Recreational angling markets to advance the conservation of a reach of the Western Ramganga River, India

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Abstract

1. Mahseer fishes of the genus Tor constitute ‘iconic species’ in Indian rivers, representing ‘flagship’ species for conservation purposes but with additional exploitable, cultural and economic values. Conservation action is required to address their vulnerability to numerous pressures on multiple habitats, and connections between them, across the extended aquatic ecosystems supporting different life stages.

2. Recreational angling for mahseer, along with associated wildlife and cultural tourism, is a growth industry dependent upon healthy river ecosystems.

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3. A cyclic, ecosystem-based model in which local people can benefit economically from sustainable mahseer exploitation through catch-and-release fisheries can form a basis for conservation of both mahseer and the wider river ecosystem.

4. Experience on the Western Ramganga River in the vicinity of the town of Bikhyasen, Uttarakhand State (in the Himalayas in northern India), demonstrates the importance of involving local people in the benefits associated with angling, wildlife and cultural tourism. This creates local incentives for river protection, and may be the most effective means for preventing destructive over-exploitation in poor rural communities.

5. Recognition of this value and its recirculation to local people can form the basis for a ‘paying for ecosystems services’ (PES) market of simultaneous benefit to river ecosystems, local people, tour operators and visiting anglers. This depends on local people benefitting from this market to a greater extent than through the killing of fish for non-renewable consumption or sale.

6. This is the basis for a potentially transferable model which may support regional development through the engagement of local people in markets for iconic species.

**Keywords**

Mahseer, iconic species, Ramganga River, Himalayas, paying for ecosystem services (PES), local benefits, participation, markets
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Introduction

Migratory species of fish are vulnerable to diverse pressures across the range of habitats supporting different life stages within extended aquatic ecosystems. They may therefore be important not merely for inherent conservation reasons but as indicators of overall ecosystem integrity and connectivity. Examples from different geographic zones include the salmonid and sturgeon fishes of the palaeartic and the yellowfishes (Labeobarbus species) and tigerfishes (Rhamphochromis and Hydrocynus species) of Southern Africa. These fishes may serve as ‘flagship’ conservation species, but they also have associated value from commercial and recreational exploitation as well as representing to a non-specialist wider public that the ecosystems supporting them are in a healthy state. Generally, these fishes are larger, predatory, charismatic and economically-important with migratory habits exploiting different habitats throughout their life cycles. They therefore indicate not only the vitality and connectivity of networks of habitats upon which all life stages depend, but also the functioning of those ecosystems and
the many associated ecosystem services of potential benefit to local people. We use the term ‘iconic species’ to address these wider social, economic and ecological roles of fishes typifying extended aquatic ecosystems in an intact and connected state.

Freshwater fisheries and freshwater ecosystems also represent important resources supporting the livelihood needs of local people. As a consequence, they are commonly subject to pressures exceeding their carrying capacity. These range from over-fishing by both inherently sustainable and destructive means, waste disposal, pollution, water abstraction, habitat degradation including excessive extraction of sand, gravel, cobble and stone, and the spread of introduced and invasive species. Impassable barriers also pose particular problems for migratory species. Freshwater ecosystems and resources in general, and fisheries in particular, are in steep decline globally with serious implications for their capacity to support continuing human well-being (Millennium Ecosystem Assessment, 2005).

The mahseer fishes of India, freshwater cyprinid species of the genus *Tor*, fall within this definition of ‘iconic species’. This brief resume of pertinent aspects of the ecology, conservation and sporting importance of mahseer is drawn from Thomas (1873), Dhu (1923), MacDonald (1948), Desai (2003), Everard (2010a) and an as yet unpublished review by Everard. Mahseer can attain substantial sizes, with recreational angling records in India up to 121lb (55kg). Although their taxonomy is contested, a number of species occur across the larger rivers fed from the Himalayas and running down into India, Pakistan,
Myanmar (Burma) and China, with Tor species also found throughout Deccan India, Sri Lanka and Indonesia. Large adult fish inhabit permanent lowland rivers and still waters but run up torrential and often ephemeral rivers as they rise during the monsoon, to spawn on gravels which are often in jungle headwaters. Adult fish run back down the river after spawning, but juveniles tend to occupy the upper river dropping downstream as flows recede and, typically, headwaters dry out. Mahseer are omnivorous, consuming a diversity of plant matter as well as crabs, other invertebrates, amphibians and fish. They are frequently top predators in many of these rivers, although it is believed that they may be preyed on opportunistically by crocodile species where present. Mahseer have substantial importance culturally, as a source of food and as a target for recreational angling. Dependence on a network of connected habitats from larger lowland waters through to spawning headwaters renders mahseer vulnerable to multiple pressures including pollution, predation, over-exploitation especially by unsustainable fishing methods, impoundments, over-abstraction and habitat loss or change. The IUCN red list of threatened species (IUCN, 2010) records that Deccan mahseer (Tor khudree) are Endangered with a decreasing population trend. Golden mahseer (Tor putitora) and the red mahseer (Tor tor) which inhabit Himalayan tributaries of the Ganges system are not evaluated by the IUCN, though populations of Tor putitora in mountain reaches were surveyed and assessed as endangered by Bhatt et al. (2004). This picture of conservation concern for India’s mahseer is supported through angling and other anecdotal information (Everard, 2010a; Sarkar, 2010), as well as by an informal survey by Lockett (unpublished) which found that mahseer of sizes of interest to
recreational anglers are now absent from the majority of sites recorded as of sporting interest by Thomas (1873). This evidence cumulatively supports the view that Indian mahseer populations are now restricted and in decline, the more so where rivers are heavily modified or exploited. There has, however, been extensive stocking of the three major river systems of Deccan India (the Cauvery, Krishna and Godavari systems) as a reactive measure to declining stocks, much apparently resulting from major hydroelectric impoundments which lack effective fish passes. There is little evidence to suggest that stocking has made any difference to the self-sustaining mahseer population. Instead, it has raised concerns about the genetic integrity of mahseer stock not merely due to the limited and potentially non-native genetic heritage of introduced fish, but also since hybrids between mahseer species have been reared in some hatcheries (Ogale and Kulkarni, 1987). Both *Tor putitora* and *Tor tor* have also been bred and raised in captivity (Ogale, 1997), though not in significant numbers. Although the mahseer fishes are of conservation concern, there appears to be little quantitative data on mahseer populations upon which to base either an authoritative conservation strategy or to determine sustainable limits to exploitation of river fisheries for either consumptive or recreational angling purposes.

This tendency to degrade freshwater fishery ecosystems and the many associated, often unrecognised, services that they provide to local communities is a consequence of the perception that short-term exploitation is more advantageous than long-term stewardship. Everard *et al.* (2009) emphasise the power of markets to change behaviours, especially in
developing world and rural situations where poorly-enforced top-down regulation is generally ineffective. They describe a cyclic ‘Integrated catchment value systems’ model, simplified in Figure 1, which connects habitats and their biodiversity with the societal uses and benefits of ecosystems, creating an incentive for community participation in their wise use, protection or restoration.

If conservation goals and the protection of aquatic ecosystems and services supporting local livelihoods are to be achieved, one of the key challenges is to create markets wherein the value of living fish exceeds that of fish killed for consumption or sale where this outstrips sustainable limits. Potential revenue flows from non-destructive activities, significantly including the promotion of catch-and-release angling tourism, may then be locally significant. It obviously follows that basic principles of fish care are observed to ensure survival on release after capture, and also that a significant proportion of revenues are re-circulated into communities local to the fishery rather than being overwhelmingly centralised by urban or foreign tour operators.

Another important feature of the model outlined in Figure 1 is recognition of different values accruing to the range of stakeholders with interests in the river ecosystem. An effective process of social negotiation is required to recognise the status and uses of the ecosystem that are of optimal benefit to all. In an over-exploited status, the killing of fish serves the short-term interests of a limited set of stakeholders consuming or selling fish but denies that benefit to others. It may even eliminate fish stocks entirely if not controlled. By
contrast, the model of sustainable angling tourism that we are proposing relies upon the extended markets associated with the capture and safe release of live fish supporting local livelihoods. In doing so, an influential majority of local people reliant upon the river ecosystem will realise and recognise greater collective advantage than when fish are killed. To achieve this, it is essential for a range of stakeholders, identified later in this paper, to agree on optimal resource use patterns and implement effective governance at appropriate scales.

This paper develops the ‘Integrated catchment value systems’ model in the context of mahseer stocks of importance as a recreational fishery in an Indian river. This is illustrated by progress made already in advancing the protection of the fishery on the upper Western Ramganga River at Bikhyasen (Uttarakhand state, formerly known as Uttaranchal, in northern India), a tributary of the Ganges system draining from springs in the Himalayas. This model is extended to consider further developments that could secure a self-sustaining economy based on angling tourism as a force for the recovery of river ecosystems for the long-term benefit of nature conservation and the livelihoods of local communities. The wider, generic applicability of the model is also considered.

The angling market in India
Recreational angling is today a rapidly-growing market in India for which the mahseer fishes of its larger rivers are popular target species (Sarkar, 2010). Recreational fishing for mahseer dates back to the British occupation of India, with various classic angling works written about mahseer fishing since the late nineteenth century (Thomas, 1873; Dhu, 1923; MacDonald, 1948). The mahseer was originally described scientifically by Hamilton (1822) and first mentioned in a sporting context in Oriental Sporting Magazine in 1833 (reported by the Trans World Fishing Team, 1984). Following Indian independence in 1947, recreational angling for mahseer fell out of favour. Indeed, there was a presumption that the large mahseer fishes had become extinct as a result of rapid development and a booming Indian population. However, the Trans World Fishing Team, a group of anglers intent on capturing specimens of the world’s largest fishes, set out to rediscover mahseer through recreational angling methods in 1977 (Trans World Fishing Team, 1984). This publicised the continued existence and sporting virtues of mahseer in Europe, the US and beyond, furthered by subsequent publicity on television and in books (Bailey, 1991).

Mahseer, reputedly one of the world’s hardest-fighting fish (Trans World Fishing Team, 1984), now represent an attractive and increasingly popular sporting quarry for travelling anglers. Many tour operators today provide angling tourism opportunities for affluent Indian and foreign anglers, with associated wildlife and cultural tourism markets.
Whilst this market should favour the conservation of mahseer stocks and the wider ecosystems that support them, the simultaneous development of India’s burgeoning and widely-scattered population also imposes significant pressures upon freshwater ecosystems and resources. These include over-fishing by both potentially sustainable and destructive means (including dynamiting and poisoning), excessive netting, snaring and pollution, and frequent impoundments disrupting riverine biota and flows of water and sediment (Everard, 2010a). These pressures conspire to threaten mahseer populations, dependent as they are on connected habitats of suitable quality across whole catchments. Furthermore, dialogue with local people at our study site revealed that many tour operators have failed to ensure that revenues from angling and other forms of tourism percolate into communities local to the ecosystems from which these services are drawn. In the absence of effective markets benefiting local people, it is then hardly surprising to find a lack of incentive for them to conserve stocks of fish and the quality of the environment that supports them for the long term. Consequently, destructive exploitation for immediate gain is perpetuated. As a consequence, most recreational angling occurs around ‘honeypot’ reaches of the Cauvery River to the south and various stretches of tributaries to the Ganges system flowing in from the Himalayas to the north. Each of these is actively protected by sporting and tourism interests or is under the cover of nature reserves or their proximity to Hindu temples within sight of which the killing of animals is not permitted. Yet, beyond these sanctuaries, the fate of mahseer, many other fishes and aquatic and terrestrial wildlife in general is far more parlous (Hussain, 2009; Everard, 2010a).
Background to the study site

The town of Bikhyasen (also sometimes translated from Hindi as Bhikia Sain) straddles the Western Ramganga River in the state of Uttarakhand, northern India. The Western Ramganga is a spring-fed river with generally clear flows strongly influenced by monsoon rainfall, traversing the Jim Corbett National Park in the Himalayan foothills to the south, where it is dammed, before merging with other rivers eventually to feed into the Ganges (Figures 2 and 3). The river holds stocks of golden mahseer (*Tor putitora*, see Figure 4) as well as chilwa (*Esomus danicus* though ‘chilwa’ is also a generic name for small fish), goonch (*Bagarius bagarius*), mullee or wallago (*Wallago attu*), kalamas (the local name for a rock-grazing fish of uncertain taxonomy), species of *Garra* (small cyprinid fishes of uncertain species also known as ‘stone sheep’ from their habit of grazing of algae from submerged surfaces), eels (*Anguilla bengalensis*) and freshwater garfish (*Xenentodon cancila*). Large specimens of mahseer attractive as angling targets tend to accumulate in deeper pools during summer low flows (approximately between December and the onset of the monsoon generally in May). However, around Bikhyasen, mahseer were largely confined to short reaches within sight of two temples where dynamiting, excessive netting and other destructive forms of fishing have been discouraged. In the wider vicinity, frequent bombing using improvised dynamite-based explosive devices as well as netting and loop-fishing have severely depleted stocks of mahseer and other valued sport fishes.
Therefore, despite otherwise suitable habitat, mahseer stocks close to Bikhyasen were restricted during the dry season to just five large pools in a 10 kilometre stretch of the Ramganga River prior to 2007. Destructive overfishing elsewhere was a consequence of lack of value flowing back to local communities from conserving the fish and the wider ecosystem. The value of dead fish for consumption or sale exceeded that of protecting these fish, notwithstanding statutory prohibition of unsustainable fishing methods including some degree of explicit protection for mahseer fishes.

From 2007 onwards, www.india-angling.com instituted a regime of angling tourism that employed local people as porters for visiting anglers, hired local tents, and bought all food stocks from the town of Bikhyasen and its environs. The temple was also progressively used and paid for accommodation for visiting anglers. Procurement of food, general and some luxury goods (beer, cigarettes, etc.) from local traders also provided a very significant revenue to local traders relative to the normal expenditure of the resident rural population. Furthermore, in association with the temple in Sarna (Bikhyasen), fishing prohibition signboards were erected on the two prime pools holding large specimens of mahseer and goonch, by order of the Sub-Divisional Magistrate (a role discussed when considering stakeholders).

The market for angling and wildlife tourism and associated purchases has been gradually increasing, related to the number of anglers hosted in the area. Formerly, most angling trips to the Western Ramganga had been organised around the Jim Corbett National Park which is governed by strict
rules covering the fishery and various aspects of hunting and other disturbances of the river and park ecosystem (Corbett Rules and Regulations, undated). (Rule 9 in Corbett Park states that: “Fishing and angling is prohibited without permit inside the Corbett National Park. Fishing with permits is allowed only in the outside Corbett National Park and Sonanadi Wildlife Sanctuary between the 1st October and 30 June”.) Since 2007, www.india-angling.com has gradually increased the number of anglers venturing into areas not covered by this explicit nature conservation protection, including the Bikhyasen reach of the river which has now become a prime angling hotspot.

Increases both in angler numbers and expenditure on goods and services sourced from the local area has resulted in a significant increase in local income. Combined spend in the locality of Bikhyasen for each typical 5-6 day angling tour catering for 2-4 anglers and accompanying tourists venturing up to this reach of the upper Ramganga in 2007 is estimated at INR 55,000/- (55,000 Indian Rupees, equivalent to $US1,220). This accounts for expenditure in stores providing general (daily use) goods, vegetables, meat and alcoholic drinks, as well as provision of tents, porter services, and ponies and their handlers (for pony treks or carrying provisions on trekking tours). In the three months of fishing (February to April) in 2010, approximately INR 350,000 (US$ 7,800) was spent on local purchases and accommodation. This is a substantial addition to the economy for a small town in the Himalayas, lacking industry with many people living close to subsistence levels. It is comparable to gross sales that might be expected in six months of
the year without angling. Fishery-related tourism has therefore benefited a variety of local people both directly and indirectly, allowing them to realise tangible advantages from safeguarding stocks of ‘iconic’ fish in their area together with the ecosystems necessary to support them. As a consequence, mahseer have been able to survive in low water conditions beyond just the isolated temple pools, enabling the identification and development of additional fishing beats. Angling tourists (and/or more typically the partners of angling visitors) have also enjoyed related wildlife and cultural tourism opportunities including shopping trips to purchase local goods, reinforcing the mutual benefits of ecotourism. [www.india-angling.com](http://www.india-angling.com) has also participated in local festivals in the area, bringing about a direct connection between international anglers and local people and thereby building cross-cultural bridges. Local traders welcome angling tourism visits, the growing ‘mahseer economy’ creating positive incentives for protection of the wider river ecosystem.

By 2010, protection of fish stocks in the Ramganga River around Bikhyasen was far from complete. However, a far greater degree of control had been undertaken by local people and, in the dry season, more large brood stock mahseer were observed in an additional five pools from which they were absent during 2007, 2008 and 2009. This provides anecdotal indication that fish stocks have responded to improved protection, also supporting additional sporting and associated economic opportunities.
Observation and discussion with local people in summer 2010, including dialogue in the local markets in Bikhyasen and Massi, revealed that around ten local people were persisting with netting and loop-snaring of fish. Although it would be best for fish stocks to eliminate all illegal fishing, exploitation at this level is not of major concern as it may be within sustainable limits and generally affects only smaller and less commercially-important fish. (The lack of quantitative surveys means that this assumption is uncertain.) More significantly, there has been no visual, audible or reported evidence of blasting by dynamite in the prime 10 kilometre angling stretch around Bikhyasen during the frequent visits of www.india-angling.com in the vulnerable low flow periods of 2008-2010. Further peer pressure within the local community is likely to reduce destructive exploitation if market advantages persist and become clearer to local people.

**Engaging stakeholders in markets for sustainable mahseer fishing**

The 'Integrated catchment value systems' model (Everard et al., 2009) has been adapted to represent the developing situation of recreation angling tourism at Bikhyasen. This comprises a self-reinforcing cycle, providing incentives to local people to safeguard improving river ecosystems through economic benefits flowing from recreational services (Figure 5).
A broad spectrum of stakeholders is required to maintain and optimise this cyclic and potentially sustainable model, ranging in scale from local community level up to national government and including:

- **Formal local markets.** People with local knowledge and networks may make the best potential wildlife and cultural guides as well as ghillies, guiding visiting anglers as to the location of fish and the best means to catch them. Also, local people can drive, carry gear, and otherwise provide support services in return for direct income.

- **Informal markets.** The ways in which tourism spend is distributed has a major impact on the overall benefit derived by local communities, including purchases of food, general trade and luxury goods, as well as the services of cooks and camp operators.

- **Spiritual interests.** It is in the interests of local temples that poaching and the killing of fish and other wildlife should cease within sight of the temple, but also across the wider catchment as a form of respect from humanity to nature. Temples at Bikhyasen already benefit from income from visitor stays but could form a network of influence further dissuading poaching across the catchment.

- **Nature conservation NGOs.** Voluntary bodies have a long history of protecting wildlife and the benefits that it provides to local people. The Indian NGO Tiger Watch ([www.tigerwatch.net](http://www.tigerwatch.net)) is already involved in research into pressures on neighbouring rivers.

- **Governance, including:**
National legislation. The fragmented and declining status of mahseer is poorly reflected in India's national legislation. Scheduling mahseer species in India's Wildlife Protection Act of 1972 would formally recognise the need for far-sighted controls, notwithstanding acknowledged shortfalls in the efficacy of top-down measures in developing world and rural contexts.

Sub-Divisional Magistrate (SDM). Governance changes at sub-state level may be more effective, where Sub-Divisional Magistrates (SDMs: the senior civil servants in sub-divisions of the state) having considerable influence. SDMs will have interests in protecting ecosystem services provided by thriving river ecosystems for people in the sub-division including the many societal co-benefits associated with tourism markets, simultaneously protecting regional income and public well-being.

Panchayats. Each agglomeration of villages is governed by a Panchayat (a group of five elders who must be local people) headed by a Sar-panch who is an elected official. The Panchayat system was given greater powers under the government of Rajiv Ghandi (1984-1989), devolving more decision-making to village or locality scale for the benefit of local people.

Tourism organisations. A range of tourism bodies share an implicit interest in thriving fish stocks and river ecosystems including:

Statutory tourism markets. At present, payments to the Forestry Department of Uttarakhand State for camping and angling licences go into central state funds. There is no evidence or perception of
direct benefit to local riparian communities, such as through measures to protect fish stocks and conserve river ecosystems.

- The national Indian body, Tourism India (www.incredibleindia.org).
- State bodies, including Uttarakhand Tourism (www.uttaranchaltourism.in).
- Private tour operators.

- **The Indian Army.** A unit of the Indian Army has specific responsibility of natural resource protection.

- **Media.** Where mahseer feature in the media (press, TV/radio, DVDs, websites), it is perhaps understandably portraying sizeable fish and the beautiful surroundings in which they thrive. Akin to media portrayal of tigers, the serious problems faced by wild populations are rarely presented in part due to potential suppression of tourism revenue. Some recent journalism is beginning to redress this situation (see Everard, 2010a and 2010b; Sarkar, 2010).

**Discussion**

The benefits of community engagement for enduring, effective and equitable nature conservation are now accepted internationally (Emerton, 1999; Larsen and Springer, 2008). Markets can provide powerful mechanisms for natural resource and ecosystem protection and conservation around the world (TEEB, 2008). The economics of angling and wider wildlife and cultural tourism can be significant for rural regions, so may constitute a positive force
for protecting wildlife and ecosystem services supporting local people (Balmford et al., 2002). However, how and where revenues from tourism are spent has a substantial impact upon benefits for local people and their potential to protect or allow the restoration of freshwater ecosystems (Mladenov et al., 2007). In a centralised model, where profits accrue largely to tour operators and chain hotels, economic benefits to local people are unlikely to create incentives to prevent them over-exploiting accessible natural resources for immediate, short-term gain. Conversely, local sharing of the benefits of recreational angling markets can, and has been found to, promote self-interested resource stewardship at community scale.

Opportunities for capacity-building and diversification of tourism support by local stakeholders in the context of the ‘cyclic ecosystem service market’ model (Figure 5) suggest potential enhancements to the evolving recreational angling market on the Western Ramganga River. This may include extending locally-provided operations such as camping, new related services such as rafting, and skills development amongst local potential ghillies and wildlife and cultural guides. Training by skilled tour operators would yield the reciprocal benefits of reliable and trusted local support staff as well as increased respect from the local community. Devolution of governance could also increase local benefits, participation and effective stewardship. SDMs have already proven effective in setting new protective rules. However, Panchayats better represent local interests and could conceivably be persuaded, directly or through agents, to organise local fishery management, distribute benefits and institute enforceable rulings about wise stewardship of ecosystems supporting
local people. If local management is thus established, it would be logical for camping, angling and other licence revenues to be passed down to local level, together with associated responsibilities, reinforcing the advantages accruing to communities from protecting river ecosystems. The loss of licence revenue at State level could be relatively minor, but the sums involved could be significant for the local communities that State government is funded to serve and for the ecosystems upon which tourism activities depend.

Tour operators are key agents in this market, connecting ‘buyers’ of ecosystem services with their ‘providers’. As in any market based on common resources, there is a risk of ‘free riders’ profiting from use of the resource without reinvestment in the fishery and local community. It may therefore be valuable to develop a published and transparent standard of responsible operation to which tour operators are required to commit if they are to be granted permission to make use of fishery beats. This ‘code of practice’ may address, for example, respecting or helping develop locally-administered beat systems, local procurement of goods and services, training local people who may also become more alert to problems in rivers when not working, providing wider community engagement (expert talks and seminars), promotion of study to address knowledge and skills gaps, and responsible waste management. The evolving and transparent ‘code’ will be of value to tour operators as a market differentiator, also serving as an informal contract between operators and local beat managers.
The practical role of the Indian Army in natural resource protection is unclear at present, but could be reframed to support local tourism management. Further market development requires knowledge and capacity-building. This may be supported in part through applied research, for example to quantify the carrying capacity of the fishery, or support funding to address development priorities such as appropriate infrastructure to deal with visitor traffic, resource use and waste generation. This is consistent with a ‘sustainable livelihoods’ approach (Chambers, 1987; Chambers and Conway, 1992), wherein local people develop capabilities to make a living from the natural and other assets to which they have access.

River managers may chose to develop additional angling beats around current ‘honeypot’ sites to extend these benefits to the ecosystem and local communities. These beats, initially of lower but potentially increasing value, would create incentives for greater controls on poaching and unsustainable fishing methods as well as development of tourism infrastructure and skills. The beat system could thus be spread to increase the overall length of river holding significant fish stocks, expanding angling opportunities, spreading the control of undesirable fishing methods along the river corridor, and increasing the overall size of the market and number of potential beneficiaries. There is already limited evidence of this effect in the Western Ramganga River. Were beats ultimately to link up current ‘honeypot’ sites, mahseer stocks could be reconnected along entire river systems with stepwise improvements facilitated by their migratory behaviour. This may also potentially boost local food
resources if smaller fish below brood stock size are captured using more sustainable methods, such as small-scale netting or looping.

This process builds upon the emerging practice of ‘paying for ecosystem services’ (PES) schemes around the world, defined by Wunder (2005) as “…a voluntary, conditional agreement between at least one ‘seller’ and one ‘buyer’ over a well defined environmental service—or a land use presumed to produce that service”. PES schemes can create self-reinforcing markets to secure the ecosystem services of water production, nature conservation and carbon sequestration (as reviewed by Mander and Everard, 2008; Everard, 2009). Beyond established and emerging markets for some ecosystem services, such as food or water production or climate change gas emissions, many ecosystem services are not yet recognised by, and therefore lie outside of, the formal economy so may consequently be eroded by practices such as agriculture and over-fishing (Millennium Ecosystem, Assessment, 2005; Randall, 2007). However, the rural space of European river corridors is increasingly valued for the multiple ecosystem services that it can deliver (Posthumus et al., in press). The sustainable angling, nature and cultural tourism model described in this paper is an example of PES market creation simultaneously beneficial to local people and river conservation. Growing awareness of the importance of ecosystem services may in time spread this approach more widely and also address more services. Some additional ecosystem services for which markets may potentially be explored in the upper Western Ramganga River, and in other similar rivers, are highlighted in Figure 5.
The primary purpose of this cyclic and potentially sustainable angling and wildlife tourism model is to guide development of the Bikhyasen fishery. However, the principles it embodies could be applied far more widely in the Western Ramganga system and elsewhere not merely in Uttarakhand but across the major river systems of India. With locally-appropriate modification, it may even constitute a generic framework for other forms of angling, wildlife and ecotourism involving ‘iconic’ aquatic species.

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