

## ARTICLE

# ON THE REHABILITATION OF A HAND-REARED ADULT SMOOTH-COATED OTTER *Lutrogale perspicillata* IN BIHAR, INDIA

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**Abstract:** Otter species have been rehabilitated to their wild habitats as a conservation measure across the world. Otter rehabilitation success and post-release survival are influenced by age on arrival in captivity, time spent in human contact during captivity, age-at-release, human disturbance to habitat, and interactions between captive and wild otters. Attempts for rehabilitation are relatively fewer in developing countries owing to inadequate technical and financial support. This is an important gap for research and conservation efforts in countries like India, where only a few cases of otter rehabilitation are known. In this paper we report on the successful rehabilitation of an 8-yr old adult smooth-coated otter *Lutrogale perspicillata* in a human-dominated floodplain landscape along the Ganga River in Bihar, India. A male otter pup was rescued from poachers in the year 2000 and hand-reared until 2008. This otter was named ‘Ganga’ and rehabilitated as an adult in May 2008 after a soft-release program in the river, which took 42 days. Until 1.5 years later, Ganga was occasionally re-sighted with a wild otter pack, until he was found dead in March 2016. We report the technical details of and constraints faced in the rehabilitation, along with associated behavioral observations on Ganga in captivity, during release, and his interactions with wild otters. We demonstrate through this case that the success of rehabilitation through soft-release procedures was a key factor that ensured excellent post-release survival of Ganga in the wild. Rehabilitation success can be influenced strongly by social contexts, hence an understanding of the socio-ecological systems in which otters have to be conserved, is crucial.

**Keywords** - Smooth-coated otter, Ganga River, rehabilitation, survival, behavioral observations, wild otters

## INTRODUCTION

Otter species are under threat from the degradation of riverine, coastal, and marine ecosystems on the one hand, and serious direct impacts from poaching, hunting, and persecution in fisheries on the other (Foster-Turley et al., 1990; Hussain, 2015). Given these threats, efforts to enable effective practices for otter rescue, captive maintenance, hand rearing, caregiving, and eventual rehabilitation or release back to the wild, holds great promise in helping otter populations recover locally in safe havens and refuges (Mason and MacDonald, 1986; Kruuk, 2006). Rehabilitation programs for otters have largely been conducted in the European Union and the Americas (e.g. Wayre, 1985; Sjøasen, 1997; Gómez et al., 1999; McTurk and Spelman, 2005; Nicholson et al., 2007), in conditions where excellent facilities exist along with technical expertise and financial resources towards ensuring rehabilitation

success. Organizations such as the International Otter Survival Fund (IOSF; [www.otter.org](http://www.otter.org)) have contributed substantially to otter release and rehabilitation efforts worldwide, including Africa and Southeast Asia (IOSF Otter News, Benza et al., 2009). These efforts are yet somewhat limited in South Asia, and rehabilitation of otters in this region is a key area for research and conservation interventions. We report on the rehabilitation of a smooth-coated otter *Lutrogale perspicillata* in Bihar (India) in this paper, after a global review of factors affecting rehabilitation success of otters.

The feeding and ranging habits of otters, their social interactions and behaviors, and their physiological adaptability to diverse conditions strongly influence prospects for their rehabilitation (Kruuk, 2006). Otters are wild semi-aquatic carnivores with peculiar social systems and habits (Mason and MacDonald, 1986; Foster-Turley et al., 1990; Kruuk, 2006). Aquatic carnivores like otters reach sexual maturity later than terrestrial Mustelid species and have prolonged periods of adult care of young (Bekoff et al., 1984). Otters could be solitary foragers, or form all-male groups, or family groups as seen in most species, to more complex societies as in giant otters and smooth-coated otters (Kruuk, 2006). River otters *Lontra canadensis* typically form all-male groups rather than mixed-groups (Blundell et al., 2002). Blundell et al. (2004) have shown conclusively for river otters that sociality might not be related to kinship or relatedness. In fact, benefits from location-based cooperative foraging strategies might increase success in capturing high-quality schooling fish prey (Blundell et al., 2002). Otters are generalist predators, with diets comprising several prey items (Carss, 1995; Hussain, 2015), ranging from fish, which are preferred and nutritionally profitable, to crustaceans, aquatic insects, birds, amphibians, reptiles, and rodents, which are less preferred but significantly supplement fish prey in resource-limited situations (Carss, 1995; Kruuk, 2006). Hunting otters might often minimize foraging costs by catching slower-moving species more frequently (Erlinge, 1968). They are also known to opportunistically change their diet as per seasonal availability and encounter frequency of diverse prey, including both native and non-native fish species (Prigioni et al., 2006). Den site selection in otters is also fairly typical, along sloping banks and firm substrates (e.g. Nawab and Hussain, 2012), and in sites protected from river or coastal inundation. Neotropical and European river otters selected den sites in upland areas protected from river flooding impacts for resting and raising young (Pardini and Trajano, 1999; Gorman et al., 2006).

In general, the overall reintroduction success for otters is attributable to availability of detailed knowledge of ecology and behavior, along with quality of captive care procedures (Wayre, 1985; Serfass et al., 1996; Yoxon, 2003; McTurk and Spelman, 2005) but also to their adaptability, social systems, and intelligence. River otters and Eurasian otters have been regularly reintroduced to the wild after initial time in captivity (Wayre, 1985; Serfass et al., 1996; Ben-David et al., 2002; Yoxon, 2003). Giant otters have also been rehabilitated quite successfully (Gomez et al., 1999; McTurk and Spelman, 2005). In this context, a review of factors that might have influenced rehabilitation success positively or negatively is required. Broadly, a few factors repeatedly emerge as impediments to successful rehabilitation: human disturbances at release sites, age-at-release, time spent in and extent of human interaction in captivity (causing semi-tame behavior), acclimatization, and social interactions with wild otters (Serfass et al., 1996; Sjoasen, 1997; Gomez et al., 1999; Ben-David et al., 2002; McTurk and Spelman, 2005). Hunting, killing, and otter trapping reduced overall survival of released otters in many cases (e.g. Ben-David et al., 2002; McTurk and Spelman, 2005). Ben-David et al. (2002) found that animals born and raised in captivity had lower survival rates than animals who had had some

experience living in the wild, even if under stressful conditions. Behavioral interactions between captive male otters were found to be more positive than negative, and close interactions were linked to spatial proximity and familiarity, rather than relatedness (Hansen et al., 2009). However, reintroduced 1-year old *Lutra lutra* in Sweden showed strong evidence for competition between males for mating with females, and otters established their home ranges, avoiding pre-existing territories of other males (Sjøasen, 1997), as would be the case for wild otters dispersing naturally. Sjøasen recommended that release sites for captive otters should be away from sites where otters already were in existence. Such avoidance was also reported by Ben-David et al. (2005). In general, compared to wild otters, young animals released after an initial captive period had lower survival rates in the wild (Ben-David et al., 2002). Survival of adult male river otters was higher than that of adult females or sub-adults (Gorman et al., 2008).

Three species of otters are known to occur in the Indian subcontinent (Pocock, 1949), of which the smooth-coated otter *Lutrogale perspicillata* is the most widespread and common (Hussain, 2015). The other two species, the Eurasian Otter *Lutra lutra* and Clawless Otter *Aonyx cinereus* are rare, and have been recorded sporadically along high-altitude streams, typically away from human disturbance (Hussain, 2015, Joshi et al., 2016). The smooth-coated otter, in contrast, is distributed across the highly human-dominated river floodplains of South Asia. In India, the species continues to survive in several areas in spite of high human disturbance and instances of local extirpation due to poaching and hunting (Hussain, 2015). The species is classified as ‘Vulnerable’ by the IUCN Red List (de Silva et al., 2015).

Smooth-coated otters are also generalist feeders and use a range of habitats, but prefer flat riverbanks with shallow waters (Hussain and Choudhury, 1997; Anoop and Hussain, 2004; Shenoy et al., 2006; Nawab and Hussain, 2012). Group-living smooth-coated otters deposit spraints at specific, often well-defined latrine sites (Hussain and Choudhury, 1997). Group sizes range from 1 to 9, and are centered on an adult breeding pair and offspring of different ages (Hussain, 2015). In areas with heavy human disturbance, these otters often switch activity to nocturnal from diurnal (Shenoy et al., 2006). Linear home ranges were estimated at 5.5 km in females with pups and up to 17 km in adult males (Hussain and Choudhury, 1995).

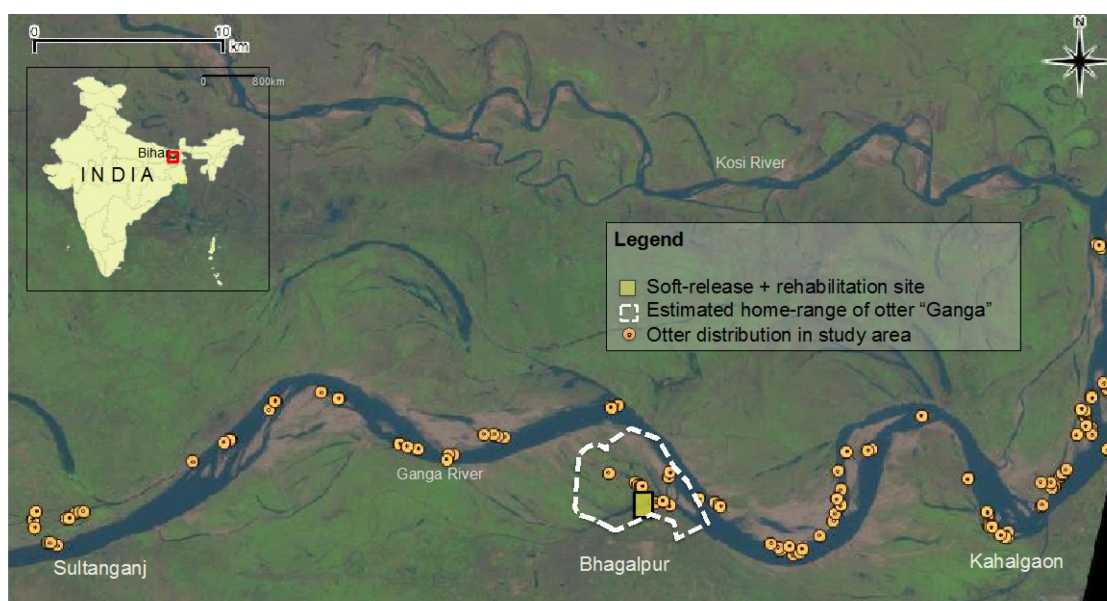
The rehabilitation of an adult smooth-coated otter, named ‘Ganga’ was conducted in a highly human-dominated stretch of the Ganga River in Bihar, India. Ganga was under the care of the first author of this paper from 2000 to 2008, and after his rehabilitation, he survived in the wild for 8 years, and was found dead in 2016. In our report we first describe the strategies we chose for Ganga’s rehabilitation program, our observations during the process, and the logistical constraints in which we worked. We include a detailed technical description of the rehabilitation program, with associated observations on behavioral changes in Ganga, and his interactions with wild otter packs near the rehabilitation site. We also compare our case with the only other reported rehabilitation attempt of a female smooth-coated otter from Bangalore, India, in 1999 (Nair, T. (rescue team member) pers. comm.; IOSF, 1999, 2000). Finally, we discuss the role of social systems in the smooth-coated otter, the importance of releasing Ganga as an adult otter, and the local socio-ecological conditions that ensured the success of rehabilitation.

## **ANIMALS, MATERIALS, METHODS, AND RESULTS**

### **Study Area**

The study area included a 5 km stretch of the Ganga River at Bhagalpur town, in the Bhagalpur district of Bihar, India. This site is within the Vikramshila Gangetic

Dolphin Sanctuary area; a 67 km river stretch designated for the protection of endangered Ganges river dolphins (Fig. 1). High densities of smooth-coated otters have been reported from the area. Wild otter pack sizes range from 2 to 10 animals, although we have once seen a pack of 13 otters. The river stretch has a vast floodplain with agriculture and alluvial plains, with many compound meanders, braids, alluvial islands, side-channels, and confluence zones. River thalweg depths range from 1 to 40 m, and channel widths from 200 m to 2 km. Details of the study area and reports of initial otter sightings are provided in Choudhary et al. (2006). Fishing activity is also high in this region, with a few thousand fishers of the Mallah (Nishad) caste-group dependent on the river-floodplains for subsistence. Importantly, these fishers have positive cultural perceptions about otters despite suffering regular losses from otter-caused damage of nets. Some fisher groups in the study area also revere otters. Detailed information on this can be found in Choudhary et al. (2015). Gudger (1927) in his delightful review “Fishing with the Otter” cites C.J. O’Donnell’s 1877 report that fishers of Bhagalpur and Rajmahal regularly kept otters to help in fishing, but this practice is now extremely rare, if it exists at all. We have known only one fisherman to have kept an otter as a pet, and this practice is now likely nonexistent in India.



**Figure 1.** Map of the study area, with known locations of otter packs from field surveys (2000 to 2017) and the site selected for soft-release and rehabilitation of the otter ‘Ganga’.

### Ethical Statement

As we have always worked as an informal research team studying river ecology and conservation, we did not have access to any institutional ethics guidelines for animal handling or captive caregiving. However, we ensured that the captive care program complied with the "Guidelines for the use of animals in research" (Animal Behavior, 1992). We also abided by the WAZA guidelines (WAZA, 2005) throughout the rehabilitation process. No invasive research was conducted on the focal male smooth-coated otter *Lutrogale perspicillata*. A female smooth-coated otter was also kept for 3 years (2005-2008) and no invasive study was conducted on her also (some details of her life in captivity are discussed later). The captive holding of both otters in the first two authors’ home premises was informed to and approved by the Sanjay Gandhi Zoological Park, Patna, Bihar, which is the relevant authority in the Bihar state government’s Department of Environment and Forests. The Divisional Forest Officer, Banka Division, Department of Environment and Forests, Bihar, granted the required permissions.

### **Hand rearing and caregiving in captivity**

A month-old male otter pup was rescued from poachers in January 2000, and named 'Ganga'. The pup had a nick in the middle of its tail-tip (1.27 cm deep) and a slight bleed from an injury there. This wound was cured with antiseptic in 3-4 days. From 2000 to 2008, Ganga was kept in captivity, at the house of the first two authors in an enclosure room of 3.65m x 3.05m (12' x 10') dimensions. A water pool was constructed for the otter to play, eat, and rest. Ganga comfortably lived in his enclosure and showed no signs of ill health or stress. He had two occasions per day, each of 1-2 h, to play in a large terrace and verandah, which he would never miss. From 2000-2001, Ganga was fed about 1.2 kg of fish, over two feeds, per day. From 2001 onwards, the daily intake increased to approx. 1.5 kg fish per day. Small fishes were fed to Ganga in the first year, and bigger sizes were introduced later. The fishes mainly included pond-cultured carps *Hypophthalmichthys molitrix*, *Catla catla*, and *Cirrhinus mrigala* (80%) and the catfish *Clarias batrachus* (20%). Occasionally, river fishes or chicken were provided. Deworming was conducted and vitamin supplements were fed once a year. Our captivity schedule and management was roughly similar to the guidelines of the IUCN/SSC Otters in Captivity Task Force (2008), which became available after the rehabilitation program. In captivity, Ganga interacted with another young female (also kept for about 3 years by the first author, but which did not survive), but these interactions were not of sexual interest to either individual. The young female was highly secretive throughout her three years in captivity. She hardly ventured beyond her small territory and her association was generally restricted to when she would call out for food. Her sudden death was likely due to captive stress, but no clear symptoms or causative factors could be identified. In contrast, Ganga associated more closely with the first author. He demonstrated acute sharpness in following instructions and signals provided by the first two authors to him, during feeding and playtime. The otter would emit distress calls in the form of high-pitched squeals and sharp whistling or chirping noises when it would perceive stress, especially with the approach of unfamiliar persons or loud noises.

Table 1 provides a timeline from the year 2000 to 2016, including the rescue, life in captivity, soft-release and rehabilitation process, post-release monitoring, and death of the otter.

### **Site selection**

After a thorough survey of the river stretch in March 2008 (summer), a sandy island north of the Hanuman Ghat in Bhagalpur (25.271N, 87.015E) was selected for the rehabilitation. The island was adjacent to a large floodplain area with extensive maize farming. Ganga the otter was taken to the site in a well-ventilated, 1.52m x 0.61m x 0.46m (5' x 2' x 1.5') grilled cage with a wooden sliding trapdoor with 2.5 cm thick plywood sheets, on 11 April 2008. As the otter was used to life in captivity, the trap cage did not affect its behavior or elicit any stress responses, as has been observed in translocated otters elsewhere (Serfass et al., 1996). The selected site had regular signs of otter presence, with fresh footprints, scat/spraints, latrines, and skeletal remains of big fish eaten by otters. The area also had regular catches of large fish, indicating good availability of prey. Local fishermen, operating in the area reported that two otter packs regularly used the island for fishing and movement across the river. The fishers particularly avoided the island to prevent net damage by otters, which often took fish from them. Regular informal monitoring and reporting by this network of fishers, and our long-term cordial relationships with them, were important factors in selecting this as the rehabilitation site.

**Table 1.** A chronological summary of phase-wise key events in the rescue and rehabilitation program, from rescuing the otter as a pup in 2000, to confirmed death in 2016.

<b>Phase of monitoring</b>	<b>Time period</b>	<b>Key events</b>	<b>Remarks</b>
Rescue	22 Jan 2000	Month-old male otter pup rescued from poachers, named 'Ganga', treated for injury on tail	Nick on tail-tip (1.27 cm deep), main identifying feature of the otter
Life in captivity	Jan 2000–Apr 2008	Housed in an enclosed room with a water pool	1.2-1.5 kg fish fed per day, observations of feeding and play recorded
Pre-release phase	Feb 2008	Condition of Ganga monitored	Slight delays in support and funding
Release: site selection	Mar 2008	Site selection, plan for soft-release	-
Release: construction and maintenance of enclosure + fish holding pen	Mar-Apr 2008	Enclosure built at site with artificial holt and fish-holding pen, catfish introduced in pen	Enclosure regularly maintained, otter use of sites and habitat exploration monitored
Release: skill development	Apr-May 2008	Need to develop skills of otter to catch fish in the river, after a long term of being used to provisioning	Rapid progress, able to catch fish from the river channel within 10 days during soft-release
Release: stamina-building	Apr-May 2008	Focus on weight reduction and improving swimming capacity of otter	Stamina building achieved considerably in 2-3 weeks
Interactions with wild otters	May 2008	Behavioral interactions monitored in detail	Antagonistic and neutral interactions, notable fighting bout with a large male of wild pack, subsequent injury and healing, assertion of territory and exploration by Ganga
Return to the wild	May 2008	Moved away with otter pack and likely mated with females from that pack	Occasional visits back to camp site, regular exploration of habitat continued
Post-release monitoring and confirmation	May 2008–Jul 2009	Confirmed to travel singly or with pack of wild otters for 1.5 years by fishers	Would respond to fishers calling out the otter by name through this period, but kept distance
Death	5 Mar 2016	Death at the same spot as the release site	Identified from the nick of the tail-tip

### **Enclosure construction for soft-release**

An acclimatization enclosure of 10.67 m x 10.67 m (35' x 35') open from above, was erected with bamboo poles. The sides were enclosed with a 2.5 cm diameter chicken net (2.13 m (7') high, with 0.9 m (3') above water), supported by long bamboo strips embedded 30.5 cm deep, into the dry land and the soft bottom of the riverbed (Fig. 2). An artificial holt was made within the enclosure, with cement bags lining the hollow, plastered with sand. Within the enclosure, a 2.44m x 1.52m (8' x 5') plastic sheet was placed with dry sand piled on it, to maintain firm and dry substrate. The enclosure was built along a small inlet of water cutting around an edge of the island to have constant movement of water. Yet, there was a marked difference in temperature inside and outside the enclosure. As a result, an algal mat started growing on the net and caused the current to erode the bottom of the enclosure, causing some fish to occasionally escape. For this a bamboo barricade was constructed in front of the enclosure to divert the flow, and as a result the algal cover reduced, and the sand bottom stabilized. This enclosure was an important part of the soft release, as it helped acclimatize the otter with its natural habitat, but also provided supply of fish in a concentrated zone, making fish easy to be hunted by the otter in the first 4-5 days. The otter would dry himself by rolling and basking in the hot day hours, along the enclosure sides. After the first 5 days, the otter started coming out of the enclosure and exploring the outside habitat, visiting the enclosure only for feeding.

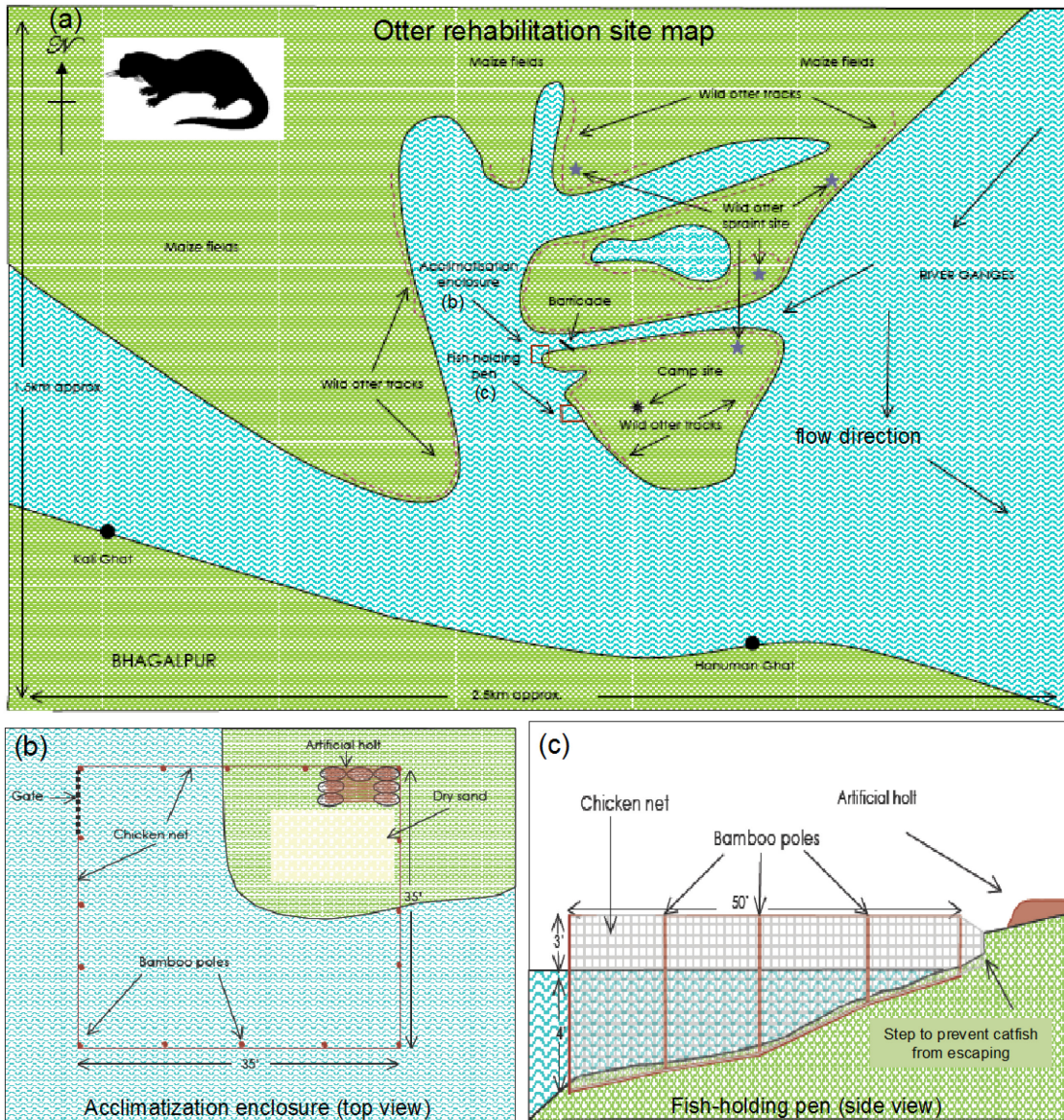
### **Construction of a fish-holding pen**

A fish holding pen of 15 m x 15 m (50' x 50') was built next to the enclosure (Fig. 2), with the same materials used for the enclosure, and almost 20 kg of the hardy native catfish species *Clarias batrachus* was put in the enclosure (each fish was c.250 g, and 75-80 fishes were introduced). Later the otter also would catch fish directly from the pen. The fish were initially kept alive on chicken entrails, but they soon started consuming small *Aspidoparia* fishes in the river, and maintained themselves. *Clarias batrachus* are catfish with accessory air sacs and can move on land, and we found some fish wriggling away through the enclosure on land. To keep them restricted to the pen, we excavated the river island slope along the pen a little deeper, after which fish stayed put inside (Fig. 2). The otter regularly fished in this pen after the first 5 days of restricting itself to the enclosure. Wild smooth-coated otters, Indian foxes, jackals, jungle cat, and a greater adjutant were also regularly seen around the fish pen. Wild otters raided the pen at night when Ganga would be sleeping or away exploring the habitat.

### **Skill development**

Ganga was reared in captivity and always fed with dead fish. The otter was also overweight when he was brought to the release site. It was thus essential to hone his natural hunting skills and catch fish irrespective of the chances of being accepted by a wild pack. The otter was experienced in capturing and eating live *Clarias batrachus* in captivity earlier, and in the enclosure, due to the greater search time for the fish, he had difficulty in catching fish underwater. The otter would tire out quickly in the first few days, as he had never swum this much in captivity. This reduced his enthusiasm to go on searching, and he started looking for food on land. Sometimes, live catfish had to be provided to him directly in the field. Gradually, with some help and cues provided to Ganga, he started catching fish in lesser time. These rewards were obviously precious, as the otter, having caught his meal, would not allow anyone to go close to it until he had devoured the entire fish. After a week, when Ganga would

return from his forays he would not eat, indicating that he had probably eaten fish while away.



**Figure 2.** Detailed site map (a) with enclosures for the soft-release and stamina-building program of the otter Ganga in 2008, along with details of habitat, use of the area by wild otter packs, and site characteristics. b) Diagram of enclosure with artificial holt for the otter to stay at night. c) Diagram of fish-holding pen during the rehabilitation process.

### Stamina-building

Ganga first exited his enclosure after 2 days, by tearing through the chicken net. He would swim and explore the site in the shallow areas of the river first. Initially, he would get tired within 30 minutes of swimming and return to the camping site. His daily routine included exploratory trips, feeding, and sleeping, both in the morning and evening, with each bout lasting for 2-3 hrs. Over time, the otter started to swim upstream with ease as it lost weight, and also started swimming long distances. While swimming he would occasionally emerge on the island to defecate, or to smell latrines deposited by wild otters at certain specific sites. Ganga would also rub himself dry at spots where we had observed wild otters do the same. Ganga would easily catch small fishes without much effort after he took to traversing long distances in these trips, lasting 5-6 hours after 10 days of initial stamina development and local exploration.



### **Behavioural Observations during Rehabilitation Program**

Interactions with wild otters began within a few days of the rehabilitation soft-release process. First, a pack of wild otters (8-9 individuals) visited the enclosure at night on the 12<sup>th</sup> April 2008, and checked the area and scent-marked at the enclosure boundary. We saw fresh footprints and scrape-marks on the sand the next morning. Late at night on 18<sup>th</sup> April, when Ganga was sleeping near the enclosure, a pack of six wild otters (two large males and four slightly smaller animals, either females or sub-adults) visited the area. When they were about 12m away Ganga became highly vocal, and chirped excitedly. The otters were also making loud chirping calls and came running towards him. A lot of growling and snarling followed between Ganga and the large adult male leading the pack, after which Ganga followed the male and the otters to the neighboring floodplain. Severe fighting was observed between him and the large male here too, in which the otters tried to bite and claw at each other. After the fight the otter pack silently exited. Ganga was also not seen until the next day, when he returned to the enclosure, badly injured. The wounds took about 3 weeks to heal. A few days after this encounter, we heard of a dead adult male wild otter on the floodplain, which was probably killed during the fight. On 16<sup>th</sup> May Ganga was seen approaching a pack of 5 otters in daytime. This encounter consisted only of sniffing and lasted for a few minutes.

### **Return to the wild: completion of the rehabilitation process**

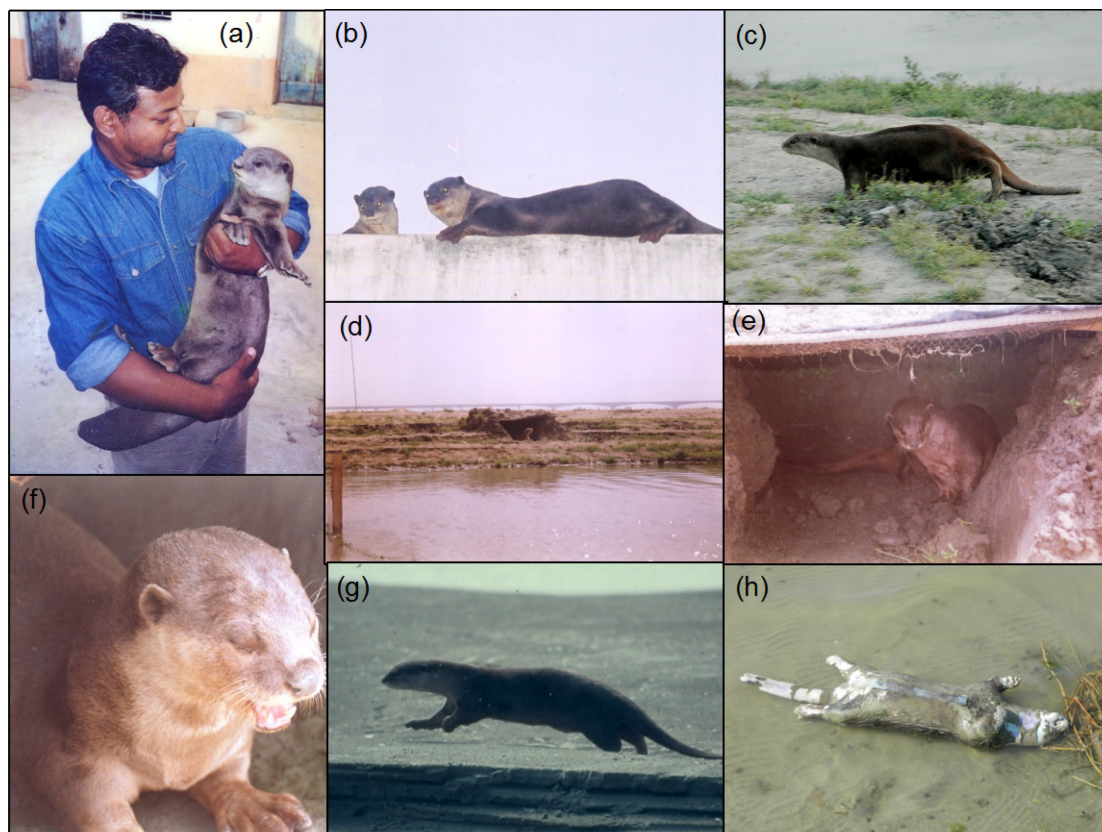
We broke camp on 25<sup>th</sup> May 2008, leaving Ganga behind, as we were convinced that he could fend for himself from now on. At this time, Ganga would spend long hours of the day and night away from the release site, and would hunt by himself in the river. He would occasionally be seen with wild otters. However, his affinity to the artificial holt lasted for some time. For about 20 days after we left, fishers would see Ganga in the same area, sometimes even sleeping inside the holt.

### **Post-release monitoring**

Floodwaters began rising from 11<sup>th</sup> June 2008, after which Ganga was not seen again for some time. Two months later, one group of fishers who knew Ganga from before the release, reported that they found him in the company of wild otters. We kept getting occasional reports of seeing Ganga from these fishermen for about 1.5 years after the rehabilitation, until late 2009. According to them, there was no attempt by the otter to approach them, despite noting their presence in the area. No confirmed reports were received about Ganga from 2010-11 to 2015-16. The approximate home range (i.e. linear river-bank distance covered), based on the few scattered observations, was estimated at about 3-4 km, which indicated continued fidelity to the rehabilitation site.

### **Death**

Ganga the otter was found dead on 5th March 2016. His age was 16 years and the animal was identified from the peculiar nicked tail-tip that was his identifying feature. He seemed in otherwise good health, except for some signs of dental wear. He had died at the same location where he was released to the wild eight years ago. Fig. 3 shows a collage of pictures of the otter Ganga in captivity, during rehabilitation, and as a dead animal.



**Figure 3.** Pictures showing Ganga the otter a) as a pup, b) in captivity, with another female otter, c) as an adult at the rehabilitation site (2008), d,e,f) using enclosure during the soft-release. A wild otter in the Ganga River (g). Death of Ganga the otter (h), identified by the nicked tail, in 2016.

## DISCUSSION AND CONCLUSIONS

Our report highlights the importance of rehabilitation of otters after the age at which they naturally leave their mothers, to ensure high post-release survival. Ganga was hand-reared by the first author using traditional care-giving methods, which might have been crucial in ensuring post-release adaptability. However, Nicholson et al. (2007) noted that success of rehabilitation was reported to be lower for sea otter pups thus reared, than those reared under the care of surrogate otter females. In this context, our case may be useful in identifying what factors might contribute to successful rehabilitation of hand-reared otters after a significant duration in captivity. We believe that Ganga's release as an adult contributed substantially to his success in the wild. We posit that his 'middle-age' release might have helped confer certain competitive advantages (physical strength, health, vigor, etc.) to him. The importance of soft-release procedures, especially those involving stamina building and skill development exercises, was vindicated by our observations.

Ben-David et al. (2002) found a negative correlation between time spent by river otters in captivity and their post-release survival. Importantly, their experimental study, based on 55 captive-reared, experimentally manipulated, and radio-tagged otters found that even exposure to physiological stressors (crude oil in their case) did not affect post-rehabilitation success as much as captive detention time. However, our result contrasts their findings. We found that Ganga the otter had considerable head-starting advantage for adjusting to wild otters and river-floodplain habitat, having grown up securely in captivity. At a younger age, the vulnerabilities he might have faced would have likely been higher. Smooth-coated otters have a life span between 11 and 15 years (Hancox, 1992). Acharjyo and Mishra (1983) reported that a smooth-coated otter lived in the Nandankanan Zoo, Orissa, in captivity, for 20 years. Ganga's

age at death, at 16 years, is therefore indicative of a successful post-rehabilitation life in the wild.

Importantly, many rescue and release programs have tended to focus on the rehabilitation of younger animals and sometimes even pups, for head-starting recruitment and establishment into wild populations. In this regard, we support the suggestion by McTurk and Spelman (2005) that rehabilitation be conducted at ages nearing adulthood, than earlier. Our observations on negative interactions between adult male otters resemble their report on the rehabilitation and captive rearing on giant otters. In their case, wild giant otters killed five out of 28 giant otters, including one adult male. In our case, Ganga the otter not only survived a fierce fight with an adult wild male, but also probably killed the rival. The observed scent-marking by Ganga was likely to assess threat from other wild male otters in the area. Scent-marking is used to indicate social status by adult male otters (Rostain et al., 2004), or indicate feeding and resource use to other groups, apart from a variety of other purposes (Kruuk, 1992). The negative interactions that we recorded were likely related to Ganga intruding into the wild male's range, and Ganga's scent being distinguished as that of an unfamiliar intruder, by the wild male. The death of the young female in captivity makes us wonder if adaptability differs between sexes. We are unsure whether this female, if alive, would have had similar rehabilitation success. However, the rehabilitation of the female otter (Sushi), through similar caregiving methods by Compassion Unlimited Plus Action (CUPA) in Bangalore, India is a useful case, indicating typically high success (IOSF 2000). Sushi was c.1 yr old at the time of release and was in captivity since being a few weeks old (IOSF 1999, 2000).

Giant and smooth-coated otters are highly similar in their dietary niche, physical characteristics, and social structure (Kruuk, 2006). It is also likely that otters with complex social systems (multi-male, multi-female packs) as seen in these species might have higher survival post-rehabilitation than other otters, in which social bonds are likely less regular. Research on smooth-coated otter social systems is still limited (Hussain, 1999), but will be important in unraveling the potential survival implications of released individuals. As reported for river otters (Blundell et al., 2004), when kinship is not a criterion for social grouping, it is likely that younger otters will be assimilated into wild packs. Interestingly, Gomez et al. (1999) reported the adoption of two young otter pups by wild giant otter packs in Colombia. We believe that such positive interactions are also plausible in the case of smooth-coated otters. In fact, despite other reports to the contrary (e.g. Sjoasen, 1997), we decided that it was important to select rehabilitation sites close to wild otter home ranges, than away. This decision was based on our observations of social interactions within and between wild otter packs for many years.

That otters are revered and not deliberately disturbed or hurt in our study area (Choudhary et al., 2015) may have been the 'X-factor' in the successful rehabilitation of Ganga. This is in sharp contrast to most other cases, where anthropogenic threats strongly affected post-release survival. As a concluding point, we strongly emphasize deep and careful engagement with local people to understand the socio-ecological contexts and cultural settings in which interventions such as rehabilitation of otters may be planned. In addition to sound technical support and long-term ecological research, there is a need to track the social dynamics that may significantly enhance or depress the long-term survival and conservation of otters in the wild.

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## RÉSUMÉ

### A PROPOS DE LA RÉHABILITATION D'UN ADULTE DE LOUTRE À PELAGE LISSE, LUTROGALE PERSPICILLATA, ÉLEVÉ AU BIBERON, À BIHAR EN INDE

Différentes espèces de loutre ont été remises en liberté à travers le monde dans leur habitat sauvage au titre de mesure de conservation. Le succès de cette remise en liberté des loutres et leur survie après leur libération sont influencés par l'âge de la mise en captivité, la durée du contact avec l'homme durant la captivité, l'âge de la remise en liberté, la perturbation humaine de l'habitat et les interactions entre loutres captives et sauvages. Les tentatives de remise en liberté sont relativement peu nombreuses dans les pays en développement à cause d'une aide technique et financière insuffisante. C'est une importante lacune pour les efforts de recherche et de conservation dans des pays comme l'Inde où seul un faible nombre de réhabilitations de loutres est connu. Dans cette publication, nous relatons le succès de la remise en liberté d'un mâle adulte de loutre à pelage lisse, *Lutrogale perspicillata*, dans un paysage de plaine inondable dominé par l'homme, le long de la rivière Ganga, à Bihar

en Inde. Un jeune mâle a été sauvé des braconniers durant l'année 2000 et élevé au biberon jusqu'en 2008. Cette loutre, nommée « Ganga », a été remise en liberté à l'état adulte en mai 2008, suite à la mise en place d'un programme de remise en liberté progressive qui a duré 42 jours. Un an et demi après, Ganga a été revue occasionnellement avec un groupe de loutres sauvages, jusqu'à ce qu'on la retrouve morte en mars 2016. Nous avons décrit les détails techniques et les contraintes de la libération, de même que des observations liées au comportement de Ganga en captivité, durant sa remise en liberté, ainsi que les interactions avec les loutres sauvages. Nous avons démontré, dans ce cas, que le succès d'une réhabilitation par des procédures de remise en liberté progressive fut un facteur prépondérant qui a assuré la réussite de la remise en liberté de Ganga dans la nature. Le succès de la réhabilitation peut être fortement influencé par les contextes sociaux, et, par conséquent, il est crucial d'avoir une compréhension des systèmes socio-écologiques dans lesquels les loutres doivent être protégées.

## RESUMEN

### **SOBRE LA REHABILITACIÓN DE UNA NUTRIA LISA *Lutrogale perspicillata* ADULTA, CRIADA EN CAUTIVERIO, EN BIHAR, INDIA**

Distintas especies de nutrias han sido rehabilitadas a sus hábitats naturales, como medida de conservación, en todo el mundo. El éxito de la rehabilitación y la supervivencia post-liberación están influenciadas por la edad de arribo al cautiverio, el tiempo transcurrido y el contacto humano durante el cautiverio, la edad al momento de liberación, el disturbio humano del hábitat, y las interacciones entre las nutrias cautivas y silvestres. Los intentos de rehabilitación son menos en los países en desarrollo, debido al inadecuado soporte técnico y financiero. Este es un importante hueco de esfuerzos de investigación y conservación en países como India, donde se conocen sólo unos pocos casos de rehabilitación de nutrias. En este trabajo informamos la rehabilitación exitosa de un adulto de 8 años de nutria lisa *Lutrogale perspicillata* en un paisaje de planicie aluvial dominado por humanos, a lo largo del Río Ganga en Bihar, India. Una cría macho de nutria fue rescatada de cazadores furtivos en el año 2000, y criada en cautiverio hasta 2008. Esta nutria fue llamada "Ganga", y fue rehabilitada como adulto en Mayo de 2008 después de un programa de liberación gradual en el río, que tomó 42 días. Hasta 1 año y medio después, Ganga fue re-avistada ocasionalmente junto con un grupo de nutrias silvestres, hasta que fue encontrada muerta en Marzo de 2016. Informamos los detalles técnicos y las limitaciones enfrentadas en la rehabilitación, junto con observaciones comportamentales asociadas, sobre Ganga en cautiverio, y sus interacciones con nutrias silvestres. Demostramos con este caso que el éxito de la rehabilitación mediante procedimiento de liberación gradual fue un factor clave que aseguró la excelente supervivencia post-liberación de Ganga en el ambiente silvestre. El éxito de rehabilitación puede estar influenciado fuertemente por los contextos sociales, por lo tanto un entendimiento de los sistemas socio-ecológicos en los cuales deben ser conservadas las nutrias, es crucial.