Suitability
<0.10	12	32	2.7	2.7/3.7	0.73
0.10-≤0.15	12	44	3.7	3.7/3.7	1.00
0.15-≤0.20	12	11	0.9	0.9/3.7	0.25
0.20-≤0.25	12	5	0.4	0.4/3.7	0.11
0.25-≤0.30	12	0	0.0	0.0/3.7	0.00
>0.30	12	0	0.0	0.0/3.7	0.00

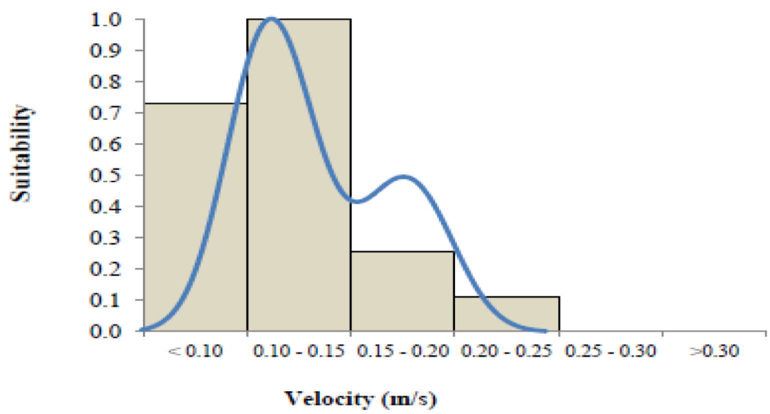

Figure 3 Normalized frequency histograms and kernel smoothed distributions (blue line) of velocity used by Lamchop rasbora (*T. espei*).

reported that *T. espei* are most abundant in small streams 1.5 to 7 m in width and less than 1 m in average depth. It was found that stream sections with 40-60% pools are optimum for providing riffle areas for spawning habitat and pools for cover (Kaewrith *et al.*, 2010). Abundant aquatic vegetation and abundant stream bank vegetation are conditions associated with high production of food types consumed by *T. espei.* Moreover, Pongsri *et al.* (2008), provided support that the abundances of this species are clear water with areas of silt and clay to small gravel substrate, suggesting the acidic water due to high organic matter accumulation. Similar findings were reported by Sumphuntharuks and Petcharoon (2003).

From the present study, normalized suitability curves describe the range of water depths, velocities, and substrates that provide suitable habitat for fish. Substrate size is hydraulically related to water depth and velocity. The physical environment of running waters has a number of particular features that pose special challenges to the organisms that dwell there (Allan and Castillo, 1995). Rabeni and Jacobson (1993) had indicated that fish distribution and abundance are influenced by depth, velocity, substrate type and cover and

Table 6 Sampling frequency and substrate category for Lampshop rosbara (*T. espei*)

Substrate category	Number of samples	Number of fish	Av.no.of fish per sample	Normalization	Suitability
Clay	12	33	2.8	2.8/3.3	0.83
Silt	12	40	3.3	3.3/3.3	1.00
Sand/silt	12	25	2.1	2.1/3.3	0.63
Gravel	12	15	1.3	1.3/3.3	0.38
Cobble	12	2	0.2	0.2/3.3	0.05
Boulder	12	0	0.0	0.0/3.3	0.00

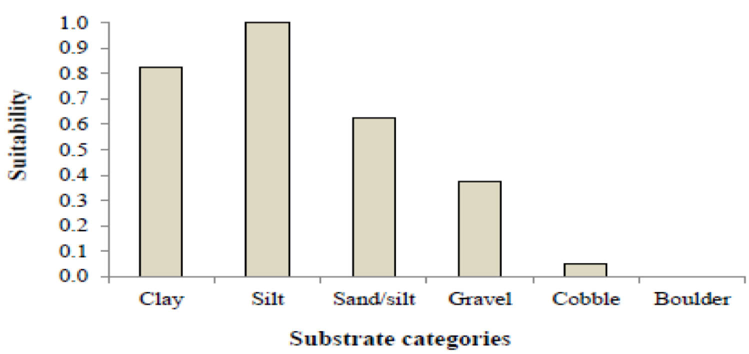

Figure 4 Suitability of habitat type and substrate for juvenile Lamchop rasbora (*T. espei*).

they respond to combinations of variables instead variables independently. This conclusion has been confirmed by many studies (Bovee, 1982; Moyle and Baltz, 1985; Yu and Peters, 1997) suggested that habitat availability affects habitat preference of fish. The present findings also show that habitat availability of velocity, depth, and substrates have significant effects on preferred habitats of *T. espei*. However, a single factor may not be enough to describe habitat use in complex ecosystems. The observations also suggest that establishing the habitat preference of fish is important, and the information can be used to support sufficient water requirements for fish activities in rivers.

CONCLUSION

In summary, the present study described the microhabitat preference of *T. espei* in natural vegetated water bodies, a section of Chanthaburi Province. The results show that depth, velocity, and substrate are important hydraulic and physical variables for habitat selection by *T. espei*. The species tends to occur in shallow water with low velocity and small sized substrate. Although this fish species is recorded throughout eastern slopes of the Gulf of Thailand and Cambodia, it is impacted through trade, but populations are considered to be stable and it is considered Least Concern (Vidthayanon, 2012). However due to the increasing of habitat loss by deforestation and chemicals used in agriculture, it has been listed as vulnerable species on the Thailand Red Data (Vidthayanon, 2005). It is anticipated that this study will provide useful information for further substantial development of Lamchop rasbora (*T. espei*) conservation and aquaculture.

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