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Biosystematics of the species *Xenentodon cancila* (Hamilton 1822) (Beloniformes: Belonidae) from Northeastern States of India, with special reference to sexual dimorphism

Rani Dhanze, Amarjit Debbarma and JR Dhanze

Abstract
Xenentodon cancila (Hamilton), is the only species of this genus inhabiting freshwater and uniformly distributed throughout the Indian subcontinent and South East Asian countries. While confirming the specific identity of fish species collected from Northeastern states of India, authors came across a lot of specimens tentatively identified as *Xenentodon* sp. However, on meticulous examination of series of specimens in respect of morphometric and meristic data and also gonad development it was observed that there is a distinct sexual dimorphism in the adult specimens of this species. Male can be distinguished from female of this species in respect of a combination of 16 morphometric proportions viz. (BD, HL %TL & SL; POL, PtOL, LJL, HD, PFL %HL; ED, IOW, PtOL %POL; HD, LCPD %BD; AFBL %AFL; LCPD, CFBL %CPL) as depicted in the (Table 1), besides a distinct hump in adult male (Fig. 1). Based on the evaluation of different morphometric traits a brief redescription of the species is provided.

Keywords: *Xenentodon cancila,* evaluation of taxonomic traits, sexual dimorphism

Introduction
Northeastern Region of India circumventing eight states is endowed with rich diversity of abundant water resources and biodiversity. One-third of India's runoff flows from the Northeast through the Brahmaputra and Barak rivers drainage system into the Bay of Bengal, traversing plain of Bangladesh, except a small area of Eastern Manipur, Nagaland and Mizoram, finds its way into Chindwin, a tributary of Irrawaddy, which flows through Yangon (*erstwhile* Rangoon) traversing its delta and falls into the Gulf of Martaban, a part of Andaman Sea. The fish fauna of these two drainage system are distinctly different in view of the geographical barrier constituted by the hill ranges such as Naga hills, Manipur hills and Longtharai. The region being situated at the trijunction of the Indo-Malayan and Palaearctic biogeography realms, encompasses a profusion of habitats characterized by diverse biota with a high level of endemism. The World Wide Fund for Nature (WWF) has identified the entire eastern Himalaya as a priority Global 2000 Eco region; and Conservation International has subsumed its eastern Himalaya "hotspot" into a wider Indo-Burma hotspot, which now includes all the eight states of the Northeast (Gurumyum, & Choudhury, 2006) [11]. During the systematic study of the fishes collected from entire Northeast Region of India under the Centre of Excellence for fishery and Aquaculture for Northeast, we observed some distinct features in respect of distributional pattern as well as bio systematic attributes, some of which are discussed in the present communication in respect of sexual dimorphic attributes of the species under the genus *Xenentodon*.

Xenentodon cancila is commonly known as the freshwater garfish which was described by (Hamilton-Buchnan, 1822) [13] as *Esox cancila* from the Gangetic province, subsequently (Day, 1877) [8] relegated the species to the genus *Belone cancila* which belongs to the family Belonidae under the order Beloniformes. However, Regan (1911) [28] erected a new genus *Xenentodon* (type-species: *Esox cancila* Hamilton-Buchanan) to accommodate all Garfishes or needle like fish from both fresh and estuarine habitat, diagnosed by the prolonged beak like jaws having canine teeth alternating with numerous conical teeth. Talwar and Jhingran (1991) [29] placed all Gar like fish taxa under the order Cyprinodontiformes but Nelson (1994) [19]

based on the comparative osteological attributes and relationship with other allied taxa considered all needle or gar fishes to be placed under the order Beloniformes, the classification which is being widely followed. Perusal of the published literature revealed that lots of biological studies (including length-weight relationship, food and feeding biology, breeding biology, occurrence, abundance, population dynamics and distributional pattern) have been conducted on *X. cancila*, by many researchers as the species is easily available in its widely distributional range (Gupta, 1971; Sehgal *et al*., 1989; Bhuiyan an Islam, 1990; Hussain *et al*., 2012; Bano *et al*., 2012; Suba and Meheta, 2012; Hossain *et al*., 2013; Chakrabarti and Banerjee, 2015; Gupta and Banerjee, 2017) [10, 23, 4, 16, 3, 26, 15, 5, 11], however, a little information is available regarding the extent of sexual dimorphism in respect of various body proportions. The taxonomic descriptions are scanty with a very less data on the morphometric and meristic range of variation associated with the age and growth, which led to the assumption that there may be some more species of the genus *Xenentodon* (Talwar and Jhingran, 1991) [29]. It is in this perspective that we have undertaken the biosystematics investigations of the species *X. cancila* from Northeastern states of India.

Materials and Methods

Under the project COE-FAB (Centre of excellence on Fisheries and Aquaculture Biotechnology) for Northeastern state of India, more than 18 extensive survey were conducted during the last four years (2013–2014), as a result 108 specimens of a different age and size groups of *Xenentodon* have been collected by using different gears, such as cast net, drag net, hand net, electro fishing equipment etc. The live colour patterns were noted, dissection of adult specimens conducted to know the sex followed by preservation in 10% formalin and tentatively identified as *Xenentodon cancila* (Hamilton, 1822). To ascertain the specific identification all the specimen were segregated sex wise after examination of their gonads and mensurated in respect of 43 morphometric characters with help of Digital Dial caliper (up to 0.01mm) and meristic counts with the help of binocular microscope. Out of total 43 morphometric characters, 38 proportions as percentage of different linear or vertical measurements for each specimen were considered as consistent and subjected to statistical analysis (to determine the range of variation, mean and SD) by employing the Microsoft Excel version 2007(12.0.4518.1014) service pack to analyze the data. These attributes include, standard length (SL), fork length (FL), head length (HL), body depth (BD) % total length; HL, BD, dorsal fin length (DFL), dorsal fin base (DFS), pectoral fin length (PFL), ventral fin length (VFL), anal fin length(AFL), caudal fin length(CFL), pre-dorsal length(PDL), post-dorsal length(Pt.DL), pre-pectoral length(PPL), pre-ventral length(PVL), pre-anal length(PAL), caudal peduncle length(CPL) % standard length; pre-orbital length(POL), post-orbital length(PtOL), upper jaw length(UJL), lower jaw length(LJL), head depth(HD), pectoral fin length %HL; eye diameter(ED), inter-orbital width(IOW), UJL, LJL, PtOL %POL; head depth (HD), caudal peduncle hight(CPH) %BD; anal fin base length(AFBL) %anal fin length(AFL); CPH %CPL (Table 1).

Material examined and deposited in the Referral Museum, COF, CAU, Lembucherra. *Xenentodon cancila* (Hamilton, 1822)

COF-CAU-291, 1ex, (155.59mm, SL), Naigram, Kachua river, Assam, N24^{0}05.524" E092^{0}25.291" Alt. 15m, 10.8.16, Coll. P. Biswas & Party.

COF-CAU-292, 2ex, (99.87–158.21mm, SL), Koliabhorma, Brahmaputra river, Assam, N26^{0}37.420" E092^{0}26.614" Alt. 56m, 21.10.16,Coll. P. Biswas, & Party.

COF-CAU-293, 1ex, (218.14mm, SL), Noigao, Sanai river, Assam, N24^{0}80.936" E092^{0}26.057" 8.8.16, Coll. P. Biswas & Party.

COF-CAU-294, 1ex, (150.38mm, SL), Sampara, Feni river, Tripura, N22^{0}59.017" E091^{0}39.058" Alt -18m, 28.3.17, Coll. Amarjit & Party.

COF-CAU-295, 1ex, (164.59mm, SL), People buai, Ghachumiabal river, Meghalaya, 03.10.13, Coll. Thongambidya Devi.

COF-CAU-297, 1ex, (152.45mm, SL), Ranigram, Sunai river, Assam, N24^{0}16.246" E092^{0}31.100" Alt: 13m, 08.8.16, Coll. P.Biswas & Party.

COF-CAU-296, 1ex, (143.18mm, SL), East suknacherra, Deo river, Tripura, N24^{0}00.776" E092^{0}11.834", 13.1.17, Coll. Hijam & Party.

COF-CAU-298, 2ex, (75.61–107.01mm, SL), Battali, Gomati river, Tripura, 22.3.15, Coll. Aktar Hossain.

COF-CAU-299, 1ex, (165.46mm, SL), Sikatode, Siang river, Arunachal Pradesh, 22.11.13, Coll. Ram Kumar.

COF-CAU-300, 7ex, (101.84–159.04mm, SL),Debbori, Gomati river, Tripura, 10.03.15, Coll. Panchali & Party.

COF-CAU-301, 1ex, (211.72mm, SL), Ekhyoyam village, Doyang river, Nagaland, N26^{0}18.429" E094^{0}21.843" Alt: 398m, 07.12.16, Coll. Himadri & Party.

COF-CAU-302, 1ex, (91.24mm, SL), Rajasala, Jingisam river, Meghalaya, 17.09.13, Coll. Thongambidya Devi.

COF-CAU-303, 3ex, (141.46–152.15mm, SL), Mamit, Dap river, Mizoram, 12.02.14.

COF-CAU-304, 2ex, (170.65–188.11mm, SL), Jampani, Siang river, Arunachal Pradesh, 13.10.13, Coll. Ram Kumar.

COF-CAU-305, 2ex, (171.88–184.95mm, SL), Bthyoyam village, Doyang river, Nagaland, N26^{0}18.429"E094^{0}21.843" Alt: 393m, 01.12.16, Coll. Himadri & Party.

COF-CAU-306, 1ex, (219.63mm, SL), Siyang, Umngot river, Meghalaya, N13^{0}00.148" E095^{0}01.342" 23.06.16, Coll. Jackei & Party.

COF-CAU-307, 1ex, (209.04mm, SL), Thakurcherra, Abang river, Tripura, N23^{0}11.399" E091^{0}36.590" Alt: 16m, 30.03.17, Coll. Amarjit & Party.

COF-CAU-308, 1ex, (177.26mm, SL), Lower bhalukpemg, Kameng river, Arunachal Pradesh, N27^{0}01.084" E092^{0}38.217" Alt: 288m, 16.05.16, Coll. J. R. Dhanze & Party.

COF-CAU-309, 5ex, (160.65–211.99mm, SL), Barkusiha, Brahmaputra river, Assam, 06.11.14, Coll. S. Kachari & Party.

COF-CAU-310, 1ex, (133.32mm, SL), Rudrasagar, Gomati river, Tripura, 21.09.13, Coll. Panchali Debnath & Party.

COF-CAU-311, 3ex. (123.39–135.59mm, SL), Darilang, Tuipawl river, Mizoram, 10.02.14.

COF-CAU-312, 1ex, (139.01mm, SL), Khayerpur, howra river, Tripura, N23^{0}50.819" E091^{0}20.686" 30.01.14, Coll. Panchali Debnath.

COF-CAU-313, 2ex, (116.65–125.89mm, SL), Forest Ghat, Brahmaputra river, Assam, N26^{0}36.978" E092^{0}47.519" Alt: 54m, 20.10.16, Coll. P.Biswas & Party.

COF-CAU-314, 1ex, (88.22mm, SL), Guramara, Katakhal river, Assam, N24^{0}48.651" E092^0 27.172" Alt: 14m, 11.08.16, Coll. P.Biswas & Party.

COF-CAU-315, 2ex, (92.28–137.61mm, SL), Chandpur,

Dhaleswari river, Assam, N24^{0}41.761" E092^{0}31.687" Alt: 10m, 11.08.16, Coll. P.Biswas & Party.
COF-CAU-316, 1ex, (201.21mm, SL), Mandirghat, Gomati river, Tripura, N23^{0}25.531" E091^{0}49.635" Alt: 64m, 08.03.14, Coll. Panchali Debnath & Party.
COF-CAU-317, 1ex, (135.45mm, SL), Khomphow, Umkham river, Meghalaya, N25^{0}43.471" E091^{0}50.820" 26.06.16, Coll. Jackei & Party.
COF-CAU-318, 1ex, (91.75mm, SL), Gwamara, Anais river, Assam, N24^{0}46.391" E092^{0}51.379" Alt: 12m, 12.08.16, Coll. P.Biswas & Party.
COF-CAU-319, 1ex, (197.19mm, SL), Suitual, Tuirini river, Mizoram, 17.12.13, Coll. Samar & Party.
COF-CAU-320, 1ex, (146.64mm, SL), Chantila, Juri river, Tripura, N24^{0}17.033" E092^{0}09.381" Alt: 12m, 12.01.17, Coll. Hijam & Party.
COF-CAU-321, 1ex, (142.58mm, SL), Pomluigma, Umpheilum river, Meghalaya, N25^{0}44.477" E091^{0}48.556" Alt: 681m, 29.06.16, Coll. Jackei & Party.
COF-CAU-322, 2ex, (90.49–93.88mm, SL), Rahimpur, Longhai river, Assam, N24^{0}42.678" E092^{0}36.609" Alt: 12m, 12.08.16, Coll. P.Biswas & Party.
COF-CAU-323, 2ex, (121.46–128.64mm, SL), Tilardia, Assam, 02.11.14.
COF-CAU-324, 1ex, (128.64mm, SL), Japhou, Chakpi river, Manipur, N24^{0}45.122" E094^{0}02.795" Alt: 792m, 21.01.14, Coll. Khogen & Party.
COF-CAU-325, 1ex, (160.56mm, SL), Wahuaba, Laitryngew river, Meghalaya, N25^{0}43.480" E091^{0}40.936" Alt: 612m, 28.06.16, Coll. Jackei & Party.
COF-CAU-326, 1ex, (157.74mm, SL), Sampara, Feni river, Tripura, N22^{0}59.017" E091^{0}39.058" Alt:18m, 28.03.17, Coll. Amarjit & Party.
COF-CAU-327, 1ex, (78.02mm, SL), Sangsangri, Daren river, Meghalaya, 03.08.13, Coll. Bidya Devi.
COF-CAU-328, 2ex, (123.38–154.13mm, SL), Bakshiganj, Teesta river, Sikkim, 12.04.14, Coll. Tanmoy & Party.
COF-CAU-329, 3ex, (165.61–187.83mm, SL), Teesta barrage, Teesta river, Sikkim, 09.03.14, Coll. Tanmoy& Party.
COF-CAU-330, 2ex, (128.17–135.08mm, SL), 3A, Teesta river, WestBangal, 08.3.14, Coll. Tanmoy & Party.
COF-CAU-331, 3ex, (123.65–136.11mm, SL), Gazaldoba, Teesta river, Sikkim, 15.01.13, Coll. Ram Kumar & Party.
COF-CAU-332, 1ex, (174.89mm, SL), Odlabari, Teesta river, Sikkim, N26^{0}51.935" E088^{0}37.408" Alt:169m, 09.03.16, Coll. Tanmoy & Party.
COF-CAU-333, 1ex, (104.60mm, SL), BOP Barun, Teesta river, Sikkim, N27^{0}18.096" E088^{0}53.272" Alt: 208m, 07.03.17, Coll. Sarat Kumar Yadav.
COF-CAU-334, 1ex, (135.96mm, SL), Mamashaghat, Teesta river, Sikkim, 23.04.15, Coll. Tanmoy & Party.
COF-CAU-335, 1ex,(143.53mm, SL), Jublipak, Teesta river, Sikkim, 07.03.17, Coll. Sarat Kr. Yadav.
COF-CAU-336, 2ex, (98.04–100.85mm, SL), Kodabari, Teesta river, Sikkim, 26.10.13, Coll. Azis & Suman.
COF-CAU-337, 3ex, (156.58–221.91mm, SL), Gazaldoba, Teesta river, Sikkim,15.07.13, Coll. Ram Kumar.
COF-CAU-338, 3ex, (120.51–131.57mm, SL), C.C. para, Teesta river, Sikkim, N26^{0}38.104" E088^{0}84.841" Alt: 252m, 05.12.14, Coll. Tanmoy.
COF-CAU-339, 2ex, (130.43–134.31mm, SL), C.C.Para, Teesta river, Sikkim, N26^{0}38.104" E088^{0}84.841" Alt: 252m, 05.12.14, Coll. Tanmoy.
COF-CAU-340, 2ex, (170.69–209.31mm, SL), Rangamati, Teesta river, Sikkim, 13.04.14.
COF-CAU-341, 1ex, (133.81mm, SL), Jublipak, Teesta river, Sikkim, N26^{0}31.184" E088^{0}44.307" Alt: 259m, 27.12.15, Coll. Tanmoy & Party.
COF-CAU-342, 1ex, (119.91mm, SL), Odlabari, Teesta river, Sikkim, N26^{0}51.935" E088^{0}37.408" Alt: 169m, 31.12.15, Coll. Tanmoy & Party.
COF-CAU-343, 2ex, (269.37–270.43mm, SL), Upper Siang, Siang river, Arunachal Pradesh, N28^{0}04.840" E095^{0}24.341" 19.03.16, Coll. J. R. Dhanze & Party.
COF-CAU-344, 2ex, (170.13–202.32mm, SL), Amolapathy, Brahmaputra river, Assam, N27^{0}45.205" E095^{0}04.419" Alt: 140m, 22.04.17, Coll. P.Biswas & Party.
COF-CAU-345, 1ex, (173.85mm, SL), Loharkheta, Assam, 02.11.14, Coll. A.das & Party.
COF-CAU-346, 1ex, (93.43mm, SL), Kolasib, Tuicheng river, Mizoram, 25.03.14, Coll. Samar & Party.

Results

Hamilton (1822) described *Esox cancila* from Gangetic province, which was subsequently relegated to different taxa by various researchers but finally as *Xenentodon cancila* (Hamilton) by Regan (1911) [28]. Till date the genus *Xenentodon* is considered as having only one freshwater species, however some author believes that there may be some more species under this genus (Rainboth, 1996) [27]. Therefore, we examined a series of specimens of different class intervals of this genus. From our cursory observation it appeared as if some of the specimen with greater body depth may be another species of this genus, however, on the analysis of morphometric data in respect of different body proportions (Table 1), it is inferred that the body depth in standard length and total length vary with the age and sex. Particularly the mature male specimen has a distinct muscular hump (crest) starting from occipital process to the middle of the body, which apparently differentiates it from rest of the specimens as a new species. But while considering the other taxonomy traits it is seen that those specimens with distinct hump fall within the morphometric range of different body proportion and meristic count of *Xenentodon cancila* (Table 1, Fig. 1). On examination of a series of specimens from smallest (84.71 mm) to largest (291.42 mm) it is observed that the development of hump started gradually in the male specimens of (144.08 mm) total length and the maximum growth of hump was seen in the largest (290.56 mm) specimens. Besides a conspicuous hump in bigger males, the other most distinguishing and consistence morphometric characters to differentiate male and female are (BD, HL %TL & SL; POL, PtOL, LJL, HD, PFL %HL; ED, IOW, PtOL %POL; HD, LCPD %BD; AFBL %AFL; LCPD, CFBL %CPL) as depicted in the (Table 1). Though, some of the earlier workers tried to establish the sexual dimorphism in this specie based on the colour pattern but in our field observation it is seen that coloration is not a dependable character as it varies with the age and habitat of the population, moreover the preserved specimens in the museum do not retain the original colour.

Fig 1: Male of *Xenentodon cancila* with a distinct Hump (close-up)

Fig 2: Male of *Xenentodon cancila* with Hump

Fig 3: Female of *Xenentodon cancila* without Hump

Fig 4: Assorted specimens of *Xenentodon cancila* (different age of both the sexes)

Discussion

Xenentodon cancila (Hamilton) is the only known freshwater species, widely distributed in almost all the lentic and lotic habitats of tropical and sub-tropical region of Indian subcontinent, however, some authors believes that there may be one more species with large scale inhabiting the brackish water of Indian peninsular region but yet to be described under this genus (Rainboth,1996, Talwar and Jhingran, 1991) [27, 29] and also some unpublished opinion of the researchers in view of the body contour variations. Perusal of the literature reveals that the description of *X. cancila* is also scanty in respect of various body proportions as a result leading to this taxonomic ambiguity at specific level (Talwar and Jhingran, *op.cit.*) [29]. It is in this perspective that we have undertaken this study so as to resolve the existing systematic ambiguity of *Xenentodon* species. Statistical analysis of different morphometric traits indicated that male and female of *X. cancila* exhibit allometric growth of different body proportions leading to distinct sexual dimorphism in adult specimens. Out of the 34 characters subjected to statistical analysis male and female differ in respect of 13 proportions significantly, which includes BD, %TL(8.83 vs. 7.15); BD %SL (9.58 vs. 7.74); HL %TL (35.42 vs. 37.04); HL %SL(38.43 vs. 40.07); POL, PtOL, LJL, HD, PFL %HL (62.21 vs. 64.54, 29.04 vs. 26.65, 57.59 vs. 59.72, 18.26 vs. 16.40, 22.26 vs. 19.67); ED, IOW, PtOL %POL(18.22 vs. 16.53, 18.46 vs. 15.80, 46.71 vs.41.37); HD, LCPD %BD(72.72 vs. 90.31, 27.16 vs. 32.01); AFBL %AFL(64.99 vs.68.65) respectively in male vs. female, however, when the data for both the sexes were pooled together, these characters indicated overlapping trends except head depth and least caudal peduncle depth %BD as delineated in bold (Table 1). Based on the evaluation of a total of 43 morphometric and meristic characters mensurated from 108 specimens of different size and age group collected from different states of Northeast India, we could clearly differentiate male and female, which would go in a long way to study breeding biology so as to consider this species for hatchery practices in view of the increasing aquarium fish trade in the country. A case of sexual dimorphism in *Xenentodon cancila* (Hamilton) from Pong Reservoir was first reported by (Sehgal *et al*., 1989) [24] but did not established the extent of sex specific morphometric variations as a result the subsequent researchers (Hossain *et al.,* 2013; Gupta and Banerjee, 2017) [14, 11] perhaps could not incorporate the different body proportion in the taxonomic description of this species. Therefore, based on our study we have drawn a brief description of *X. cancila*, delineating the numerical values of different proportions besides morphological characters, which would help the researchers to identify male and female of this species. All the specimens studied has been deposited in the referral Museum of college of Fisheries, Lembucherra under specific registration Nos. as mentioned in the material examined, for easy accessibility of future researchers in the region.

Description

Xenentodon cancila (Hamilton, 1822)

Esox cancila Hamilton-Buchanan, 1822, Fishes of Ganges: 213,380, pl.27, fig.70 (type-locality: Gangetic provinces).

Esox (Belone) *hindostonicus* Falconer, 1868, *Paleontological memoirs and notes of the late* Hugh Falconer,1:589 (type-locality "Saharanpoor", Uttar Pradesh); Myers 1960, *Stanford Ichthyol, Bull*., 7:245 (Status discussed).

Belone cancila: Day, 1877, *Fishes of India*: 511, pl. 118, fig.5; Day, 1889, *Fauna Br. India*, Fishes, 1:420, fig. 136.

Xenentodon cancila (Hamilton): Talwar and Jhingran, 1991, Inland Fishes of India and adjacent countries, 2: 743

Diagnostic characters

General body contour cylindrical, tapering gently from occipital region to the tip of snout; jaws disproportionately very long forming a beak like structure, gill rackers absent; dorsal placed far behind, originate almost at the same vertical line through anal fin origin, caudal fin truncate or slightly emarginated (Pl. I, fig. 1, 2).

D ii 14– ii 16; P i 8–i 11; V I, 5; A ii 15–ii 16; C ii 8+ii 7

Body very elongated, cylindrical and slightly compressed posterior one third. Head broad with a longitudinal groove on the dorsum but tapering from operculum to tip of snout; jaws disproportionately very long forming a beak like structure studded with canine teeth, lower jaw slightly longer than upper jaw. Gill opening wide but gill rackers on gill arches are absent. Adult males are with distinct muscular hump originating from the occipital process to mid dorsum. The size of the hump gradually increases with the overall growth in male specimens of 140mm to 300mm TL. The most consistent and reliable body proportions which we evaluated to distinguish male and female are body depth in male 9.58 (6.93–13.45) *vs.* female 7.74 (5.38–12.36) % SL, post-orbital head length male 46.71(41.02–52.76) *vs*. female 41.37 (34.66–52.09)) % HL, head depth male 72.72 (63.75–78.41)

vs. female 90.31(84.09–98.69) %BD, eyes are moderate in both the sexes, its diameter male 18.22(16.12–23.14) *vs.* female 16.53(13.71–19.94) %POL, inter-orbital width male 18.46(14.93–24.30) *vs*. female 15.80(12.63–21.51) %POL, post-orbital head length greater in male 46.71(41.02–52.76) *vs*. female 41.37(34.66–52.09) %POL, least caudal peduncle depth male 27.16 (19.38–34.62) *vs.* female 32.01(24.95–46.34) %LCPD, anal fin base length male 64.99(46.79–76.46) *vs*. female 68.65(50.90–83.97) %AFL (Tab. 1 & 2). Entire body covered with minute scales in irregular rows except opercular region. No sexual dimorphism was observed in respect of meristic characters (Table 2) and colour pattern Both the sexes are light greenish to dark greenish gray above lateral line and pale yellow below, 6–9 dark blotch along the lateral line which are more prominent in male, however the intensity of colouration varies with the habitat and preservation, museum specimens exhibit grayish colour above and pale slaty below (Pl. I, fig. 1–4).

Table 1: Comparative morphometric data of Male *vs.* Female specimens of *Xenentodon cancila*

	Male + Female(n=108)			Male(n=24)			Female(n=84)		
	Range	**Average**	**SD**	**Range**	**Average**	**SD**	**Range**	**Average**	**SD**
Total length	84.71–291.42	165.96		144.08–290.56	193.91		84.71–291.42	157.98	
% Total length									
Standradlength(SL)	89.58–94.30	92.38	0.93	90.39–94.01	92.20	0.94	89.58–94.30	92.43	0.93
Fork length (FL)	90.43–99.80	99.08	0.91	98.82–99.80	99.29	0.23	90.43–99.80	99.03	1.02
Head length (HL)	27.97–41.18	36.68	1.90	27.97–37.85	35.42	2.13	33.58–41.18	37.04	1.68
Body depth(BD)	4.95–12.47	7.53	1.29	6.44–12.47	8.83	1.32	4.95–11.52	7.15	1.02
% Standard length									
Head length (HL)	29.93–44.54	39.71	2.05	29.93–41.48	38.43	2.39	36.28–44.54	40.07	1.80
Body depth(BD)	5.38–13.45	8.15	1.40	6.93–13.45	9.58	1.40	5.38–12.36	7.74	1.10
Dorsal fin length(DFL)	6.32–11.10	9.39	0.79	7.42–10.66	9.58	0.66	6.32–11.10	9.34	0.82
Dorsal fin base length(DFBL)	11.23–16.66	14.65	0.86	14.15–16.66	15.28	0.65	11.23–16.26	14.47	0.83
Pectoral fin length(PFL)	6.24–12.12	8.00	0.90	7.03–10.83	8.52	0.76	6.24–12.12	7.85	0.88
Ventral fin length (VFL)	3.32–5.97	4.50	0.45	4.22–5.97	4.66	0.35	3.32–5.79	4.46	0.46
Anal fin length(AFL)	7.00–14.43	9.82	0.96	7.00–11.01	9.75	0.92	7.07–14.43	9.84	0.98
Caudal fin length(CFL)	6.53–11.02	8.79	0.86	7.34–11.02	9.10	0.90	6.53–10.86	8.71	0.84
Pre-dorsal length(PDL)	76.83–82.31	79.37	1.24	76.83–81.06	78.85	1.20	77.26–82.31	79.52	1.21
Post-dorsal lenght (PtDL)	4.39–7.72	6.07	0.75	4.91–7.30	6.22	0.70	4.39–7.72	6.02	0.76
Pre- pectoral length(PPL)	35.60–45.47	40.81	1.90	35.60–42.30	39.57	1.62	37.88–45.47	41.17	1.83
Pre-ventral length(PVL)	61.31–69.23	64.64	1.63	61.31–67.63	63.67	1.35	61.87–69.23	64.92	1.60
Pre-anal length(PAL)	76.59–81.95	79.55	1.18	76.59–81.15	78.95	1.29	77.42–81.95	79.72	1.09
Caudal peduncle length(CPL)	4.63–8.28	6.42	0.71	5.66–7.67	6.71	0.57	4.63–8.28	6.34	0.73
% Head length									
Pre-orbital length(POL)	60.15–68.33	64.02	2.05	60.19–64.64	62.21	1.17	61.10–68.33	64.54	1.96
Post-orbital length(PtOL)	23.37–33.63	27.18	1.91	26.52–33.63	29.04	1.65	23.37–31.67	26.65	1.63
Upper jaw length(UJL)	58.94–68.77	64.24	1.98	60.53–66.74	63.11	1.59	58.94–68.77	64.56	1.97
Lower jaw length(LJL)	54.14–64.81	59.25	2.20	54.14–60.60	57.59	1.78	55.23–64.81	59.72	2.09
Head depth(HD)	12.06–27.72	16.95	2.15	14.26–27.72	18.86	2.54	12.06–22.15	16.40	1.68
Pectoral fin length(PFL)	14.22–30.97	20.24	2.83	17.74–29.27	22.26	2.57	14.22–30.97	19.67	2.65
%Pre-orbital Head length									
Eye diameter(ED)	13.71–23.14	16.91	1.70	16.12–23.14	18.22	1.64	13.71–19.94	16.53	1.53
Inter-orbital width(IOW)	12.63–24.30	16.39	2.09	14.93–24.30	18.46	2.06	12.63–21.51	15.80	1.69
Upper jaw length(UJL)	90.24–99.97	98.24	1.47	95.26–99.79	98.18	1.35	90.24–99.97	98.26	1.51
Lower jaw length(LJL)	81.17–96.63	92.55	2.31	85.92–95.76	92.58	2.31	81.17–96.63	92.54	2.32
Post-orbital Head length(PtOL)	34.66–52.76	42.56	4.04	41.02–52.76	46.71	2.95	34.66–52.09	41.37	3.50
%Body Depth									
Head depth(HD)	63.75–98.69	86.40	3.35	63.75–78.41	72.72	3.92	84.09–98.69	90.31	4.01
Least Caudal peduncle depth(LCPD)	19.38–46.34	30.93	4.42	19.38–34.62	27.16	3.44	24.95–46.34	32.01	4.08
Anal fin base length(AFBL)% AFL	46.79–83.97	67.84	6.91	46.79–76.46	64.99	7.22	50.90–83.97	68.65	6.64
%Caudal peduncle length									
Least depth caudalpeduncle(LCPD)	29.88–51.01	38.75	4.10	29.88–47.77	38.40	3.82	29.88–51.01	38.85	4.20
Caudal fin base length(CFBL)	46.37–74.81	57.75	5.47	49.66–64.89	57.79	4.30	46.37–74.81	57.74	5.79

Table 2: Frequency distribution of meristic characters in male and female of *Xenentodon cancila*

Characters	**Male+Female**		**Male**		**Female**	
	Range	**Mean**	**Range**	**Mean**	**Range**	**Mean**
Dorsal fin rays	ii14–ii16	ii15	ii14–ii16	ii15	ii14–ii16	ii15
Pectoral fin rays	i8–i11	i10	i8–i11	i10	i8–i11	i10
Ventral fin rays	i5	i5	i5	i5	i5	i5
Anal fin rays	ii14–ii16	ii15	ii14–ii16	ii15	ii14–ii16	ii15
Caudal fin rays	15	15	15	15	15	15

Geographical distribution India

Widely distributed in all tropical and sub-tropical fresh waters of Indian sub-continent.

Fishery information Earlier the freshwater gar fish *X. cancila* was not considered as commercially important but now a days it is a good source of nutrition for poor people in the rural area, besides its use as experimental aquatic organism in different academic Institutions because of its abundance. Furthermore, with the advent of aquarium fish trade the demand of this species is increasing, however, with a little

breakthrough of its breeding in captivity in our country.

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