

# Conserving the Perilled Tiger of River: Golden Mahseer in Upper-Ganga, India

Project ID: 03326617

Host country: India

Location: Uttarakhand [Devprayag (30°08'49.5"N and 78°35'51.9"E) to Rishikesh (30°5'13.7"N and 78°16'5.2"E)]

September 2017-April 2019

Population status, threats and conservation measures of the endangered 'golden mahseer'



**Saurabh Dewan<sup>1</sup>, Ajay Pandey<sup>2</sup>, Jitendra Singh Rana<sup>1</sup>, Rajeev Lochan<sup>1</sup>**

<sup>1</sup>Department of Zoology & Biotechnology, HNB Garhwal University, Srinagar Garhwal, Uttarakhand, INDIA, <sup>2</sup>National Fisheries Development Board, Hyderabad, INDIA. \*[saurabhdewan86@gmail.com](mailto:saurabhdewan86@gmail.com)

Date when the report was completed: 12 October 2019

## Table of Contents

<b>Section</b>	<b>Subtitles</b>	<b>Page number</b>
<b>Section 1</b>	Summary	3
	Introduction	3
	Project members	5
<b>Section 2</b>	Aim and Objectives	6
	Changes to original project plan	6
	Methodology	7
	Outputs and Results	8
	Communication & Application of results	12
	Monitoring and Evaluation	13
	Achievements and Impacts	16
	Capacity Development and Leadership capabilities	18
<b>Section 3</b>	Conclusion	18
	Problems encountered and lessons learnt	19
	In the future	20
	Financial Report	20
<b>Section 4</b>	Appendices	21
	Bibliography	23
	Address list and web links	24
	Distribution list	25

### **Project Partners & Collaborators**

*State Fisheries Department (Pauri Division), Uttarakhand* - We acknowledge the fisheries department for providing permissions for field work, and for their support with manpower, organization of public outreach programs, logistics and accommodation facilities.

*HNB Garhwal University, Srinagar-Garhwal, Uttarakhand* - We acknowledge the Department of Zoology & Biotechnology for providing office and laboratory space and various professors of the department for their support, suggestions and technical advices.

## **Section 1:**

### **Summary**

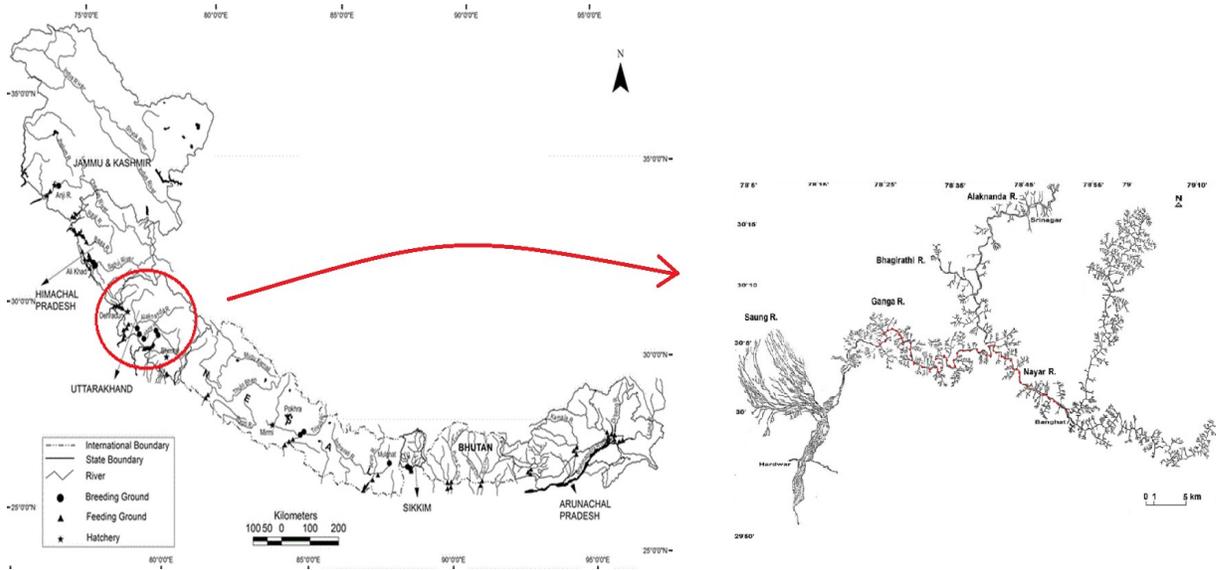
The population structure of golden mahseer (*T. putitora*) was assessed in the upper Ganga stretch between Devprayag and Rishikesh. Public outreach, education and engagement activities were done to increase local commitment to best conservation practices. For more than a year size-composition was studied to record size at different age classes. Some critical breeding grounds were marked in Nayar River and essential habitat factors were documented. Indiscriminate fishing has led to distorted population structure as the pre-reproductive age group (0-4) constituted above 85% of the stock assessed, dominated by 0-2 group (~62%). The catch per unit effort was higher in Nayar (3.1-14.6 kg) than Ganga (0.45-8.4 kg). In 2017-18, the catch size was between 28-57cm in Ganga and 11-91cm in Nayar. However, in the current year it reduced to 14-37cm in Nayar with around 25-30% reduction in catch. In, 'Vyas ghat' and 'Baagi', the two target villages near the confluence, six awareness campaigns, eleven open meetings, two workshops were conducted with active involvement of the state fisheries department. Some dedicated youth and women self-help groups were allocated 5km river beats and are being trained as 'Guardian of rivers' for conservation as well as alternative income generation from river and its resources.

### **Introduction**

Inherent biological constraints (delayed maturity, low fecundity, long hatching period) coupled with habitat fragmentation and indiscriminate fishing has led to decline of golden mahseer (*T. putitora*) in the upper stretch of River Ganga. We made an attempt to assess the population structure in the upper Ganga between Devprayag and Rishikesh, so as to identify river stretches that constitute critical mahseer habitats and which can be prioritized for conservation and restoration. Further, the evaluation of its population current structure, dynamics and comparison with previous published records was done to help in ascertaining the current reproductive status of the population and what we may expect in near future.

Golden mahseer is a rheophilic species inhabiting hill streams with rocky/stony substrate, preferring deep pools and shallow riffles in the run of the river. The channels of river Ganga and its tributaries runs into short stretches in the Greater Himalaya, long stretches up to Rishikesh through the Lesser Himalaya and a small stretch through the Siwaliks along the left bank and Doon Valley along the right bank from Rishikesh to Haridwar (Nautiyal et al 2013). A stretch of upper Ganga through the lesser Himalaya

from Devprayag to Rishikesh was assessed in the present study along with Nayar, a major spring fed tributary in this stretch and a major spawning-cum nursery ground.



**Figure 1** Location of project site and course of the Ganga and Nayar rivers sampled in this study (Adapted from Bhatt and Pandit 2015 and Nautiyal *et al.* 2008)

The adults inhabit the foothill stretch of the Ganga and migrate upstream for spawning into smaller tributaries like the Nayar, which harbour the young ones. The migrants of varying sizes (juveniles, adolescents both immature, maturing virgins and mature adults) are observed in the Alaknanda for few months (February to June), thereafter migrating to the tributaries like Nayar with the onset of monsoon (Figure 2a, Nautiyal *et al.*, 2001). The Nayar river serve as critical breeding ground providing essential microhabitat components for spawning, feeding and growth of youngs, thus attracting large brooders beside other factors as homing instinct or reinforced learning (Nautiyal *et al.*, 2001).



**Figure 2** a) Migratory pattern of golden mahseer (Nautiyal 2014), b) Confluence of the Ganga and Nayar rivers at Vyas ghat and Baagi village

The large size brooders (above 80 cm) can easily be observed and studied during the migratory phase in these breeding grounds; however they are also most vulnerable to poaching in these stretches.

Several stakeholders as village community, fishermen, youth, local leaders, the state fisheries and forest department officials in different capacities were required so as to achieve long term conservation goal. Several awareness campaigns and public meetings were done with local communities aimed at inculcating sustainable fishing practices and compliance with regulations and to increase local commitment in conservation of this charismatic species. Regular orientation programs and interactions were held with the state fisheries and forest department officials and their representatives were actively engaged in awareness programs, public discussions and patrolling visits.

### Project members

Member	Qualification	Experience	Current occupation	Role	Age group
Saurabh Dewan	MSc, PhD	Fish biology, habitat assessment, stress management	DST National Post Doc Fellow, National Bureau of Fish Genetic Resources, Lucknow	Team leader Population assessment, analysis, interaction with stakeholders	30+
Ajay Pandey	MSc, PhD	Project monitoring and evaluation, Organizing of outreach activities	Consultant, National Fisheries Development Board, Hyderabad	Coordination and regular evaluation of the project, mediation with Fisheries department and other regulatory authorities	35+
Jitendra Singh Rana	MSc, PhD	Geography, hydrology, ecological aspects of Ganga river basin, Impact assessment studies	Fisheries Scientist, Department of Zoology and Biotechnology, HNB Garhwal University, Srinagar (Garhwal)	Identification of sampling sites, habitat assessment, Data collection and statistical analysis	40+
Rajeev Lochan	MSc	Post graduate student	Department of Zoology and Biotechnology, HNB Garhwal University, Srinagar (Garhwal)	Sample collection, Coordinating with local students for awareness campaigning	20+

### **Section 2:**

## **Aim and objectives**

Our aim was to ascertain the current population structure and identification of important river stretches that constitute critical habitats for conservation and restoration of golden mahseer. Also, spreading awareness of breeding biology and migration behaviour of the fish and good fishing practices to local communities living along rivers, in order to reduce indiscriminate fishing.

## **Objectives**

- 1) Assessment of population abundance (per unit area) and relative abundance (Catch per unit effort).
- 2) Evaluation of population dynamics (Juvenile abundance, recruitment and growth) and population structure (Mean length and age; Proportional size distribution; Sex ratio; length, weight and age at maturity; Juvenile:adult ratio).
- 3) Collection of past years data from secondary sources as published literature, catch (from local fishermen) and angling associations in the region.
- 4) Development of print material/Do's and Don'ts lists/fishing manuals for local communities and inexperienced anglers for awareness towards biology of golden mahseer and good fishing practices.

## **Changes to original project plan**

Considering, the published literature for migration pattern we initially planned to finish population assessment by September, 2018. However, we observed some receding migrants until November and continued our assessments up to December, 2018. The final tabulation, analysis and evaluation took another three months as the fisheries department officials were also involved in analysis and interpretation. Final results presented here were also presented to the department for approval; however, this one year assessment being based on single breeding season cannot be validated. With limited finance and resources we are continuing data collection up to December, 2019 to generate robust results for scientific publications.

During outreach activities we experienced initial restrain from the villagers. Though, we successfully conducted few awareness programs and distributed print materials, t-shirt etc., we couldn't put up the banners/boards, well in time before the start of breeding season, last year. The villagers worried that such banners will highlight them, and they may face wrath of authorities. Later, with frequent interactions and open meetings (including government representative), the villagers became more open and receptive.

Subsequently, with support from the State fisheries department, we made this a sustained, mass awareness campaign throughout the year along the Nayar river valley.

### **Methodology**

All year round sampling was done at the identified spots and fishes were landed using gill nets and cast nets. The size of gill net employed were as per previous studied for *T. putitora* varying from 60x10 and 40x7 m. (l x w) with mesh size of 10 and 7 cm, respectively (Bhatt et al 2000, 2004, Nautiyal et al 2008). Large fish were landed through angling following established landing and release protocols, to minimize the stress to the fish. Catch data was also recorded at the local fish markets and from fishermen, selling locally.

Age and growth was evaluated through microscopic analysis of the 'key scales' from the dorsal fin region above lateral line. The annulus formation was determined according to the criterion suggested by Bagenal (1978) and adopted by Nautiyal (1990). The number of annuli for each scale were recorded and age classes was determined on the basis of annuli as 1+, 2+, 3+ and so on (Bhatt et al 2004). A percentage frequency table was prepared on the basis of fish size at regular interval to record the size of fish at different age classes and to compute age composition in different sex and years (Bhatt et al 2000). The growth parameters were estimated as suggested by Gulland and Holt (1959).

Restoration zones were identified based on assessment of essential fish habitat (EFH) factors related to waters and substrates necessary for spawning, feeding and growth to maturity of these endangered species. All the activities which have the potential to affect the EFH were discouraged. The strategy entailed identification and protection of potential breeding grounds and compliance of no fishing season during monsoon, with the help of state fisheries and forest department.

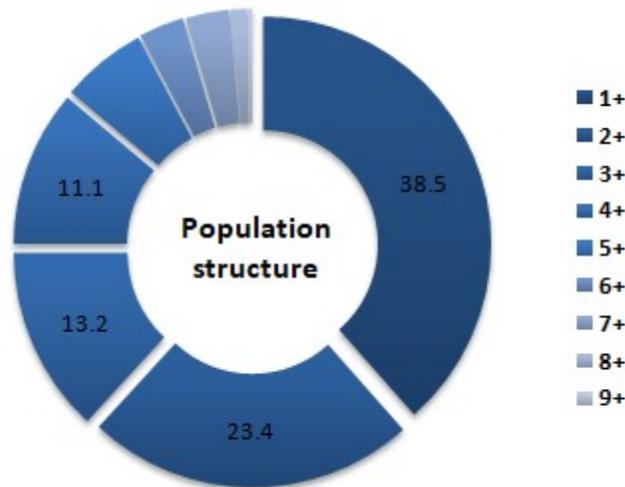
Past years, catch data for golden mahseer was also be obtained from local fisherman, published scientific literature and by consulting national and international catch-and-release anglers, and some guides who visited the region in past for recreational fishing.

Public outreach, education and engagement activities were done to increase local commitment to best conservation practices. Awareness campaigns and patrolling were done with the help of state fisheries department to deter poachers from fishing during breeding period and illegal practices of using dynamites, electrocution and fish toxins. Banners were installed along most fished stretches highlighting Do's and Don'ts list. Several workshops were done with the help of resource persons to train local youths in methods of recreational fishing, aquaculture, tourist guiding and personality development. Angling manuals with code of conduct (specific to fishing aspects of *T.*

*putitora*) is being prepared with inputs from some renowned national and international anglers, suggesting protective measures to be taken for catch and release angling.

### Outputs and Results

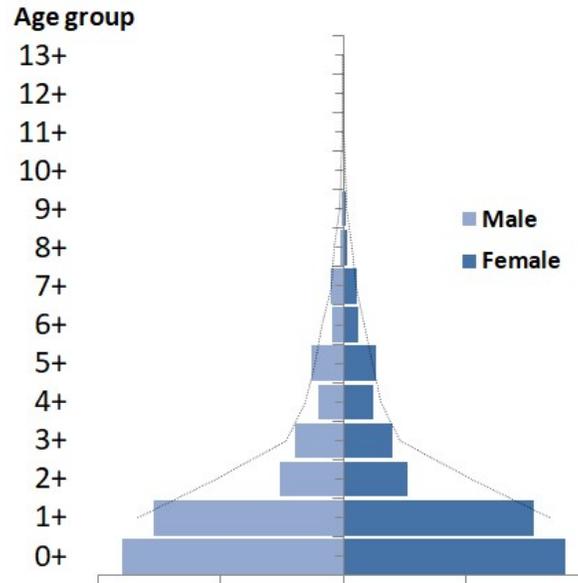
For population study (**Objectives 1 and 2**), data was generated by fishing random samples (catch and release) and from the local fishermen catch, village household, and nearby fish markets. Hook and line or Rod and line fishing was most effective in catching adults otherwise the samples were landed using gillnets and cast nets (8-10 cm). For all the samples, total length and weight was recorded to the nearest unit (cm, gm). The average catch ranged from 2.6-31 kg/day and 0.38-2.9 kg/hour in Nayar and 1.5-17.6 kg/day and 0.21-1.6 kg/hour in parts of Ganga above Rishikesh. In Nayar, the maximum catch was recorded in September-October while in Ganga during the months of April-May. The catch per unit effort (CPUE) ranged from 3.1-14.6 kg and 0.45-8.4 kg in the Nayar and Ganga rivers, respectively. In 2017-18, the catch size was between 28-57cm in Ganga and 11-91cm in Nayar. However, in the current year it reduced to 14-37cm in Nayar with only few occasional records of large size brooders being caught and the rough estimates from same data sources suggest around 25-30% catch reduction.



**Figure 3** Population structure of golden mahseer in the upper Ganga stretch (Devprayag to Rishikesh) and the river Nayar

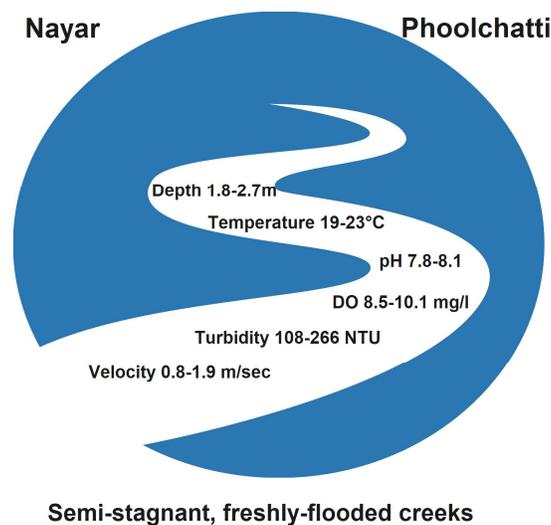
For growth study all the samples were grouped into different classes (10 cm size interval) to obtain 'Length-Age frequency key' (Nautiyal et al. 2008). Based on the current data (sample size (n) = 477) collected from all above mentioned sources, the length ranged from 3.4 to 90.7 cm. In the river Ganga, mahseers from 21.5-46.7 cm in length were recorded while Nayar being a critical breeding and feeding ground had 3.4

to 90.7 cm of fish from fry to juveniles inhabiting it throughout the year and larger size matures visiting to spawn in the monsoon.



**Figure 4** Sex composition of golden mahseer in the study area

The samples until now suggest distorted population structure as pre-reproductive age group (0-4) constituted more than 85% of the stock assessed, dominated by 0-2 age group with ~62% (Figure 3). Almost equal sex-composition was seen up to 0-3 age group above which fewer male were recorded (Figure 4). Essential habitat factors related to spawning and growth were assessed at critical spawning grounds in Nayar as well as minor streams in Phoolchatti (Figure 5).



**Figure5** Essential habitat factors related to spawning and growth assessed at critical spawning grounds in Nayar as well as minor streams in Phoolchatti

In order to compare current data to past records (**Objective 3**) we did extensive literature search for studies done on this stretch of the river Ganga and Nayar, and also collected some data through personal communications. Major studies/ or data, we got is for the year 1980-81 and 1994-95 and the decadal trends being analyzed in 2005-06 (Nautiyal and Lal 1982, Bhatt et al. 2004, Nautiyal et al. 2008). After further data collection for another year, comparative decadal trend analysis will be done. We also intended to collect data from records in anglers logbooks or fishing guides, which is an inexpensive and reliable source of fishing data, especially in these areas where regular scientific are not being done. However due to recent ban on angling by Hon'ble court and subsequent hue and cry, we had only three anglers visiting the confluence site and their records and of some guides we interviewed in the region didn't seem reliable enough to be included in our data set.



Awareness campaign organised at Baagi village

Public outreach, education and engagement activities were done to increase local commitment to best conservation practices (**Objective 4**). In, 'Vyas ghat' and 'Baagi', the two target villages near the confluence, six awareness campaigns were done involving 40-65 villagers and 5-8 representatives from the State fisheries department, Tourism department, Social welfare department, Village head, NGOs, University Professors etc. Eleven open meetings (public hearings) were conducted in these two villages as well as adjoining 'Chaitur' and 'Matoli' villages, who were are not directly involved in fishing but regularly purchase and consume fish. Distribution of print materials, t-shirt etc. was done during outreach programs and the banners/boards were put up along the Nayar valley. A well coordinated patrol was also conducted in 'no

fishing' season from July to September, involving government representatives, our team and a member of village self-help group. Two workshops to explore the prospects of recreational fishing as alternative livelihood were done with the help of resource persons from Wildlife Association of South India (WASI) and active involvement of the state fisheries department. Among 10-12 village youths that participated, the six identified would be groomed as fishing and tourist guides. A guideline for guides and amateur anglers is being prepared with inputs from Mr. Suprio Mukherjee (Gamefishing Asia).



Open meetings and public hearings in different villages along Nayar valley

### **Communication & Application of results**

Initially, the fish catch data collected from the local fish markets or from fishermen, selling locally and from various secondary sources like village visits, interaction with fishermen families was communicated and discussed with the state fisheries department to increase their awareness and understanding of indiscriminate fishing of mahseers from the breeding grounds in Nayar valley. The ground data generated helped us in raising seriousness of government officials towards the issue and getting their active involvement in awareness campaigns and other outreach activities. As a result, 'No fishing season' during breeding period was implemented strictly (for the first time) through morning, evening patrols by a team comprising representatives of fisheries department, forest department, policemen, our team and members of village self help groups.



Seized nets and lines during patrolling in 'no fishing' season

The final reports and data on current population structure, critical habitats, essential micro-habitat components has been provided to the state fisheries department and will find application in proper implementation and compliance of the state fisheries act. The data collected on various socio-economic issues of the communities living along the Nayar river and our recommendations on developing river resource based alternative livelihood means is also being communicated to the department of tourism and department of social welfare.

## Monitoring and Evaluation

As, “the effective management of a fish stock is not so much about the fish as about the people trying to catch them” (Davies, 2013). However, the behaviour of people and response to regulations in ways, often surprising to us as researchers or regulators. We felt a need to understand their motivation and incentives, so as to have better understanding of their response and achieve desired behaviour change.

**Table 1** Identified target audience, desired behaviour and barriers to behaviour change

Target Audience	Characteristics	Desired behaviour change	Barriers to behaviour change
<b>Influencers/ Leaders (L)</b>	Head of the village Eldest villager/s Respected individual/s	Increased involvement in outreach programs Constant nudge and motivation to villagers	Lack of leadership skills, fear of being denounced by villagers, or loosing the next elections
<b>Community members (C)</b>	Villagers General population	Open to attending awareness campaigns Willing to adopt good fishing practices, alternative livelihoods	Social structure, Economic background, lack of other means to livelihood
<b>Destructors (D)</b>	Illegal fishing practicers Some villagers Migrant labourers	Avoid using destructive fishing practices, or use less destructive ones	Resistive to investing time and labour in less destructive method
<b>Regulators (R)</b>	Government officials from State Fisheries and Forest department	Increased involvement in outreach programs Receptive to our suggestions	Lack of motivation, willingness, expertise and workforce

For monitoring and evaluation purpose we monitored our target audience (Influencer, Community members, Destructors, and Regulators) for desired behaviour change, before, during and at few months gap after our field activities.

**Table 2** Response (in % of total respondents) of target audience during project period

Indicator	September 17				November 18			
	L	C	D	R	L	C	D	R
<b>About Fish and conservation</b>								
Are aware of breeding behaviour of golden mahseer?	85	69		91	94	91		100
Are aware of good fishing practices (GFP)?	84	57		80	91	93		100

Have told someone about GFP?	21	35	88	98	90	91
Are against use of destructive fishing methods (DFM)?	98	96	100	100	100	100
Have talked to someone about ill effects of DFM?	79	75	91	96	98	93
Have warned someone about using DFM?	37	68	72	78	86	86
Feel, if mahseer size or numbers has reduced?	72	89	96	78	92	97
Feel that conservation is also their responsibility.	75	67	100	97	90	100
Are willing to contribute to the cause of conservation?	80	48	81	95	92	100
<b>Alternative livelihood</b>						
Will totally give up fishing if provided an alternative?		NS			76	
Will continue to fish even if provided an alternative?		NS			12	
Are eager to take up other means of livelihood?		NS			69	
Are eager to take up fish related livelihood means?		NS			56	
Are eager to learn tourism/recreational activities?		NS			42	
Are willing to use part of their savings?		NS			22	
Are willing to take up govt loans at minimal interest?		NS			27	

**Respondents:** 19 L, 146 C, 15 R from three villages and 11 D along Nayar valley (8+3 in 2017, 18 respectively but none responded during our interaction, however reduction in their number from eight to three in 2018, is itself an indicator). NS-'Not surveyed'; aspects for alternative livelihood were not discussed in our initial survey, before start of the project.



Semi structured interviews with local villagers

These responses were documented via direct interaction with respondent in semi-structured interviews putting open ended question, and subsequent discussions on the issue. A remarkable increase in knowledge of the respondents related to biology of golden mahseer and its conservation issues was documented at the end of project. Also, the community members seemed more receptive to the ideas of alternative profession, provided they get support from concerned government departments.

**Table 3** Response (in % of total respondents) of target audience around three and six months after project outreach activities

Indicator	January 19			April 19		
	L	C	R	L	C	R
<b>About Fish and conservation</b>						
Have heard/observed/implemented 'No fishing season'?	72	87	98	64	79	99
Are using/or suggested use of the nets with recommended mesh size?	64	58	93	52	40	92
Have heard/observed/or know someone using destructive fishing methods?	46	53	88	59	72	95
Have stopped someone from using destructive fishing methods?	39	50	80	42	55	84
Have discussed/or heard about mahseer conservation?	96	95	100	87	78	100
Have felt the need of conserving mahseer/ or feel pride in having mahseer in their river?	90	86	98	88	75	100
Feel responsibly towards fish and river, as a resource.	97	90	100	96	82	98
Have actively contributed/or are willing to contribute to the conservation program and activities?	80	68	87	75	52	80
<b>Alternative livelihood</b>						
Have totally given up fishing?		12			16	
Do fish sometime but have also started with an alternative source of income?		24			32	
Have approached government departments for funding or new schemes?		45			18	
Have taken or are willing to take government loans to start alternative profession?		08			10	
Have used/or are willing to their own savings to start alternative profession?		05			06	
Are willing to conserve local pools and sell seeds to government hatcheries?		58			40	
Have taken part/or are eager to attend tourism/recreational fishing		66			59	

**Respondents:** 16 L, 162 C, 14 R from three villages along Nayar valley. Leaders and Regulators were not involved for alternative livelihood survey.

The respondents were again interviewed around three and six months after completion of project to monitor the impact of our public outreach activities. However, these interviews as compared to previous had similar but more direct questions on fish conservation and livelihood issues. The responses suggest slight reduction in positivity and will of the people with time. We are making efforts towards creating a sustained, mass awareness campaign in the Nayar River valley with the help of the state fisheries department.

### **Achievements and Impacts**

**Reduction in catch size and numbers during breeding season** - Our data based on randomly fished samples (catch and release) and observations of the local fishermen catch, village household, and nearby fish markets suggest that, the catch size was between 11-91cm in Nayar in the last breeding season which got reduced to 14-37cm, with only occasional records of large size brooders being caught and sold. The rough estimates from observations (three months, July-September) at fish-market and discussions with fishermen and village household suggest, somewhere around 25-30% catch reduction.

**Population study after fifteen years** - Major studies/or data-mined through literature survey or personal communications was for the year 1980-81 and 1994-95 and the decadal trends being analyzed in 2005-06 (Nautiyal and Lal 1981, Bhatt et al. 2004, Nautiyal et al. 2008). The current population assessment is done after almost fifteen years, thus would find application in predicting changes in population structure and dynamics over time. But in order to have robust predictions, larger dataset is required, thus we will generate data for another year before comparative analysis and publications.

**Identification of critical breeding grounds and related habitat factors** - Several spawning grounds were identified in Nayar as well as minor streams in Phoolchatti, near Rishikesh. These were mainly semi-stagnant, freshly-flooded creeks, where the essential habitat factors related to spawning and growth were assessed. The recently advocated conservation strategies as development of freshwater protected areas or e-flow prescriptions in this region lack any background research. The essential habitat factors identified here in critical stretches may help in prioritizing fish restoration zones.

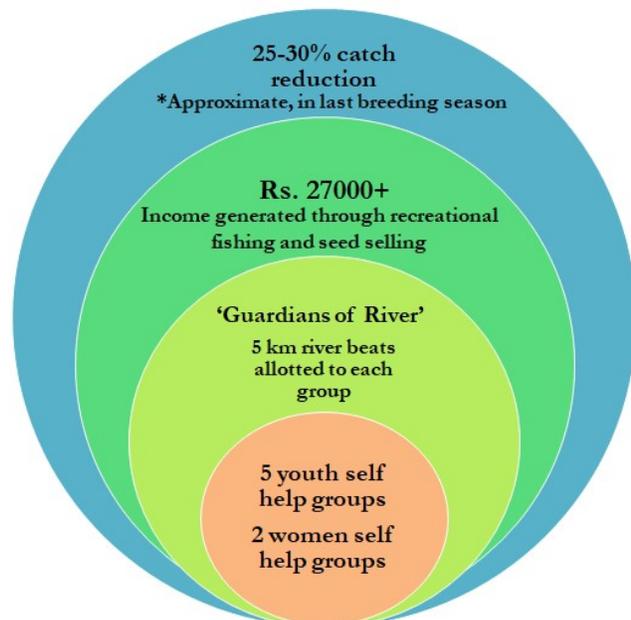
**Strict implementation of 'no fishing' season** – For the first time, 'no-fishing' season (July-September) was 'strictly implemented, on ground' in the Nayar river valley. A well

coordinated patrol was conducted in morning and evening, randomly three to five days a week by a team involving a policeman, government department representative, a member of our team and of village self-help group. Plenty of cross river nets, hook-lines, noose-lines were removed and seized. Eleven illegal fishing practicers (8+3 in 2017 and 18), mainly migrant labours and some villagers were interrogated on suspicion of dynamiting. The reduction in number from eight to three in 2018, indicate that regular patrolling had deterrent effect.



Capacity building workshops at Vyaas ghaat village

**Capacity building and income generation** - Five youth self-help groups were formed in three villages considering individual's willingness to contribute towards the cause of conservation. These groups were allocated 5km river beats, and will act as 'Guardian of rivers', responsible for checking illegal fishing and conserving breeding pools. The members are being trained for seed collection, supported for sales to department and the six identified youths are under grooming as fishing and tourist guides. In the initial phase, a sum of Rs. 27000+ has been generated through some tourist inflow and seed selling. Two exclusive all women group were also formed and they are being



trained to motivate other families, where men are actively involved in fishing. Such groups are acting as strong mediators of our effort in these villages.

### **Capacity Development and Leadership capabilities**

The project greatly increased our scientific curiosity and general awareness for processes and impacts on aquatic ecosystem. It helped us in implying our past experiences of aquatic biodiversity assessments and other monitoring and management studies in answering broader question regarding population dynamics of this iconic mahseer species. It also improved our project teams understanding of proper study design, actual field execution, and standardization of sampling methods as well as management and statistical analysis of biological data. The project activities like public outreach programs, awareness campaigns and public hearings, etc strengthened leadership abilities and organizational capabilities of all team members. Successful smaller events boosted and encouraged us to hold multi stakeholder meetings and orientation programs with the State government departments and present a strong case regarding plight of mahseers and assert the failure of existing legislative framework towards its protection. The regular interactions with local communities increased our emotional bond and helped us in identifying some potential youngsters that can be groomed as future biologists, and can aid in conservation of this species.

On personal ends, working out technicalities, or the problems faced (especially while community dealing) and different challenges helped us in recognizing individual strengths, adaptive methods which eventually led to creation of an efficient and responsible team, over the duration of project. Working together we also learnt the process of strategic risk-taking and often came up with creative solutions, in the process.

### **Section 3:**

#### **Conclusion**

Size-composition of mahseer stock studied for more than a year suggests that the fish has negatively reacted to the increased fishing pressure, over the years. Indiscriminate, large-scale harvests, mainly of brooders during breeding period in Nayar river valley and in stretches of Ganga during ascending migration have led to reduction and distorted proportions of different age groups as compared to last decade (recorded 15-20 years ago). Although our data provides hint on current population structure and dynamics, it's still insufficient. Data is being collected to generate robust interpretations. Further, behaviour change in fishermen community is difficult owing to their socio-economic

interest associated with fishing culture. However, we felt that initial trust building and economic empowerment through alternative avocations could be critical components in engaging the community. Awareness through public outreach programs and alternative livelihood measures as tourist guides, fishing guides and seed selling though seem to work but need training and support system from the state authorities, for long term viability and sustenance. Along with capacity building and monetary empowerment of communities, deterrence may also be required for few years to achieve long term conservation goal. The strict patrol and interrogation of offenders during breeding season had some positive effect. However, legislation alone cannot work as the regulatory departments often working as advocacy organizations have failed to gain community trust. Thus, there is need to balance advocacy and facilitation in order to reconcile community interests with our long-term conservation goals.

### **Problems encountered and lessons learnt**

Before the start of project and initial few months, we spent lot of time in building relationship with the state fisheries and the state forest department officials deputed in our study area. A lot of personal meetings, orientation programs and canvassing were done to generate goodwill with them. This greatly helped us in securing field permissions, well in time. Also, under our assurance that we will involve them in all activities, will highlight their department efforts and share our data and reports, the department often provided manpower and logistic support during our field visits. They also provided accommodation facilities to our trainers and resource persons during workshops in government guest houses. This bondage with officials helped us in saving time, labour and meeting unplanned expenditures, which could otherwise have affected our budget.

A major challenge was bringing together all local stakeholders on a common platform and reconciling differing social and ecological issues. We made an attempt to identify all major stakeholders from local communities to regulatory authorities, individuals to groups working in the region and identified their interests and concerns. To our dismay, we faced strong restrain and opposition from villagers, in initial meetings as we brought authorities to the erstwhile isolated villages. Though we did conduct few awareness programs and distributed print materials, t-shirt etc., we couldn't put up the banners/boards, well in time before the start of breeding period due to initial restrain from the villagers. They worried that such banners will highlight them, and they may face wrath of local authorities. We faced huge difficulty in fostering community involvement, stimulating government and managing conflict between them.

We realised that the local villagers in the Nayar river valley have several socio-economic interest associated with fishing culture. We thus mapped social status and economic interests of fishermen communities in three villages to develop an understanding of potential areas of conflict and synergies. Talks were held with higher authorities to achieve consensus on providing alternative means of livelihood for local communities, as well as involving them in future decision-making. The open meetings (public hearings) where villagers spoke to their heart proved useful initially, in trust building while training some identified youths for economic empowerment, in later stages of the project seemed critical components towards the desired behaviour change.

### **In the future**

In collaboration with the state fisheries department, the data generation will continue this year. The two year population assessments will be then rigorously analysed for robust interpretation against past records to get decadal trend. Though some grant applications are in pipeline to generate more funds, we will carry on public outreach activities with the department and support from organizations like Wildlife Association of South India and The Mahseer Trust. In order to strengthen training and support system and for long term viability and sustenance of the alternative livelihood programs, we will connect the state department to some of our resource persons, who will train the youths along with our team members. Regular follow up meetings will be done with the newly formed youth and women self help groups, to check the inflow-outflow of the income to the target villages. Some promotional and advertising events for recreational fishing are also being planned in the near future with the help of the state fisheries department to attract tourists, national and international anglers.

### **Financial Report**

<b>Itemized expenses</b>	<b>Total CLP Requested (USD)</b>	<b>Total CLP Spent (USD)</b>
<b>PHASE I - PROJECT PREPARATION</b>		
Communications (telephone/internet/postage)	300.00	297.28
Field guide books, maps, journal articles and other printed materials	700.00	691.72
Insurance	500.00	507.79
Visas and permits		
Team training	400.00	401.79

Reconnaissance	600.00	594.34
Other (Phase 1)		
<b>EQUIPMENT</b>		
Scientific/field equipment and supplies	1,500.00	1550.56
Photographic equipment	500.00	486.12
Camping equipment	750.00	736.06
Boat/engine/truck (including car hire)	1,000.00	1008.51
Other (Equipment)		
<b>PHASE II - IMPLEMENTATION</b>		
Accommodation for team members and local guides	800.00	242.29
Food for team members and local guides	1,000.00	917.74
Travel and local transportation (including fuel)	700.00	640.48
Customs and/or port duties		
Workshops	650	657.67
Outreach/Education activities and materials (brochures, posters, video, t-shirts, etc.)	1,500.00	1600.40
Other (Phase 2) For hiring of fishing guides		558.53
<b>PHASE III - POST-PROJECT EXPENSES</b>		
Administration	500.00	498.94
Report production and results dissemination	750.00	730.17
Other (Phase 3)		
<b>Total</b>	<b>12,150.00</b>	<b>12,120.38</b>

#### **Section 4:**

#### **Appendices**

Output	Number	Additional Information
Number of CLP Partner Staff involved in mentoring the Project	-	
Number of species assessments contributed to (E.g. IUCN assessments)	One	For the records of the Uttarakhand State Fisheries Department (Pauri Division)
Number of site assessments contributed to (E.g. IBA assessments)	-	

Number of NGOs established	One	The Himalayan Conservancy (Registration, under process)
Amount of extra funding leveraged (\$)	-	In pipeline
Number of species discovered/rediscovered	-	
Number of sites designated as important for biodiversity (e.g. IBA/Ramsar designation)	-	
Number of species/sites legally protected for biodiversity	One (Nayar river valley)	Critical breeding ground of golden mahseer; recommended for protection to the Uttarakhand State Fisheries Department (Pauri Division)
Number of stakeholders actively engaged in species/site conservation management	Eight to ten	Local community, Village heads, State Fisheries Department, State Forest Department, Local University Professors, Similar working groups, NGOs and individuals etc
Number of species/site management plans/strategies developed	One	Some recommendations made for incorporation into the State Fisheries Act
Number of stakeholders reached	Eight to ten	
Examples of stakeholder behaviour change brought about by the project.		Village youth groups acting as 'Guardians of river'; attending awareness campaigns, trainings and workshops; receptive to learning about alternative professions
Examples of policy change brought about by the project	-	
Number of jobs created	-	Six identified youths are being groomed as fishing and tourist guides
Number of academic papers published	-	Under preparation
Number of conferences where project results have been presented	Four	ICCB Kuala Lumpur 2019, IMC Bhutan 2018, SCCS Bengaluru 2018, SCB Asia Bishkek 2018

Appendix 4.1 CLP M&E measures

## Bibliography

Bagenal T (1978) Methods for Assessment of Fish Production in Freshwaters. Blackwell Scientific Publication, Oxford.

Bhatt JP, Nautiyal P and Singh HR (2000) Population structure of Himalayan Mahseer, a large cyprinid fish in the regulated foothill section of the river Ganga. *Fisheries Research* 44: 267- 271.

Bhatt JP, Nautiyal P and Singh HR (2004) Status (1993-1994) of the endangered fish Himalayan Mahseer *Tor putitora* (Hamilton) (Cyprinidae) in the mountain reaches of the river Ganga. *Asian Fisheries Society* 17(4):341-355.

Bhatt JP and Pandit MK (2015) Endangered Golden mahseer *Tor putitora* Hamilton: a review of natural history. DOI 10.1007/s11160-015-9409-7.

Gulland JA and Holt SJ (1959) Estimation of growth parameters for data at unequal time intervals. *Journal de Con. International pour l'Exploration de La Mer.* 25(1): 47-49.

Nautiyal, P. and M.S. Lal. 1982. Recent records of Garhwal mahseer (*Tor putitora*) with a note on its present status. *Journal of the Bombay Natural History Society* 79: 639-695.

Nautiyal P (1990) Natural history of Garhwal Himalayan mahseer: growth rate and age composition in relation to fishery, feeding and breeding ecology, pp. 769-772. In: R. Hirano and I. Hanyu (eds.), Proceedings of 2nd Asian Fisheries Forum, Tokyo.

Nautiyal, P. 2001. Spawning ecology and threats to Mahseer. In: *Coldwater Aquaculture and Fisheries* (eds. H. R. Singh and W. S. Lakra), pp. 291-306. Narendra Publishing House, New Delhi.

Nautiyal, P. 2002. The Himalayan Mahseer: Migratory pattern in relation to ecological characteristics of the Ganga river system in Garhwal Himalaya, pp. 172-195. In: *Highland Fisheries And Aquatic Resource Management.* (eds. K. K. Vass and H. S. Raina), National Research Centre on Coldwater Fisheries (ICAR) Bhimtal.

Nautiyal P, Rizvi AF, Dhasmana P (2008) Life– history traits and decadal trends in the growth parameters of Golden mahseer *Tor putitora* (Hamilton 1822) from the Himalayan stretch of the Ganga river system. *Turkish Journal of Fisheries and Aquatic Science* 8:125–132.

Nautiyal P, Nautiyal R, Semwal VP, Mishra AS, Verma J, Uniyal DP, Uniyal M and Singh KR (2013) Ecosystem health indicators in the Ganga Basin (Uttarakhand, India): Biodiversity, spatial patterns in structure and distribution of benthic diatoms, macro-invertebrates and ichthyofauna, *Aquatic Ecosystem Health & Management*, 16:4, 362-373.

Nautiyal P (2014) Review of the art and science of Indian mahseer (Game Fish) from nineteenth to twentieth century: road to extinction or conservation? Proceedings of National Academy of Science, India, Section B Biological Science 84:215–236.

### **Project findings presented at International conferences**

1. **Turning poachers into protectors: Towards conservation of mahseers in Nayar River Valley, Uttarakhand, India.** Poster presentation at **International Congress on Conservation Biology, 21-25 July, 2019, Kuala Lumpur, Malaysia.** Saurabh Dewan, Jitendra Singh Rana, Ajay Pandey, Rajeev Lochan, Anand Kumar, Upendra Singh, Prakash Nautiyal.
2. **Multi-stakeholder engagement in the conservation, restoration and management of Golden Mahseer: An initiative in Nayar River Valley, Uttarakhand, India.** Oral presentation in **International Mahseer Conference, 2-8 Dec, 2018, Paro, Bhutan.** Saurabh Dewan, Jitendra Singh Rana, Ajay Pandey, Rajeev Lochan, Anand Kumar, Upendra Singh, Prakash Nautiyal.
3. **A tale of ‘river tigers’: Study on population, threats and conservation measures of Golden mahseer in upper Ganga river, India.** Poster presentation at **Student Conference on Conservation Science, 27-30 Sep 2018, Bengaluru.** Saurabh Dewan, Jitendra Singh Rana, Ajay Pandey, Rajeev Lochan, Anand Kumar, Upendra Singh.
4. **Conserving the river tigers: Golden mahseer in upper Ganga river, India.** Oral presentation delivered at **Conservation Asia, 6-10 Aug, 2018, Bishkek, Kyrgyzstan.** Saurabh Dewan, Jitendra Singh Rana, Ajay Pandey, Rajeev Lochan, Anand Kumar, Upendra Singh.

### **Address list and web links**

#### *Our team*

**Saurabh Dewan**, National Bureau of Fish Genetic Resources, Lucknow and Department of Zoology & Biotechnology, HNB Garhwal University, Srinagar Garhwal, Uttarakhand, email: saurabhdewan86@gmail.com

**Ajay Pandey**, National Fisheries Development Board, Hyderabad, Telangana state, email: ajayp\_2@yahoo.co.in

**Jitendra Singh Rana**, AHPC Mahseer hatchery, Department of Zoology & Biotechnology, HNB Garhwal University, Srinagar Garhwal, Uttarakhand, email: ranajitendra14@gmail.com

**Rajeev Lochan**, Department of Zoology & Biotechnology, HNB Garhwal University, Srinagar Garhwal, Uttarakhand, email: lochanrajeev96@gmail.com

*Associates*

**Anand Kumar**, Department of Zoology & Biotechnology, HNB Garhwal University, Srinagar Garhwal, Uttarakhand, email: akumar.ags@gmail.com

**Upendra Singh**, Central Inland Fisheries Research Institute, Allahabad Regional Centre and Department of Zoology & Biotechnology, HNB Garhwal University, Srinagar Garhwal, Uttarakhand, email: upendra481@gmail.com

*Advisors*

**Prof. J.P. Bhatt**, Former Director - Chauras Campus, H.N.B. Garhwal University, Srinagar-Garhwal, Uttarakhand, email: profjpbhatt@gmail.com

**Prof. P. Nautiyal**, Department of Zoology & Biotechnology, H.N.B. Garhwal University, Srinagar-Garhwal, Uttarakhand, email: pn.mahseer@gmail.com

**Distribution list**

1. Office of the District Fisheries In charge, State Fisheries Department (Pauri Division), Uttarakhand
2. Department of Zoology & Biotechnology, H.N.B. Garhwal University, Srinagar-Garhwal, Uttarakhand

## महाशीर फिश को बचाने में जुटे जंतु विज्ञानी

जागरण संवाददाता, श्रीनगर गढ़वाल : विलुप्त होने के कगार पर पहुंच चुकी महाशीर फिश को बचाने को लेकर गढ़वाल केंद्रीय विश्वविद्यालय के जंतु विज्ञानी एक शोध परियोजना के तहत बड़ा अभियान भी चला रहे हैं। जिसमें वह सतपुली से लेकर ब्यासघाट तक नयार नदी क्षेत्र के गांवों में लोगों को महाशीर मछली की महत्ता और उसके संरक्षण के बारे में जागरूक कर रहे हैं। गढ़वाल केंद्रीय विश्वविद्यालय के वरिष्ठ जंतु विज्ञानी प्रो. प्रकाश नौटियाल के दिशा निर्देशन में इस कार्ययोजना को अमलीजामा पहनाया जा रहा है। जिसमें वर्ड वाइड फंड फॉर नेचर दिल्ली डब्ल्यूडब्ल्यूएफ और प्रदेश का मत्स्य विभाग भी सहयोगी है।

उत्तराखंड में नयार नदी महाशीर के लिए सर्वोत्तम मानी जाती है। वरिष्ठ जंतु विज्ञानी प्रो. प्रकाश नौटियाल का कहना है कि नयार के पानी के तापमान और पारिस्थितिकीय तंत्र को महाशीर अपने अनुकूल मानती हैं। पारिस्थितिकीय तंत्र को अपने अनुरूप मानते हुए अधिकांश महाशीर मछलियां अंडा देने के लिए भी इस नदी क्षेत्र को चुनती हैं। इसे स्टेट फिश का दर्जा भी मिला है। यहां गोल्डन महाशीर प्रजाति की महाशीर ज्यादा मिलती हैं। प्रो. प्रकाश नौटियाल के दिशा निर्देशन में सतपुली से ब्यासघाट तक



### बागी के ग्रामीणों को किया विशेष जागरूक

ब्यासघाट के समीप बागी गांव के अधिकांश परिवार मछुआरा संबंधी कार्यों से जुड़े हैं। प्रो. प्रकाश नौटियाल के दिशा निर्देशन में नयार के समीप बागी गांव के परिवारों को विलुप्त हो रही महाशीर के संरक्षण और संवर्द्धन में विशेष रूप से सहयोगी भी बनाया जा रहा है। जिसके लिए विश्वविद्यालय जंतु विज्ञान विभाग के शोधार्थी प्रो. नौटियाल के निर्देशन में बागी में डेरा भी डाले हैं।

चल रहे अभियान में महाशीर के संरक्षण के तरीकों को भी ग्रामीणों को बताया जा रहा है। प्रो. नौटियाल का कहना है कि अत्यधिक दोहन के कारण महाशीर विलुप्त होने के कगार पर भी आ चुकी है। ऐसी स्थिति में जरूरी भी है कि अंडे वाली महाशीर का दोहन किसी भी स्थिति में नहीं किया जाए। नेशनल ब्यूरो फिश जैनेटिक रिसोर्स लखनऊ के विशेषज्ञ डॉ. सौरभ दीवान भी इस परियोजना में सहयोगी बने हुए हैं।



Project activities covered by local print and TV media (Dainik Jagran e-paper, 10 August, Page6 and TV100 News bulletin on 13 September, 2018)

## Public outreach



Awareness campaigns, structured interviews, group discussions with different stakeholders



Women centred sensitization campaigns



Fish hatchery visits organised for students from Government Girls Inter college



A women displaying golden mahseer, caught by a male family member

Patrolling visits in 'No fishing' season



Illegal fishing nets, nooses and dead samples recovered during patrol in 'No fishing' season



## Training/Workshops



Hands on workshop on 'Recreational fishing'

## Field sampling



Confluence of the river Ganga and Nayar at Vyas Ghat, near Devprayag



Critical breeding habitats of golden mahseer



Casting for gold



Length and weight assessment



Our Team and associates