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COMMUNICATION

LENGTH-WEIGHT RELATIONSHIPS OF TWO CONSERVATION-CONCERN MAHSEERS (TELEOSTEI: CYPRINIDAE: TOR) OF THE RIVER CAUVERY, KARNATAKA, INDIA

Adrian C. Pinder, Rajeev Raghavan, Shannon D. Bower & J. Robert Britton

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Length-weight relationships of two conservation-concern mahseers (Teleostei: Cyprinidae: *Tor*) of the river Cauvery, Karnataka, India

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Abstract: Length-weight (LW) relationships are presented for two conservation-concern species of mahseer (*Tor* spp.) from southern India's river Cauvery. Constructed from angler catch data, these are the first available LW relationships for the Critically Endangered *Tor remadevii* and the non-native and locally invasive *Tor khudree*. For *T. remadevii*, the value of *b*, the allometric parameter, was 2.94 (95% CI: 2.75–3.14) and was not significantly different from 3.0, indicating isometric growth ($t = 0.61$, $P = 0.54$). For *T. khudree*, *b* was greater at 3.18 (95% CI: 3.01–3.38), but with this also not significantly different from 3.0 ($t = 1.91$, $P = 0.06$). Outputs are discussed with reference to species conservation and recreational catch-and-release fisheries.

Keywords: Angling, Critically Endangered, invasive fish, *Tor khudree*, *Tor remadevii*.

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Author details: ADRIAN PINDER is based at Bournemouth University (UK) and is the Director of Research at the Mahseer Trust. He is a fish ecologist with a special interest in the conservation of threatened species. RAJEEV RAGHAVAN is interested in conservation of aquatic biodiversity of Western Ghats with special reference to freshwater fishes. SHANNON BOWER's primary area of research is fish and fisheries, with an emphasis on recreational fisheries, social-ecological systems analysis, sustainable development, and partnerships. This work has taken her around the world, offering insights into the role cultural systems and beliefs play in our relationships with the world aquatic and the solutions we create to solve our problems. ROB BRITTON is a Professor at Bournemouth University. His research interests cover the impacts on aquatic fauna of anthropogenic stressors, including invasive alien species, habitat loss and climate change.

Author contribution: All authors contributed equally to the study design and data collection. ACP and JRB did the data analysis. ACP wrote the first draft. All authors contributed equally finalizing the manuscript

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infinity



INTRODUCTION

Despite its global iconic status as a premier sport fish and the largest growing of all mahseers (*Tor* spp.) (Pinder et al. 2019), the formal taxonomic identity of the mega-faunal Hump-backed Mahseer has until recently eluded ichthyologists since first being brought to their attention in the 19th century (Jerdon 1849). Now known to be endemic to the Cauvery River catchment (Pinder et al. 2015a), recent research has confirmed this fish to be conspecific with *Tor remadevii* (Pinder et al. 2018a), a species for which the formal description was based on 19 juvenile specimens collected from the river Pambar, the southernmost tributary of the river Cauvery in Kerala, India (Kurup & Radhakrishnan 2007, 2010). Due to estimated population reductions in excess of 90% and an extremely limited distribution range, *T. remadevii* was recently assessed as Critically Endangered on the IUCN Red List of Threatened Species (Pinder et al. 2018b), making it the most imperilled of all *Tor* species.

Introductions of *T. khudree* into the river Cauvery from the 1970s has been implicated in the collapse of the endemic *T. remadevii* population (Pinder et al. 2015a; Pinder et al. in press). In recognition of the non-native and invasive status of *T. khudree* outside its native distribution range, India's current National Wildlife Action Plan 2017–2031, includes the action of actively removing *T. khudree* from Cauvery, through angling or other suitable means, to reduce the population of this undesirable species. This goes hand-in-hand with a further recommendation, that captive bred 'orange-finned' mahseer *T. remadevii* should be stocked to assist the recovery of this endemic species (Ministry of Environment, Forests and Climate Change, 2017). Furthermore, due to the establishment of *T. khudree* beyond its native range throughout much of southern India (see Pinder et al. in press), this species has recently been reassessed on the IUCN Red List from Endangered to Least Concern (de Alwis Goonatilake et al. 2020).

Here, the derivation of length-weight relationships from data collated from angling catches on the river Cauvery provides important biological parameters for both species for the first time. The results are discussed in relation to their indication of body allometry, their contributions to existing knowledge and persisting knowledge gaps which require urgent attention to better understand the biological and ecological mechanisms which may drive competitive interactions between these two species. Outputs are also discussed in the context of recreational catch-and-release fisheries and how stakeholders can utilise the data presented here to

assist the urgent conservation of *T. remadevii*.

MATERIALS AND METHODS

Historic length-weight statistics for *T. remadevii* were recovered from the former angling camps and protected reaches of the middle River Cauvery that extend across 24km between Doddamakali Nature Camp (12.307°N & 77.215°E) and Mekedatu Gorge (12.259°N & 77.447°E), Karnataka, India (Fig. 1). Data used in the analysis date from 1976 to 1990 and were seasonally restricted between the months of December and May when river flows are suitably reduced to allow the recreational fishery to operate. These fish were captured by rod-and-line angling, with their fork lengths and weights recorded before release. Lengths were measured using non-rigid tape measures and weights from 'spring-balances'. For the latter, due to the combination of the size of some of the fishes (> 40kg) and their recording in field conditions, the weights were typically recorded to the nearest 250g.

For *T. khudree*, length-weight data of individual fish were collected from the upper river Cauvery (Ammangala Village, Valnur; 12.457°N & 75.960°E, in Kodagu District (Coorg), Karnataka, India (Fig. 1) during March 2014 and between February and April 2015. Captured using rod and line tactics, the data for each fish were recorded by trained fishery professionals. Fish lengths (FL) were recorded using a standard rigid measuring board (to 0.1cm) and weights recorded using a protective weigh sling and a spring balance appropriate to individual fish size (models: Salter Super Samson 20kg/100g and 5kg/25g). All fish were released following their processing.

To assess the length-weight relationships of each species, and to, thus, investigate allometry, their data were fitted to the linear form of the length-weight power function $W = aFL^b$, where a is the intercept parameter (shape coefficient) and b is the regression coefficient (allometric parameter), and where the linearised form of the equation is $\ln(W) = \ln(a) + b\ln(FL)$. In fishes, when the value of b is not significantly different from 3.0 (tested here via a 2-tailed t-test), it implies isometric growth, where there is a cubic increase in fish weight as length increases (Ali et al. 2013). If b is significantly lower than 3.0, it implies negative allometric growth and significantly higher than 3.0 implies positive allometric growth (Riedel et al. 2007). Should non-isometric growth be apparent then the factors driving this deviation can be explored (Ali et al. 2013).



Figure 1. River Cauvery showing the 24-km sampling reach of *Tor remadevii* between Doddamakali Nature Camp and Mekedatu Gorge (A–B) and *Tor khudree* at Valnur (C) in Kodagu District (Coorg), Karnataka, India.

RESULTS

The length-weight relationships were derived from a sample of 90 *T. remadevii* and 59 *T. khudree*. The subsequent values of a and b , and their associated statistical information, are provided in Table 1. For *T. remadevii*, the value of b , the allometric parameter, was 2.94 (95% CI: 2.75–3.14) and was not significantly different from 3.0, indicating isometric growth ($t = 0.61$, $P = 0.54$). For *T. khudree*, b was greater at 3.18 (95% CI: 3.01–3.38), but with this also not significantly different from 3.0 ($t = 1.91$, $P = 0.06$). Linearised relationship of fork length (cm) versus weight (g) for both species is provided in Figure 2.

DISCUSSION

The results suggest that the growth of both the *Tor* species analysed were isometric, i.e., there was a cubic

increase in fish weight as length increased. These data are important in the context of biological information on these fishes that, to date, has been extremely limited.

Indeed, the substantial population decline of endemic *T. remadevii* that has occurred in the last 15 years now prevents the contemporary sampling of their populations to obtain new biometric data (Pinder et al. 2015a, 2018b). The high historical recreational and trophy value of this fish has, however, resulted in collection of data by anglers in previous years, enabling these data to be used here and highlighting the inherent value of angler log books to provide important biological data from catch data (Cooke et al. 2000; Pinder & Raghavan 2013; Pinder et al. 2015b). This did, however, result in the use of data collected by anglers in extreme field conditions (e.g., high air temperatures) using relatively crude equipment (spring-balances recording to an accuracy of 0.25kg). Nevertheless, some of the fish in the dataset were large, over 40kg, and thus would be inherently difficult to weigh to a greater level of accuracy

Table 1. Length (fork, cm) weight (g) relationship for *Tor remadevii* and *Tor khudree* from the river Cauvery, southern India, where $W=aL^b$, n = sample size; r^2 = coefficient of determination. All length-weight relationships were significant at $P < 0.001$. All data represent the first reporting of the length-weight relationship for the species.

Species	n	Length range (cm)	Mean length (cm)	Weight range (kg)	Mean weight (kg)	a	95% CI a	b	95% CI b	r^2
<i>T. remadevii</i>	90	40–175	111.83	1.5–45.3	19.7	0.016	0.006–0.040	2.94	2.75–3.14	0.91
<i>T. khudree</i>	59	15.5–83	34.92	0.06–8.8	0.87	0.007	0.003–0.012	3.18	3.01–3.38	0.95

Table 2. Summary of maximum length and weights reported from this study and previous studies (*Kurup & Radhakrishnan 2007; **<http://www.fishbase.org/>, version 12/2019)

Species	Previous maximum reported size		Data presented here	
	Max length (cm)	Max weight (kg)	Max length (cm)	Max weight (kg)
<i>Tor remadevii</i>	33.2 (TL)*	N/A	175 (FL)	45.3
<i>Tor khudree</i>	50 (TL)**	2.7**	83 (FL)	8.8

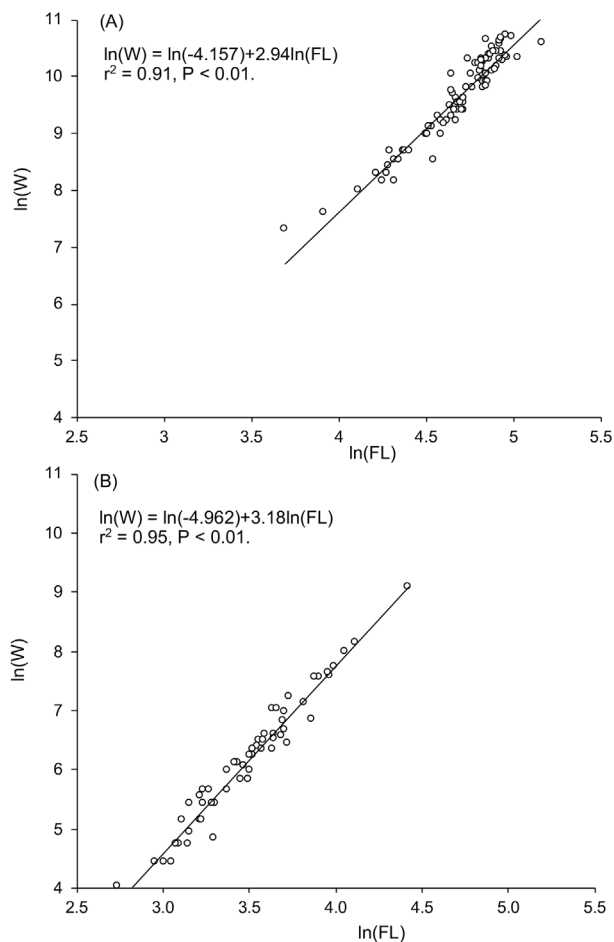


Figure 2. Linearised relationship of fork length (cm) versus weight (g) for (A) *Tor remadevii*, and (B) *Tor khudree*, according to $\ln(W) = \ln(a) + b\ln(FL)$. The straight lines are the relationship between the variables according to linear regression.

unless killed and also were unable to be captured by alternative methods to angling. Consequently, despite the method of data collection, it is argued these data have high value in the context of this conservation-dependent species that is currently close to extinction (Pinder et al. 2015a) and for which no adult length-weight data currently exist.

Due to the previous taxonomic confusion regarding the taxonomy of southern Indian *Tor* species (Pinder & Raghavan 2013; Pinder et al. 2018a, 2019) many previous studies have erroneously synonymised the ‘nom de plume’ *Tor* (or *Barbus*) *mussullah* (under the guise of the Hump-backed Mahseer (now known to be *T. remadevii*)) with *T. khudree*. As a consequence, much of the biometric data presented in the scientific literature, and open access resources (e.g., FishBase) for *T. khudree* need to be treated with appropriate caution. With reference to previous scientific studies where a high level of confidence can be applied to correct taxonomic use, the data reported here dramatically revise the maximum lengths and weights for both species (Table 2). Moreover, despite an absence of length records, other published data sources report weights of the Hump-backed Mahseer (*T. remadevii*) to 54.4kg (Wild Life 1977) and *T. khudree* to 27.9kg (Pinder et al. 2015a).

The results presented here provide the first biological data that can act as a base on which to build knowledge that is urgently required in a conservation context to both better understand the invasion consequences of *T. khudree* and to inform planning for the population restoration of *T. remadevii*, including understanding novel species interactions, and the range of biological parameters and ecological plasticity that may drive

competitive advantages between these species (Pinder et al. in press).

Given the isometric growth of both species, these data can now be applied in a conservation context by enabling sport anglers using catch-and-release angling techniques to keep the fish in the water for unhooking, with weights then estimated from measured lengths. This would eliminate a high proportion of the manual handling and air exposure of the fish, minimising the stress that this is known to cause, along with the associated elevated risk of post-release mortality (Cooke & Suski 2005; Cook et al. 2015; Bower et al. 2016).

REFERENCES

- Ali, A., N. Dahanukar & R. Raghavan (2013). Length-weight and length-length relationship of three species of snakehead fish, *Channa diplogramma*, *C. marulius* and *C. striata* from the riverine reaches of Lake Vembanad, Kerala, India. *Journal of Threatened Taxa* 5(13): 4769–4773. <https://doi.org/10.11609/JoTT.o3353.4769-73>
- Bower, S.D., A.J. Danylchuk, R. Raghavan, S.E. Clark-Danylchuk, A.C. Pinder & S.J. Cooke (2016). Rapid assessment of the physiological impacts caused by catch-and-release angling on Blue-finned Mahseer (*Tor* sp.) of the Cauvery River, India. *Fisheries Management and Ecology* 23: 208–217.
- Cook, K.V., R.J. Lennox, S.G. Hinch & S.J. Cooke (2015). Fish out of water: how much air is too much? *Fisheries* 40: 452–461.
- Cooke, S.J., W.I. Dunlop, D. Macclennan & G. Power (2000). Applications and characteristics of angler diary programmes in Ontario, Canada. *Fisheries Management and Ecology* 7: 473–487.
- Cooke, S.J. & C.D. Suski (2005). Do we need species-specific guidelines for catch-and-release recreational angling to effectively conserve diverse fishery resources? *Biodiversity and Conservation* 14: 1195–1209.
- de Alwis Goonatilake, S., M. Fernando & O. Kotagama (2020). *Tor khudree*. *The IUCN Red List of Threatened Species* 2020: e.T169609A60597571. Accessed on 14 May 2020. <https://doi.org/10.2305/IUCN.UK.2020-1.RLTS.T169609A60597571.en>
- Jerdon, T.C. (1849). On the fresh-water fishes of southern India. *Madras Journal of Literature and Science* 15: 302–346.
- Kurup, B.M. & K.V. Radhakrishnan (2007). *Tor remadevii*, a new species of mahseer from Kerala (South India), and distribution and abundance of *Tor* spp. in the river systems of Kerala. In: Siraj, S.S., A. Christianus, N.C. Kiat, & S.S. De Silva (eds.). *Mahseer, the Biology, Culture and Conservation*. Proceedings of the International Symposium on the mahseer, Kuala Lumpur, Malaysia (Malaysian Fisheries Society Occasional Publication No 14, Kuala Lumpur) 2007, 236pp.
- Kurup, B.M. & K.V. Radhakrishnan (2010). *Tor remadevii*, a new species of *Tor* (gray) from Chinnar Wildlife Sanctuary, Pambar River, Kerala, Southern India. *Journal of the Bombay Natural History Society* 107: 227–230.
- Ministry of Environment, Forests and Climate Change (2017). India's National Wildlife Action Plan. http://www.indiaenvironmentportal.org.in/files/file/nwap_2017_31.pdf, Accessed on 17 June 2020.
- Pinder, A.C. & R. Raghavan (2013). Conserving the endangered mahseers (*Tor* spp.) of India: the positive role of recreational fisheries. *Current Science* 104: 1472–1475.
- Pinder, A.C., R. Raghavan & J.R. Britton (2015a). The legendary Hump-backed Mahseer *Tor* sp. of India's River Cauvery: an endemic fish swimming towards extinction? *Endangered Species Research* 28: 11–17.
- Pinder, A.C., R. Raghavan & J.R. Britton (2015b). Efficacy of angler catch data as a population and conservation monitoring tool for the flagship Mahseer fishes (*Tor* spp.) of southern India. *Aquatic Conservation: Marine and Freshwater Ecosystems* 25: 829–838.
- Pinder, A.C., A. Manimekalan, M.J.D. Knight, P. Krishnankutty, J.R. Britton, S. Philip, N. Dahanukar & R. Raghavan (2018a). Resolving the taxonomic enigma of the iconic game fish, the Hump-backed Mahseer from the Western Ghats biodiversity hotspot, India. *PLoS ONE* 13(6): e0199328. <https://doi.org/10.1371/journal.pone.0199328>
- Pinder, A.C., U. Katwate, N. Dahanukar & A. Harrison (2018). *Tor remadevii*. The IUCN Red List of Threatened Species 2018: e.T56096394A56717605. Accessed on 14 May 2020. <https://doi.org/10.2305/IUCN.UK.2018-2.RLTS.T56096394A56717605.en>
- Pinder, A.C., J.R. Britton, A.J. Harrison, P. Nautiyal, S.D. Bower, S.J. Cooke, S. Lockett, M. Everard, U. Katwate, K. Ranjeet, S. Walton, A.J. Danylchuk, N. Dahanukar & R. Raghavan (2019). Mahseer (*Tor* spp.) fishes of the world: status, challenges and opportunities for conservation. *Reviews in Fish Biology and Fisheries* 29(2): 417–452.
- Pinder, A.C., R. Raghavan & J.R. Britton (in press). From scientific obscurity to conservation priority: research on angler catch rates is the catalyst for saving the Hump-backed Mahseer *Tor remadevii* from extinction. *Aquatic Conservation: Marine and Freshwater Ecosystems*.
- Riedel, R., L.M. Caskey & S.H. Hurlbert (2007). Length-weight relations and growth rates of dominant fishes of the Salton Sea: implications for predation by fish-eating birds. *Lake and Reservoir Management* 23(5): 528–535.
- Wild Life (1977). The monster mahseers of Karnataka. The Wildlife Association of South India, Bangalore: 1–8.



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