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SHORT COMMUNICATIONS

THE ECOLOGY AND DISTRIBUTION OF PERCID FISH *DARIO NEELA* FROM WAYANAD IN THE WESTERN GHATS OF KERALA, INDIA

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THE ECOLOGY AND DISTRIBUTION OF PERCOID FISH *DARIO NEELA* FROM WAYANAD IN THE WESTERN GHATS OF KERALA, INDIA

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Abstract: *Dario neela*, a newly described badid fish endemic to the Western Ghats is little known to science. Distribution and ecology of this species is not well documented. In this paper, we provide information on new records of this rare fish from Wayanad region of the Western Ghats and discuss its distribution, ecology and conservation.

Keywords: Badid fish, conservation, distribution, ecology, endemic, new records.

The genus *Dario* Kullander & Britz, 2002, of the family Badidae are known by three species from the Western Ghats, viz, *Dario urops* Britz, Ali & Philip, 2012, *D. huli* Britz & Ali, 2015, and *Dario neela* Britz, Anoop & Dahanukar, 2018. *Dario neela* is at present known only from the type locality, an unnamed stream joining Periya Stream a tributary of Kabini River in Wayanad, Kerala, 11.82416°N & 75.86250°E, 738m (Britz et. al 2018).

At present, the further distribution of *Dario neela* is not known, although the presence of *Dario* species in Wayanad is known from the collections by Francis Day about 140 years ago (Britz et al. 2012). The perusal of ichthyological literature until Britz et al. (2012) avows that none of them reported the presence of *Badis* or *Dario* from the Western

Ghats of Kerala and Wayanad in particular (Shaji & Easa 1995, 1997; Easa & Basha 1995). None of them could locate the specimens from Day's locality, which may either be due to the rarity of the species or unavailability of the exact location of Day's collection. *Dario neela* was described in 2018 based on the collections from Wayanad and the study also suggested that Day's collections were in fact *Dario neela* and not *Dario urops* (Britz et al. 2018).

A recent survey in the Kabini watershed of the Cauvery basin in Wayanad helped in documenting the further distribution of this species in the Kerala part of the Western Ghats (Fig. 1). We provide new information on the habitat and ecology of the species. Specimens were collected and a few were reared in captivity to study the social and reproductive behavior of the species.

MATERIALS AND METHODS

Fishes were collected mostly by sieving with clothes and mosquito nets. A few specimens were fixed in 10% formalin and transferred into 70% ethanol for permanent storage. Ten individuals with two males and eight females were selected, grouped and reared under captivity to study the

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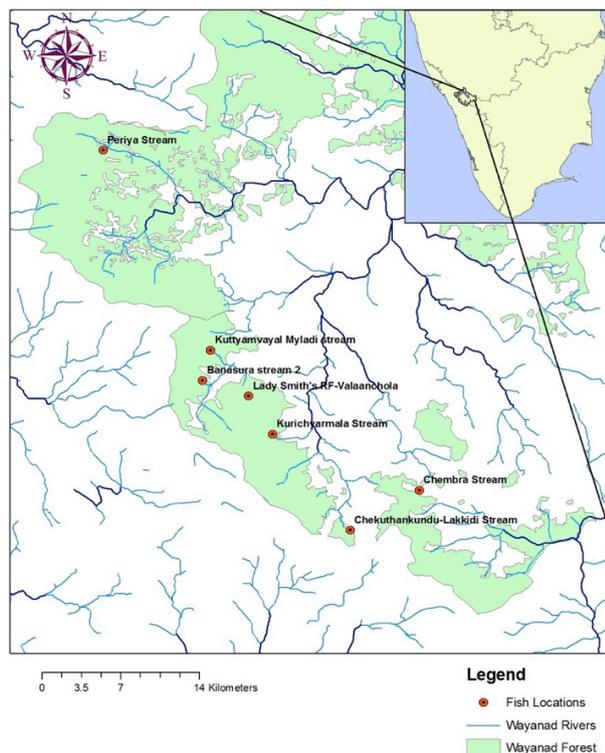


Figure 1. Distribution of *Dario neela* in Kabini watershed of Wayanad, Kerala

social and breeding behavior of the species.

Physical parameters of the stream habitat, viz, substrate, canopy cover, stream temperature, stream type, and stream width were recorded at each collection site. Substrate was classified as bedrock, boulder, cobble, pebble, gravel, sand, and mud. Canopy cover was measured using a spherical densiometer. Temperature was measured using a submersible digital thermometer (Mextex- Multi Thermometer). Elevation, altitude and latitude of sampling locations were recorded using global positioning system meter (Garmin- GPS 72H) ($\pm 10\text{m}$). Morphometric measurements were taken point-to-point to the nearest 0.1mm using digital calipers.

RESULTS

The morphological data of the species is given in Table 1.

There is an appreciable difference in the morphological attributes of male and female (Images 1 & 2). Males were larger than females with well-developed fin rays. The pectoral fin length and caudal fin length were found to be higher in males when compared with females. Caudal peduncle length and pre-anal length were higher in females.

Distribution in Wayanad

The specimens were collected from seven different

localities of South Wayanad Forest Division, viz., Kuttyamvayal-Myladi Stream and an unnamed stream of Banasura forests, Valaanchola Stream of Lady Smith's RF, Chekuthankundu Stream of Lakkidi RF (Image 4), two unnamed streams of Kurichyarmala and Chembra and from two locations in North Wayanad Forest Division, from the Periya Stream (Image 5) and the type locality, a small unnamed stream joining Periya Stream (Table 2). All these are lower order streams draining into Kabini, an east flowing river (Fig. 1). All these collection localities were sections of the streams flowing through evergreen forest patches and the species could be recorded from an elevation range between 700–1,050 m.

Habitat and Ecology

The flow rate was minimal and the collection localities were characterized mostly by pools and runs. The substrates were constituted by sand, mud, gravel, pebbles, boulders and bed rocks. Boulders and sand dominated in the study sites altogether (80%) and the average constitution of the pebbles and gravels were of 10% in the sites of collection. All the collection sites were characterized by heavy litter fall over various substrates. The water temperature varied from 17.9–22.6 °C. The canopy cover varied from 70.38–97.43 %. The physical parameters of various sites at the time of collection are given in Table 3. Shallow regions of the streams were heavily occupied by vegetation like *Lagenandra* sp., *Colocasia* sp. etc. which acted as fish cover. *D. neela* specimens were mostly collected from submerged leaf litter, tree roots, submerged vegetation and *Ochlandra* clumps. The co-occurring species recorded from various collection localities were *Devario* cf. *malabaricus*, *Barilius gatensis*, *Haludaria fasciata*, *Schistura* cf. *nilgiriensis*, *Schistura semiarmata* and *Neolissochilus wynaadensis*.

Although not a shoaling species, *D. neela* tend to live in small groups of 5–10 individuals in the wild, with a well-defined territory for each individual. The groups are typically formed by two males and several females defending territories near each other. In such groups, one male always dominated the other invariably. Larger dominant males defended larger territory when compared with the inferior male and females. The dominant males were darker colored (black with a bluish tinge) and the colour disappeared when the animal was stressed (Image 3). The distal margin of the fins were an iridescent blue-green. The inferior males were greyish brown in colour with faded brown vertical bands which fade away soon after preservation. The distal margin of fins were similar in colour and appearance to that of dominant males. Females were smaller than males and had a beige-brown colour on the body with irregular vertical bands and the fins were devoid of the iridescent colour. The

Table 1. Morphometric data of the *Dario neela* (n=11) collected from different locations in Wayanad.

Morphometric data (mm)	Range	Mean	SD
Total length:	28.4–38.6	33	5.1
Standard length:	23.1–31.1	27.2	4
Head length:	7.9–9.4	8.6	0.7
Eye Diameter:	2.4–2.6	2.5	0.1
Depth of body at D.O:	7.2–9.6	8.5	1.2
Depth of body at A.O:	6.4–8.9	7.8	1.3
Inter Orbital Width:	2.3–3.9	3.1	0.8
Snout Length:	0.6–1.9	1.2	0.6
Dorsal fin Height:	4.1–6.4	5.5	1.2
Pectoral fin Length:	4.2–6.8	5.2	1.3
Ventral fin length:	3.3–6.2	4.8	1.4
Anal fin Length:	3.4–6.9	5.4	1.8
Caudal peduncle length:	3.4–4.2	3.8	0.4
Caudal fin length :	5.3–7.5	5.8	1.5
Pre-dorsal length :	7.7–11.3	9.9	1.9
Pre-Anal length:	14.6–18.5	16.6	1.9
Pre–Pectoral length :	8.1–9.6	8.8	0.7
Pre- pelvic length:	8.6–10.5	9.6	0.9
Length of the base of dorsal fin:	12.5–16.1	14.4	1.8
Length of the base of Anal fin:	4.7–6.9	5.8	1.1
Inter nostril distance:	1.3–1.7	1.5	0.2
Height of Caudal peduncle:	2.3–4.2	3.5	1

Morphometric data (%SL)	Range	Mean	SD
Head length	30.2– 34.1	32.0	2.8
Eye diameter	8.3–10.3	9.4	1.4
Depth of body at dorsal origin	30.8– 32.4	31.5	1.1
Depth of body at anal origin	27.7–30.2	28.8	1.8
Inter orbital width	9.9– 12.5	11.2	1.8
Snout length	2.5 –6.1	4.2	2.4
Dorsal fin height	17.7–22.2	20.1	3.1
Pectoral fin Length	17.5–21.8	19.1	3.0
Ventral fin length	14.2–19.9	17.3	3.9
Anal fin Length	14.7–22.1	19.6	5.2
Caudal peduncle length	13.5–14.7	14.1	0.8
Caudal fin length	16.7–24.1	21.2	5.1
Pre-dorsal length	33.3–39.4	36.3	4.2
Pre-Anal length	59.4–63.2	61.3	2.6
Pre-Pectoral length	30.8–35.0	32.8	2.9
Pre-pelvic length	33.7–37.2	35.4	2.4
Length of the base of dorsal fin	51.7–54.1	53.2	1.6
Length of the base of anal fin	20.3–22.1	21.2	1.3
Inter nostril distance	5.4– 5.8	5.6	0.2
Height of caudal peduncle	9.9–15.3	12.9	3.7



Image 1. General appearance and colour differences in the dominant male, inferior male and female of *Dario neela* under natural conditions
A - Dominant male; B - Inferior male; C - Adult female

caudal spot was present in all specimens (Image 1).

Breeding behavior

The spawning behavior of *Dario neela* was studied in a well-planted glass tank, which mimicked the natural ecosystem from where the fish were collected. A large tank (190L) was used to study the social and breeding behavior of the species. Tank water properties like pH and temperature were almost similar to the stream condition. The tank was planted with locally available aquatic vegetation like *Lagenandra toxicaria* and *Cabomba* sp. Hiding spaces were provided in the form of large rocks and artificial caves. The substrate was set with sand and leaf litter collected from the streams.

Dominant males mostly occupied the heavily planted regions of the tank with enough hiding spaces and

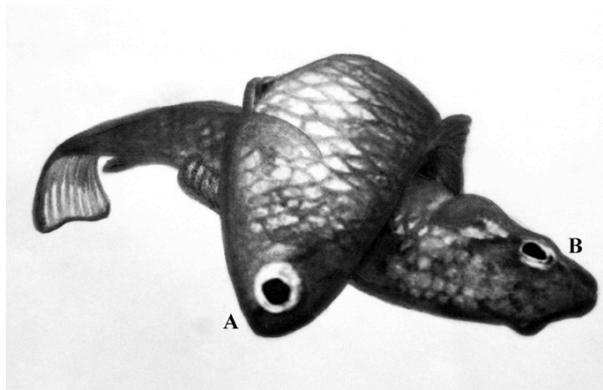


Figure 2. Simple U-loop spawning embrace in *Dario neela*: A - male, B - female



Image 2. Size differences in male and female specimens of *Dario neela*; A - male, and B - female

aggressively defended the territory (typically 40cm²) from the inferior male and females. Females were found to hide under leaf litter and rocks, while the inferior male defended smaller territory when compared to the dominant male.

Male *Dario neela* chased the females and displayed his bright colors to attract the females, shivering and shaking his body. Gravid females when ready to spawn followed the male to his territory. Mating is usually attained by a spawning embrace, where the mates wrap around each other (Fig. 2). The female released eggs after two to three fake matings and the males fertilized it. Eggs were usually scattered in dense vegetation, in caves or under leaf litter. After spawning, the male chased away the female preventing her from eating the eggs. Eggs were found to hatch within 48 hours in normal conditions, with the larvae hiding in vegetation immediately after hatching. Males were found to protect their territories aggressively after spawning.

DISCUSSION

Dario neela is the only species of badid fish known from the Western Ghats of Kerala. The present study described the distribution of this rare species in the Wayanad part of Nilgiri Biosphere Reserve. *Dario urops* was described based on the specimens collected from a stream draining into Barapole tributary of Valapattanam River in Karnataka and the specimens collected by Francis Day (1875–1878) from Wayanad were originally assigned to this species (Britz et al. 2012). A recent study (Britz et al. 2018), however, revealed that the specimens collected from Wayanad is in fact a separate species and named it as *Dario neela*, referring to its blue coloration.

Dario neela could not be recorded from any other locations outside Wayanad and in Wayanad the species could be recorded only from the east flowing streams draining into the Kabini River, suggesting that the species is



Image 3. Dominant male of *Dario neela* showing disappearance of dark body colours under stress
A - Dominant male under natural conditions; B - Dominant male after being handled - notice the disappearance of the natural dark colour.

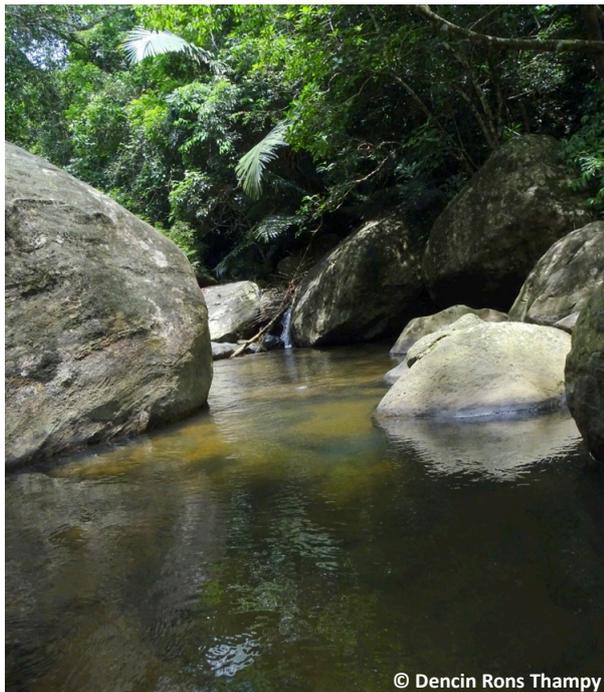
endemic to the Kabini River System in the Western Ghats of Kerala.

The population trends of this species is not well studied and the present study indicates that the species is a habitat specialist, recorded only from less disturbed clear water mountain streams which might have accounted for its rarity.

The antiparallel spawning embrace has been reported in Badidae, Anabantoides, Nandidae and Channidae by Barlow et al. (1968). A similar type of spawning embrace was observed in *Dario neela*. The present success in captive breeding helps in developing future ex situ conservation plans for this species.

Table 2. Physical settings of the habitat of *Dario neela*

Location	GPS location	Elevation (m)	Stream type	Stream width (m)	Substrate	Water temperature (C)	Canopy Cover (%)
Myladi-Banasura	11.66330°N & 75.93182°E	864.4	Pool	3	Sand (50%) Mud (50%)	19.00	89.45
Banasura-Unnamed Stream	11.63886°N & 75.92524°E	779	Run	3.3	Sand (40%) Mud (20%) Boulders (40%)	18.70	97.43
Valaanchola-Lady Smith's RF	11.62625°N & 75.96217°E	848.9	Run	4	Sand (30%) Gravel (10%) Pebbles (10%) Bed Rock (50%)	17.90	96.51
Chekuthankundu-Lakkidi RF	11.51808°N & 76.04332°E	857	Pool	7	Sand (70%) Boulders (20%) Gravel (10%)	18.60	95.98
Kurichyarmala-Unnamed Stream	11.59557°N & 75.98148°E	1019	Pool	2.5	Boulder (80%) mud (20%)	18.90	93.22
Chembra-Unnamed Stream	11.55043°N & 76.09874°E	1046	Run	2.2	Sand (80%) Mud (20%)	21.50	75.12
Periya Stream	11.82465°N & 75.84604°E	741	Run	8.5	Sand (50%) Mud (20%) Boulders (30%)	22.60	70.38
Type locality at a small unnamed stream flowing into Periya Stream	11.8241°N & 75.86250°E	738	Run	1.5	Sand (50%) Mud (10%) Boulders (40%)	21.43	76.52

**Image 4. *Dario neela* habitat - Lakkidi River****Image 5. *Dario neela* habitat - Periya stream showing dense growth of *Lagenandra toxicaria* in the shallow regions****REFERENCES**

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