The JSFS 85th Anniversary-Commemorative International Symposium
"Fisheries Science for Future Generations"
Symposium Proceedings, No. 02007

Original article

Aspects of the reproductive biology of Brook trout *Neolissochilus stracheyi* (Day, 1871) in Northern, Thailand

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Keywords: Reproductive biology; *Neolissochilus stracheyi*; In Northern; Thailand.

Received: 18 July 2017 / Accepted: 4 September 2017

Introduction

Neolissochilus stracheyi (Day, 1871) is a riverine large cyprinid species and widely distribution from India through Southeast Asia e.g. Myanmar, Laos, Vietnam, Cambodia, Malaysia and Thailand [1,2]

The reproductive cycle and the factors affecting it are important issues in fish and fisheries biology [2,3]. Studies of teleost reproductions are often reported in commercial or valuable native species [4-7]. Although some studies on the reproductive biology of *Neolissochilus* have been reported from India, Nepal and Malaysia [8,9] information regarding the reproductive biology of *N. stracheyi* is poorly reported. As this fish is highly market demand in the aquarium trade in Thailand and eatable in Malaysia. Also, the information on the reproductive biology would be important for conserving its stock. The purpose of this paper was to consider aspects of biology, including the length-weight relationship, gonadosomatic index, fecundity, spawning season of *N. stracheyi* in Northern, Thailand.

Materials and methods

Collection of specimens
The study site was a rocky stream of Wa River Maejarim District, Nan Province. Fish were collected monthly from October 2010 to September 2011 by using gillnet. A total of 821 individuals were sampled and immediately preserved in 10% formalin.

Laboratory procedures and data collection
All fish were measured to the nearest 1 mm. in the total length (TL) and weighted to the nearest 0.1 g. Data were used to establish the length-weight relationship $W = aL^b$, Where a and b are specific constant values. Gonads of the fish were examined under a dissecting microscope for its external features color in order to determine a maturity stage [10].

Fecundity estimates and relative fecundity
Fecundity was estimated on the basis of total weight of ovaries. The fecundity was obtained by using the following equation [11]:

$$F = \frac{\text{No. of samples eggs x Gonad weight}}{\text{Sample weight}}$$

Temporal reproductive cycle
Paired gonads were weighed individually in our study to the nearest 0.01 g. Gonadosomatic Index (GSI) was determined monthly by the equation: GSI = (GW/SW) × 100 [12,13]. The condition factor (K) was calculated monthly with the formula K = (W/L3) × 100 [14]. Six mature gonad (i.e. 3 testes and 3 ovaries) per month were used for histological studies. Maturity classification of our study specimens is followed of seven- macroscopic stages adapted from [14-16].

Results and discussion

Length-weight relationship
Ranging from 7.4–61 (23.32 ± 5.91) cm, 821 samples. There were 353 males that had fish samples there were 8.5–45.1 cm of TL (22.36 ± 5.91cm) and 468 females that had 7.4 ± 61 cm of TL (24.04 ± 7.09 cm). The relationships equation between total length and weight was $W = 0.008TL^{3.064}$ ($r^2 = 0.940$) for total fish, $W = 0.007TL^{3.107}$ ($r^2 = 0.946$) for females and $W = 0.010TL^{3.003}$ ($r^2 = 0.930$) for males.

Fecundity estimates and relative fecundity
The absolute fecundity ranged from 220 to 3,500 eggs per female, with an average of 1404.55 ± 651.51 eggs. The relationships between fecundity and total length revealed F = 121.1TL-2100 (r = 0.874, N = 119) and relationships between fecundity and weight revealed F = 4.535 + 128.78 (r = 0.839, N = 119).This result means that fecundity increase with body length at a constant rate.

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Temporal reproductive cycle

The mean GSI of shows three peaks throughout a year (Fig. 1). The first peak was in month of January (GSI = 2.465) followed by June (MGSI = 2.776) which the highest peak. Then the last peak was in August (GSI = 1.239) (Fig. 1). The histology of the gonads (Fig. 2) confirmed that *N. stracheyi* has two spawned. The mean gonad weight and GSI of females and males of *N. stracheyi* in the area increased gradually from maturing virgin stage to the peak value at the gravid stages and decreased to the lowest value at the spent stage).

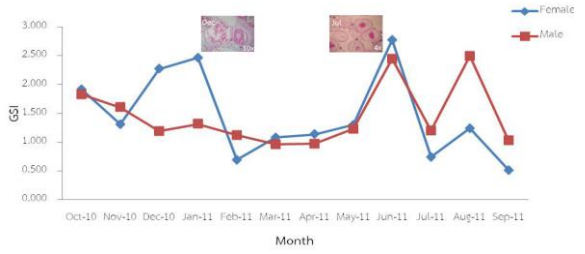

Fig. 1. Average monthly gonadosomatic index (GSI) of *N. stracheyi* in Wa River, Thailand from October 2010 to September 2011.

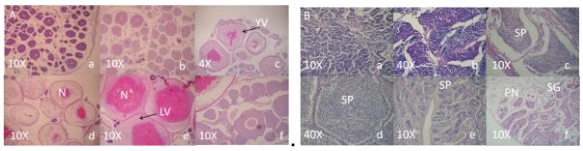

Fig. 2. (A) Histological appearance of ovary maturation, *N. stracheyi*. (a) Immature ovary; (b) mature or rebuilding ovary; (c) mature ovary; (d) fully mature or ripe ovary; (e) mature ovary; (f) spent ovary: LV, lipid vesicle; N, nucleus; YV, yolk vesicle. (B) Histological appearance of testis maturation, *N. stracheyi*. (a) Immature testis; (b) mature or rebuilding testis; (c) mature testis; (d) fully mature or ripe testis; (e) mature testis; (f) spent or resting testis: SP, spermatozoa; SG, spermatogonia; PN, pycnotic nets of degenerating cells.

Conclusions

The spawning season occurred in January to August, while spawning of *N. soroides* high rainfall distribution during November and April [9] and Swar and Craig [17] studied on the reproductive biology of *N. hexagonolepis* were found to have a prolonged breeding season from April to October. The historogy of the gonad confirmed that *N. stracheyi* has multiple spawners. Protracted multiple spawners, usually take their spawning cues from extrinsic factors such as rainfall, water level, temperature and photoperiod. In tropical regions, such as in Thailand, temperatures, day length photoperiod and annual rainfall distribution may have small seasonal variation and probably had little effect on the fish breeding activities [18,19].

Acknowledgements

The study was financially by the Faculty of Fisheries Technology and Aquatic Resources Maejo University.

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