

Using Radio Telemetry to Study Mahaseer Movement in Bhutan



Project Report Submitted by:
David Philipp and Julie Claussen
Fisheries Conservation Foundation

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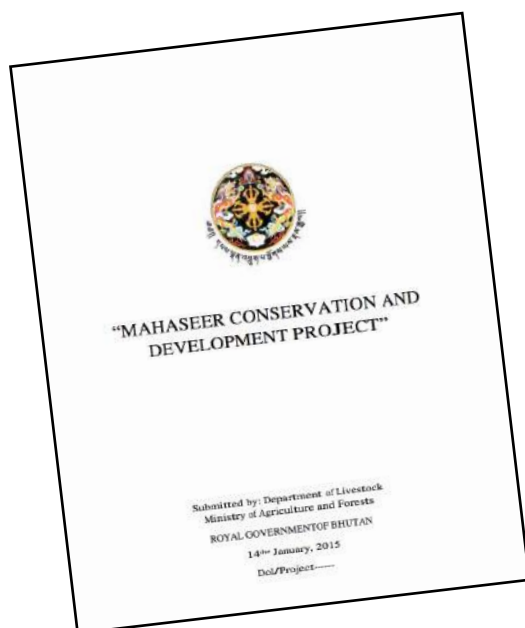


Background

In 2014, discussions began with World Wildlife Fund Bhutan on how best to approach some of the issues associated with the conservation and management of Mahaseer in Bhutan. To determine the interest in and feasibility of developing a joint Mahaseer research project in Bhutan and to assess the logistical challenges that would have to be considered, an exploratory trip was made to Bhutan November 4–14, 2014 by David Philipp and Julie Claussen from the Fisheries Conservation Foundation (FCF) and Michael Philipp from World Wildlife Fund (WWF). That trip began with a meeting with Minister Yeshey from the Ministry of Agriculture and Forests (MoAF), who designated Tshewang Tashi as our official liaison to travel with us as we surveyed potential field sites. Several days were spent in the Mangde Chu-Manas area assessing the feasibility of conducting a telemetry study there. On our return to Thimphu, the team met with the Prime Minister, who challenged us to begin a research project in March 2015 on Golden Mahaseer. Plans then began in earnest to design a study using radio telemetry to determine Mahaseer movements, including their spawning migrations, their use of overwintering sites, and their potential movement out of Bhutan into India.

During the next few weeks an official project proposal was formalized (with WWF partnering with FCF to work in conjunction with the MoAF), and Tshewang Tashi was designated as the Project Manager. Funds and logistical support were secured for this project from the Ministry of Agriculture and Forestry, World Wildlife Fund Bhutan, Fisheries Conservation Foundation, and the University of Illinois.

Various telemetry systems were then assessed to determine the system best suited for such a study, taking into account Bhutan's field conditions. Sigma Eight from Ontario, Canada was selected as the system that would best meet the project needs. Some of the key pieces of equipment (e.g., receivers, antennas, amplifiers, transmitters, programmers, solar panels, and manual trackers) were purchased and tested in Illinois before being shipped to Bhutan. Other pieces of equipment (e.g., 12volt batteries and Battery changers/tenders) were purchased locally in Bhutan or India.



Visits were made to UWICE and the National Aquaculture Centre in Gelaphu in November, 2015.

Goal for Phase One of the Telemetry Study

As stated in the “Mahaseer Conservation and Development Project” document, the overall goal for phase one is to generate information on Mahaseer life history, reproductive biology, and seasonal movements in an effort to determine effective conservation strategies and help initiate and develop appropriate regulations for ecotourism opportunities that could include a recreational fishery.

The research questions to be addressed using radio telemetry were to determine:

1. When and where do Mahaseer go to spawn, and what is the length of that migration?
2. When and where do Mahaseer live during the rest of the year?
3. How do Mahaseer navigate high water during the monsoon season?
4. Do Mahaseer move into India, where they are potentially harvested?
5. What are the critical habitats for each of the Mahaseer’s life history stages?

The specific objectives for fieldwork during the March-April expedition were to:

1. Construct 11 receiver stations;
2. Capture Mahaseer using angling;
3. Surgically implant Golden Mahaseer with transmitters (six fish from each of three study areas);
4. Manually track tagged Golden Mahaseer when possible;
5. Download movement data from the receiver stations at the end of the trip.



The study area for phase one of the Mahaseer Conservation Project is indicated by the black box.

Pre-Expedition Preparations in Thimphu

Two members of the FCF science team (David Philipp and Julie Claussen) arrived in Bhutan on March 1, 2015 to begin equipment inventory, assembly, and testing, as well as to make preparations for the upcoming fieldwork, including the details for equipment transportation to various field locations. Prior to this, several large shipments had been made from the US, including solar panels, rafts, and coaxial cable. In addition, some items had to be purchased in Thimphu. On March 4th, science presentations by David Philipp and Julie Claussen were made to his Excellency Minister Yeshey, and other MoAF officials followed by signing of the agreements and the official launch of the project.



Radio telemetry equipment was purchased in the U.S. and tested prior to Bhutan. A study of this scope and magnitude has never been attempted given the considerations for the field conditions in Bhutan. The team researched several options before selecting equipment that would withstand the climate and remote locations.



Presentations were made to Ministry officials on the science of telemetry, how it is used in various aquatic systems, and how it will be applied to Mahaseer in Bhutan.



His Excellency Minister Yeshey, Director Samdup, and Dr. David Philipp sign the official document to formally launch the Mahaseer Project.



Work space was provided by World Wildlife Fund at their headquarters for the science team to unpack, sort, and prepare the various components for telemetry and sampling equipment that would be needed in the field.

Team members for the expedition included:

World Wildlife Fund: Jigme Tsuendrup, Tandin Wangdi

Royal Manas National Park: Tshering Dorji, DK Gurung, Tenzing Dorji

National Fish Conservation Centre: Karma Wangchuk

Fisheries Conservation Foundation Science Team: David Philipp, Julie Claussen

Fisheries Conservation Foundation Field Team: Jeff Koppelman, Karl Anderson, Chris Haak

Logistical Support (provided by WWF): Chening Dorji, Lopsang Dorji, Sonam Drukpa, Uygen, Dawa

External Project Support supplied by: Tshewang Tashi (MoAF), Michael Philipp (FCF & WWF), Dechen Dorji (WWF)



Several members of the Mahaseer field team.

TASK 1: Workshop at the National Centre for Aquaculture in Gelaphu

The team's first stop was in Gelaphu to conduct a workshop organized by the National Centre for Aquaculture Director, Nomgay Dorji. The goals of the workshop were to bring together officials from the surrounding area to hear science presentations on fish telemetry research, explain the details of this study, and discuss the fieldwork schedule. In addition, Golden Mahaseer from the hatchery were used to test anesthesia and surgical methods, as well as to train NCA fisheries staff on surgical techniques used to implant transmitters.

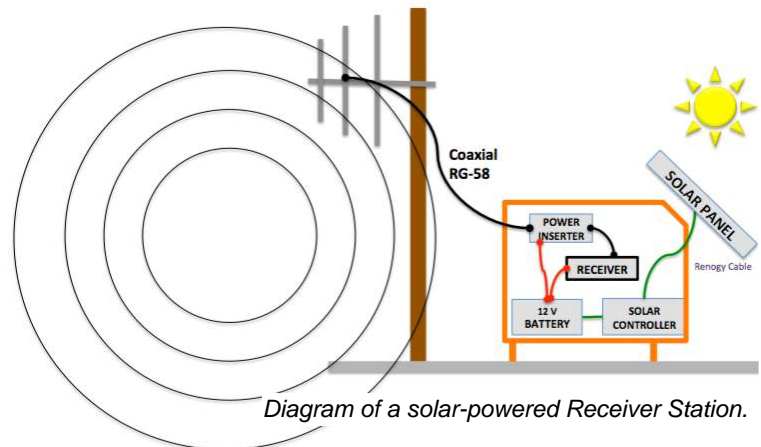


TASK 2: Construction of the 11 Telemetry Receiver Stations

Following completion of the workshop in Gelaphu, the science team began construction of the Telemetry Receiver Stations at various sites along the Mangde Chu and Dangme Chu. This construction effort took 475+ man-hours to complete. The 11 Receiver Stations used in this study employed telemetry equipment that was custom manufactured by Sigma Eight Telemetry and powered by either solar panels or by direct line electric power from local sources. Construction of each station included transporting all equipment to the site, getting the antenna placed in a tree, measuring and placing coaxial cable into conduit tubing (to protect against damage by small animals), building supports for the receiver station housings (large aluminum boxes were used), and wiring the receiver-charger-battery in the box. Once all wiring and power supply was completed, the receiver had to be programmed to receive information on the correct frequencies, noise levels had to be adjusted, and range sensitivity was tested. All stations required an antenna with good line-of-sight to the river, which proved to be one of the more difficult tasks as, in most cases, this meant that the antennas needed to be placed high in a tree. Fortunately, Manas National Park Ranger DK Gurung was very skilled at locating trees at good sites with the required height that he was able to climb, clear the foliage, and wire the antennas. Because of his skills, we were able to place all of the antennas in excellent locations. Although the construction of each Receiver Station presented its own challenges, the team was able to work through all of them because each member of the team brought a different set of skills, ideas, and expertise.

Solar powered stations (see diagram) required 100watt solar panels to be installed in a location that received ample sunlight, which meant that most panels were placed in a tree near the antenna. The Receiver Stations constructed at Berti, Chamkar Chu, Panbang Ecolodge, Confluence of Mangde Chu and Dangme Chu, Manas Beach and Zarkapola were all solar powered.

Line powered stations were possible only in locations where we could tap into a nearby power source, yet still near enough to the river for good reception. The Receiver Stations constructed at Goling, Pantang Ecolodge, Panbang Village, Manas Ranger Station and Yangmari all used line power. The locations of each of the 11 receiver stations are marked on the map at the end of this report.



Some of the equipment used in the Receiver Stations (1), including a solar-charge controller for solar stations (2), the receiver unit (3), and for direct power, a batter charger (4).

Construction of the 11 Telemetry Receiver Stations



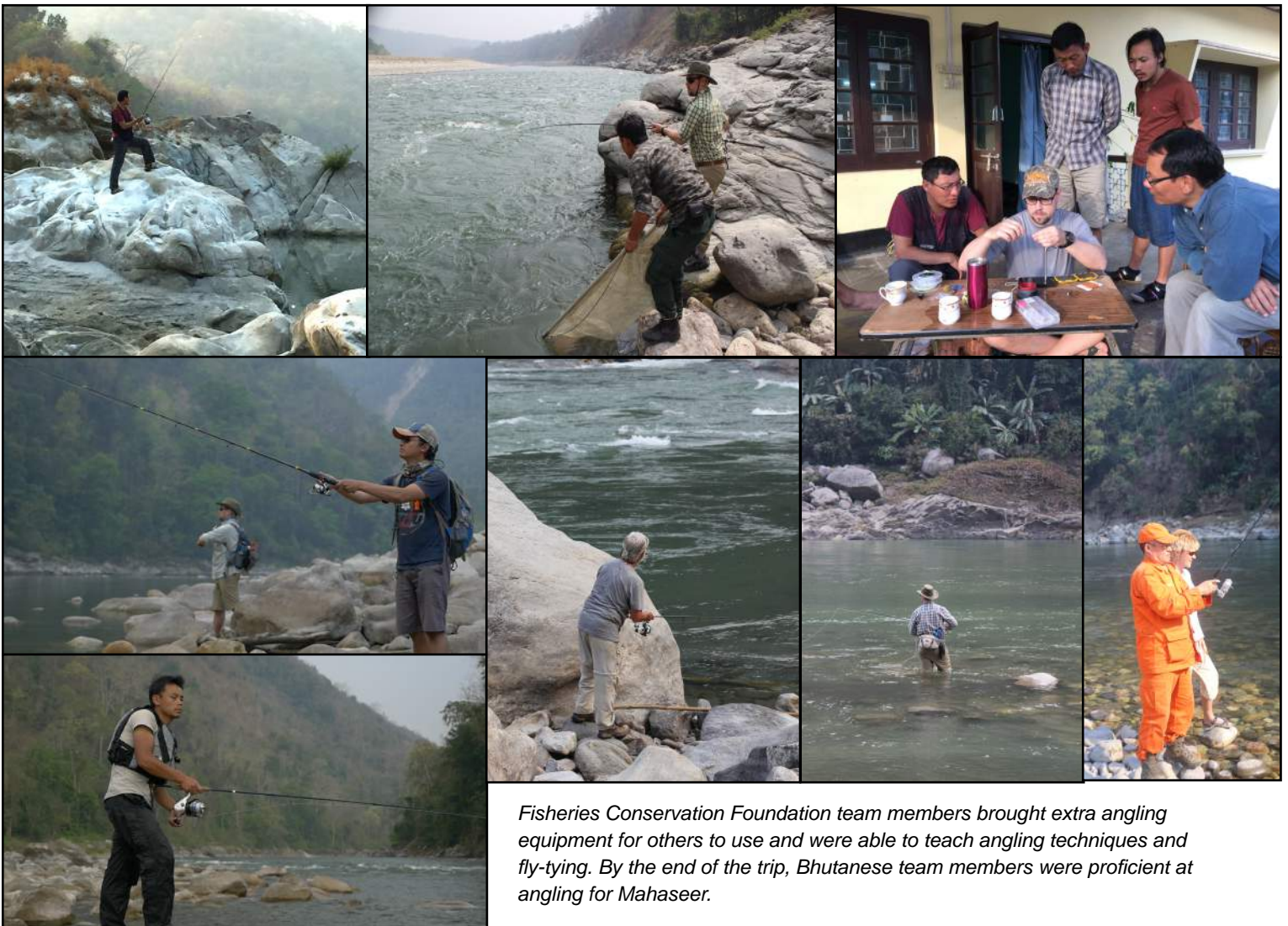
TASK 3: Angling to Collect Mahaseer

Three of our Bhutanese team members, Tshering Dorji, DK Gurung, and Karma Wangchuk, were enthusiastic about learning to fish, and not only became proficient at angling, but were instrumental in the success of catching fish large enough to tag.

To minimize stress on individual fish, angling was used to capture all Mahaseer. During the three weeks of angling (March 11 – April 3), a total of 30 Golden Mahaseer and 40 Chocolate Mahaseer were landed. During this period, however, many more fish were hooked but not landed. In addition, in a number of locations, we were able to spot large fish even if we were unable to hook them.

We worked one day in conjunction with a local fisherman using cast nets at the mouth of the Rindeygang tributary upstream from Pantang Ecolodge in an attempt to capture Golden Mahaseer, but were only successful catching a very few Chocolate Mahaseer. Angling was by far the most effective method to capture Mahaseer and keep them healthy.

Although all team members tried using both spinning and fly fishing equipment, under most conditions, using spinning gear proved to be a much more effective technique for hooking fish, and we were able to bring the fish directly to shore more easily. A variety of different lure types were used to successfully catch Mahaseer of various sizes. All of the anglers were successful in capturing Mahaseer.



TASK 4: Surgical Implantation of the Transmitters

The transmitters for this project are coded radio tags manufactured by the Sigma Eight Company in Ontario, Canada. They use one of six different frequencies (149.340, 149.720, 149.749, 149.760, 149.780, and 149.800 Mhz) for transmission. Each tag is programmed to emit a coded signal every three seconds, which should allow them to last up to three years. Transmitters were attached to the fish by surgically implanting the tag into the body cavity of each fish with the antenna trailing on the outside of the body.

For surgery, Mahaseer were first anesthetized using a clove oil and ethanol mixture, which has been used by the FCF team on several other fish species. In addition we tested its efficacy on Mahaseer during the Gelaphu hatchery workshop. Once the fish was placed in the holding tank and anesthesia added, it took approximately 3 minutes before the fish rolled over and was ready for surgery. Once anesthetized, the fish was placed on a foam platform, and water was pumped over its gills to keep the fish wet and its blood oxygenated. An incision was made in the upper body to insert the transmitter tag into the body cavity. An external antenna trails out of the body for detection by the receivers. After two stitches were made to close the wound, the fish was placed in a cradle net in the river to recover. Before release, each fish was measured, and scales were taken along the lateral line to be used for age and growth analysis. After 20 minutes, the fish were fully recovered and released.

Surgery took place as quickly as possible after capture to assure that fish were kept in healthy condition. We developed mobile surgical stations that were relatively portable so they could be set up adjacent to where fishing was taking place. To allow anglers to be more mobile, they carried fish cradles to hold fish until a surgery table could be set up next to them. Mahaseer tolerated surgery very well, and on average the process took 7–8 minutes to anesthetize the fish, implant a transmitter tag, close the wound and get fish into a fresh water recovery bath.

All FCF members had surgical experience, but during the trip, team members DK Gurung and Karma Wangchuk both learned these techniques and became proficient at surgeries as well. Three transmitters, a surgery table and surgical supplies were left in Tingtibi. Team members, DK Gurung and Karma Wangchuk will attempt to angle and implant transmitters in 2–3 Mahaseer during a spring sampling trip to the Berti Tributary site.



The mobile surgery station consisted of a crate with a tarp to hold water, a battery, pump, and tubing to circulate water, and a foam platform to hold the fish and keep it cool and wet.

Two scales (pictured right) were removed from each fish to see if age can be determined from the growth rings present on each scale.

Mahaseer Surgical Procedure



Fish are placed in the crate and anesthesia is added.



The fish is put in the surgical cradle and a hose with recirculating water with diluted anesthesia is placed in the fishes mouth. An incision is made and the transmitter is placed in the body cavity of the fish.



The incision is closed with two surgical sutures.



Fish are then placed in a cradle net in the river to recover. Once the fish was fully active (approximately 20 minutes), it was released.



TASK 5: Manual Tracking

Fish with transmitters can be manually tracked with a handheld receiver. These Manual Trackers were used to detect fish after release, to assure that they were moving, and hence, had survived surgery. In addition, we attempted to detect tagged fish whenever we moved through an area where fish had been tagged. Two catarafts (purchased in the US and shipped to Bhutan) were used during rafts trips to listen for tagged fish. The catarafts were excellent boats for moving about the rivers, both for angling access and for manual tracking.



TASK 6: Downloading Data from Receiver Stations

At the end of the trip, before the departure back to Thimphu, each receiver station on the Manas and Mangde Chu was visited to see if all were in working order and to collect data recorded thus far.

All stations will be visited in May/June. DK Gurung, a team member that took part in the construction of each of the receiver stations will be in charge of checking on the status of all receiver stations, retrieving the existing data cards and installing new ones, and contacting WWF for the data to Thimphu. He will contact and work with the appropriate person in each district during that station's visit.

The first data download revealed a high number of transmitter detections from fish that were first caught near the Manas Ranger Station. The data from this (very early) download revealed that first, these fish were moving and therefore, still alive, as well as that none of the tagged fish had moved very far. The next download should reveal whether these fish are residents of this area or move north with the higher water levels.



Early Impressions

Evidence for Illegal Local Fishing Activity Within the Study Area:

Many places within the study area showed signs of illegal fishing, including signs of gill netting and basket fishing, especially in the lower Manas area. Gill nets would be very effective at capturing Golden Mahaseer, and the team doubts that Mahaseer that are caught in this manner would survive release. The evidence that gill netting is a common activity in the Manas area is a concern for the health of the population in general, but also specifically for the survival of our tagged fish, because we doubt any fisherman would release or report catching a fish with a transmitter.

Impact of Construction Activities:

It remains unclear how construction activities such as road building, streamside gravel mining, and dam construction actually directly affect Mahaseer, especially their movements and spawning activities. We observed that river turbidity near construction areas increased. It was also our experience that increased turbidity negatively impacted our recreational angling success. It may be possible in the future to assess how construction activities affect Mahaseer by monitoring the behavior of tagged fish in impacted versus non-impacted areas. In areas like the Chamkar Chu, where new road construction will occur in the next year or two, there is an excellent opportunity to do before-and-after assessments.



Angling Impressions:

As mentioned, we used both fly-fishing and spinning techniques to capture Mahaseer. The team feels that both of these methods are viable to pursue for recreational angling. Most team members used both types of angling during our trip, but because more areas of the river could be better covered with spinning gear, that was the method we used most during the study. In addition, it was easier to fight and land a fish quickly with spinning gear, thereby keeping fish in better shape for surgery, which was important for our needs. Although we did land 70 Mahaseer during the three weeks of angling, many others were hooked on a lure, but were lost before landing. Some of these losses were due to large fish bending the hooks, indicating how strong large Mahaseer can be. We recommend that standard hooks on lures be replaced with stronger versions.



Needed Guide Skills:

During the course of our trip, we became more skilled at both identifying good water to fish (i.e., stretches that were holding Mahaseer) and observing their subtle movements in the water, all of which greatly enhanced our ability to hook and land fish. We believe that these skills, as well as knowing how to angle with both spin and fly-fishing methods would be invaluable for any potential fishing guide.

Angling Impressions for Chocolate Mahaseer

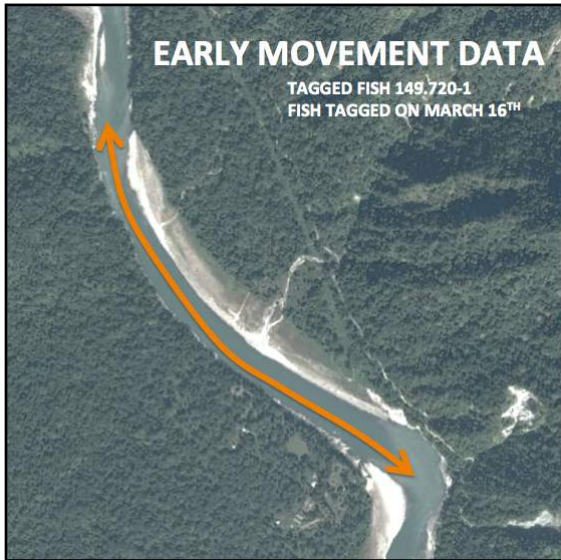
The team successfully caught many Chocolate Mahaseer, some that were quite large in size. Based on our small sampling effort, it appears that Chocolate Mahaseer are more plentiful than Golden Mahaseer (at least in March and April in the Manas Basin). These fish are attracted to similar lures, are in the same areas where Golden Mahaseer reside, and would be of great interest to recreational anglers. As a result, we felt that this species should be promoted as a target for any recreational fishing effort in Bhutan, and as a result should be studied as well.



Some of the Chocolate Mahaseer caught by the field team during the expedition.

First Look at Movement Data

Just before the research team left the field site, most receiver stations were visited and data cards downloaded. This provided a very early look at the movement of some of the tagged fish, as well as the amount of data that can be provided by this technology. Because each tag sends a signal every three seconds, when a fish is within range of a receiver, thousands of data points can be generated in short time. One of the fish tagged near the Manas ranger station showed ten days of activity with the fish regularly swimming back and forth between receiver stations 6 and 7, a distance of about 1 km. This early peek at the data reveals that Golden Mahaseer are quite active on a local scale, both during the day and at night. It also reiterates that if Mahaseer are staying in the lower Manas for long periods of time, rather than just passing through, they are quite vulnerable to the gill



netting that occurs there. We did not expect any long term movements of tagged fish after only a week or two post surgery, however, the number of detections of tagged fish near the receiver station where they were originally tagged shows that there was excellent survival after the surgical implantation of the transmitters.

Movement of tagged fish 149.720-1, which was tagged at the Manas Ranger Station on March 16th, 2015. Movement data showed this fish moved up and down the river for ten days in the area marked with the orange arrow.

NEXT STEPS

Spring Data Collection:

The plan is for the SD data cards at each of the 11 receiver stations to be collected in May/June, sent to Thimphu, and downloaded onto the project computer. Those activities will be conducted and coordinated by DK Gurung (RMNP) and Jigme Tsuendrup (WWF). The receiver station at Zarkapola may be difficult to get to during the rainy season; if that is the case, then that data card can be retrieved at a later date. Once the data is downloaded, we will be able to assess real movement data, and we will send a summary of the findings to all project personnel.

Upcoming Conferences:

Presentations on the Mahaseer study in Bhutan will be given at two upcoming conferences this summer. The first is the 3rd International Conference on Fish Telemetry, which takes place July 16–20 in Halifax, Nova Scotia, Canada. The second is the annual meeting of the American Fisheries Society, which takes place August 16–20 in Portland, Oregon, USA.



Fall Trip to the Study Area:

A follow-up trip is planned to Bhutan by David Philipp and Julie Claussen in the fall of 2015. Analysis of the spring data will determine what the focus of the activities will be during this visit. Adding more receiver stations and tagging more fish with transmitters may be possible and warranted, but that will depend on what the spring movement data shows and if the required funds can be raised by the fall trip. The possible activities that are being assessed are:

- Visiting each receiver station to attend to repairs and making adjustments, etc.;
- Adding a receiver station on the Kuru Chu;
- Adding a receiver station further up the Chamkar Chu if the movement data shows sufficient Mahaseer activity in the Chamkar Chu;
- Fishing for Mahaseer to determine fall angling success;
- Implanting transmitters into Golden Mahaseer in the Mangde Chu and at other locations that would be determined from summer data assessment;
- Implanting transmitters into Chocolate Mahaseer to determine how their movement data differs from Golden Mahaseer;
- Meeting with project team to determine next steps and timing for 2016.

Exchange Program:

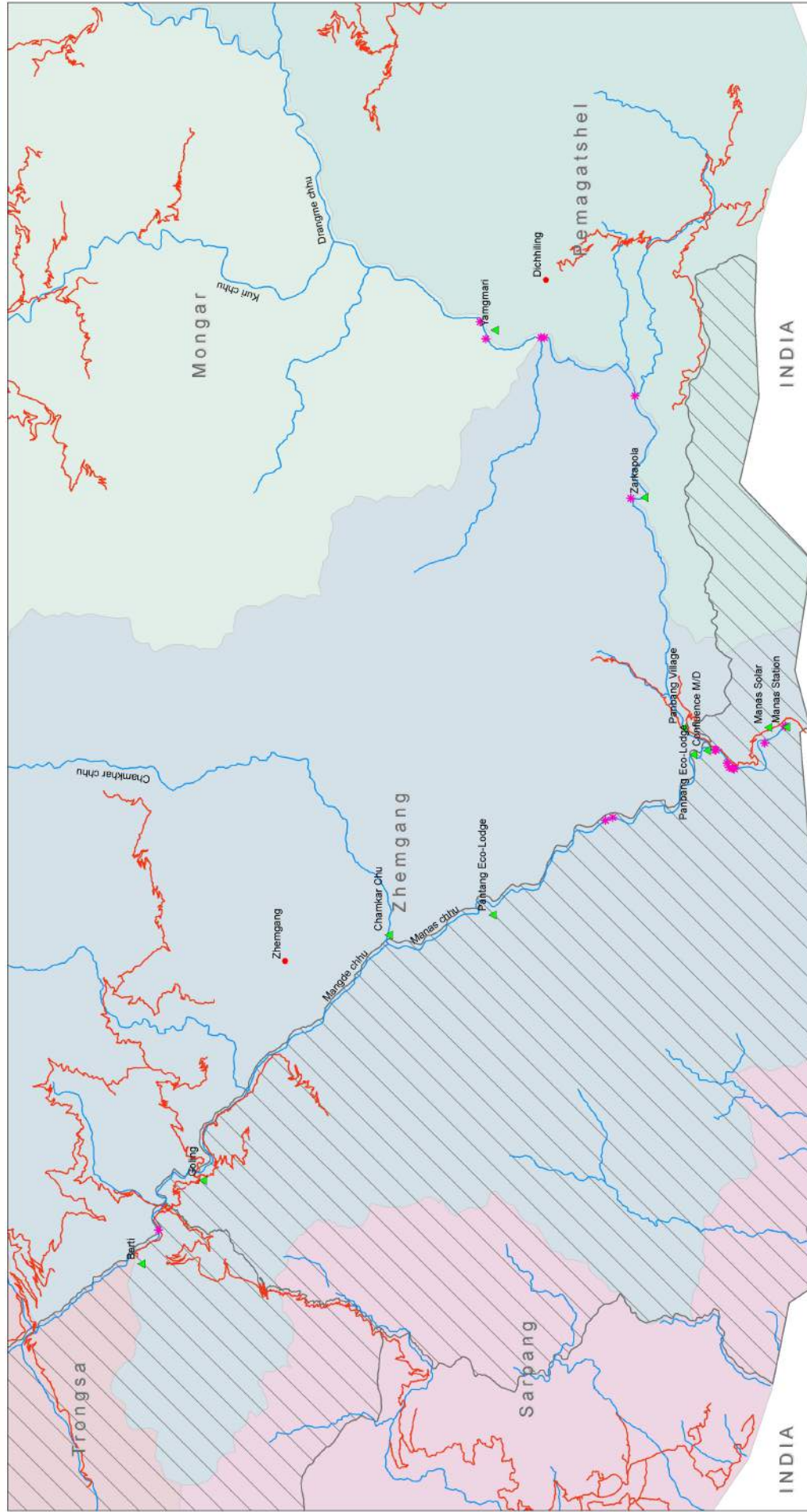
A central goal of the entire study is to promote informational exchange between Bhutanese and US scientists. A great deal of mutual information exchange was accomplished during the field research trips to Bhutan by FCF scientists, but more can be done. Getting two or more Bhutanese that are involved in the project to the US for a short visit would be a huge step in furthering the exchange of information about aquatic natural resource management and conservation. The annual meeting of the American Fisheries Society is the premier fisheries meeting in North America for biologists, managers, culturists, educators and administrators working on aquatic natural resources. We feel that this meeting would be an excellent opportunity for Bhutanese on the Mahaseer team to learn about fisheries management, culture, river conservation, and fish passage for dams. The 2015 AFS meeting will be held August 16-20 in Portland, Oregon, which is on the shores of the Columbia River. The meeting will be attended by over 3000 fisheries biologists from around the world and there will be special sessions on large dams, hatcheries for dam mitigation, fish passage, conservation of aquatic biodiversity, etc. The Columbia River has fourteen dams on the main river, and there would be an opportunity to tour one of those dam complexes and talk with fishery managers in the area. In addition, we will be presenting the work on the Mahaseer study at a special poster session, and having Bhutanese Mahaseer Team members there to present the work with us would be an excellent demonstration of the cooperative nature of the entire Project. We recommend that Karma Wangchuk (Haa NFCC) and DK Gurung (RMNP) be part of this exchange visit, as they were the two members of the Mahaseer Team that were on the ground with us during the March/April field trip and continue to be integral members of all aspects of the study. We feel that we have funding in place to cover their participation, but also feel that we should raise more money to include more participants if at all possible, particularly if this trip could be expanded to include participation in fundraising activities for both future Mahaseer research as well as for the Bhutan For Life Campaign.

We will be submitting a separate, more detailed proposal for this activity.



Mahseer Tracking using Telemetry in Bhutan

Field Campaign - March 2015



Legend

- Receiver Stations
- Transmitters in Fish
- Road
- River
- Town
- RMNP



Map prepared at WWF-Bhutan
Data sources: NLC & Mahseer Project

The Field Schedule for the Mahaseer Tracking Study March 9 - April 4, 2-15

TASK	DATE	LODGING
Workshop in Gelaphu	March 9th	Gelaphu
Receiver 1 at Goling	10th	Gomphu Ec lodge
Receiver 11 at Bertti	11th	Pantang Ec lodge
Receiver 2 at Chamkar Chuu	12th	Pantang Ec lodge
Receiver 3 at Pantang	13th	Pantang Ec lodge
Receiver 4 at Pangbang Ec lodge + Receiver 5 at Confluence	14th	Pantang Ec lodge
Receivers 6 at Pangbang Village Receiver 7 Manas Ranger Station Receiver 8 Manas Beach	15th	Pantang Ec lodge
Angling on Manas	16th	Manas Ranger Station
Angling on Manas	17th	Manas Ranger Station
Angling on Manas	18th	Manas Ranger Station
Angling on Manas	19th	Manas Ranger Station
Angling on Manas	20th	Camp at Confluence
Angling on Manas	21th	Camp at Confluence
Angling on Mangde Chu	22th	Pantang Ec lodge
Angling on Mangde Chu	23th	Pantang Ec lodge
Angling on Mangde Chu Packing for Raft Trip	24th	Pantang Ec lodge
Receiver 10 at Yangmari	25th	Yangmari/Camping
Rafting / Angling on Dangme Chu	26th	Rafting/ Camping
Rafting / Angling on Dangme Chu	27th	Rafting / Camping
Receiver 9 at Zarkapola Rafting / Angling on Dangme Chu	28th	Rafting/Camping
Rafting / Angling on Dangme Chu	29th	Manas Ranger Station
Angling on Manas	30th	Manas Ranger Station
Angling on Manas Download Data from Receivers 5, 6 & 8	31st	Manas Ranger Station
Download Data from Receivers 4 & 6	April 1st	Pantang Ec lodge
Angling on Mangde Chu Download Data from Receivers 2 & 3	2nd	Pantang Ec lodge
Angling on Mangde Chu Download Data from Receivers 1 & 11	3rd	Tingthi
Return to Thimphu	4th	



Contact Information:

David Philipp

Chair, Board of Directors
Fisheries Conservation Foundation
dpphilipp@fishconserve.org

Professor, Emeritus
University of Illinois
1816 S Oak St., Champaign, IL 61820
217-369-2952
philipp@illinois.edu

Julie Claussen

Director of Operations,
Fisheries Conservation Foundation
jclaussen@fishconserve.org

Fisheries Biologist
University of Illinois
1816 S Oak St., Champaign, IL 61820
217-840-9702
juliec@illinois.edu



Fisheries Conservation Foundation
302 E. Green Street #2102, Champaign IL, 61825
www.fishconserve.org
Twitter: @fishconserve
Facebook: facebook.com/fishconserve
Instagram: fishconserve

