International Journal of Fisheries and Aquatic Studies 2016; 4(3): 528-531

ISSN: 2347-5129
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.352
IJFAS 2016; 4(3): 528-531

www.fisheriesjournal.com
Received: 06-03-2016
Accepted: 07-04-016

M Raja
Department of Biotechnology, Periyar University, Periyar Palkalai Nagar, Salem - 636 011, Tamil Nadu, India.

R Karthik Raja
Department of Biotechnology, Periyar University, Periyar Palkalai Nagar, Salem - 636 011, Tamil Nadu, India.

R Ramkumar
Department of Biotechnology, Padmavani Arts & Science College for Women, Salem - 636 011, Tamil Nadu, India.

M Kavitha
Department of Biotechnology, Periyar University, Periyar Palkalai Nagar, Salem - 636 011, Tamil Nadu, India.

D Aiswarya
Department of Biotechnology, Periyar University, Periyar Palkalai Nagar, Salem - 636 011, Tamil Nadu, India.

P Deepak
Department of Biotechnology, Periyar University, Periyar Palkalai Nagar, Salem - 636 011, Tamil Nadu, India.

P Perumal
Department of Biotechnology, Periyar University, Periyar Palkalai Nagar, Salem - 636 011, Tamil Nadu, India.

Correspondence
P Perumal
Department of Biotechnology, Periyar University, Periyar Palkalai Nagar, Salem - 636011, Tamil Nadu, India.

First report on the occurrence of abnormal vertebrae-containing Giant *Danio*-fish, *Devario aequipinnatus* (McClelland, 1839) in Stanley Reservoir of Cauvery River, Tamil Nadu (India)

M Raja, R Karthik Raja, R Ramkumar, M Kavitha, D Aiswarya, P Deepak and P Perumal

Abstract
Vertebral deformities in a wild specimen of Giant *Danio*- fish, *Devario aequipinnatus* (McClelland in 1839) (Cyprinidae: Danioninae), are reported for the first time from Stanley reservoir of Cauvery river. Radiological and morphological study of a normal and deformed fish revealed vertebral malformation in the caudal to the dorsal fin. Adverse environmental factors, such as chemical pollution of the habitat, are considered to be the cause of such deformities.

Keywords: Malformation, X-ray image, Western Ghats, India.

1. Introduction

The Giant *Danio* (*Devario aequipinnatus*) is a tropical fish belonging to the minnow family, Cyprinidae and it is one of the big sized among Danionins. This Giant *Danio*- fish, was described by McClelland in 1839 [1] from Assam and its members are distributed throughout the freshwaters of South and Southeast Asia, from Pakistan to Thailand [2]. It is a hill stream fish, inhabits streams as low as 300 m elevation. Its size ranges from around 40 to 80 mm in standard length and exhibit a colour pattern consisting of a series of bars and/or stripes [3]. Along the sides of the body. The fish is naturally accustomed to life under varying stream habitats. Also it has been found to be peaceful and hardy in aquaria. Giant *Danios* is abound in running streams and rivers, and are generally adopted to moderately cool and well-aerated water. It is a least concern species IUCN [4]. The Giant *Danio* species *Devario aequipinnatus* is intended to be a model species as it has gained a great importance in the field of developmental genetics, functional genomics, aquatic toxicology, neuro science and in many areas of biomedical research [5]. More recently, the Giant *Danio* has been proposed as a model to study skeletal muscle growth [6], cardiac remodeling and regeneration [7], visual impairment of retinal layer associated with diabetic retinopathy [5].

Deformities in teleosts have been occasionally found in wild populations [8, 9], and several such studies have focused on the deformities of the skeletal region and wide range of causes has been reported [10, 11]. Many such malformed fishes belonging to other orders have already been reported. *Viz*, *Labeo fimbriatus*, *Catla catla, Labeo rohita* [12]. *Cirrhinus mrigala* and *Hypothalmichthys molitrix* [13]. *Ompok bimaculatus*, *Mystus cavasius*, *Channa punctatus*, *Channa striatus*, *Heteropneustes fossilis*, *Notopterus notopterus* [14]. *Bagarius bagarius* [15]; *Mystus gulio* [16]. *Puntius denisonii* [17]. *Catla catla* [18]. *Clarias gariepinus* [19]. However, information about the abnormalities of *Devario aequipinnatus* is scanty and this is being reported for the first time, a case of deformity in wild populations of *D. aequipinnatus* from Stanley reservoir of Cauvery River.

2. Materials and Methods

During the course of regular fish samplings, a deformed specimen of *Devario aequipinnatus* (n=1) was caught by cast net from Stanley reservoir of Cauvery river, (11° 53' 21.33" N, 77° 50' 33.12" E), on 12th November. 2015. after taking photograph of the morphological abnormality with a digital camera (Canon 1100 Digital SLR), the fish was preserved in 7% Formalin solution.

The deformity was further examined by digital X-ray system (Fujifilm FCR Capsula XL II Reader). For the comparison purpose, a normal fish (Figs. 1 A & B) of same catch (Total Length= 89.1 mm, Standard Length= 73.1 mm, Total Weight= 7.495 g) was also collected. The collected specimens were transported to the Department of Biotechnology Cum Laboratory Museum of the Periyar University Museum of Natural History (PUMNH), Salem, Tamil Nadu (India). The specimens were with catalogue numbers (PUMNH 251/2015 & PUMNH 252/2015). The species identification and confirmation were carried out using the available literature [20, 21]. Morphometric measurements and meristic counts for taxonomic identifications were carried out by the following methods of Hubbs and Lagler [22]. Measurements were taken to the nearest 0.1mm using digital calibers. Head characters are expressed as proportion of Head Length (%HL), Head length and body characters are expressed as proportion of standard length (%SL).The species valid nomenclatural names were adopted as per the Catalogue of Fishes of the California Academy of Sciences [23] and fish status was checked in IUCN red list (IUCN, 2013).

3. Results

3.1 Description of the deformed specimen

The collected solitary aberrant specimen of *Devario aequipinnatus*, measuring total length of 82.9 mm, standard length of 64.6 mm and total weight of 7.105g was recognized by the presence of post-dorsal dome and a trough between dorsal and caudal regions (Figs. 1 A & B). The number of lateral line scales was 34 in both normal and abnormal fish. The lateral line scales was normal and have run from anterior to the posterior end of the body. In this aberrant fish specimen, lateral line, after 17th scales, posteriorly formed a trough follows by a dome between 18th to 34th scales. Number of fin rays in paired and unpaired fins of this aberrant fish showed no deviation from the normal fish (Table. 1). Dorsal fin with iii.12 rays; anal fin with iii.13 rays; principal caudal-fin rays 10+9; pelvic-fin rays i.7; pectoral-fin rays i.12. Pectoral-fin origin slightly anterior to vertical through posterior- most point of opercular opening, not reaching to pelvic-fin origin when depressed. Pelvic-fin origin well in advance of dorsal-fin origin, posterior most tip of pelvic fin reaching to vertical through dorsal-fin origin. Dorsal-fin origin anterior to anal-fin origin, its distal margin straight to weakly convex. Anal-fin origin opposite to point of insertion of 4th branched dorsal-fin ray, its distal margin straight. Caudal fin forked, its lobes rounded distally, upper lobe slightly longer than lower lobe. Lateral line complete, declining steeply for first 7–8 scales, perforating 33 body scales along its length. 12 scale rows around caudal peduncle; pre-dorsal scales 16.

Body ratio showed a well-marked variation from the normal fish (Table 2). Head and body compressed. Body depth was greatest at pelvic-fin origin. Dorsal body surface profile slightly more rounded than ventral body surface profile. Snout was shorter, slightly greater in length than eye diameter. Cleft of mouth oblique and extending to under the anterior margin of the orbit; a bluntish knob at symphysis. A large, rounded symphysial knob present on lower jaw, fitting into shallow groove on inner margin of upper jaw with mouth closed**.** Two pairs of barbels. Rostral barbels reaching to or slightly past anterior margin of orbit. Maxillary barbels short, less than half as long as rostral barbels. Dorsal surface of head with well-developed skin grooves along supraorbital shelves. A single row of small, conical tubercles present along upper margin of lower jaw.

When compared to the normal fish the deformed specimen of *D. aequipinnatus* possessed vertebral abnormality in the post-dorsal fin region. Further the radiological examination has revealed the presence of 35 and 34 vertebrae, in normal and abnormal fish, respectively (Figs.2 A & B). Vertebral column, in the aberrant fish, between 1st to 12th vertebrae, formed an arc giving the appearance of a dome. Between 13th to 27th vertebrae, vertebral column formed a semi-circular trough, 13th to 15th vertebrae formed the anterior limb of trough, 16th to 25th vertebrae the bottom and 26rd to 28th vertebrae formed the posterior limb of trough. Vertebrae have reduced intervertebral space and vertebral thickness. Posteriorly, vertebral column between 29th to 34th vertebrae slightly truncated and vertebral thickness and intervertebral spaces reduced.

Fig 1: Normal (A) (live) and Deformed (B) (Formaldehyde fixed) specimens of *Devario aequipinnatus*

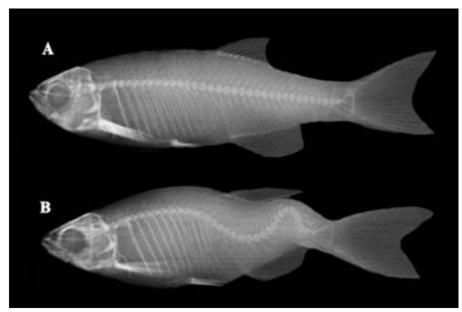

Fig 2: Digital X-ray image of *Devario aequipinnatus* Normal (A) and Deformed (B)

Table 1: Meristic counts of normal and abnormal specimens of *Devario aequipinnatus*. NS: Normal specimen; DS: Deformed specimen.

S.No	Meristic counts	NS (n=1)	DS (n=1)
1	Unbranched dorsal fin rays	3	3
2	Branched dorsal fin rays	12	12
3	Unbranched anal fin rays	3	3
4	Branched anal fin rays	13	13
5	Unbranched pelvic fin rays	1	1
6	Branched pelvic fin rays	7	7
7	Unbranched pectoral fin rays	1	1
8	Branched pectoral fin rays	12	12
9	Caudal fin upper lobe	10	10
10	Caudal fin lower lobe	9	9
11	Lateral line scales	34	33
12	Predorsal scales	14	14
13	Upper transverse rows	6.5	6.5
14	Lateral line to pelvic scale rows	4.5	4.5
15	Lower transverse rows (anus)	3.5	3.5
16	Circumpeduncular scales	12	12
17	Anal scale rows	2	2

Table 2: Morphological measurements of normal and abnormal specimens of *Devario aequipinnatus*. NS: Normal specimen; DS: Deformed specimen.

	Morphometric counts	NS (n=1)	DS (n=1)
1	Total length (mm)	89.1	82.9
2	Standard length (mm)	73.1	64.6
3	Snout to urocentrum	98.5	98.6
4	Preanal length	62.9	67.2
5	Predorsal length	59.2	62.5
6	Prepelvic length	34.4	50.3
7	Prepectoral length	25.8	27.5
8	Peduncle length	27.1	23.1
9	Dorsal origin to pelvic insertion	29.7	32.9
10	Dorsal spinous height	19.7	28.7
11	Anal fin height	15.8	18.6
12	Peduncle depth	11.4	11.5
13	Caudal fin length	25.2	30.9
14	Dorsal fin height	20.1	25.0
15	Pectoral fin length	21.8	23.5
16	Pelvic fin length	14.2	17.0
17	Pelvic auxiliary scale length	4.7	4.7
18	Occiput to dorsal origin	42.7	40.9
19	Occiput to pectoral insertion	20.7	45.7
20	Occiput to pelvic insertion	36.4	45.7
21	Dorsal insertion to pelvic insertion	18.6	25.1
22	Dorsal origin to pectoral insertion	27.1	31.1
23	Dorsal origin to anal origin	27.4	31.0
24	Dorsal insertion to caudal base	22.1	30.0
25	Dorsal insertion to anal insertion	17.6	17.8
26	Dorsal fin base length	22.5	19.0
27	Anal fin base length	21.2	16.0
28	Pectoral insertion to pelvic insertion	21.5	19.6
29	Pectoral insertion to anal origin	40.7	35.8
30	Pelvic insertion to anal origin	14.2	15.9
31	Post dorsal length	43.3	33.7
32	Body depth	26.4	35.8
33	Distance b/w pectoral fin to vent	38.2	36.0
34	Distance b/w pelvic fin to vent	17.4	17.1
35	Head length (mm)	18.7	18.3
36	Snout to opercle	87.8	67.9
37	Upper jaw length	30.9	30.1
38	Snout length	18.0	24.7
39	Prenasal length	15.9	11.8
40	Orbit width	35.0	31.9
41	Interorbital width	29.4	28.5
42	Internasal width	24.6	25.1
43	Preoccipital length	76.4	75.5
44	Head width	94.5	84.1
45	Lower jaw to isthmus	103.6	69.2
46	Head depth at nostril	39.6	37.5
47	Head depth at pupil	61.6	63.6
48	Head depth at occiput	90.7	83.6

3.2 Coloration
In life, yellowish white; a wide bluish band extends along the body from the eye to the centre of the base of the caudal fin; in its course are sometimes several round silvery spots; below it was another narrow band (which occasionally joined the central one anteriorly); there were two other lighter bands above the central one. The intermediate ground colour was yellow. Fins yellowish. Dorsal and anal fins each with a broad bluish band along their outer half. In some specimen there was a dark mark behind the gill opening. Median fins with light scattering of small melanophores along interradial membranes, except anterodistal most tips of dorsal and anal fins, which are devoid of pigment. Pectoral and pelvic fins without pigmentation.

4. Discussion
In fish, individual and population levels of abnormality have been shown to be positively related to a wide range of abiotic, biotic and genetic stresses. Environmental stress can give rise to decreased developmental stability of individuals, which may result in reduced performance of fitness components [24, 25]. Abiotic factors such as acidification, toxic chemicals or heavy metals are considerable to be the common stressors that produce an elevated levels of deformities [26, 27, 28]. From the present study, it is clear that the fish teratology is very complex and cannot be attributed to a single factor but it would have been due to the effect of multiple factors such as pollution, salinity fluctuations, low level of dissolved oxygen, radiation etc. However, genetic study of these fishes would help us to find out the exact cause of these abnormalities and still further study is needed.

5. Acknowledgements
The first author is grateful to SERB- DST (Government of India) – for approval of Startup Research Grant for Young Investigators (File No. DST No. SB/YS/LS-36/2013) to carry out this study. The authors of this research work are thankful to Tamil Nadu - State Inland Fisheries Department, and Mr. S. Mathiyalagan Mettur Dam for their kind support fish samplings.

6. References
1. McClelland J. Indian Cyprinidae. Asiatic Researches, 1839; 19:217-471.
2. Barman RP. A taxonomic revision of the Indo-Burmese species of Danio, Hamilton Buchanan (Pisces: Cyprinidae). Records of the Zoological Survey of India. Occasional Paper 1991; 137:1-91.
3. Fang F. Redescription of *Danio kakhienensis*, a poorly known cyprinid fish from the Irrawaddy basin. Ichthyol. Explor. Freshw 1997a; 7:289-298.
4. IUCN. Red List of Threatened Species. 2013. Version, 2013. Electronic Database accessible at http://www.iucnredlist.org/.
5. Raja M, Kavitha M, Ramkumar R, Anandhi M. Perumal P. The 'Giant *Danio'* (*Devario aequipinnatus*) - Another Model for Diabetic Retinopathy Study: Induction of Hyperglycemia and Resultant Retinal Impairment. Endocrinol Diabetes Res., 2015; 1:2.
6. Biga PR, Meyer J. Growth hormone differentially regulates growth and growth-related gene expression in closely related fish species. Comp Biochem Physiol A Mol Integr Physiol., 2009; 154:465-473.
7. Lafontant PJ, Burns AR, Grivas JA, Lesch MA, Lala TD, Reuter SP, *et al*. The Giant *Danio* (*D. aequipinnatus*) as a model of cardiac remodeling and regeneration. Anat Rec (Hoboken) 2012; 295:234-248.
8. Sennar IW. An Evolutionary Ecological Perspective. In: Soule, M.E. and Wilcox, B.A. (Eds.). Conservation Biology., California University Press, California. 1980, 161.
9. Tutman P, Glamuzina B, Skaramuca B, Kozul V, Glavic N, Lucic D. Incidence of spinal deformities in natural populations of sandsmelt, *Atherina boyeri* (Risso, 1810) in the Neretva River Estuary, middle Adriatic. Fish. Res 2000; 45:61-64.
10. Orska J. Anomalies in the Vertebral column of the pike *Esox lucicus*. Acta Biological Cracovtenym Series of Zoology 1962; 5:327-345.

11. Koumoundouros G, Gagliardi F, Divanach P, Boglione C, Cataudella S, Kentouri M. Normal and abnormal osteological development of caudal fin in *Sparus aurata* L.fry. Aquaculture 1997; 149:215-226.
12. Pilli CT, Thampy DM. Cases of deformities in some cultivable fishes. Indian J Fish. 1990; 37:171-173.
13. Panday KD, Awasthi SK. In: Dehadari PV, Das P, Verma, SR. (Eds.). Threatened fishes of India Nature conservators, Muzaffarnagar, 1994, 480.
14. Raj AJA, Seetharaman S, Haniffa MA. Skeletal deformities in few freshwater fishes from Bhavani River, Tamil Nadu. J Zoos print. 2004; 19(9):1628-1629.
15. Subba BR. Abnormality in *Bagarius bagarius* (Ham.) (Cypriniformes: Sisoridae) from Nepal. Our Nature. 2008; 6:26-29.
16. Marimuthu K, Haniffa MA, Muruganandam M, Raj AJA, Johnson A. Vertebral column deformities in a freshwater catfish *Mystus gulio.* Indian J Fish. 2000; 47(4):391-393.
17. Sajan S, Anna-Mercy TV, Malika V. Record of a wild specimen of Redline torpedo fish, *Puntius denisonii* (Actinopterygii: Cyprinidae) with vertebral deformity Anales de Biología. 2014; 36:33-35.
18. Wani MA, Dutta SPS. First Record of an Anomalous *Catla catla* (Ham. Buch) in Fresh Water Fish Ponds of Gurdaspur District, Punjab (India). J Aquac Res Development. 2014; 5:246.
19. Alarape SA, Hussein TO, Adetunji EV, Adeyemo OK. Skeletal and Other Morphological Abnormalities in Cultured Nigerian African Catfish (*Clarias Gariepinus*, Burchell 1822). IJFAS 2015; 2(5):20-25.
20. Talwar PK, Jhingran AG. Inland fishes of India and adjacent countries. Oxford and IBH Publishing Co., New Delhi. 1991, 2000; 1, 2:1-1158.
21. Jayaram KC. The freshwater fishes of the Indian Region. Narendra Publishing House, New Delhi, India. 2010, 616.
22. Hubbs CL, Lagler KF. Fishes of the Great Lake region. Ann Arbor: University of Michigan press. 1964, 213.
23. Eschmeyer WN, Fricke R. Catalog of Fishes electronic version. Electronic database accessible at 2011, 2016. http://research.calacademy.org/research/ichthyology/ catalog/ fishcatmain.asp/.
24. Clarke GM. Relationships between developmental stability and fitness: application for conservation biology. Conserv. Biol 1995; 9(1):18-24.
25. Moller AP, Swaddle JP. Asymmetry, developmental stability, and evolution. Oxford Series in Ecology and Evolution. Oxford University Press, New York. 1997, 291.
26. Allenbach DM, Sullivan KB, Lydy MJ. Higher fluctuating asymmetry as a measure of susceptibility to pesticides in fishes. Environ. Toxicol. Chem., 1999; 18:899-905.
27. Franco A, Malavasi S, Pranovi F, Nasci C, Torricelli P. Ethoxyresorufin Odeethylase (EROD) activity and fluctuating asymmetry (FA) in *Zosterisessor ophiocephalus* (Teleostei, Gobiidae) as indicators of environmental stress in the Venice lagoon. J Aquat. Ecosyst. Stress Recov. 2002; 9(4):239-247.
28. Estes ECJ, Katholi CR, Angus RA. Elevated fluctuating asymmetry in eastern mosquitofish (*Gambusia holbrooki*) from a river receiving paper mill effluent. Environ. Toxicol. Chem., 2006; 25:1026-1033.