

1 **Involving recreational fisheries stakeholders in development of research and conservation**  
2 **priorities for mahseer (*Tor spp.*) of India through collaborative workshops**

3

4 Shannon D Bower<sup>\*a</sup>, Andy J. Danylchuk<sup>b</sup>, Rajeev Raghavan<sup>c,d</sup>, Sascha Clark Danylchuk<sup>e</sup>,  
5 Adrian C. Pinder<sup>d,f</sup>, Aaron M. Alter<sup>g</sup>, and Steven J. Cooke<sup>a</sup>

6 \* Corresponding author at: [Shannon.Bower@carleton.ca](mailto:Shannon.Bower@carleton.ca)

7

8 <sup>a</sup> Fish Ecology and Conservation Physiology Laboratory, Department of Biology, Carleton  
9 University, 1125 Colonel By Dr., Ottawa, ON K1S 5B6 Canada

10 <sup>b</sup> Department of Environmental Conservation, University of Massachusetts Amherst, 160  
11 Holdsworth Way, Amherst, MA, 01003, USA

12 <sup>c</sup> Department of Fisheries Resource Management, Kerala University of Fisheries and Ocean  
13 Studies, Kochi, 682 506, Kerala, India

14 <sup>d</sup> Mahseer Trust, c/o The Freshwater Biological Association, East Stoke River Laboratory,  
15 Wareham, Dorset, BH20 6BB, United Kingdom

16 <sup>e</sup> Fish Mission, 11 Kingman Rd., Amherst, MA, 01002

17 <sup>f</sup> Faculty of Science and Technology, Bournemouth University, Fern Barrow, Poole, Dorset,  
18 BH12 5BB, United Kingdom

19 <sup>g</sup> Fishery Promotion and Conservation, Baobab Educational Adventures, 49 Seahorse Ln.,  
20 Christchurch, VA, 23031, USA

21

22

23

24

25

26

27

28

29 **Abstract**

30 The mahseer (*Tor* spp.) of India are a group of potamodromous cyprinids currently facing  
31 numerous challenges in their native ranges including overfishing, pollution, and hydropower  
32 development. As a result of such challenges, four of the seven Indian species of *Tor* have been  
33 listed as ‘Endangered’ on the IUCN Red List, including two of the most popular recreationally  
34 fished species, *Tor khudree* and *Tor putitora*. Stakeholders in the mahseer recreational fishery  
35 may serve as an ally for this group of iconic fishes, fostering aquatic stewardship and providing  
36 livelihood alternatives for poachers. Yet, information regarding species-specific responses to  
37 recreational fishing practices is lacking and a 2009 decree equating fishing with hunting in the  
38 Indian Wildlife Protection Act (1972) has since 2011 effectively banned angling within protected  
39 areas and rendered the future of mahseer recreational fisheries elsewhere uncertain. In 2014, our  
40 team collaborated with local organizations, fisheries professionals, non-governmental  
41 organizations (NGOs), and anglers to conduct two stakeholder workshops designed to develop a  
42 research agenda for various species of Indian mahseer. General knowledge gaps identified in the  
43 two workshops were very similar and included biological, sociological, and economic  
44 considerations. The resulting research priorities in both locations strongly highlighted local  
45 context, indicating that while opportunities for addressing knowledge gaps through collaboration  
46 exist at the national scale, there is a need for regional- or fishery-specific governance strategies  
47 and approaches to mahseer research and conservation.

48

49 **Keywords:** recreational fisheries, freshwater fish, migratory fish, social-ecological systems,  
50 stakeholder engagement

51

52 **Highlights**

- 53 • Stakeholder workshops were used to develop research agendas for Indian mahseer
- 54 • Knowledge gaps constraining mahseer research and conservation are multi-disciplinary
- 55 • Participants identified similar knowledge gaps, but prioritized research goals differently
- 56 • Research priorities identify opportunity for multi-scale governance strategies

57

58 **1. Introduction**

59 Stakeholder engagement, the active participation of individuals in planning, research, or  
60 management processes that impact them (Sloan 2009), has become a popular topic in fisheries  
61 research (e.g., in the US, Feeney et al. 2010; in the UK, Hartley and Robinson 2008; in Europe,

62 Mackinson et al. 201; for spatial planning, Pomeroy and Douvere 2008). A number of concerns  
63 associated with the incorporation of stakeholder engagement into research have been identified  
64 (e.g., negative impacts on scientific integrity, Abbott and Guijt 1997; the potential exclusion of  
65 already marginalized groups from the engagement process, Kothari 2001; Prell et al. 2008;  
66 potential consequences of negative trust relationships, Smith et al. 2012). Other studies,  
67 however, have noted that incorporating local context led to improved research outcomes as a  
68 result of access to more relevant information (e.g., anticipating problems or conflict, Koontz and  
69 Thomas 2006; facilitating social learning Steyaert et al. 2011; promoting trust among  
70 collaborators, Yochum et al. 2012). These benefits may be critical for developing sound  
71 management strategies for data deficient recreational fisheries. For example, Arlinghaus and  
72 Krause (2013) suggested that under certain conditions stakeholder estimates of population size  
73 could be as reliable as more traditional stock assessment methods. Other benefits associated with  
74 the stakeholder engagement process include improved relationships between researchers and the  
75 public, the development of ongoing partnerships, and acceptance and self-enforcement of  
76 management decisions based on research outcomes (Reed 2008, Steyaert et al. 2007).

77 Recreational fisheries have been recognized as a complex social-ecological system, where  
78 changes to either component result in changes to the other (Mora et al. 2009). In these systems,  
79 wicked problems, or problems that by their nature are difficult to solve due to a combination of  
80 complexity and stochasticity, can arise which require extensive communication and efforts  
81 among numerous disciplines to tackle effectively (Jentoft and Chuenpagdee 2009). Stakeholder  
82 engagement and partnership strategies have proven successful in recreational fisheries research  
83 and conservation efforts by incorporating multiple viewpoints and facilitating angler  
84 participation to engender cooperation and support (e.g. see Armitage et al. 2008; Granek et al.  
85 2008; Hartley and Robertson 2006). Indeed, when consultation and participatory conditions are  
86 met, harnessing the support of freshwater and marine anglers can contribute greatly to aquatic  
87 stewardship (Cowx et al. 2010; Granek et al. 2008; Tufts et al. 2015; but see also Danylchuk and  
88 Cooke 2011).

89 An example of this potential can be found in the management and conservation challenges  
90 surrounding the mahseer (*Tor* spp.) recreational fishery of India. Mahseer are a group of large-  
91 bodied potamodromous cyprinids targeted by commercial, subsistence and recreational fishers in  
92 Asia. Despite the fact that four of the seven *Tor* species in India have been listed as endangered  
93 (an additional species is listed as 'Near Threatened', IUCN 2015), very little information is  
94 currently available describing the ecology of these species (but see Bhatt et al. 2004; Bhatt and  
95 Pandit *In Press*; Nautiyal et al. 2008; Nautiyal 2013 describing migration behaviours and  
96 ecology of *Tor putitora*). Catch and release (C&R) was advocated as an angling ethic in the  
97 1970s in an effort to control poaching activities after anglers noted a decline in the body size and  
98 rate of catch (Gupta et al. 2015a). In an effort to mitigate concerns surrounding the state of the  
99 fishery, anglers developed 'coalitions' and leased property along river reaches, developing  
100 training programs for guides and monitoring river activities to reduce poaching (Everard and

101 Kataria 2011; Gupta et al. 2015b; Pinder and Raghavan 2013). Angler catch data collected from  
102 a former angling camp on the Cauvery River has demonstrated an increase in catch rate (along  
103 with concomitant decreases in body size), indicating strong recruitment has occurred since this  
104 type of fisheries management model was established (Pinder et al. 2015b). However, in 2009, a  
105 legislative decree equating C&R fishing with hunting effectively shut down the recreational  
106 fishery in protected areas, while leaving other locales virtually unaffected. This uneven  
107 application of regulations has since resulted in anecdotal reports of elevated poaching and illegal  
108 fishing activity within the Cauvery Wildlife Sanctuary (Pinder et al. 2015a, 2015b).

109 In 2013, WWF India issued a report detailing the current status and challenges surrounding  
110 mahseer conservation (see WWF India 2013). A key report finding was the need to develop an  
111 evidence based research agenda to support mahseer conservation. In 2014, our team collaborated  
112 with local organizations, fisheries professionals, NGOs, and anglers in two regions to conduct  
113 stakeholder workshops designed to meet this need by facilitating discussions to clarify the  
114 current state of mahseer research, identify key knowledge gaps constraining mahseer  
115 conservation, and to develop a research agenda based on the outcomes of these discussions.

## 116 **2. Methods**

117 The goal of both stakeholder workshops was to collaborate with researchers, industry and  
118 stakeholder partners to identify key knowledge gaps and develop a research agenda for mahseer  
119 that addresses these knowledge gaps and supports current and future research and conservation  
120 efforts. The unique characteristics of each location, and associated fisheries, threats, and focal  
121 species necessitated different approaches for each workshop. In both cases, preparation consisted  
122 of identifying local experts in the target areas to seek their partnership in facilitating workshops  
123 through planning and participation (as per Reed et al. 2006). These facilitators populated a  
124 balanced list of key stakeholders from multiple arenas, including fisheries managers,  
125 representatives from fishing associations (including the Coorg Wildlife Society, the Wildlife  
126 Association of South India, Jungle Lodges, The Himalayan Outback, Baobab Educational  
127 Adventures), lodge and homestay owners, anglers, and representatives from conservation NGOs  
128 (WWF India and Zoo Outreach Organization).

129 The South India workshop took place at Jungle Lodges and Resorts, Bannerghatta Nature Camp,  
130 Bangalore, Karnataka on March 28 and 29, 2014. Mahseer recreational fishing was firmly  
131 established in the southern states, including Karnataka (Gupta et al. 2015b; Sehgal 1999).

132 Participants in this workshop were interested in discussing developments in the recreational  
133 fishery, including rules and regulations governing fishing activity, including the angling ban in  
134 protected areas. The North India workshop took place on April 5, 2014 at the Byasi Beach  
135 Camp, Rishikesh, Uttarakhand, on the banks of the Ganges River, and on April 6, 2014 at Atali  
136 Ganga, Rishikesh, Uttarakhand. Mahseer recreational fishing is growing as a tourism industry in  
137 the northern states (including Uttarakhand), though it is not known to be a popular activity  
138 undertaken by domestic recreational anglers. Participants of this workshop were interested in

139 discussions regarding the role of tourism in promoting the sport, and strategies for achieving  
140 balance between tourism- and locally-based activities (e.g., small-scale commercial and  
141 subsistence fishing).

142 The nature and type of both workshops was developed in response to the preferences of  
143 participants and partners. For example, the workshop held in South India (Bannerghatta) was  
144 very structured, with specific time frames allotted for presentations and discussion. In North  
145 India (Byasi/Atali Ganaga), the workshop process was more flexible, leaving more time for ad  
146 hoc discussions and deviations from planned topics. Time frames were estimated for individual  
147 topics and were adjusted according to how much/how little participants had to contribute.

148 Both workshops were scheduled over two days, with different goals set for each day. We opted  
149 to provide numerous opportunities for relationship-building and conversation prior to initiating  
150 discussion regarding the research agenda (as per Allen et al. 2011; Reed 2008). For example, on  
151 Day 1, participants identified local and regional-scale issues impacting mahseer, discussed the  
152 management and conservation context for these issues, and background topics associated with  
153 the research (i.e., current state of recreational fisheries research, C&R research and associated  
154 best practices; Figure 1, Figure 2). This method transformed the process from a top-down  
155 scenario to a bottom-up process in accordance with Reed's (2008) best practices for stakeholder  
156 engagement, and afforded the opportunity to discuss any potential flashpoint issues in an open  
157 atmosphere. These flashpoint issues were aired, but not considered an essential part of the  
158 research agenda by any attendees. The list of knowledge gaps was populated at the end of Day 1  
159 in both workshops. The second day (Day 2) was devoted to developing a research agenda for  
160 mahseer based on knowledge gaps and discussion from Day 1.

### 161 **3. Results**

162 Stakeholder workshop participants identified knowledge gaps across disciplines (e.g., biological,  
163 sociological, economic). While similar points were recognized in both workshops, location-  
164 specific knowledge gaps were also identified (Table 1). Twelve knowledge gaps were identified  
165 by Bannerghatta workshop participants (5 biological; 4 sociological; 3 economic). Fifteen  
166 knowledge gaps were identified by Byasi/Atali Ganga workshop participants (6 biological; 7  
167 sociological; 2 economic). Both locations shared similarities among five biological knowledge  
168 gaps, three sociological knowledge gaps, and one economic knowledge gap.

169 In both workshops, participants developed the list of top six research priorities from the  
170 established knowledge gaps. These identified priorities were also multi-disciplinary but exhibited  
171 fewer similarities than occurred through developing the list of knowledge gaps (Table 2). Both  
172 groups retained three of the shared knowledge gaps, but on refining them into more detailed  
173 research priorities differentiated greatly on focus (Table 2).

### 174 **4. Discussion**

175 The knowledge gaps and research priorities identified in both workshops highlight the need to  
176 establish research programs that acknowledge the integrated nature of fisheries, including multi-  
177 disciplinary approaches in research (a need also identified in Europe, Arlinghaus 2006), and  
178 addressing the requirements of location-specific stakeholders and sectors (e.g., balancing  
179 participation among different forms of tourism and fisheries). Indeed, workshop participants  
180 identified a greater number of sociological and economic knowledge gaps than biological  
181 knowledge gaps constraining mahseer conservation. The shared identified knowledge gaps  
182 indicate that there are opportunities to collaborate among states/regions to establish an evidence  
183 base for mahseer biology, ecology, and behaviour, in addition to opportunities for research  
184 studying the biological, social, and economic impacts of recreational (and other sector) fisheries.

185 Both groups prioritized the research agenda items based on local issues and concerns (i.e.,  
186 context mattered) and no individuals or groups disagreed with any included items. For example,  
187 both groups identified impacts of invasive species and hydropower development as knowledge  
188 gaps, but on prioritizing issues for the research agenda, participants in the Bannerghatta  
189 workshop prioritized invasive species concerns over hydropower development, while  
190 participants in the Byasi/Atali Ganga workshop prioritized issues arising from hydropower  
191 development over invasive species. Bannerghatta workshop participants were interested in  
192 partnering with management entities to explore enforcement options and alternatives in an  
193 already established fishery, while Byasi/Atali Ganga workshop participants identified  
194 community engagement and benefit-sharing as a priority management strategy to build the  
195 mahseer fishery. These differences in priority setting highlight the need for multi-scale  
196 approaches (i.e., national and state) to fisheries research and management. Shared knowledge  
197 gaps (including impacts to mahseer by invasive species, hydropower development, illegal fishing  
198 methods, and the use of mahseer as an umbrella species to promote freshwater conservation)  
199 could be studied at the national level, while adopting management strategies based on research  
200 outcomes may benefit from a state- or location-level focus.

201 Regional-level differences in dominant mahseer species and ecology further support the need for  
202 multi-level mahseer research and management strategies. Recent research by Everard and  
203 Kataria (2011) and Gupta et al. (2014a) suggests that the golden mahseer (*T. putitora*) may be  
204 useful as a flagship species for promoting freshwater conservation throughout the Himalaya  
205 Rivers in Northern India, where this species is found (Nautiyal 2013). *T. khudree*, while  
206 endangered in its native waters (IUCN 2015), has been artificially cultured and since the 1970's  
207 been periodically introduced to the Cauvery. This intended augmentation of the stock is now  
208 strongly suspected to have played a role in the decline of the yet to be described humpback  
209 mahseer endemic to the Cauvery River in the South (Pinder et al. 2015a). These nuances indicate  
210 that while priorities for mahseer research (as identified by workshop participants) may be  
211 similar, there will be a need for species-specific approaches in order to sufficiently address the  
212 identified knowledge gaps.

213 The occurrence of mahseer species in different countries in Asia (e.g., *T. putitora*, Nguyen et al.  
214 2008) suggests collaboration and cooperation may also be possible at the international level.  
215 Current research efforts examining the behavioural ecology of *T. putitora* in Bhutan (Claussen  
216 2015) for example, could offer valuable insights for the same species in the Himalayan  
217 watershed across the border in India. Similarly, ongoing research efforts in India may be useful  
218 in supporting the development of research priorities for mahseer in other countries (e.g., in  
219 Malaysia, Nguyen 2008). As such, we suggest that international collaboration of mahseer  
220 researchers may be beneficial for aligning goals and strategies to identify synergies in research  
221 priorities and opportunities for collaboration.

222 The involvement of stakeholders in the research agenda development process was integral to  
223 identifying priority focal points that may have otherwise been missed, or possibly discounted.  
224 Through stakeholder participation, we were not only able to benefit from the varied perspectives  
225 and expertise of workshop participants, but incorporate regional and local priorities into goal  
226 setting in a manner that may not have been possible at a more formalized national meeting. It is  
227 essential to note that while we took care to invite individuals representing as many viewpoints as  
228 possible, a strong majority of the invitees viewed recreational fisheries positively, and none of  
229 the attendees were representatives of management organizations other than the Fisheries  
230 Department (i.e. Forestry Department), subsistence fishers, or members of migrant communities.  
231 As such, priorities of these communities may not be adequately represented in the respective  
232 research agendas (see Kothari 2001; Prell et al. 2008). The views of local communities and  
233 stakeholders vary among fisheries (for e.g., see Gupta et al. 2014b). As such, we recommend that  
234 any future efforts to adopt research outcomes into management strategies include consultation  
235 with these stakeholder groups also.

236 This workshop process is an example of the overall value of stakeholder engagement for  
237 addressing data deficiencies in global recreational fisheries. Stakeholder engagement affords the  
238 opportunity to gather many perspectives together, thereby bringing more information to the table  
239 through which to develop a knowledge base (Hartley and Robertson 2008; Reed et al. 2008;  
240 Steyaert et al. 2011). Many recreational fisheries around the world are data deficient, and many  
241 managing bodies may be constrained in supporting fisheries research by limited expertise and  
242 funding (Mahon 1997). Creative approaches will be essential in addressing deficiencies  
243 effectively as we move towards improving global fisheries management and conservation using  
244 best available science. Several tools have been developed and used as a way of addressing such  
245 data deficiencies in recreational fisheries to ensure that we are not ‘managing blind’ (rapid  
246 assessments, Bower et al. 2016, Lennox et al. 2015; species-specific C&R research, see  
247 examples in Cooke and Schramm 2007, Cooke and Suski 2005), but to date these approaches  
248 have heavily favoured the biological responses of species to fisheries processes. There continues  
249 to be a dearth of suitable tools available for rapidly and thoroughly incorporating sociological  
250 and economic considerations in fisheries research (Arlinghaus 2005), though strategies for  
251 incorporating adaptive management and co-management processes are increasing in other fields

252 (e.g., see Armitage et al. 2008; Mackinson et al. 2011; Pomeroy and Douvere 2008). Using  
253 effective methods of stakeholder engagement can help researchers to address data deficiencies by  
254 allowing researchers to incorporate local knowledge into priority and goal setting, and better  
255 understand the socio-economic context of specific fisheries.

256

## 257 **Acknowledgements**

258 Bower is supported by the Ontario Graduate Scholarship Fund and Too Big to Ignore. Cooke is  
259 supported by the Canada Research Chairs Program and the Natural Sciences and Engineering  
260 Research Council of Canada. Danylchuk is supported by the National Institute of Food &  
261 Agriculture, U.S. Department of Agriculture, the Massachusetts Agricultural Experiment Station,  
262 Department of Environmental Conservation and the Whiting Foundation. Raghavan is supported  
263 by the Mohammed Bin Zayed Species Conservation Fund. Pinder is supported by the Mahseer  
264 Trust. All coordinators were supported by the Fisheries Society of the British Isles Small  
265 Research Grant Program with additional sponsorship received from Lotek and Smith Root. We  
266 appreciate logistic support provided by CWS, WASI and our many volunteer anglers, and  
267 permission for the study (through CWS) from Dr. Ramakrishna, Joint Director of Fisheries,  
268 Government of Karnataka. Special thanks go to Steve Lockett, Neethi Mahesh, Dr. Ambily Nair,  
269 Shyam Aiyappa, Aiyappa C.P., Dr. Dayan Mandappa, Sandeep Chakrabarti, Shine Sathvik,  
270 Naren Sreenivasan, Dr. A.J.T. JohnSingh, Dr. Sanjay Molur, Dr. Romulus Whitaker, Misty  
271 Dhillon and Suman Panwar. Thanks also go out to all of the individuals and organizations who  
272 participated in the workshops and shared their time and expertise.

273

## 274 **References**

275 Abbot, J., & Guijt, I. (1997). Changing views on change: A working paper on participatory  
276 monitoring of the environment. International Institute for Environment and Development (IIED),  
277 London, UK. 96p.

278 Allen, W., Fenemor, A., Kilvington, M., Harmsworth, G., Young, R. G., Deans, N., ... & Smith,  
279 R. (2011). Building collaboration and learning in integrated catchment management: the  
280 importance of social process and multiple engagement approaches. *New Zealand Journal of*  
281 *Marine and Freshwater Research*, 45(3), 525-539.

282 Arlinghaus, R. (2005). A conceptual framework to identify and understand conflicts in  
283 recreational fisheries systems, with implications for sustainable management. *Aquatic Resources,*  
284 *Culture and Development*, 1(2), 145-174.

285 Arlinghaus, R. (2006). Overcoming human obstacles to conservation of recreational fishery  
286 resources, with emphasis on central Europe. *Environmental Conservation*, 33(01), 46-59.



- 287 Arlinghaus, R., & Krause, J. (2013). Wisdom of the crowd and natural resource  
288 management. *Trends in Ecology & Evolution*, 28(1), 8-11.
- 289 Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J., ...  
290 & McConney, P. (2008). Adaptive co-management for social-ecological complexity. *Frontiers in*  
291 *Ecology and the Environment*, 7(2), 95-102.
- 292 Bhatt, J. P., & Pandit, M. K. (In Press). Endangered Golden mahseer *Tor putitora* Hamilton: a  
293 review of natural history. *Reviews in Fish Biology and Fisheries*, 1-14.  
294 <http://link.springer.com/article/10.1007/s11160-015-9409-7>
- 295 Bhatt, J. P., Nautiyal, P., & Singh, H. R. (2004). Status (1993-1994) of the endangered fish  
296 Himalayan Mahseer *Tor putitora* (Hamilton)(*Cyprinidae*) in the mountain reaches of the river  
297 Ganga. *Asian Fisheries Science*, 17, 341-355.
- 298 Bower, S.D., Danylchuk, A.J., Raghavan, R., Clark Danylchuk, S., Pinder, A., & Cooke, S.J. (In  
299 Press). Rapid assessment of the physiological impacts caused by catch-and-release angling on  
300 blue-finned mahseer (*Tor* sp.) of the Cauvery River, India. *Fisheries Management and Ecology*,  
301 00, 000-000.
- 302 Bower, S. D., Danylchuk, A. J., Brownscombe, J. W., Thiem, J. D., & Cooke, S. J. (2016).  
303 Evaluating effects of catch-and-release angling on peacock bass (*Cichla ocellaris*) in a Puerto  
304 Rican reservoir: A rapid assessment approach. *Fisheries Research*, 175, 95-102.
- 305 Claussen, J. (2015, August). The Bhutan Telemetry Project: Tracking Golden Mahaseer in the  
306 Manas Watershed. In *145th Annual Meeting of the American Fisheries Society*. AFS, Bethesda,  
307 Maryland, USA.
- 308 Cooke, S. J., & Suski, C. D. (2005). Do we need species-specific guidelines for catch-and-release  
309 recreational angling to effectively conserve diverse fishery resources? *Biodiversity &*  
310 *Conservation*, 14(5), 1195-1209.
- 311 Cooke, S. J., & Schramm, H. L. (2007). Catch-and-release science and its application to  
312 conservation and management of recreational fisheries. *Fisheries Management and*  
313 *Ecology*, 14(2), 73-79.
- 314 Cowx, I. G., Arlinghaus, R., & Cooke, S. J. (2010). Harmonizing recreational fisheries and  
315 conservation objectives for aquatic biodiversity in inland waters. *Journal of Fish Biology*, 76(9),  
316 2194-2215.
- 317 Danylchuk, A. J., & Cooke, S. J. (2011). Engaging the recreational angling community to  
318 implement and manage aquatic protected areas. *Conservation Biology*, 25(3), 458-464.

319 Everard, M., & Kataria, G. (2011). Recreational angling markets to advance the conservation of  
320 a reach of the Western Ramganga River, India. *Aquatic Conservation: Marine and Freshwater*  
321 *Ecosystems*, 21(1), 101-108.

322 Feeney, R. G., La Valley, K. J., & Hall-Arber, M. (2010). Assessing stakeholder perspectives on  
323 the impacts of a decade of collaborative fisheries research in the Gulf of Maine and Georges  
324 Bank. *Marine and Coastal Fisheries*, 2(1), 205-216.

325 Gupta, N., Sivakumar, K., Mathur, V. B., & Chadwick, M. A. (2014a). The 'tiger of Indian  
326 rivers': stakeholders' perspectives on the golden mahseer as a flagship fish species. *Area*, 46(4),  
327 389-397.

328 Gupta, N., Nautiyal, P., Borgohain, A., Sivakumar, K., Mathur, V. B., & Chadwick, M. A.  
329 (2014b). Catch-and-release angling as a management tool for freshwater fish conservation in  
330 India. *Oryx. doi*, 10(1017), S003060531400078.

331 Gupta, N., Raghavan, R., Sivakumar, K., Mathur, V., & Pinder, A.C. (2015a). Assessing  
332 recreational fisheries in an emerging economy: Knowledge, perceptions and attitudes of catch-  
333 and-release anglers in India. *Fisheries Research*, 165, 79-84.

334 Gupta, N., Bower, S.D., Raghavan, R., Danylchuk, A.J., & Cooke, S.J. (2015b). Status of  
335 recreational fisheries in India: development, issues and opportunities. *Reviews in Fisheries*  
336 *Science & Aquaculture*, 23(3), 291-301.

337 Hartley, T. W., & Robertson, R. A. (2006). Stakeholder engagement, cooperative fisheries  
338 research and democratic science: the case of the Northeast Consortium. *Human Ecology Review*,  
339 13(2), 161.

340 Hartley, T. W., & Robertson, R. A. (2008). Stakeholder collaboration in fisheries research:  
341 integrating knowledge among fishing leaders and science partners in northern New  
342 England. *Society and Natural Resources*, 22(1), 42-55.

343 IUCN 2015. *The IUCN Red List of Threatened Species. Version 2015-4*.  
344 <<http://www.iucnredlist.org>>. Downloaded on 19 November 2015.

345 Jentoft, S., & Chuenpagdee, R. (2009). Fisheries and coastal governance as a wicked  
346 problem. *Marine Policy*, 33(4), 553-560.

347 Koontz, T. M., & Thomas, C. W. (2006). What do we know and need to know about the  
348 environmental outcomes of collaborative management? *Public Administration Review*, 111-121.

349 Kothari, U. (2001). Power, knowledge and social control in participatory development. In:  
350 Kothari, U., & Cooke, B. (Eds.) *Participation: The New Tyranny?*, Zed Books, London, UK, pp  
351 139-152.

352 Lennox, R. J., Brownscombe, J. W., Cooke, S. J., Danylchuk, A. J., Moro, P. S., Sanches, E. A.,  
353 & Garrone-Neto, D. (2015). Evaluation of catch-and-release angling practices for the fat snook  
354 *Centropomus parallelus* in a Brazilian estuary. *Ocean & Coastal Management*, 113, 1-7.

355 Mackinson, S., Wilson, D. C., Galiay, P., & Deas, B. (2011). Engaging stakeholders in fisheries  
356 and marine research. *Marine Policy*, 35(1), 18-24.

357 Mahon, R. (1997). Does fisheries science serve the needs of managers of small stocks in  
358 developing countries. *Canadian Journal of Fisheries and Aquatic Sciences*, 54(9), 2207-2213.

359 Mora, C., Myers, R.A., Coll, M., Libralato, S., Pitcher, T., Sumaila, R., ... & Worm, B. (2009).  
360 Management effectiveness of the world's marine resources. *PLOS Biology*, 7(6), e1000131.

361 Nautiyal, P., Rizvi, A. F., & Dhasmanaa, P. (2008). Life History traits and decadal trends in the  
362 growth parameters of Golden Mahseer, *Tor putitora* (Hamilton 1822) from the Himalayan  
363 stretch of the Ganga River System. *Turkish Journal of Fisheries and Aquatic Sciences*, 8, 125-  
364 132.

365 Nautiyal, P. (2014). Review of the Art and Science of Indian Mahseer (Game Fish) from  
366 Nineteenth to Twentieth Century: Road to Extinction or Conservation? *Proceedings of the*  
367 *National Academy of Sciences, India Section B: Biological Sciences*, 84(2), 215-236.

368 Nguyen, T. T. (2008). Population structure in the highly fragmented range of *Tor douronensis*  
369 (Cyprinidae) in Sarawak, Malaysia revealed by microsatellite DNA markers. *Freshwater*  
370 *Biology*, 53(5), 924-934.

371 Nguyen, T. T., Na-Nakorn, U., Sukmanomon, S., & ZiMing, C. (2008). A study on phylogeny  
372 and biogeography of mahseer species (*Pisces: Cyprinidae*) using sequences of three  
373 mitochondrial DNA gene regions. *Molecular Phylogenetics and Evolution*, 48(3), 1223-1231.

374 Pinder, A. C., & Raghavan, R. (2013). Conserving the endangered Mahseers (*Tor* spp.) of India:  
375 the positive role of recreational fisheries. *Current Science*, 104(11), 1472-1475.

376 Pinder, A. C., Raghavan, R., & Britton, J. R. (2015a). The legendary hump-backed mahseer *Tor*  
377 sp. of India's River Cauvery: an endemic fish swimming towards extinction? *Endangered*  
378 *Species Research*, 28, 11-17.

379 Pinder, A. C., Raghavan, R., & Britton, J. R. (2015b). Efficacy of angler catch data as a  
380 population and conservation monitoring tool for the flagship Mahseer fishes (*Tor* spp.) of  
381 Southern India. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 25(6), 829-838.

382 Pomeroy, R., & Douvère, F. (2008). The engagement of stakeholders in the marine spatial  
383 planning process. *Marine Policy*, 32(5), 816-822.

384 Prell, C., Hubacek, K., Quinn, C., & Reed, M. (2008). 'Who's in the network?' When  
385 stakeholders influence data analysis. *Systemic Practice and Action Research*, 21(6), 443-458.

386 Reed, M. S., Fraser, E. D., & Dougill, A. J. (2006). An adaptive learning process for developing  
387 and applying sustainability indicators with local communities. *Ecological Economics*, 59(4),  
388 406-418.

389 Reed, M. S. (2008). Stakeholder participation for environmental management: a literature  
390 review. *Biological Conservation*, 141(10), 2417-2431.

391 Reed, M. S., Dougill, A. J., & Baker, T. R. (2008). Participatory indicator development: what  
392 can ecologists and local communities learn from each other. *Ecological Applications*, 18(5),  
393 1253-1269.

394 Sehgal, K. (1999). Coldwater fish and fisheries in the Western Ghats, India. In: Petr, T. (Ed.)  
395 *Fish and Fisheries at Higher Altitudes: Asia*, FAO Fisheries Technical Paper 385. FAO, Rome,  
396 pp 41-64.

397 Sloan, P. (2009). Redefining stakeholder engagement. *Journal of Corporate*  
398 *Citizenship*, 2009(36), 25-40.

399 Smith, J. W., Leahy, J. E., Anderson, D. H., & Davenport, M. A. (2013). Community/agency  
400 trust and public involvement in resource planning. *Society & Natural Resources*, 26(4), 452-471.

401 Steyaert, P., Barzman, M., Billaud, J. P., Brives, H., Hubert, B., Ollivier, G., & Roche, B. (2007).  
402 The role of knowledge and research in facilitating social learning among stakeholders in natural  
403 resources management in the French Atlantic coastal wetlands. *Environmental Science &*  
404 *Policy*, 10(6), 537-550.

405 Tufts, B. L., Holden, J., & DeMille, M. (2015). Benefits arising from sustainable use of North  
406 America's fishery resources: economic and conservation impacts of recreational  
407 angling. *International Journal of Environmental Studies*, 72(5), 850-868.

408 WWF- India (2013) Mahseer Conservation in India: Status, Challenges and the Way Forward. P.  
409 Nautiyal, S. Babu & S. Behera (Eds.), WWF-India, New Delhi, India, 38p.

410 Yochum, N., Starr, R. M., & Wendt, D. E. (2011). Utilizing fishermen knowledge and expertise:  
411 keys to success for collaborative fisheries research. *Fisheries*, 36(12), 593-605.

412