

**Morphology and Some Biological Aspects of
Common Spiny or Lesser Loach (*Lepidocephalichthys thermalis*) and
Banded Mountain or Spotted Loach (*Schistura notostigma*)
of Sri Lanka**

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ABSTRACT. Members of family Cobitidae and Balitoridae, commonly known as loaches are either indigenous or endemic to Sri Lanka and no studies have been carried out so far on their biology. Morphometric and meristic characters, Condition Factor under different habitats (i.e., natural and captive), feeding biology and reproductive biology of *Lepidocephalichthys thermalis* (Spiny loach) and *Schistura notostigma* (Banded mountain loach) from two different streams of Mahaweli river basin were studied. This knowledge would be useful for providing information on feasibility of breeding and culturing them under captive conditions.

Condition Factor of Spiny loach collected from the natural habitat was significantly higher than the laboratory reared fishes ($P < 0.05$) while it did not show a significant difference ($P > 0.05$) for Banded mountain loach. These results indicate that the laboratory conditions including the type of feed should be improved to achieve a better Condition Factor for breeding them in aquaria.

The number of gill rakers on the 1st gill arch was 9-10 and relative gut length was 0.53 ± 0.21 in Spiny loach while those parameters were 7-8 and 0.42 ± 0.03 respectively in Banded mountain loach. When the gut contents were examined, detritus found in Spiny loaches. Both detritus and parts of insects were found in Banded mountain loaches. Hence it can be inferred that Spiny loach and Banded mountain loach are omnivorous feeders.

In Spiny loach the males and females had the same fin ray formulae. But in the females the spine in the pectoral fin was flexible, and in the males it was ossified. This character could be used to identify males from females and is useful for breeding. Ovaries of Spiny loach contained three different sized eggs. Mean number of mature yolky eggs or fecundity was 326 ± 0.02 . These results give the conclusion that the Spiny loach is a multiple spawner.

INTRODUCTION

Freshwater fish of Sri Lanka are often considered to be one of the best known fish fauna in the world. Sixty-two freshwater dispersant, 26 saltwater dispersant and 20 exotic

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fishes have been recorded from Sri Lanka's inland waters. Among the 62 freshwater dispersants, 26 fishes are endemic to Sri Lanka (Pethiyagoda, 1994).

Of the freshwater fish, the loach belong to either family *Cobitidae* or family *Balitoridae* (Pethiyagoda, 1991). Several genera and species of loaches invade worldwide distribution. However, a few types are found in Sri Lanka (Table 1) of them Spiny loach (*Lepidocephalichthys thermalis*) and Mountain banded loach (*Schistura notostigma*), are the commonly available types of loaches. Although loaches have an ornamental value and indigenous or endemic status in Sri Lanka, no studies have been carried out so far on their biology.

Table 1. Types of loaches found in Sri Lanka.

Family	Genus and species	Common name	Status	Distribution
1. <i>Cobitidae</i>	<i>Lepidocephalichthys thermalis</i>	Common spiny loach or Lesser loach (E) <i>Pulli Ehirava</i> , <i>Ehirava</i> , <i>Ehiraya</i> (S)	Indigenous	Sri Lanka, India, Burma and Thailand
	<i>Lepidocephalichthys jonklaasi</i>	Spotted loach or Jonklaas loach (E), <i>Pulli Ehirava</i> , <i>Jonklaas Ehirava</i> (S)	Endemic	Sri Lanka
2. <i>Balitoridae</i>	<i>Schistura notostigma</i>	Banded mountain loach (E), <i>Puwakbadilla</i> , <i>Gomera Ehirava</i> , <i>Kandu Ehirava</i> (S)	Endemic	Sri Lanka
	<i>Acanthocobitis urophthalmus</i>	Tiger loach (E), <i>Vairan Ehirava</i> (S)	Endemic	Sri Lanka

According to Deraniyagala (1952) the origin of pectoral fin is fleshy, the outer ray single, the inner ray is usually flattened and ossified in adults. Roberts (1989) indicated that in the genus *Lepidocephalichthys*, some fishes have an ossified spine in their pectoral fin and there is no clear method to identify males and females.

The aim of this study was to get background data on biology, specifically morphometric and meristic characters, Condition Factor under different habitats, feeding biology and reproductive biology of *Lepidocephalichthys thermalis* and *Schistura notostigma* for providing information on feasibility of breeding and culturing them under captive conditions.

MATERIALS AND METHODS

Fish samples were collected from streams of *Mahaweli* river basin. *Lepidocephalichthys thermalis* were collected from the stream, which was located at the Blackwater Estate at *Ginigathena* and *Schistura notostigma* from the *Sarasavi oya* in the University of Peradeniya (Fig. 1 and Fig. 2). A sample of loaches of each variety was also conditioned to the laboratory and was fed with a formulated feed (Table 2). Since these fishes have an indigenous/endemic status, minimum required number of fish were caught from the natural resources. The laboratory analysis was conducted at the Dept. of Animal Science, Faculty of Agriculture, University of Peradeniya.

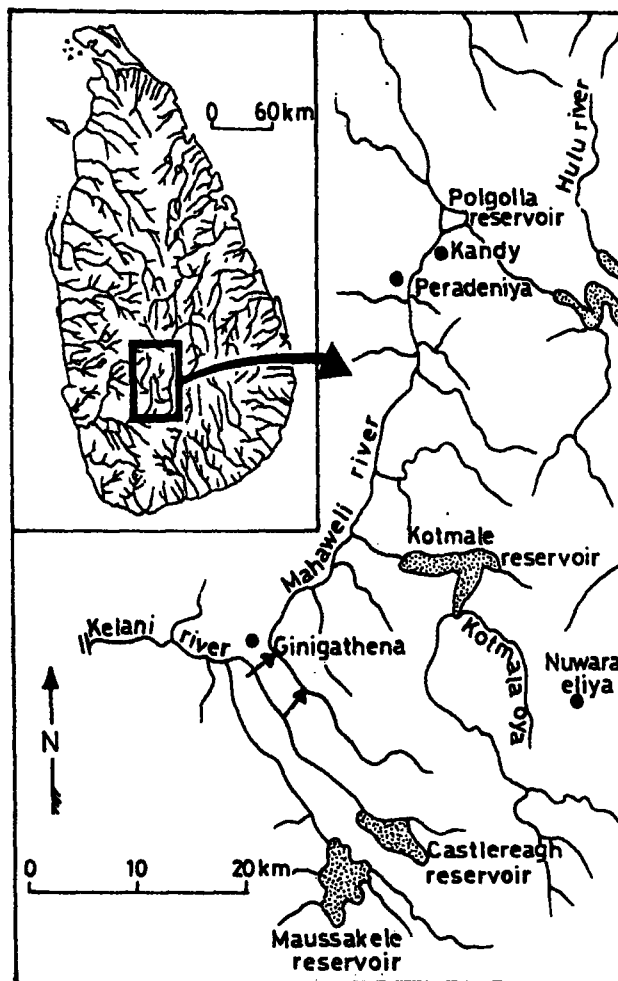


Fig. 1. Sampling areas (indicated by arrows) of a stream of *Mahaweli* river at *Ginigathena* area.

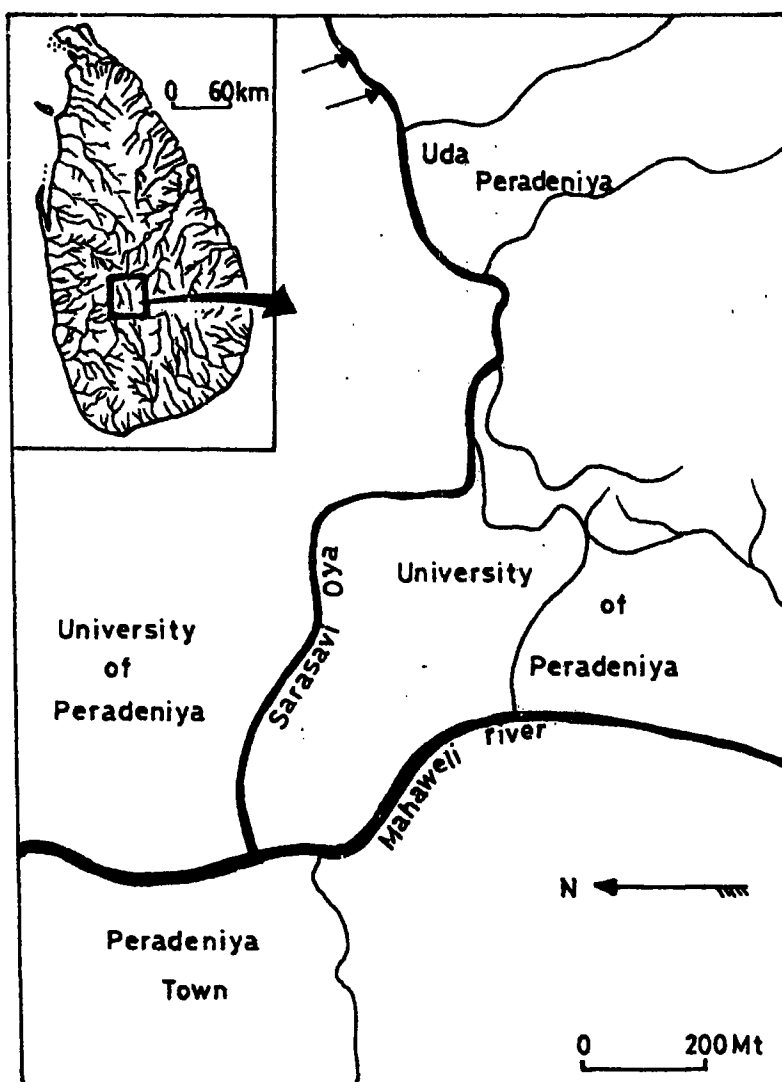


Fig. 2. Sampling area (indicated by arrows) of *Sarasavi Oya*, a stream of *Mahaweli* river at University of Peradeniya.

Table 2. Composition of the laboratory formulated feed.

Component	Percentage
Protein	46.3
Fibre	6.2
Dry matter	93.0
Ash	13.6

Study of morphometric and meristic characters

The total body length, standard length, head width, body width and depth, snout length as morphometric characters and number of fin rays and spines, number of gill rakers in the first gill arch as meristic characters were recorded in the adults of Spiny loach and Mountain banded loach using 10 fishes from each habitat *i.e.*, *Ginigathena* and *Sarasavi oya*. In differentiating rays from spines, branched ones were identified as rays while unbranched ones were counted as spines. A centimetre scale and a vernier caliper were used to take these measurements. Counting of fin rays and spines, and the observations of scales of fishes were done using a microscope.

Determination of Condition Factor

Condition Factor was calculated for the sample of 15 fish collected from *Ginigathena*, *Sarasavi oya* and also for laboratory reared fish. The standard length and live weight of fish were measured using a centimeter scale and an electronic balance, respectively. Sexes were not considered for the determination of Condition Factor due to the difficulties experienced in differentiating the sexes. Means of the Condition Factor were compared using the SAS package.

$$\text{Condition Factor (C)} = \frac{\text{Weight}}{(\text{Length})^3}$$

Feeding biology

Standard length, total length and gut length of the fish collected from both *Ginigathena* and *Sarasavi oya* were measured using a centimeter scale. Relative gut length was calculated for both fish types.

$$\text{Relative Gut Length (RGL)} = \frac{\text{Gut length}}{\text{Standard length}}$$

The food items present in the gut of each fish were counted separately in order to find out the most preferred feed type.

Study of reproductive biology

Identification of males and females

The morphometric and meristic characters of fishes of both types were compared to find a method to differentiate males from females. In addition, the nature of the cloaca was also studied in detail and slight pressure was applied on the vent of each mature fish in order to extract milt or eggs. Finally they were dissected to observe the type of gonad. Status of maturity of ovaries was also recorded.

Determination of fecundity and egg diameter

The ovaries were preserved in Gilson's fluid for one week to harden and extracted the eggs from the ovarian tissues (Bagenal and Braum, 1978). After one week, fecundity and egg diameter were measured using a magnifying glass/microscope and an eye piece micrometer and staged according to Nikolskii (1963). Mature males and females of Banded mountain loach could not be collected for this study.

RESULTS AND DISCUSSION

Morphometric and meristic characteristics of Spiny loach and Banded mountain loach

Morphometric and meristic characters of Spiny loach and Banded mountain loach are shown in Table 3 and Table 4 respectively.

According to Pethiyagoda (1991), the Banded mountain loach attains a maximum total length of 6 cm at maturation. However, a specimen measuring a maximum total length of 8.3 cm and standard length of 7.1 cm was caught from the *Sarasavi oya* in April 2001. Maximum total length of Spiny loach found during the study period was 5.5 cm and the standard length was 4.8 cm, which were comparable with those reported by Pethiyagoda (1991).

Table 3. Morphometric characters of Spiny loach and Banded mountain loach.

Morphometric characters (cm)	Spiny loach (Mean \pm S.E.)	Banded mountain loach (Mean \pm S.E.)
Standard length	4.03 \pm 0.18	5.66 \pm 0.19
Total length	4.80 \pm 0.12	6.83 \pm 0.24
Body depth	4.70 \pm 0.26	4.90 \pm 0.18
Body width	4.40 \pm 0.16	5.40 \pm 0.18
Head width	2.50 \pm 0.16	3.20 \pm 0.20
Snout length	2.50 \pm 0.16	2.20 \pm 0.13

Table 4. Meristic characters of Spiny loach and Banded mountain loach.

Meristic character	Spiny loach	Banded mountain loach
Dorsal fin rays and spines	I 8	I 7-8
Anal fin rays and spines	II 6	I 6
Pectoral fin rays and spines	II 5	I 8-9
Ventral fin rays and spines	I 6	I 6-7
Caudal fin rays and spines	IV 15	IV 16-17

Fin ray formulae of Spiny loach is D I 8, A II 6, P II 5, V I 6, C IV 15. The nature of the spine which was present in the inner side of the pectoral fin was found to be different in males from females. It is ossified in males whereas flexible in females. Fin ray formula of Banded mountain loach is D I 7-8, A I 6, P I 8-9, V I 6-7, C IV 16-17 and there was no difference in the nature of the spines of males and females. Fin rays of both types of loaches branched at the upper end of the fins. The meristic characters were not comparable with the former findings of Derniyagala, 1952; Munro, 1955 and Fernando, 1990 (Table 5).

The lateral line in Spiny loach was absent and an incomplete lateral line was found in Banded mountain loach. Both types of loaches had cycloid scales (Deraniyagala, 1952; Fernando, 1990).

Table 5. A comparison of fin ray formulae.

Author's name	Spiny loach	Banded mountain loach
Deraniyagala (1952)	D 2.6, A 2.5, P 1.6, V 1.6, C 16	D 3.6-8, A 3.5, P 1.7-9, V 1.6, C 16-18
Munro (1955)	D II 6, A ii 5; P I 6	D III 6-8, A III 5, P I 7-9
Fernando (1990)	D II 6, A II 5, P I 6	D III 6-8, A III 5, P I 7-9
Present study	D I 8, A II 6, P II 5, V I 6, C IV 15	D I 7-8, A I 6, P I 8-9, V I 6-7, C IV 16-17

Determination of the Condition Factor

Mean Condition Factor for Spiny loach caught from *Ginigathena* area was 0.015 ± 0.01 and for laboratory reared specimen was 0.011 ± 0.00 . The Condition Factor of *Ginigathena* area was found to be significantly higher than that of those fish reared in the laboratory ($P < 0.05$).

The natural habitat of Spiny loach is fast flowing streams with sandy and pebbled bottoms where it does not have any competition from other fishes. They are not so active and most of the time lie on the bottom, feeding on detritus which accumulates. Although these Spiny loaches were fed with the laboratory feed, the amount of feed intake was less since they were not used to such feeds. Therefore, the conditions available in their natural habitat were more suitable for them than in the laboratory.

In the case of Banded mountain loach the mean Condition Factor value for the *Sarasavi oya* was 0.013 ± 0.00 and for laboratory reared Banded mountain loach was 0.012 ± 0.00 . There was no significant difference between the Condition Factor in the two habitats ($P > 0.05$). Like the Spiny loach, the Banded mountain loach lives at the bottom of streams. All of them were found not in the flowing water area but in the pooled regions in the streams. The population in that area was extremely high and the availability of food items in their natural habitat probably were limited. Therefore, the conditions in the natural habitat were less conducive and it was comparable with the laboratory conditions.

Feeding biology

Gill rakers

Gill rakers on the 1st gill arch of the Spiny loach were 9-10 (Fig. 3) and 7-8 in Banded mountain loach (Fig. 4). Both the loach varieties had serrated and conical shaped gill rakers. However, the size of the gill rakers of the Banded mountain loach were smaller compared to Spiny loach. The less number of gill rakers indicate that these two varieties of loaches are omnivorous.

Relative gut length (RGL)

The mean Relative Gut Length of Spiny loach was 0.53 ± 0.21 and for Banded mountain loach was 0.42 ± 0.03 . These values indicate that both loach varieties have very small relative gut length and therefore they are omnivorous.

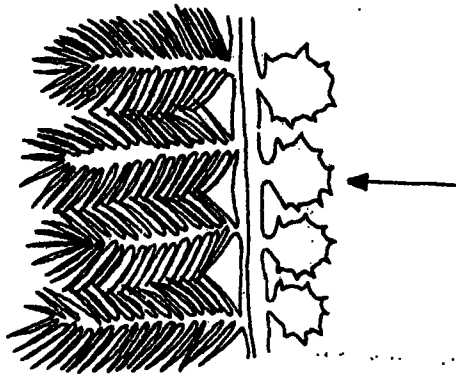


Fig. 3. Drawing of gill rakers of *Lepidocephalichthys thermalis*.
[Magnified: 10 x 10 x 2]

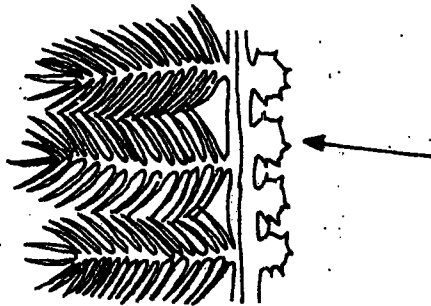


Fig. 4. Drawing of gill rakers of *Schistura notostigma*.
[Magnified: 10 x 10 x 2]

Gut analysis

The gut analysis of Spiny loach showed that they have fed only on detritus and in Banded mountain loach, some have fed on small insects and most of them on detritus. The Spiny loach lives in fast flowing streams and where the presence of phytoplankton and zooplankton are scanty. Therefore, they have had fed on the available feeds such as detritus which were accumulated at the bottom. The Banded mountain loach were found in pool areas of the stream, where there was shade. The availability of detritus as well as insects/insect larval forms at the bottom were higher than the phytoplankton and zooplankton.

Reproductive biology

An ossified spine was found on the inner side of the pectoral fin of mature males of Spiny loach. When a slight pressure was applied on the abdomen of the males, milt oozed from their cloaca. In the mature female of Spiny loach, an ossified spine was absent on the pectoral fin. Cloaca was dark red in colour. When a slight pressure was applied to the vent, yellow coloured eggs came out through the cloaca. Out of 30 Spiny loach which were caught from the natural habitat, only two mature females at the stage of V were found. When the ovaries were fixed separately in the Gilson's fluid, eggs of three different sizes were observed.

The mean diameter of the mature/yolky eggs was 500.10 μ , medium sized light yellow coloured eggs was 238.94 μ and small whitish coloured eggs was 61.12 μ . Mean number of mature yolky eggs or fecundity was 326 ± 0.02 . The other type of eggs were numerous than the mature eggs and counting those was very difficult. These results indicated that Spiny loach is a multiple spawner.

CONCLUSIONS

Spiny loach (*Lepidocephalichthys thermalis*)

The Condition Factor for Spiny loach (*Lepidocephalichthys thermalis*) collected from the stream of *Ginigathena* area is significantly higher ($P < 0.05$) than that of laboratory reared Spiny loaches. This result indicates that the culture conditions should be improved to achieve a better Condition Factor for captive breeding.

Number of gill rakers on the 1st gill arch, the mean RGL and the gut contents infer that the Spiny loach is an omnivorous feeder. The fin ray formula is D I 8, A II 6, P II 5, V I 6, C IV 15. An ossified inner spine was found in the pectoral fin of males whereas it was flexible in females. These findings are different from Demiyagala, 1952; Munro, 1955; Fernando, 1990. The present study confirms that this character could be used to differentiate the male from the female of Spiny loach. Due to the presence of three different sized eggs, the Spiny loaches can be considered as multiple spawners.

Banded mountain loach (*Schistura notostigma*)

The Banded mountain loach grows up to a maximum length of 8.3 cm which contradicts the findings of Pethiyagoda (1991). There is no significant difference between the Condition Factor of the fishes caught from the natural habitat and the laboratory reared ($P > 0.05$). Since the requirement is to achieve a better Condition Factor in the laboratory, favorable conditions and different feeding procedures should be provided.

The number of gill rakers on the 1st gill arch and the mean RGL with the gut contents confirm that Banded mountain loach is an omnivorous feeder.

There was no difference in the morphometric and meristic characters between males and females. Therefore, further studies should be carried out to differentiate sexes of the Banded mountain loach and their reproductive biology.

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