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The Project Tiger Crisis in India: Moving Away from the Policy and Economics of Selectivity

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ABSTRACT

This paper discusses the economic and philosophical inadequacies that have characterised the Project Tiger scheme in India. Launched in the 1970s to protect the habitats of the Royal Bengal Tiger, Project Tiger has over time evolved into a management system that has abstracted the tiger from its habitat by highlighting its charismatic functions. However the abstraction has also caused the tiger to be valued for its narrow consumptive uses. By comparison the habitats that have nurtured the tiger have received less attention. The paper critiques partial equilibrium frameworks that have attempted to value a tiger in terms of demand and supply functions rather than as an integral element of an ecosystem. While considering the superiority of the Total Economic Value concept as a value-determining method, the paper also points to the limitation of the concept in not addressing the conflicts between use and non-use values of a tiger. In the light of these facts, the paper advances the theory of complementarity as a valuation approach that considers the tiger and its habitat as a joint resource that needs to be protected and conserved in the larger interests of biodiversity conservation in India.

KEYWORDS

Project Tiger, Total Economic Value, complementarity, valuation, monism

INTRODUCTION

Project Tiger has been India's most ambitious conservation programme initiated in the post-independence period. The fundamental objective of the project, which commenced in 1973, was to rescue *Panthera Tigris Tigris,* popularly known as the Royal Bengal Tiger (hereafter 'tiger') from the verge of extinc-

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tion. The project adopted a charismatic species approach to management. In the three decades following the launch of the project, the tiger population of India increased from 1,827 in 1972 to 3,750 in 1993. The project also gave a major impetus to the movement in India to protect wildlife and wilderness through a network of protected areas carved out of the country's reserved and protected forests. In recent years Project Tiger has been the target of serious criticisms, most of which can be attributed to the drop in the tiger population in tiger reserves. This paper critically examines the issues that have caused Project Tiger to fall into a crisis. The basic argument of the paper is that it is 'species selectivity' and a narrow economic perspective of 'the tiger as a resource' that have contributed to the present crisis. While species selectivity led to an over–emphasis on the tiger in Project Tiger reserves, economic theories based on partial equilibrium frameworks have analysed the worth of the carnivore in terms of simple supply and demand functions. While noting the superiority of the concept of Total Economic Value (TEV) in overcoming the limitation of partial valuation approaches, the paper nevertheless considers the TEV also to suffer from inadequacies. The paper accordingly advances the notion of 'complementarity' as an improved valuation approach for assessing the worth of a tiger and its habitat in an integrated manner.

The discipline of Environmental Economics has attempted to grapple with the issue of valuation of biological and natural resources. Indeed many efforts have been made in India to value forests and other sensitive ecosystems, such as wetlands. In the context of keystone species and species of charismatic importance such as the tiger and the elephant, though there have been no specific valuation studies in the Indian situation, there exist interesting exercises in the context of other countries. A classic case in point is the estimation of tourism revenues worth over $500,000 by Durrell (1986), for a live, fully-grown maned lion in the Amboseli National Park of Kenya (Butler, Hvenegaard and Krystofiak 1994: 257). Butler et al. (1994) have likewise estimated the economic value of bird watching with reference to the Point Pelee National Park in Canada. There has been a flurry of studies on elephants as well. These include the economic analysis of the African elephant by Cumming and Jackson (1984), a study on the 'viewing value of elephants' in Kenya by Brown and Henry (1993), analysis of demand patterns for ivory by Barbier, Burgess, Swanson and Pearce (1990) and studies on the financial and economic viability of habitats populated with elephants by Douglas-Hamilton (Mendelssohn, 1999: 131). A recent study worth mentioning is that of Allen and Loomis (2005). With reference to the 'Golden Eagle' of the Snake River Basin of Idaho, the authors demonstrate how conventional contingent valuation techniques can be extended to work out the values of lesser-known species in terms of their contribution to better-known species.

Broadly, these works can be divided into two categories – those that focus on the value of 'live' charismatic animals, and others that delve into the by-products of a dead animal.

Mendelssohn (1996 and 1999) has reviewed these studies. Mendelssohn's basic point is that the analysis of the value of 'single species' is fraught with difficulties, as it is not logical to abstract the costs and benefits of one species, particularly when it is closely linked with others. He considers indirect approaches as more promising. In this context he refers to the study of Vorhies and Vorhies (1993) regarding the re-introduction of lions in Pilansesberg National Park in South Africa. Mendelssohn also considers the absence of studies regarding 'removal effects of keystone species from ecosystems' to be a major deficiency of valuation studies. In the final analysis, Mendelssohn believes that studies focusing on multidisciplinary approaches have a better chance of gaining acceptance by decision makers. As we shall see, these views are valid, to a large extent, if one goes by the experience with the Project Tiger scheme in India.

INDIA'S PROJECT TIGER

The genesis of 'Project Tiger' goes back to the 1970s when there were alarming reports about the critical state of the tiger population in India. In 1972 the Government of India set up a Task Force to look into the issue of the decrease of the tiger population in India (Sankhala 1978*:* 195–6). The Task Force, after examining various issues, recommended the launch of a national-level Project Tiger programme in India.[1] The project was launched in 1973 (ibid: 196)**.** The ostensible goal of the project was to protect the habitats of the tiger from destruction. In its initial phase Project Tiger was taken up in nine tiger inhabitation areas, which were declared to be Project Tiger reserves. These reserves were carved out of reserved forests, sanctuaries and national parks. The underlying assumption was that the creation of tiger reserves would help increase the tiger population to its optimum level by improving the biotope (Sankhala op.cit). The Government of India subsequently declared the tiger the country's national animal. In the words of its founding Director, Project Tiger was 'committed to the philosophy of total environmental preservation in selected areas where nature was allowed to play its part in full'. It was further stated that 'management would be limited to eliminating or at least minimising human disturbance and to repairing damage already caused by man' (Sankhala 1978: 196). The criterion for selecting the nine reserves for Project Tiger in the 1970s was that each of them was representative of a certain type of tiger habitat and was to be left undisturbed (Sankhala 1978: 196–7).[2] The habitat was still considered to be the basic foundation for tiger conservation. The shift towards 'premier tiger habitats' (Thapar 1999: 296), which was subtle but effective, occurred from the 1980s. By the 1980s the focus of the project shifted towards increasing the tiger population in various reserves. The new slogan was 'The Tiger is at the apex of the Biotope. Save the tiger and you save the habitat' (Damodaran 2000: 6). Even today the Project Tiger Directorate reinforces this approach, as is evident

from its following statement, 'Tiger is symbol of wilderness and well-being of the ecosystem. By conserving and saving tigers the entire wilderness ecosystem is conserved' (Projecttiger.nic.in).[3] Thus over a period of time the focus of the project shifted to the tiger, the charismatic and keystone species. The charismatic carnivore was to be protected and replenished through dedicated funding and management plans

The Project was initially successful not only in increasing the tiger population but also in increasing the spread of the tiger reserves. The tiger population increased from 268 to 962 during the period from 1972 to 1983 in Project Tiger reserves. By the year 2001, Project Tiger reserves in India numbered 27, spanning an area of 37,761 square kilometres, which was more than double the 16,339 square kilometres covered by the original nine reserves (Jain 2001). By 2001–2, the 27 reserves reported a tiger population of 1,576.

Indeed the obsession for increasing 'tiger numbers' in reserves was accompanied by the desire of park authorities to provide 'tiger sightings' for tourists. In the 1970s 'live baits of cattle' were arranged for the tigers of Kanha Tiger Reserve of the State (Province) of Madhya Pradesh, to draw in tourists.[4] Thus 'amusement value' took precedence over 'habitat value'. The ecological and biodiversity features of the Project Tiger habitats in India are demonstrated in Table 1. The Table provides a synoptic view of Project Tiger reserves that were

TABLE 1. Ecological Profile of Tiger Reserves in India funded by the Global Environmental Facility

Sl. No.	Name of the Tiger Reserve	Area (sq. km.)	Natural Vegetation Gradient	No. of Tigers (2001)	Whether Rare Medicinal Plants Available
1.	Buxa	761	Evergreen Forests; Semi-Evergreen Forests; Wet Hill Forests; Wet Mixed Forest; Moist Mixed Deciduous Forest; Moist Sal Savannah	31	√
2.	Palamau	1026	Moist Deciduous; Moist Peninsular Low Level Sal; Dry Mixed Deciduous;	32	√
3.	Pench (Madhya Pradesh)	758	Moist Deciduous; Dry Mixed Deciduous; Dry Deciduous	40	√
4.	Periyar	777	Tropical Evergreen Forests; Semi Evergreen Forests; Wet Grasslands; Moist Deciduous Forests;	36	√
5.	Ranthambore	1335	Tropical Dry Deciduous Forests;	35	√
7.	Nagarhole	643	Dry Deciduous Forests	52	√

Source: www.Projecttiger.nic.in.

taken up for funding through the Global Environmental Facility (GEF). As the Table shows, apart from tigers, Project Tiger reserves are also rich in terms of other unique resources, such as medicinal plants (Jain, 2001: 96–201).

The shift in emphasis from the 'habitat' to the 'tiger' is also evident from changes in the management plans of tiger reserves. Two measures were significant here. The first one related to use of 'habitat manipulation' as a tool in Project Tiger reserves to facilitate stabilisation and increase the tiger population in the reserves.[5] The second measure related to active efforts to relocate village populations from tiger reserves, in order to prevent tiger-human conflicts. Even today this thinking persists, as evidenced by the emphasis of the GEF-assisted 'India Ecodevelopment Project' on the relocation of local communities from tiger reserves.

In the 1990s, concerns about the declining tiger population in India mounted. By 1997 the situation took a serious turn, with the then Director of Project Tiger declaring that the tiger population had fallen to below 3,000 in number, compared to the 1993 census report, which had estimated the number at 3,750 (Jain 2000: 100). It was at this juncture that the World Bank launched the GEF-assisted 'India Ecodevelopment Project' in the tiger reserves of Buxa in West Bengal, Nagarhole in Karnataka, Palamau in Bihar, Pench in Madhya Pradesh, Periyar in Kerala and Ranthambhore in Rajasthan, at a total cost of $67 million (MacKinnon et al. 1999: 308). Indeed, by 2004 and 2005, reports of tiger deaths in the Sariska Tiger Reserve in Rajasthan (not covered under the GEF project) had received so much media attention that the government was forced to initiate an investigation by the Central Bureau of Investigation.

Poaching has been considered the main reason for the decline of the tiger population both in Project Tiger and non-Project Tiger reserves in India (Thapar 1999: 305). In Project Tiger reserves such as Ranthambhore in Rajasthan (one of the pioneer nine reserves) the cause of the decline is also attributed to extraction of medicinal plants from the reserve (McKinnon et al. 1999: 308). In the wake of the Sariska Tiger Reserve crisis, an additional fact that has come out is that Project Tiger authorities had inflated tiger numbers through faulty census procedures, resulting in over-counting and exaggeration in tiger numbers (Anonymous 2005).

THE ECONOMICS OF THE ROYAL BENGAL TIGER

The economics of the Royal Bengal Tiger have been analysed from a partial equilibrium framework, involving 'supply' and 'demand' functions. 'Supply' of tigers is considered to be constrained in view of their small population in natural conditions and the strict entry conditions imposed by authorities. Mitra (2005) attributes the high profitability of trade in tiger products as resulting from supply constraints associated with the carnivore. It is further argued that

the restricted supply of tigers has only served to increase the value of the 'dead tiger'. However, the analytical underpinnings of this argument are questionable. The theory of Total Economic Value (TEV) clearly brings out the fact that a live tiger in its natural habitat could confer multiple values as compared to the narrow use values conferred by the products of a dead tiger.

The concept of TEV has been advanced as the most appropriate method of valuing biological resources located in a habitat. In terms of this method, a sum of use values, existence values, option values and quasi-option values accounts for the total worth of biodiversity in an ecosystem. Use values are categorised into consumptive and non-consumptive values. Non-use values, particularly 'existence values', can be associated with 'pleasure without use' or 'pleasure from knowledge about a public good' (Diamond 1996). Further, non-use values 'do not leave any behavioral trail' (Diamond, op.cit). While biomass that is tangibly consumed by human communities comes under the category of consumptive use values, non-consumptive use values include non-tangible services rendered by forests in the form of watershed protection, soil conservation, tourism etc. In the category of non-use values fall 'option values', which are likely to emerge in a tangible form in future. Stakeholders who are located far away from habitats typically cherish or nurture 'existence values'. TEV conveys the fact that there are multiple utilities that can be derived from an ecosystem. Interestingly the heterogeneous goods and services generated by an ecosystem are matched by equally heterogeneous demand patterns. This complicates the working of the 'supply and demand' mechanism.

TEV is based on an 'additive approach', where each category of value is aggregated to arrive at the 'total' value. Valuation methods such as 'willingness to pay', or 'contingent valuation' have been employed as techniques to assess the TEV in terms of their non-tangible features**.** An interesting example of a TEV calculation is that of de Groot, (1994), in relation to the Galapagos National Park. The study arrives at the total monetary and capital value of the park on the basis of aggregating the different value dimensions.

Thus tigers exist in two forms – as 'resources' that can be consumed, or as 'resources' that need to be conserved. As a resource, a tiger is a 'privately appropriable good', which can be utilised for realising any consumptive values. For India's Project Tiger programme, the tiger is a non-consumptive public good that commands value in terms of its live existence as a keystone species. Further, in a Project Tiger reserve the tiger is a non-excludible, public good. This means that one visitor's sighting of a live tiger does not affect another viewer's chance of a sighting. However, in a tiger farm, a tiger becomes an excludible private good that has 'consumptive use value'.

Tiger poaching results in the transformation of the tiger from a 'non-consumptive public good' to a 'private good', which incidentally represents the tiger in the 'dead' form. In other words, for private appropriation of tiger products to happen it is essential that the tiger is killed. It also follows that a 'dead tiger',

which is valued in international markets for its by-products such as bones, nails, skin, genitals and other body parts, conveys consumptive 'use values' in comparison to a live tiger, which has essentially 'non-consumptive use values' or 'existence values'.

As a 'conservation possibility', a tiger acquires value for its ability to ensure conservation of its habitat. This is in addition to its 'existence' and 'non-consumptive' use values. The tiger as a non-consumptive public good is valuable for its non-consumptive use value and existence value, while a dead tiger is valuable only as a consumptive use value item. Therefore the switch from a 'resource economics' perspective to a 'conservation economics' perspective represents a switch from consumptive use values to non-consumptive use values and existence values. Also a shift from a resource perspective to a conservation perspective marks a shift towards high-end values that are provided by a forest ecosystem.

The merit of TEV is that it overcomes the partial equilibrium framework that just reduces the value of a tiger to its 'consumptive use value'. As has already been stated, as live entities tigers enjoy 'existence value'; under the TEV scheme of things a tiger has value in both its 'live' and 'dead' forms.

At the same time TEV suffers from limitations. As the earlier analysis in relation to the tiger clearly conveys, the different components of TEV are not mutually supportive. The tiger's use value clashes with its 'existence' and 'non-consumptive' use values. Thus to optimise use values one has to ensure the destruction of the tiger. This will deny the possibility of realising the other 'value sets' flowing from a live tiger in a natural habitat. This is a serious problem considering the fact that a live tiger is many times more valuable than a dead tiger. A simple exercise will prove this point. By transforming per land unit area investments in Project Tiger reserves of India into per tiger investments, it is possible to arrive at the value of a live tiger in a Project Tiger area. Thus for GEF-funded Project Tiger reserves, investments per 100 square kilometres are estimated to be of the order of $220,000 which, if related to the average tiger density of five per 100 square kilometres, translates to a value of $440,000 per animal (Damodaran 2000: 8). If the density level hits the maximum of 16 per 100 square kilometres, a tiger's value would decrease to $138,000 per animal (Karanth and Stith 1999: 102). By comparison, the value of a dead tiger is reckoned to be of the order of $14,000 (Highley 1993).

Damodaran (1993) points to the limitations of the TEV model based on the 'additivity' principle, noting that additive approaches ignore the fact that managers of forests or protected areas seek to optimise a select set of current benefits to the exclusion of others.[6] In such situations an additive approach may not reflect an 'optimum' total economic value. It will at best represent 'realised value'.

A related problem that arises from the TEV approach is that by including use values in its fold, it overvalues certain keystone resources at the cost of others. In the context of the Project Tiger scheme this has precisely been the tendency

since the 1980s, when the tiger received a disproportionate focus in comparison to its habitat. This approach engendered problems. It created a situation where the development of a second keystone species or resource undermined the position of the tiger. For instance, the occurrence of key medicinal plants in a tiger reserve such as Ranthambhore create 'binary resource centricity'. This had the potential of creating a clash between the 'existence values of tiger' and the 'consumptive use value of medicinal plants'.

COMPLEMENTARITY AS A VALUATION PERSPECTIVE

Accordingly, an approach to valuation that centres on the concept of complementarity is advocated here, whereby a habitat or an ecosystem is valued for benefits that are non replicable in other habitat/ecosystems. Figure 1 explains the principle of complementarity.

While the non-shaded portions of Figure 1 indicate use values (V_1 and V_2) emanating from dead tigers that are reared or housed in tiger farms and safaris (where live baits are arranged for tourist amusement), the shaded portion of the

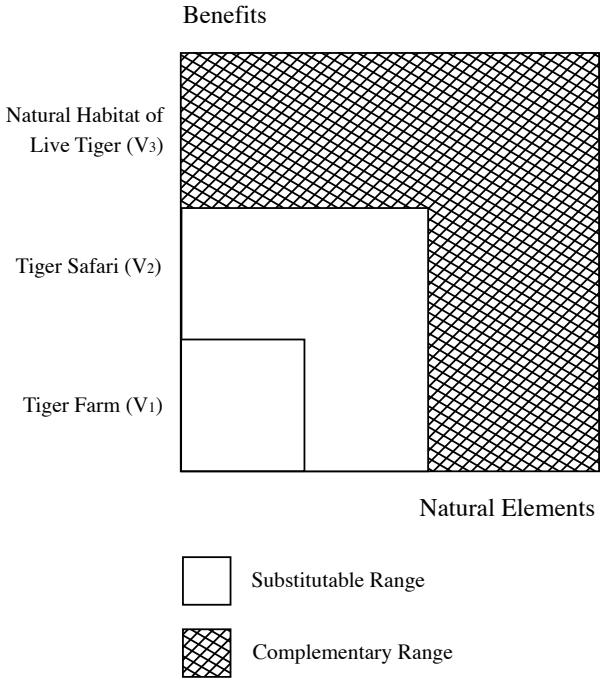

FIGURE 1. Benefits from Different Tiger Regime

diagram indicates the 'complementary values', which are not replicable outside the ecosystem and therefore are irreplaceable. The theory of complementarity is rooted in the principle of 'conservation economics' as against the 'selectivity bias' of resource economics. Further, the theory is non-additive and transcends the TEV concept by taking into account benefits that are not reducible to numbers. Accordingly, the theory of complementarity places a larger value on the non-substitutable elements of an ecosystem (V_3). This is because it is assumed that substitutable resources lose their value if and when replicated outside the ecosystem. It is therefore clear from Figure 1 that 'use values' and 'existence values' have a minor role in valuation, as they represent resources that are replicable outside the ecosystem. All the same, use values and existence values are neither mutually independent nor exclusive of each other. A tiger can be changed from a unique complementary asset to a substitutable good once it is reproduced in ex-situ conditions. Both option values and existence values can be resource-centric (say the tiger or a medicinal plant) or habitat-centric. The same is true of complementary value, except that the form of value extends to resources or habitat features that are not substitutable. Similarly the complementary value of a habitat might already be in 'existence' or yet to be discovered. Where the value is speculated to exist, 'contingent valuation' and 'willingness to pay' approaches could be employed to yield tangible existence values. Where the complementary value is yet to be discovered the value approximates that of an option value.

Thus in terms of the theory of complementarity a tiger inhabiting wilderness is 'non-substitutable', and therefore it is this that enjoys the highest value, not the tiger per se. Accordingly, the theory considers the tiger and its habitat as a bundled entity. This is at variance with the Project Tiger programme, which has unbundled the tiger from its habitat by adopting a key focus approach to the tiger since the 1980.[7]. This blurs the distinction between a live tiger in natural habitat and a farm or safari animal.[8] Thus tigers housed in tiger farms (for slaughter) or in 'tiger safaris' (which provide 'baiting' thrills) cannot by any stretch of imagination be considered a 'complementary asset'.

A management response that harps on ex-situ breeding of tigers in non-natural environments, or their rearing in 'constructed safaris', assumes that ex-situ sources of tiger product supplies or tiger populations could serve to whet the appetite of philistine tourists and consumers of tiger by-products. But there are many imponderables with this analysis. Tiger farms can be viable only if they do not face competition from low-priced illegal supplies emanating from natural reserves. Indeed, illegal trans-boundary sales of dead tiger products have flourished due to the arbitrage between low harvest costs (in tiger range countries) and the price paid by consumers (Highley 1993). Since farm-bred tigers will be subject to full cost pricing, it pays a trader to source his requirements from poachers operating in tiger reserves.[9]

There is a related puzzle. Unbundling a joint resource and promoting one of the components at the cost of the other could create a relative devaluation of the ignored component. This is particularly true of the tigers in Project Tiger reserves. Thus every decline in the tiger population causes the habitat to become devalued in relation to the tiger, which acquires a higher scarcity value in the process. This situation may be due to a shift in resources from habitat conservation activities to maintenance of tiger populations. Thus the recent revelations (Gupta 2005) regarding tiger poaching and tiger deaths in different Project Tiger reserves in India have created a situation where the tiger is depicted as becoming extinct, thus paradoxically adding to its value on account of the scarcity factor. In the wake of tiger deaths, extra investments are put into poaching control measures These include increased expenditure on patrolling and policing of reserves, and relocation of local communities suspected of acting as agents of poachers.[10] Paradoxically such expenditure leads to a further devaluation of the habitat. Moreover, the ratio of tiger to habitat decreases as a result of tiger deaths.

The problem is exacerbated by valuation exercises that harp on the tiger as the sole object of valuation. In terms of these approaches, a decline in the tiger population is certain to induce a decline or 'devaluation' of habitat. Though it is a highly successful international convention that has more-or-less effectively controlled illegal trading in endangered plants and animal species, the Convention on International Trade in Endangered Species (CITES) unfortunately is species-specific and not habitat-specific, and valuation exercises that focus on species covered under CITES also tend to suffer from the problem stated above.[11]

A management strategy which aims to move away from 'tiger farms' and 'tiger safaris' to 'tiger reserves' represents a graduated movement towards realising 'complementary values'.

Let V_1, V_2 and V_3 in Figure 1 form points of a Relation 'X' which captures values corresponding to the three management regimes, viz. tiger farms, tiger safaris and tiger reserves. Figure 2 illustrates the relation in terms of a diagraph. The figure captures the three possible management regimes for tigers. The loop associated with V3 indicates the desirability of keeping existing project tiger reserves intact.

Let *'R'* capture the relationship amongst the three regimes.

From Figures 1 and 2, it is clear that

$$X = (V_1, V_2, V_3) \qquad (1)$$

In the event of 'complementarity' being the management strategy for tigers in India

$$V_1 \, R \, V_2 \neq V_2 \, R \, V_1 \qquad (2)$$

$$V_3 R \, V3 \qquad (3)$$

where

$$F V_3 = S V_3 \quad (4)$$

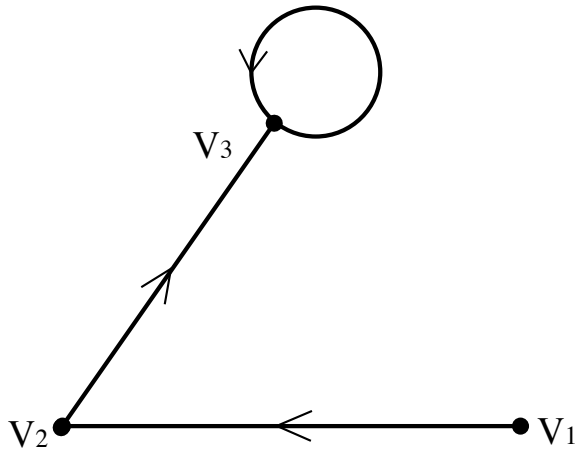

FIGURE 2. Trajectory of Management Regimes for Tigers in India

In terms of Figure 2 and the above relationship this means that a management strategy that is committed to the ideal of complementarity should carefully conserve existing project tiger reserves while actively seeking to oppose or phase out 'tiger farms' and 'constructed safaris'. Complementarity is not a measuring tool. It is only an approach to valuation that underlines the need to place value on the irreplaceable elements of an ecosystem. Once these elements are determined, current valuation tools such as contingent valuation can be employed to determine the value of complementary resources. At the same time it needs to be noted that complementary valuation approaches that rely on a bundling of the tiger and its habitat as a joint good and that value it as such, do not deny the possibility of delineating the value of the tiger vis-à-vis its habitat. It is possible to decompose the components of complementary value. The value for a live tiger can be estimated by working out its hedonic demand function. Alternatively, 'stated preference' methods that seek to derive willingness-to-pay (WTP) values for a 'live tiger' in its natural habitat could be derived.

Unfortunately in India, where tourism revenues are low and the scope of clocking a high level WTP is limited, the other alternative is to rely on the Government's WTP for conserving the unique characteristics of a Project Tiger habitat.[12] Though this method is not entirely satisfactory as compared to stated valuation techniques, it nevertheless yields satisfactory results for Project Tiger reserves funded by the GEF.[13]

THE WAY FORWARD

The basic policy issue with Project Tiger in India is its distinct philosophical approach to the issue of conservation. The Project has been premised on an extreme monistic approach to environment, which subsumes the totality of elements in a habitat under the rubric of a charismatic species.[14] The project is at the same time interventionist in its approach, as it supposes that the habitat can be manipulated through managerial interventions that reinforce the dominance of the charismatic species. Further the project attempts to capitalise on the aesthetic sensibilities of people towards charismatic species, which in turn tend to value the tiger for its individual grace and beauty rather than for what Russow refers to as its 'unique adaptation to a certain environment' or 'certain sort of life' (Russow 1998: 503). This approach has produced its logic of conservation that attempts to value the tiger for its appeal as an abstracted entity. But the process of abstraction also has an opposing tendency – encouraging us to see the tiger in natural habitats as a consumptive use value item, in contrast to its aesthetic value. This has created confusion as well. Thus partial equilibrium frameworks employed to price tigers have unwittingly glossed over the differences in values afforded by 'dead' and 'live' tigers. In comparison, the Total Economic Value concept seems to arrive at a balanced view of the tiger, by emphasising its consumptive and non-consumptive values. However as the paper points out, the Total Economic Value concept, through its additive approach, tends to overlook the potential clash of a tiger's consumptive values vis-à-vis its non-consumptive values. Apart from this limitation, the Total Economic Value concept tends to be 'componential' in approach and glosses over the integrative or systemic values of a habitat. In the TEV scheme of things, individual bearers of value assume more importance than the value of the overall system (Katz 1996). Also, as Randall (1991: 320) states, total economic value, when considered within a 'piece use sequential framework', causes the 'value of a particular component to be dependent on its place in the valuation sequences'. It is these limitations that the notion of complementarity seeks to address through its emphasis on the non-substitutable elements of an ecosystem.

There have been both philosophical and ethical reservations regarding economic approaches to valuation of the non-human world. Indeed one could question the concept of biodiversity as a key conservation value. These larger

issues are not considered here. The object of this paper has been to propose the adoption of a policy approach based on the philosophy and economic theory of complementarity that overcomes the problems associated with a resource-selective approach and seeks to value the tiger and its habitat as a 'joint resource' with unique, non-substitutable properties. In management terms this means the adoption of a habitat-based approach to tiger conservation that overcomes the distortions of a keystone species approach, as is the case now. A more inclusive form of governance, which seeks to mainstream local communities in the management of tiger reserves, could facilitate the shift in policy along the lines stated. Such inclusive governance systems could render it difficult to illegally hunt and kill tigers in their natural habitats, thus preventing the flow of cheap tiger by-products to consumer markets. A parallel process of raising consumer and community awareness about the non-desirability of trading in tiger products, as has been done in Japan, could facilitate the conservation of the tiger and its natural habitat. Policy approaches on these lines would ensure that the tiger and its habitat are conserved in the larger interests of their true biodiversity potential.

NOTES

[1] It is for this reason that experts have characterised Project Tiger as a top-down command and control programme in which the tiger exists as a public good (Seidensticker et al. 1999: 193–8).

[2] In recent times the idea of a tiger habitat has received further refinement through the introduction of the idea of Tiger Conservation Units (TCUs); a TCU is defined as, 'a block or a cluster of blocks of existing habitats that contain, or have the potential to contain, interacting populations of tigers'. A TCU need not include the entire landscape of natural habitats over which tigers may disperse and become established (Wikramanayake et al. 1999: 257). Further the TCU is also based on the single criterion of persistence of tiger populations (Wikramanayake et al. 1999: 258).

[3] Still more succinct is the statement of the present Director of Project Tiger that runs as follows, 'We can say that tigers are indicators of the well being of the ecosystem. A healthy tiger population indicates that the other ecological components in its habitat are equally robust, since tigers need large amounts of prey and good habitat' (Gopal 2005).

[4] Live baits in tiger reserves are stated to have contributed to the disruption of the territoriality of the tiger. Since baiting is done in specific locations accessible to tourists, this has encouraged localisation of the tiger population around these locations, leading to internecine fights and deaths (Panwar, 2000: 19). Live baits were stopped in the reserve after a while. However when it existed, Kanha was more of an 'amusement safari' than a tiger reserve.

[5] By habitat manipulation is meant changes induced by managers in tiger habitats through altered land and water regimes. For instance in the Kanha Tiger Reserve of Madhya Pradesh, 'habitat manipulation' measures undertaken included improvement of water

bodies, swamps and tall grass cover to facilitate the feeding habits of the swamp deer, considered to be the main prey base of the tiger in the reserve (Shukla 2000: 146).

[6] Thus in a Project Tiger reserve, excessive focus on the tiger and associated habitat manipulations could conceivably induce ecosystemic changes that deny realisation of possible high-end option values.

[7] Perrings et al. describe this state as one where demand for the services of an ecosystem is derived from the demand for a particular species (Perrings et al. 1992: 202)

8 As Seidensticker et al. (1999: 194) state, 'Tigers are value laden and it is we humans who affix value in the way we perceive them… For those of us who have seen, or who someday want to see, or simply place great value on tigers living out their lives in an ideal nature, tigers living in zoos can be seen as the antithesis of wild tigers'. It is perhaps this fact that lends greater credence to the concept of 'reasonable valuing', advanced by Hiedanpaa and Bromley (2002), which seeks to incorporate multiple value sets on the issues of 'good' and 'bad' and 'right' and 'wrong'.

[9] It needs to be clarified that India does not have tiger farms and has not been in favour of this idea, though in recent times there have been arguments by some experts for change of stance.

[10] Indeed the net social cost of protection of rhinos in Chitwan National Park in Nepal is considered high due to larger budgets for policing efforts (Hyde et al. 1994: 175).

[11] The Convention accords varying degrees of protection to more than 30,000 plant and animal species, depending on their biological status and the impact that international trade may have upon this status (Anonymous 2004).

[12] It needs to be noted that despite the increasing focus of Project Tiger on tiger populations, the funding of the Government does not betray the bias. Indeed funding of the tiger reserves in India has not been linked to tiger population though there have been suggestions to this effect (Rajesh Gopal, personal communication, 2005).

[13] This is not to argue that private investment is not an important factor in wildlife conservation. In South Africa, the Natal Parks Board has gone in for commercialisation since 1994 in a bid to reverse under-funding. Tourism was adopted as a revenue earning measure and services were privatised. Indeed healthy game auction systems set up by the Park to dispose of surplus animals such as white rhinos was fruitful in terms of gross revenues (Hughes 2004: 204–12).

[14] As Zimmer (1990: 8) states, in the pre Buddha period, there was considerable preoccupation in India with the rediscovery and assimilation of 'self', which entailed a process of withdrawal from the normal world. And this involved 'radical introjections' which have surfaced in the Vedic hymns. In many ways, these introjections marked a major effort to unify multiple faculties in a subject. Herein lie the roots of monism in Indian philosophy, which went on to receive greater articulation in the hands of the Advaida School. Interestingly in the Atharva Veda the multiple faculties of brilliance, lustre and beauty have been traced to animals such as the lion, the tiger, the serpent and the panther (Zimmer op.cit: 9–10). Whereas Vedic hymns attempted to unify these faculties in human subjects, the Project Tiger movement in India attempts the unification in the charismatic carnivore, 'the Royal Bengal Tiger'.

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