

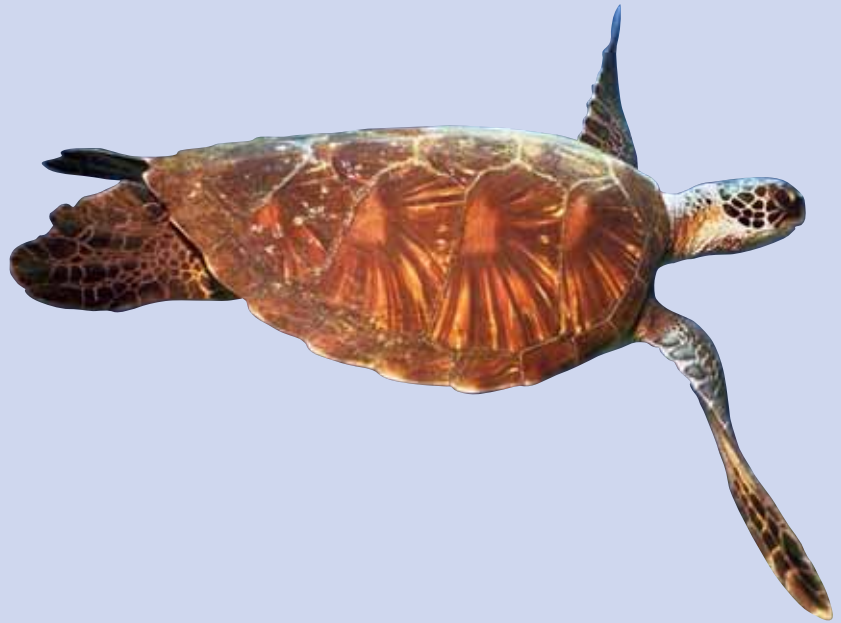


Sebastian Troëng and Carlos Drews

MONEY TALKS

**economic aspects
of marine turtle use
and conservation**





FRAN & EARLE KETLEY

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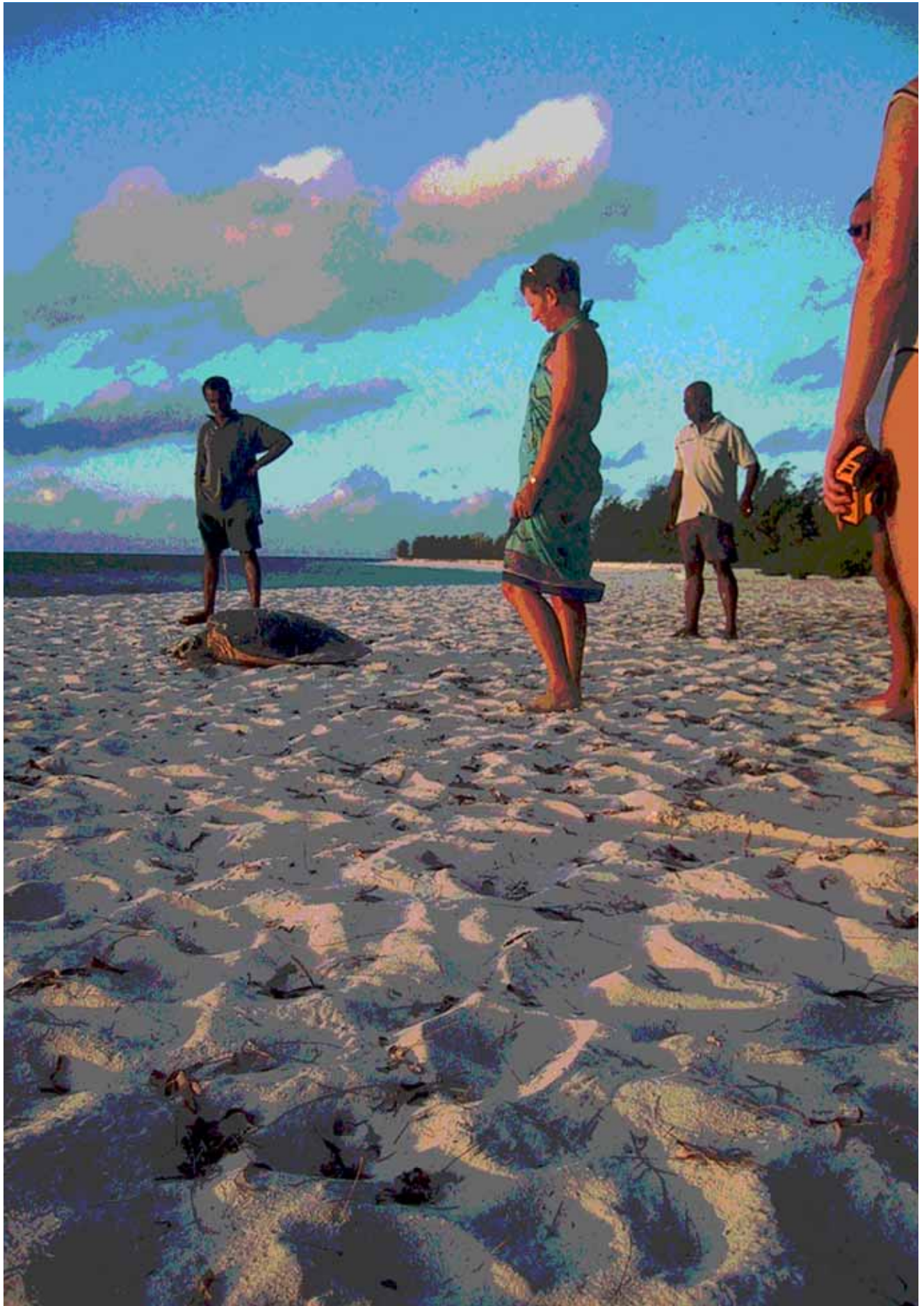
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Summary



For thousands of years, marine turtles have provided sustenance to coastal communities around the world. Unfortunately, their populations have declined drastically due to human overexploitation, fisheries by-catch and habitat destruction. Six of seven species are classified by the World Conservation Union (IUCN) as endangered or critically endangered. Marine turtles occur predominantly in developing countries. These countries stand to lose most from continued decline and have most to gain from reversing negative population trends. Economic factors are often behind marine turtle declines. Therefore, we set out to analyze economic aspects of marine turtle use and conservation. Decision-makers defining policies for sustainable economic development and poverty alleviation may incorporate the results of this study as additional criteria to reconcile their agendas with marine turtle conservation goals.

We estimate gross revenue from consumptive use of marine turtle meat, eggs, shell, leather and bone at nine case study sites in developing countries. Gross revenue from consumptive use range from US\$158 to US\$1,701,328 yr^{-1} per case study with an average of US\$581,815 yr^{-1} . Direct beneficiaries from consumptive use vary from a handful to several hundred. Gross revenue for nine case studies where non-consumptive use of marine turtles, such as tourism, is a major revenue generator range from US\$41,147 to US\$6,714,483 yr^{-1} per site with an average of US\$1,659,250 yr^{-1} . Gross revenue at four sites where marine turtles are one of many attractions varies between US\$3,387-US\$105,997 yr^{-1} with an average of US\$40,791 yr^{-1} . Direct beneficiaries from non-consumptive use range from ten tourism operators to 1,280 persons per case study.

Non-consumptive use generates more revenue, has greater economic multiplying effects, greater potential for economic growth, creates more support for management, and generates proportionally more jobs, social development and employment opportunities for women than consumptive use. Both consumptive and non-consumptive uses result in leakage of revenue from local to national and international levels. Rivalry between uses means that population decline caused by consumptive use can have negative economic impacts on uses at other locations. Consumptive and non-consumptive uses may in many cases be incompatible at the same location. In addition to gross revenue and number of beneficiaries, other variables to consider

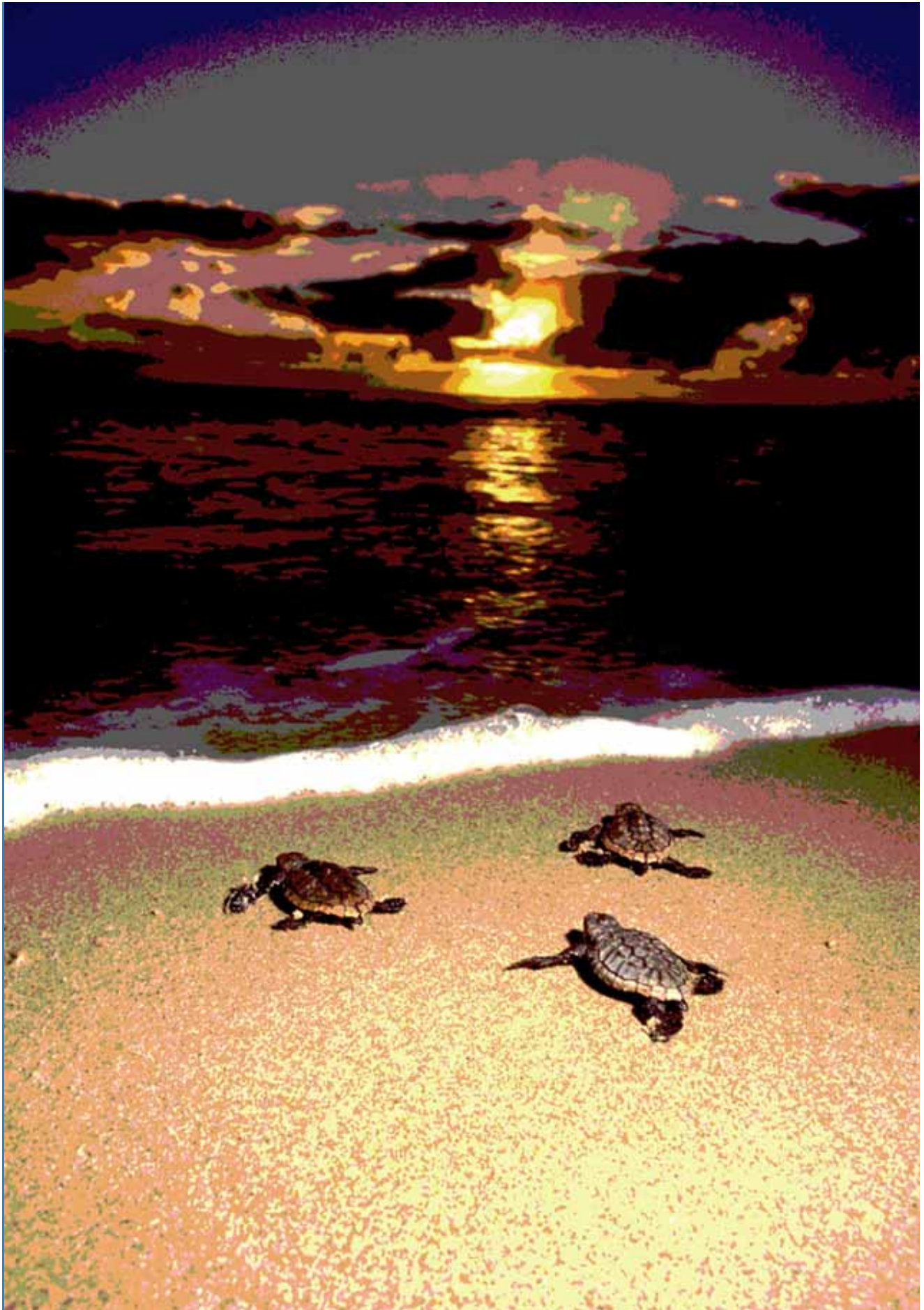
when evaluating use options are contribution to poverty alleviation, cost of production, distribution of revenues and potential for economic diversification. Environmental and social impacts should also be examined when evaluating use options for a particular site. Thus, promotion of non-consumptive use needs to go along with careful planning, and it may not be a feasible option at some sites. The case studies suggest that promotion of consumptive uses of endangered marine turtles is not precautionary, either from an ecological or an economic perspective.

Marine turtles have a wide range of passive use values including option, intrinsic, ethical, existence and bequest values. We chose to quantify a lower boundary for the passive use value as the expenditure of a sample of 162 conservation organizations and conventions in marine turtle conservation. Current global marine turtle conservation expenditure is estimated at a minimum of US\$20 million per year.

In order to maintain the intrinsic values of marine turtles, their roles in ecosystem functioning and in providing benefits to people, their populations need to be restored worldwide to healthy levels. Failure to reverse marine turtle decline would imply a replacement cost for nesting females through captive breeding estimated at US\$245.9-US\$263.3 million for green and US\$2.5 billion for leatherback turtles. The cost of rearing turtles in captivity suggests that conservation of marine turtles in the wild is less expensive.

Overexploitation of marine turtles and other negative impacts on their populations continue unabated in many places because of local economic incentives. Governments, international agencies and non-governmental organizations can prevent over-exploitation by creating local economic incentives in favour of adequate management through employment and/or retraining of people overexploiting marine turtles, promoting use regulations, enforcing restrictive legislation, establishing fines comprehensive of marine turtle values, facilitating funding, subsidies and/or microcredits for non-consumptive use where pertinent, eliminating perverse subsidies, and establishing concessions and use fees. Such economic incentives, once in place, will add value to the marine turtles and thereby encourage measures to mitigate additional threats, such as habitat destruction and fisheries by-catch.

Why consider economic aspects of marine turtle use and conservation?



For thousands of years, marine turtles have been a source of food and sustenance for coastal communities in tropical and subtropical regions. Today, six of the world's seven species of marine turtle are classified as endangered or critically endangered and lack of information prevents classification of the status of the flatback turtle (IUCN 2003). Human activities, noticeably overexploitation, fisheries by-catch and habitat destruction, have been identified as the main reasons for marine turtle declines (Seminoff 2002, Spotila *et al.* 2000). Clearly, there is a pressing need to identify and implement policies and actions that will reverse the trend so that these endangered species and the benefits they provide to human societies and ecosystems are not lost forever (WWF 2003).

Marine turtles are highly migratory and represent an open-access resource. Many countries recognize the need to reduce marine turtle mortality from human sources and have provided partial or total legal protection for marine turtles. However, attempts to exclude users and reduce human impacts have met with limited success, particularly in countries where funds to enforce restrictive legislation are scarce. We need to understand the underlying factors driving human impacts on marine turtles in order to appropriately address threats to marine turtle survival.

In recent decades, there has been increased recognition that economic factors are behind many human activities that cause declines in habitats and species. Economists and ecologists to a large extent agree that methods combining economic and biological information can help us to identify strategies to reverse biodiversity and ecosystem loss. The methodological approaches used in environmental economics have met with criticism from economists (e.g. Bockstael *et al.* 1998) and ecologists (e.g. Mooney 2000). In spite of shortcomings, fusion of biological and economic information reflects interactions that are pertinent to biodiversity management decisions.

Marine turtle management policies need to consider, among other things, the ecological roles of turtles (Bjorndal & Jackson 2003), biological limitations such as slow growth and late maturation (Heppell *et al.* 2003; Thorbjarnarson *et al.* 2000), risk of extinction (IUCN 2003), institutional capacity to regulate use (Epperly

2003, Trinidad & Wilson 2000), as well as cultural and social impacts (Campbell 2003). However, the economic importance of the flow of goods and services provided by marine turtles is often ignored when policies are formulated.

Quantification of the economic consequences of marine turtle use and conservation could contribute significantly to our understanding of use options and their ecological impacts, and hence further the process of defining adequate management policies. This is a timely and urgent issue. Motivations behind the use of marine turtles are currently influenced more by economic incentives than any other impetus. Growing human populations, decline in other natural resources and societies striving for greater wealth mean that economic considerations are likely to become even more dominant factors controlling marine turtle use and conservation in the future.

Goods and services provided by marine turtles are valued by societies around the world. The values put on these goods and services are defined by user groups and are relative in nature (Daily *et al.* 2000). An economic perspective on marine turtle values addresses one of many dimensions through which humans interact with these animals. A framework of universal, basic values of nature discriminates the utilitarian, naturalistic, ecologicistic-scientific, aesthetic, symbolic, dominionistic, humanistic, moralistic and negativistic dispositions associated with the human inclination to affiliate with the natural world (Kellert 1996). The economics of marine turtle uses are an expression of their utilitarian value, for this reflects the traditional notion of material benefit derived from exploiting nature to satisfy various human needs and desires. In addition, non-consumptive uses that generate economic revenue capitalize on other dispositions that make marine turtles attractive to tourists and scientists, such as the naturalistic, ecologicistic-scientific and aesthetic values.

The cultural meanings of marine turtles can be quite diverse, even within a small region. For example; the

In recent decades, there has been increased recognition that economic factors are behind many human activities that cause declines in habitats and species.

ethnic diversity and cultural change on the Caribbean coast of Costa Rica have historically generated meanings that include the marine turtle as deity, food, merchandise, medicine, aphrodisiac, scientific object, protected animal, managed animal, tourist attraction, and object of art (Vargas-Mena 2000). Although values associated with some of the meanings can conflict with each other, in principle these are not mutually exclusive and several can be present simultaneously in the same person or institution. Due to a lack of information on the economic value of marine turtles for all of these meanings, any analysis will inevitably fail to cover the rich range of relationships between humans and these reptiles. We believe, however, that those meanings, which are most commonly related to economic revenue throughout the world, namely the marine turtle as merchandise, mainly for food (meat and eggs) and handicrafts (hawksbill scutes), and as tourist attraction can be quantified. Also, economic analysis of passive use of marine turtles implicitly addresses Kellert's (1996) notion of their symbolic, humanistic and moralistic values.

Some previous studies focused on identifying different economic values of marine turtles and how many turtles are needed to support consumptive and non-consumptive use (Frazer 2001, Witherington & Frazer 2003). Extensive work to quantify the economic benefits of marine turtle tourism and identifying the economic rationale for turtle conservation has been carried out at a loggerhead nesting beach in Mon Repos, Australia (Tisdell & Wilson 2001, Tisdell & Wilson 2002, Wilson & Tisdell 2001). Case studies of the economic aspects of marine turtle use in developing countries include socio-economic analyses of olive ridley egg use in Costa Rica (Campbell 1998, Hope 2002), Honduras (Lagueux 1991) and Nicaragua

(Hope 2002). At Playa Grande, Costa Rica annual gross revenue from turtle tourism at the leatherback nesting beach was estimated at US\$900,460 in 1993 (Gutic 1994). Woody (1986) estimated annual gross revenue from a fishery for olive ridleys in Oaxaca at US\$707,000 in 1985. In 2000, the economic impact of illegal fishing of green turtles in Costa Rica was estimated at US\$1,142 per turtle (Castro *et al.* 2000).

Marine turtles are predominantly tropical and subtropical species. Their distribution extends principally through countries with developing economies (IUCN 2003, OECD 2000). For five of the seven species of marine turtle, 78%-91% of countries where they occur are countries with developing economies (Table 1).

Marine turtles are predominantly found in countries with developing economies.

Table 1 Distribution of marine turtle species.
(own elaboration from IUCN 2003, OECD2000)

Species	Countries and territories present	Proportion with developing economies %
Loggerhead <i>Caretta caretta</i>	58	78
Green <i>Chelonia mydas</i>	123	81
Leatherback <i>Dermochelys coriacea</i>	64	80
Hawksbill <i>Eretmochelys imbricata</i>	110	81
Kemp's ridley <i>Lepidochelys kempii</i>	3	67
Olive ridley <i>Lepidochelys olivacea</i>	35	91
Flatback <i>Natator depressus</i>	1	0

Two thirds of countries with developing economies have marine turtles, 61% of developing countries have at least two species and a third of developing countries have three or more species (Table 2). Therefore, the future of marine turtle populations and their potential to generate benefits to human societies depend mainly on policies implemented in countries with developing economies. These are the countries that stand to lose most from continued marine turtle decline. Conversely, developing countries would benefit most from increasing marine turtle populations.

Table 2 Number of marine turtle species in countries and territories with developing economies.
(own elaboration from IUCN 2003, OECD2000)

Number of species	Number of countries & territories	Proportion %	Cumulative proportion %
6	1	1	1
5	16	10	10
4	20	12	23
3	18	11	34
2	44	27	61
1	11	7	68
0	53	33	100
TOTAL	163	100	100

The main objectives of this report are to quantify gross revenue of marine turtle use at case study sites in developing countries, to quantify marine turtle conservation expenditure and to determine the cost of having to replace nesting marine turtles in the wild with captive bred individuals to maintain the flow of marine turtle goods and services. Based on the results, we provide recommendations aimed at simultaneously reversing marine turtle decline and maintaining economic benefits to human societies.

We hope that the study will be useful to governments, management authorities, organizations, communities and individuals concerned about the sustainability of marine turtle use and its potential to contribute to economic development. We also hope to generate debate and stimulate further studies in what we see as a crucial area of research.

Countries with developing economies stand to lose most from continued marine turtle decline.



Tourists observing nesting hawksbill turtle - Bird Island, Seychelles.

Analytical framework and methodology



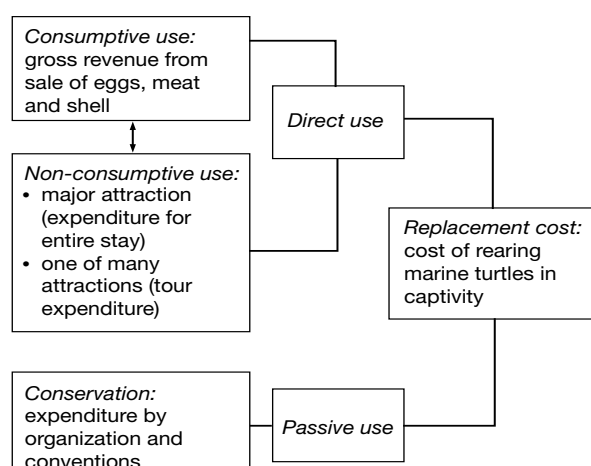
Economic valuation theory is based on the preferences and choices of individuals (Freeman 2003, Simpson 1998). The economic value of a good or service is based on what a person is willing to forfeit in terms of other goods and services. This is commonly known as willingness to pay. Willingness to pay is constrained by income and available time. Willingness to pay also depends on the substitutability of goods and services. Goods and services that are easily substituted are generally less valuable than those that are difficult to replace. It can be argued that marine turtle eggs could be easily substituted with eggs from domestic fowl and marine turtle meat could be replaced with beef, pork or chicken so substitutability is high. The replacement of cultural connotations attached to marine turtle products, however, is not straight forward. Also, marine turtles used non-consumptively as an ecotourism attraction are not easy to substitute at a given site, but visitors may change to other tourism sites where marine turtles are present. In the long-term, substitutability will decrease as marine turtle populations continue to decline. The unit used in this study to measure people's willingness to pay in the market economy is currency.

Economic theory defines economic value as the gross revenue plus consumer surplus minus the cost of production (Perman *et al.* 2003). Gross revenue is estimated by multiplying the number of units (quantity) by sales price or expenditure. Consumer surplus is the additional value to a customer beyond what was paid for a good or service. In the case of consumptive marine turtle use, an example of consumer surplus is the ability to eat meat at a lower price than the cost of beef or pork. If a person's willingness to pay for meat is the same as the market price for beef or pork, then consumer surplus would be the difference between the market price of beef/pork and the market price of marine turtle meat. Cultural preferences that make people appreciate marine turtles more may result in a greater willingness to pay for marine turtle products and if market prices are low, contribute to a large consumer surplus. For non-consumptive use, consumer surplus can be exemplified by tourists willing to pay more for a marine turtle tour than they are actually charged.

Economic valuation theory is based on the preferences and choices of individuals.

Figure 1 shows the framework used to quantify the economic aspects of marine turtle use and conservation. Although not exhaustive, the framework covers the most important uses behind local economic incentives for and against overexploitation of marine turtles. It also addresses the issue of having to replace the flow of goods and services provided by marine turtles.

Figure 1 Analytical framework to quantify economic aspects of marine turtle use and conservation.



However, information on consumer surplus and the cost of production for direct use of marine turtles in developing countries is not readily available. Therefore, per capita net revenue was not calculated, although it is an important economic measure of marine turtle use. Consequently, our study is limited to an estimate of gross revenue of direct use rather than economic value. Gross revenue reflects the extent of economic activity in an area and has implications for employment rates. Both these aspects are particularly important in the context of countries with developing economies. All gross revenue and expenditure estimates were converted to 2002 US dollars using the US Consumer Price Index.¹

An underlying assumption of our study is that an increment in revenue corresponds to an improvement in the quality of life. Although one case study (Table 10) suggests that higher income is indeed associated with greater likelihood of basic needs being satisfied, an analysis of the relationship between income and quality of life is beyond the scope of this report.

¹ [ftp://ftp.bls.gov/pub/special.requests/cpi/cpiiai.txt](http://ftp.bls.gov/pub/special.requests/cpi/cpiiai.txt)

We estimate gross revenue from direct use of marine turtles at case study sites in developing countries. We had two criteria for selecting case study sites. Information to estimate gross revenue had to be available and also we wanted a geographically and culturally diverse selection of case studies from Africa, Asia, Latin America and the Caribbean. No developing country site was left out if gross revenue could be estimated. Detailed information for each case study is available in the Appendix 1. Appendix 2 lists sites with non-consumptive uses identified during this study, including number of visitors per year where available.

For passive use, we estimate gross expenditure in marine turtle conservation for a sample of organizations and conventions. It has been suggested that only expenditure for advocacy and direct conservation actions should be included when estimating preservation values and that all other conservation

organization expenditure should be excluded (Freeman 2003). We choose to include all expenditure, as administrative and other expenses create employment opportunities and therefore may influence local economic incentives regarding marine turtle use and conservation. The estimate of annual conservation expenditure is based on budget information provided by organizations for fiscal years 2002-2004.

The replacement cost of substituting all nesting turtles in the wild with individuals raised in captivity was estimated for two marine turtle species based on captive breeding case studies (Appendix 1).

A limitation of projections into the future based on our analysis is that total take, visitation, supply and demand for marine turtle goods and services can change over time with subsequent changes in prices and gross revenue.

Direct use



Consumptive marine turtle use

Marine turtles have been used for eggs, meat, shell, oil, leather or other products at least since 5000 BC (Frazier 2003). Ancient human societies from the Ubaid culture of the Arabian Peninsula and surrounding areas, to the Mesoamerican Mayas and other Amerindians had consumptive marine turtles use in common (Frazier 2003, Wing & Wing 2001). During colonial times, marine turtle utilization increased for use as food by ships' crews and for export to European countries (Jackson 1997, Parsons 1962, 1972). Due to such trade, the green turtle was once called "...the world's most valuable reptile..." (Parsons 1962). Today, intentional capture of marine turtles for consumptive use continues in tropical and subtropical regions. Marine turtles are easily caught and their eggs collected by local inhabitants or concession holders when emerging to nest on sandy beaches. Marine turtles are also caught using nets, harpoons or traps in feeding grounds and during their migrations.

We analyzed nine case studies of consumptive use, which include examples of use for meat, shell, eggs, bone and leather (Appendix 1). The case studies illustrate marine turtle use in countries bordering the Atlantic, Indian and Pacific Oceans (Figure 2). We estimate gross revenue for consumptive use by multiplying the number of units extracted each year (for example; turtles or eggs) by the final sales price per unit.

Figure 2 Case studies of consumptive uses of marine turtles.



Gross revenue from consumptive use of marine turtles ranged from US\$158 to US\$1,701,328 per year with an average of US\$581,815 per year (Table 3). Direct beneficiaries from consumptive use at the case study sites vary from a handful to several hundred (Table 3). They include fishermen and egg collectors in communities close to marine turtle feeding areas and nesting beaches. Often traders or other intermediaries are involved in aggregating value and transporting marine turtle products before final sale in towns and cities located further away, sometimes even in other countries. It is likely that the intermediaries receive the greatest share of the gross revenue.

In several cases, overexploitation has caused drastic declines in marine turtle populations (Jackson 1997, 2001, Jackson *et al.* 2001, Meylan & Donnelly 1999, Seminoff 2002, Thorbjarnarson *et al.* 2000, TRAFFIC Southeast Asia 2004, Troëng 1997). Consumptive uses remove turtles of many life stages from their population and hence reduce survivorship rates and reproductive output of marine turtle populations. If use exceeds sustainable levels, the utilized populations begin to decline. It is reasonable to assume that the consumptive uses are at least partly responsible for the negative population trends at six of the nine case study sites (Table 3). Marine turtle population trends at the remaining three case study sites are uncertain although nesting is probably increasing at one of the sites (Table 3).

Marine turtles have been used for eggs, meat, shell, oil, leather or other products at least since 5000BC.

Conversely, changes in marine turtle abundance have consequences for consumptive use. Smaller marine turtle populations can sustain less consumptive use and hence will generate less gross revenue. At Rantau Abang, Malaysia nesting declined from 10,000 leatherback nests per year in 1956 to 3 nests in 2002 due to overexploitation of eggs and fisheries by-catch (Appendix 1). The nesting decline caused gross revenue from consumptive use at Rantau Abang to fall to US\$158 in 2002 (Table 3). However, in places such as Ostional, Costa Rica consumptive use of marine turtle eggs is believed to be biologically sustainable (Valverde 1999). There are yet other consumptive use projects, like the legal fishing of a mixed stock of hawksbill turtles in Cuba, where the issue of sustainability remains contested (Rhodin & Pritchard 1999).

Table 3 Gross revenue from consumptive use case studies (for sources see text in Appendix 1)

Case Study (Appendix 1)	Year	Species	Population trend	Units	Price per unit US\$	Estimated gross revenue US\$	Adjusted to 2002 using US CPI	Direct beneficiaries
1 Bali, Indonesia	2002	<i>Cm</i>	-	8,208 turtles	146.2-268.4	1,701,328	1,701,328	fishers on 56- 101 boats, traders and employees
2 Mexican Pacific	1985	<i>Lo</i>	-	28,000 turtles	25.3	707,280	1,182,525	100's of fishers?, wholesaler and employees
3 Cuba	2002	<i>Ei</i>	-?	~650 kg shell	1,654.6	1,075,455	1,075,455	fishers 5 communities (Cuba), 234 manufacturers (Japan)
4 Ostional, Costa Rica	2003	<i>Lo</i>	+?	4,137,000 eggs	0.12-0.37	1,011,615	992,851	235 egg collectors, ~66 intermediaries
5 Nicaraguan Caribbean	2003	<i>Cm</i>	±?	10,166 turtles	9.8-52.1	256,467	251,709	fishers in ≥12 communities
6 Seychelles (domestic)	1993	<i>Ei</i>	-	~1,250 kg shell	~211.3	264,091	328,789	fishers and ~40 artisans
(for export)	1982	<i>Ei</i>	-	591 kg shell	148.7	87,878	163,826	fishers and traders
7 Turtle Islands, Philippines	2003	<i>Cm, Ei</i>	-	386,714 eggs	0.18-0.26	85,078	83,500	egg collectors on 4 islands traders
8 Maldives	2003	<i>Cm, Ei</i>	-	163,833 eggs	0.24	38,731	38,013	egg collectors and traders
9 Rantau Abang, Malaysia	2002	<i>Dc</i>	-	240 eggs	0.66	158	158	1-3 egg collectors

Cm = Green turtle, *Ei* = hawksbill turtle, *Dc* = leatherback turtle, *Lo* = olive ridley

A discussion of the biological sustainability of marine turtle use is beyond the scope of this report.

In the light of these trends, promotion of consumptive use of marine turtles is not precautionary, either from an ecological or an economic perspective. Countries throughout the world recognize the potential negative impact of consumptive use on marine turtle populations. National legislation, protective of endangered species, often prohibits the take of marine turtles and domestic trade in their products. In a sample of 45 countries including Central America, the northern Caribbean, the Atlantic coast of Africa, Indonesia and Vietnam, legislation included restrictions on consumptive use in all but one nation (Chacón 2002, Fleming 2001, Fretey 2001, TRAFFIC Southeast Asia 2004, van Dijk & Shepherd 2004). The precise level of protection and its species coverage was unclear in the literature in nine cases. Among the 36 nations for which enough information was readily available, 53% granted full protection to marine turtles and 44% partial protection. The latter category either excluded some species from the protection scheme or allowed for regulated take of eggs and, in few cases, of turtles for meat and shell. Recent changes in national legislation leading to absolute protection of marine turtles in Vietnam, acknowledge that consumptive uses caused overexploitation in that country (TRAFFIC Southeast Asia 2004). Trade is regarded as a major contributor to the decline of Vietnam's marine turtle populations. Wholesale, illegal international trade persists in Asia and prevents marine turtle populations from recovering (TRAFFIC Southeast Asia 2004, van Dijk & Shepherd 2004).

Non-consumptive marine turtle use

Non-consumptive use refers mainly to the use of marine turtles as a tourism attraction, either on land when turtles come to nest or bask, or in-water. The production and sale of items with marine turtle motifs associated with conservation projects, and the provision of board and lodging services to scientists and volunteers is another form of non-consumptive use. Non-consumptive use of marine turtles is a relatively recent phenomenon. Tourists were travelling to Rantau Abang in Malaysia to watch nesting leatherback turtles as early as in the 1960s. In the 1980s, tourism to observe marine turtle nesting began in the Turtle Islands Park in Sabah, Malaysia and in Tortuguero National Park, Costa Rica. Now, 8,450 and 32,854 tourists, respectively, visit each year these sites to observe marine turtles nesting (Appendix 1). In the 1990s and during the first years of this century, marine turtle tourism has become popular at many sites in Africa, the Americas and Asia. Worldwide, non-consumptive marine turtle use occurs at least at 92 sites in 43 countries (Appendix 2). Each year, more than 175,000 tourists participate in marine turtle tours (Appendix 2).

We estimated gross revenue at nine case study sites where non-consumptive marine turtle use represents a major generator of revenue and four places where marine turtles are one of many attractions. The case studies are distributed in the tropics and subtropics of Africa, Asia, Latin America and the Caribbean (Figure 3). We estimate gross revenue for non-consumptive use, by multiplying tourist expenditure by the number of tourists participating in marine turtle observation. For locations where marine turtles represent a major generator of revenue, the estimate includes all expenditure (food, accommodation, souvenirs, transport and other costs) incurred by tourists during their time at the turtle-watching location.

Figure 3 Case studies of non-consumptive uses of marine turtles.



Costs for tours to observe marine turtles are relatively low, as little local transport and no specialized equipment are needed. However, marine turtles tend to nest on remote beaches and mostly at night resulting in high expenditure for within-country travel to the site and accommodation. The ratio of total expenditure/tour fee is higher for marine turtle tourism than for example whale watching (Hoyt 2001). Based on information from five case studies², we estimate that total expenditure is 26 times the tour fee. For case studies where information was available only on tour fee expenditure, we multiplied this number by 26 to estimate gross revenue. At sites where marine turtles are one of several tourism attractions, we included only the tour fee expenditure in the estimate of gross revenue.

Gross revenue at case study sites where non-consumptive marine turtle use is a major revenue generator ranged from US\$41,147 to US\$6,714,483 per year with an average of US\$1,659,250 per year (Table 5). Gross revenue at sites where marine turtles are one of many attractions varied between US\$3,387 and US\$105,997 per year with an average of US\$40,791 per year (Table 5).

A minimum of 30+ tour guides, hostel and resort owners and their employees to as many as 1,280 people receive direct economic benefits from non-consumptive use at sites where marine turtles are a major generator of revenue (Table 5). At sites where marine turtles are one of many attractions, direct beneficiaries vary from ten tourism operators to include

several dive operators, tour guides, business owners and their employees (Table 5). As in the case of consumptive use, one set of beneficiaries, in this case tourism business owners are likely to receive a larger share of the economic revenue than other user groups.

Tourism development can have both positive and negative economic, environmental and socio-cultural impacts (Table 4). In Rantau Abang, Malaysia uncontrolled tourism affected the behaviour of nesting leatherback turtles (K. Ibrahim pers. comm.). On Zakynthos Island, Greece, lights from hotels and restaurants and the compacting of sand by cars and tourists have changed the distribution of loggerhead nests on Laganas Bay beaches (pers. obs.). The economic benefits from tourism can only be sustainable long-term if appropriate control measures are in place.

There are guidelines to maximize the benefits of nature tourism, while minimizing its drawbacks (e.g. Lindberg 1991). It appears that regulation of marine turtle tourism often takes time. In the Maldives, tourism development began in the 1970's and first stimulated an increase in turtle catch to supply the souvenir market with tortoiseshell souvenirs and stuffed turtles (Frazier *et al.* 2000). Since then, some tourism operators have realized the importance of a healthy marine environment in attracting visitors to the Maldives. Environmentalists and tour operators were instrumental in promoting a ten-year ban on marine turtle catching that came into effect in June 1995 (Hussein 2000). Tourism can result in decreased marine turtle mortality and positive population trends if it creates economic incentives for stakeholder groups to stop overexploitation. Also, the presence of scientists, tour operators and tourists on nesting beaches is a deterrent against the illegal take of turtles and eggs, hence contributing to better protection.

One serious concern is that tourism has a large "ecological footprint" because it stimulates air travel

Non-consumptive use refers mainly to the use of marine turtles as a tourism attraction, either on land when turtles come to nest or bask, or in water.

² Tortuguero (Costa Rica), Sabah (Malaysia), Ras Al Hadd (Oman), Rekawa (Sri Lanka), Rantau Abang (Malaysia)

and other resource intensive activities (Table 4). Theoretically, marine turtle tourism can incite people to travel abroad and hence cause an increase in international travel and augment resource use. However, we believe that in most cases marine turtle tourism attracts visitors that have already decided to travel and therefore it redistributes rather than increases total resource use.

Marine turtle abundance can influence tourism visitation to nesting and in-water sites. As a consequence, turtle tourism will be affected when the probability of observing marine turtles falls below a certain level. Tisdell & Wilson (2001) suggested that at least 200 marine turtle females per year were needed to maintain tourism at current levels at Mon Repos, Australia. The threshold concept is consistent with observations at Rantau Abang, Malaysia where tourism declined rapidly once leatherback nesting fell below 100 nests per year (Appendix 1). Similarly, at Playa Grande, Costa Rica tourist visits declined during seasons when annual nesting fell below 100 females (Appendix 1).

Nature oriented tourism is growing worldwide at a rate of 10-30% per year which is faster than the global overall tourism growth of 4% (Reingold 1993). Similarly, marine turtle tourism has shown great potential for growth (Appendix 1). At Tortuguero, tourism visitation increased at a rate of 16% per year between 1988 and 2002. At Turtle Islands Park, Sabah tourism visitation increased 13% per year between 1988 and 2002. In Oman, the number of visitors grew with 20% per year between 1991 and 1996. In Rantau Abang, national tourism grew with 15% and international tourism with 9% per year between 1989 and 1994. The potential of long-term growth is apparent at the two non-consumptive use programs generating the greatest gross revenue – Tortuguero, Costa Rica and Projeto TAMAR were both initiated over 20 years ago (Appendix 1).

Table 4 Potential impacts of tourism
(adapted from Kiss 2004, NOAA 2002, Peskin 2002, Scheyvens 1999)

Impacts	Positive	Negative
Economic	<ul style="list-style-type: none"> • Greater tax base • Creation of jobs • Increase in household incomes • Improved infrastructure 	<ul style="list-style-type: none"> • Price inflation as demand for goods and services increase • Unequal distribution of economic benefits • Leakage of revenues • Unsteady income streams from seasonal jobs
Environmental	<ul style="list-style-type: none"> • Greater support for conservation efforts • Heightened environmental awareness 	<ul style="list-style-type: none"> • Greater 'ecological footprint' • Habitat destruction/damage • Negative impacts on plant and animal species • Generation of garbage • Noise pollution • Air and water pollution
Social	<ul style="list-style-type: none"> • Greater awareness and appreciation for other cultures • Increased standard of living • Improved access to public services • Greater cooperation and sense of ownership among stakeholders 	<ul style="list-style-type: none"> • Crowding • Displacement of local residents • Loss of cultural heritage • Increase in alcohol and drug abuse • Prostitution

Table 5 Summary of non-consumptive use case studies
(for sources see text in Appendix 1)

Case study (Appendix 1)	Year	Major species	Nesting trend	Visitors	Spending per visitor US\$	Estimated gross revenue US\$	Adjusted to 2002 using US CPI	Direct beneficiaries
<i>Major revenue generator</i>								
4 Tortuguero, Costa Rica	2002	<i>Cm</i>	+	26,292	255.4	6,714,483	6,714,483	owners of 25 hotels and hostels, ~265 hotel employees, 235 tour guides
10 Projeto TAMAR, Brazil	2001	<i>Cc</i> <i>Ei</i> <i>Lo</i>	+?	N/A	N/A	2,635,656	2,677,326	1,280 employees
4 Playa Grande, Costa Rica	2002	<i>Dc</i>	-	4,234	338-676**	2,113,176	2,113,176	business owners and employees, 41 tourism operators
11 Ras Al Hadd, Oman	1997	<i>Cm</i>	±	11,558	98.3	1,136,151	1,273,481	tour company owners and employees
7 Sabah, Malaysia	2002	<i>Cm</i>	+	8,450	113.7-115.5	975,044	975,044	tour company owners ~54 persons including park rangers, resort staff, boat captains, tour guides
12 Matura, Trinidad & Tobago	2001	<i>Dc</i>	+	10,693	21.2-390.0**	559,014	567,852	beach monitors, turtle taggers, tour guides, business owners and employees
9 Rantau Abang, Malaysia	2002	<i>Dc</i>	-	12,259	26.3-65.5	480,149	480,149	Concession holders, business owners and employees
4 Gandoca, Costa Rica	2003	<i>Dc</i>	+	610	151.3*	92,300	90,588	taxi drivers, shop & bar owner and employees, tour guides, owners and employees of 7 hostels, 6 conservation project employees
13 Rekawa, Sri Lanka	2003	<i>Cm</i>	?	1,710	24.5	41,925	41,147	17 tour guides, 13+ hostel and resort owners, business owners and employees One of many attractions
<i>One of many attractions</i>								
14 Barbados	2003	<i>Cm, Ei</i>	+	1,400	20-100	108,000	105,997	dive operators, tour guides, BSTP, business owners and employees
15 Maputaland, South Africa	2003	<i>Cc, Dc</i>	+	~1,750	7.1-94.1	45,597	44,751	4 tour companies and employees
16 Brazil	2002	<i>Cc</i>	+?	260	13.6-45.9	9,031	9,031	tour companies and employees
17 Cape Verde	2003	<i>Cc</i>	?	~300	11.5	3,451	3,387	10 tourism operators

Cc = loggerhead turtle, *Cm* = Green turtle, *Ei* = hawksbill turtle, *Dc* = leatherback turtle, *Lo* = olive ridley

*Direct income for community

**Extrapolated from tour fee

Table 6 Case studies where consumptive use was continued or replaced with non-consumptive use (for sources see text in Appendix 1).

Case study	Consumptive use continued	Gross revenue consumptive use US\$	Gross revenue non-consumptive use US\$	Population trend	Gross revenue trend
9 Rantau Abang, Malaysia	Yes	158	480,149	-	-
7 Turtle Islands, Philippines	Yes	83,500	0	-	-
Turtle Islands, Sabah, Malaysia	No	0	975,044	+	+
4 Ostional, Costa Rica	Yes	992,851	?	+	±
Tortuguero, Costa Rica	No	0	6,714,483	+	+
6. Seychelles	No	0	?	+	+

Direct use options: economic consequences of a fundamental policy decision

Decision-makers are faced with the choice to allow consumptive use to continue or to ban such use and instead promote non-consumptive use as an alternative generator of jobs and revenue. Consumptive use of marine turtles has thus far resulted by-and-large in population declines (Table 3), a reason why this kind of use has often been questioned (Thorbjarnarson *et al.* 2000). On the other hand, unregulated tourism as a substitute for consumptive use can also have negative impacts (Table 4). To discern the economic consequences of the two use options, we identified four case studies where policy decisions were made to continue consumptive use or to stop such use and instead promote non-consumptive use (Table 6, Appendix 1).

Non-consumptive use generally generates greater gross revenue than consumptive use (Table 6). In our case studies, the average gross revenue was 2.9 times higher at sites where marine turtles are a major tourist attraction than the average gross revenue of consumptive use sites (Table 3 c.f. Table 5). This difference in gross revenue is conservative since multipliers to determine the total economic impact of service industries such as tourism tend to be higher than for fisheries (Stynes 1999). One major reason is that tourism requires input from other economic sectors such as agriculture (e.g. food), transport and manufacturing (e.g. furniture) whilst fisheries require minimal input from other sectors (Arabsheibani & Delgado-Aparicio 2002).

There are other aspects to consider when evaluating the economic consequences of direct use options. These are relevant to policy decisions regarding the promotion of certain uses over others.

Firstly, the potential for growth is different for consumptive and non-consumptive use. The revenue from consumptive use at an optimal level will remain the same or perhaps under ideal conditions grow slightly. If use exceeds sustainable levels, the revenue from consumptive use will decline over time as demonstrated by many of the sites with large-scale consumptive use (Appendix 1). From local and national perspectives, aggregating values to the raw material could increase the revenue from consumptive use. For example, tortoiseshell could be made into jewellery before export to industrialized countries. Due to vested interests, aggregation of value has proven difficult for other wildlife products (Hutton *et al.* 2001). Also, increasing the value at a local or national level can result in more effort being directed towards consumptive use. For example; the increase in the price of tortoiseshell caused increased exploitation of hawksbill turtles in Seychelles (Mortimer 1984). There is a maximum carrying capacity for non-consumptive use too but with careful regulation, impacts on marine turtle populations can be kept at a minimum and economic, social and ecological benefits maximized (e.g. Lindberg 1991). It would appear that non-consumptive use has greater potential for long-term growth than consumptive use (Table 6). Marine turtle tourism has grown steeply at most sites where nesting can be reliably offered as an attraction. If marine turtle tourism becomes more commonplace, will each site receive fewer visitors

or will prices for turtle tours decline as more sites offer similar services? Worldwide more than 175,000 tourists per year pay for marine turtle tours (Appendix 2). The number of global whale watching tourists is one order of magnitude greater and still growing (Hoyt 2001). We therefore think that it is unlikely that participation in marine turtle tours or tour prices will decline in the near future as a result of supply exceeding demand.

Secondly, consumptive and non-consumptive uses contribute differently to social development, mainly through job generation and benefits to women. Tourism tends to require more workers than fisheries (Stynes 1999). In addition, multiplying effects result in more indirect jobs created by tourism than by fisheries. Also, tourism employs a higher proportion of women than do fisheries (Cattarinich 2001). Employment of women tends to contribute more to social and economic development than if only men are employed (Cattarinich 2001). Projeto TAMAR's efforts and Tortuguero tour guides are two examples of women involved in non-consumptive use of marine turtles (Appendix 1). In Costa Rica, a community with non-consumptive use has more basic needs satisfied than two communities without such use (Appendix 1, Table 10). Marine turtle tourism in developing countries has the potential to contribute to the economy of rural and isolated coastal areas with few active economic sectors, little production and scarce job opportunities

(Cattarinich 2001). Niche tourism, such as nature tourism has greater economic multiplier effects and better links to local economies than mass tourism (Cattarinich 2001).

Thirdly, cost of production varies for direct uses. Community-based ecotourism projects in many cases depend on external funding for long periods (Kiss 2004). Non-consumptive use requires considerable investments in terms of infrastructure to provide board and lodging for tourists or production facilities for manufacturing items with marine turtle motifs. Guiding services on the other hand do not require much investment aside from initial training costs. The cost of production for consumptive use depends on where and how marine turtles are exploited. Collection of eggs and take of turtles on nesting beaches require little investment. Catching turtles at sea may have higher costs including purchase of vessels, motors and gasoline.

Fourth, the distribution of revenue amongst users is an important consideration. A large number of beneficiaries at a local level, each with a fair share of the revenue, are most likely to represent an economic incentive in favour of adequate marine turtle management. Several researchers have expressed concern that leakage of revenue means that local community members receive few economic benefits

Table 7 Estimated distribution of gross revenue from marine turtle use for cases in which the information was available.

Location	Type of use	Local	National	International
Cuba ³	Fishery for export		\$318,500 =30%	\$756,955 =70%
Ostional, Costa Rica ⁴	Domestic egg sales	\$202,323 =~20%	\$809,292 =~80%	
Tortuguero, Costa Rica ⁵	Tourism	\$642,417 =~10%	\$3,050,549 =~45%	\$3,029,394 =~45%
Playa Grande, Costa Rica ⁶	Tourism	\$325,104 =~16%	\$792,441 =~39%	\$914,355 =~45%

**Non-
consumptive
use generally
generates
greater gross
revenue than
consumptive
use.**

³ Based on the assumption of an export price of US\$490/kg for tortoiseshell from the Cuban state fishery (ROC 2002) and a final sales price in Japan of US\$1,655/kg.

⁴ Based on local sales of 4,137,000 (Chacón 2002) eggs at US\$0.05/egg (R. Morera pers. comm.) and a final sales price of US\$0.25/egg (pers. obs.).

⁵ Based on the assumption that 55% of revenue stay in-country (Bann 1996), local revenue assumed to include 72% of turtle tours (Peskin 2002), minimum salaries for 265 people during five months and 5% of visitors spending half the average expenditure at a local level

⁶ Based on the assumptions that 55% of revenue stay in-country (Bann 1996) and 16% remain locally (Gutic 1994)

from marine turtle tourism (Campbell 1999, Hope 2002). Leakage of revenue from local and national levels is an issue for both marine turtle tourism and fisheries (Table 7). It has been estimated that on average 55% of tourism expenditure remain outside the destination country (Cattarinich 2001). Potential tortoiseshell exports from Cuba to Japan, where 70% of the revenue would be aggregated in the importing country, demonstrate the same problem for some marine turtle fisheries (Table 7). Although the proportion of gross revenue remaining locally may be higher for domestic consumptive use, the absolute local economic income is higher for turtle tourism in the Costa Rican case studies (Table 7).

Fifth, marine turtle use has the potential to create support for conservation and responsible management. Tourism to observe marine turtles in the wild creates a direct link between revenue and conservation of marine turtle populations. Good examples of such linkage include Turtle Islands Park, Sabah and Maputaland, South Africa (Appendix 1). In both these places conservation and tender fees are reinvested in marine turtle protection and monitoring. There are ample examples of tourism operators promoting conservation of marine turtles. In Maldives, the tourism sector was instrumental in achieving a ban on trade in marine turtles and marine turtle products in 1995 (Hussein 2000). In Costa Rica, hotel owners formed part of the coalition of groups and individuals behind the lawsuit that resulted in green turtle fishing being outlawed in 1999 (pers. obs.). These in-situ examples of marine turtle use are different from captive breeding operations that generally results in few if any incentives for conservation of wild populations (Hutton *et al.* 2001). Proponents of Cuban tortoiseshell export suggest such trade would increase funding for marine turtle conservation activities in the country (ROC 2002). Alternatively, a share of dive and turtle tourism revenue could be invested in marine turtle conservation in Cuba and elsewhere in the Caribbean.

Sixth, there is an issue of rivalry between uses. Overexploitation has the potential to cause negative economic impacts on local and distant, consumptive and non-consumptive use projects. Consumptive use on a nesting beach or of a mixed foraging stock may have effects on the abundance of marine turtles in waters of another country and vice versa (Appendix 1).

The reduced populations are less likely to sustain consumptive use or allow for development of non-consumptive uses. Non-consumptive uses are less likely to have negative impacts on other uses and will therefore not affect the economic revenue at other locations (Appendix 1). This is a key aspect as marine turtles are highly migratory. Also, consumptive and non-consumptive uses may be socially incompatible at the same location (Hope 2002). Visitors paying for marine turtle tours, who admire live turtles in their natural habitats, will not tolerate consumptive use of these turtles. Therefore, the decision to advocate for one form of use in many cases excludes the possibility of developing the other.

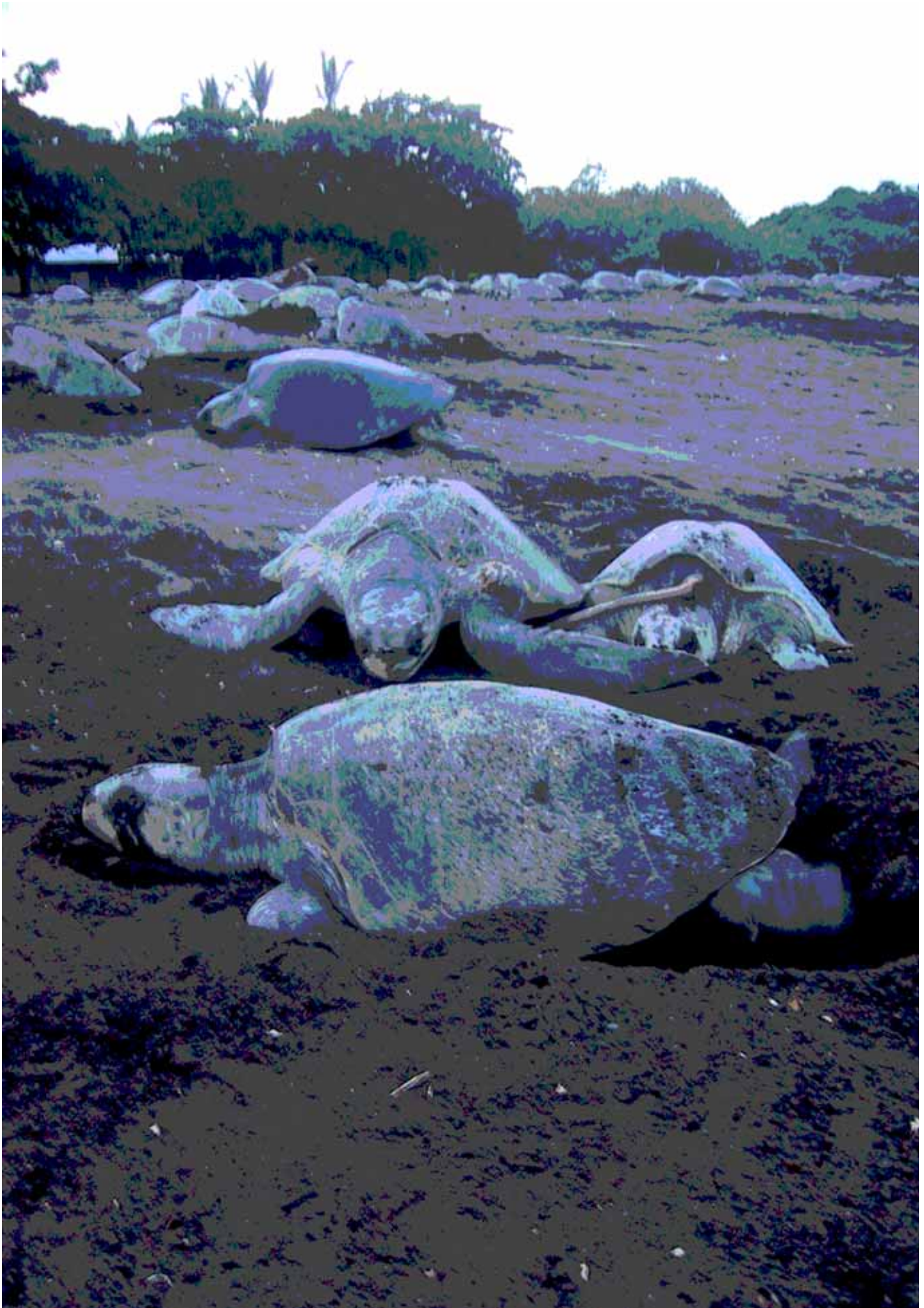
Seventh, economic diversification reduces risk, allows for robust development and ensures that local economies are less likely to be susceptible to a sudden decline in one economic activity. Use options that avoid reliance on one resource (in this case marine turtles) and permit diverse sources of income are more likely to generate long-term economic growth and social development. With regards to risk of resource decline, two thirds of consumptive use case studies showed a decline (Table 3). Only two of thirteen non-consumptive use sites had declining marine turtle populations (Table 5). In both cases, declines were caused by overexploitation of eggs and fisheries by-catch rather than the established tourism scheme (Table 5).

Eighth, non-consumptive use has the potential to break the vicious circle of poverty and environmental degradation (Dasgupta *et al.* 2000) by materializing a value for conserving marine turtles. Local economic incentives created by non-consumptive use can result in increased protection of marine turtles, thus permitting a recovery of populations that in turn contribute to local ecological and economic well-being. The result is that the positive feedback mechanism between poverty and environmental degradation is reversed.

Finally, all economic, environmental and social impacts should be considered when evaluating direct use options for a particular site. Local circumstances may result in certain types of consumptive and non-consumptive use being unfeasible.

Marine turtle use has the potential to create support for conservation and responsible management.

Passive use



Marine turtles have a wide range of passive use values. These include option, intrinsic, ethical (Naess 1989, Rolston 1994), existence and bequest values. Option value represents the value of maintaining options for direct and passive uses that may emerge in the future. For biodiversity, a commonly mentioned option value is the potential of harbouring chemical compounds that could yield active ingredients for future pharmaceutical products. Although it is very difficult to determine the probability of marine turtles containing such compounds, the importance of option values should not be underestimated. An illustrative example is that up until a few decades ago, marine turtle tourism represented but an option value. If decision-makers then had had the foresight and knowledge to recognize the option value of marine turtle tourism, marine turtle use may already have been transformed at that time with the implementation of stronger conservation measures. Although we are currently not able to estimate the option value, it does not mean it is zero. It is plausible that new direct and passive marine turtle uses could emerge in the future.

Passive use values are difficult to measure in currency. Many studies aimed at quantifying passive use values utilize contingent valuation methods (CVM), which in essence is how much respondents state that they are willing to pay to maintain or avoid something. For example; a study in North Carolina in 1991 suggested that respondents would be willing to pay on average US\$33.2 per year to conserve loggerhead turtles (Whitehead 1992). The stated willingness to pay depends on many factors. Stated willingness to pay has little practical relevance for local economic incentives that drive marine turtle use and conservation in developing countries for it does not typically translate

into actual payment of the quoted amounts. Therefore, we chose to quantify the passive use value as the expenditure of marine turtle conservation organizations and conventions. Our estimate should be considered a minimum given that "Free-rider" behaviour may be common (Freeman 2003). Some people and organizations may not contribute funds to conservation in spite of valuing marine turtles because they figure others will take on that cost.

Worldwide, 162 organizations and conventions conducting marine turtle conservation activities were identified, divided into groups by region and category and contacted about their expenditure (Table 8). A total of 55 organizations and conventions provided information on expenditure and number of employees dedicated to marine turtle conservation. The information from these 55 organizations and conventions is assumed to be representative for others in the same region and category. Total marine turtle conservation expenditure was at least US\$20 million in 2002 (Table 8). The estimate should be considered a minimum value as other organizations and also governments invest considerable amounts in marine turtle conservation. Also, many organizations engage volunteers in their conservation activities. The value of the time invested by volunteers is not included in our estimate.

Local and national level organizations in North America and Europe to a large extent depend on volunteers that are not included under the estimated employees. Therefore salaries make up a smaller proportion of overall expenditure and the amount of expenditure per job is higher (Table 8).

Up until a few decades ago, marine turtle tourism represented but an option value.

Table 8 Annual expenditure for marine turtle conservation worldwide.

Region	Category	Total org's (#)	Org's (#) providing data	Estimated expenditure (US\$)*	Estimated employees (#)	US\$ to generate one job
Global	Global	28	10	6,468,486	165.2	39,155
North America	International	5	2	487,500	13.8	35,455
	National	2	1	98,145	2.0	49,073
	Local	36	8	6,326,477	129.3	53,052
Europe & Mediterranean	International	2	1	116,971	16.0	7,311
	National	4	1	1,784,298	98.0	18,207
	Local	2	1	45,333	2.0	22,666
Latin America & Caribbean	International	7	3	1,511,588	23.3	64,782
	National*	16	8	290,791	76.0	3,826
	Local	17	3	197,088	181.3	1,087
Projeto TAMAR**	National	1	1	1,595,583	436.9	3,652
Africa	International	1	1	818,795	16.0	51,175
	National	8	4	189,423	160.0	1,184
	Local	3	2	59,623	25.5	2,338
Asia	International	1	1	5,165	1.0	5,165
	National	12	1	234,000	168.0	1,393
	Local	11	4	82,141	55.0	1,493
Oceania	International	0	0	0	0.0	0
	National	5	2	74,420	2.8	27,062
	Local	1	1	32,154	2.0	16,077
Total		162	55	20,417,981	1,564.0	13,055

* Estimated expenditure and employees are based on extrapolation of information provided by the organizations listed in the previous column

**Projeto TAMAR, Brazil is not included with other national organizations in Latin America and the Caribbean, as it is not considered representative of the size of other organizations in the category.

Replacement cost



Marine turtles are keystone species in coastal and oceanic marine ecosystems. Green turtles digest sea grass leaves and part of the sea grasses' nutritional content becomes available to other organisms much more rapidly than through normal decomposition (Thayer & Engel 1982, Thayer *et al.* 1984). The presence of green turtles contributes to healthy seagrass beds (Bjorndal & Jackson 2003). Seagrass bed ecosystems are amongst the most valuable ecosystems on the planet, with ecosystem services worth an estimated US\$19,004 ha⁻¹yr⁻¹ in 1994 or US\$3.8 trillion yr⁻¹ globally, mainly because of nutrient cycling services (Costanza *et al.* 1997, Green & Short 2003). Hawksbill turtles feed predominantly on sponges at coral reefs and provide biological control of sponges that may otherwise out-compete corals for space (Leon & Bjorndal 2002, Bjorndal & Jackson 2003). The potential net benefit from coral reefs worldwide was recently estimated at US\$30 billion (Cesar *et al.* 2003). Marine turtles function as biological transporters of nutrients from marine to terrestrial ecosystem with benefits to numerous species of fauna and flora (Bouchard & Bjorndal 2000). Loggerhead, leatherback, olive and Kemp's ridley turtles are important predators in coastal and open ocean ecosystems. Decline of marine turtles has adverse ecological impacts with subsequent economic effects on human societies (Jackson 2001, Jackson *et al.* 2001).

The complex ecological interactions between turtles and the ecosystems they inhabit make it difficult to quantify the value of the ecological services provided by marine turtles. A minimum estimate can be calculated by determining the cost of raising marine turtles in captivity to replace them, should they go extinct in the wild. This rearing service is normally provided by nature but can also be provided by aquarium or farm facilities. Three criteria should be fulfilled to justify the use of the replacement cost method (Freeman 2003). The replacement method must be the least costly alternative for maintaining the ecological service provided, the replacement must provide a service of equivalent quality and magnitude,

and individuals must be willing to incur the cost of the replacement. We estimate the cost of replacing all currently existing green and leatherback turtles nesting in one year worldwide at least at US\$246 million and US\$2.5 billion respectively, based on the cost of rearing these species in captivity (Appendix 1).

Table 9 Replacement costs for nesting green and leatherback turtles
(for sources see text in Appendix 1).

Case study	Cost of producing one adult US\$	Annual global nesting population	Replacement cost US\$
18 Greens: Ferme CORAIL, Reunión	1,672	147,056-157,424 (Seminoff 2002)	245.9-263.3 million
9 Leatherbacks: TUMEC, Rantau Abang, Malaysia	72,632	34,500 (Spotila <i>et al.</i> 1996)	2.5 billion

Nesting females represent but a tiny fraction of marine turtle populations. Also, since the current global populations are depleted, larger population sizes will be needed to truly restore their ecological role and environmental services. The replacement cost estimates above do not consider non-nesting females, males and juveniles and should therefore be considered very conservative.

It would be difficult to replace the turtles' ecological functions by other means so the first criterion for using the replacement cost method is fulfilled. It is less clear that reared turtles are equivalent to wild turtles or that people would be prepared to incur the above costs to replace marine turtle functions. Even so, the estimates serve to demonstrate that conservation of turtles in the wild is probably less costly than captive breeding.

Marine turtles function as biological transporters of nutrients from marine to terrestrial ecosystem with benefits to numerous species of fauna and flora.

Policy and management implications



Direct use

Our analysis shows that from a macroeconomic point of view, non-consumptive uses generate or have the potential to generate greater gross revenue and sustain greater economic growth than consumptive use. Governments of countries like Costa Rica and Seychelles have recognized this fact and consequently banned the consumptive use of marine turtles to stimulate tourism.

Still, legal and illegal consumptive use of marine turtles continues in many countries. One explanation for this apparent contradiction is that revenue from non-consumptive use does not benefit those that use marine turtles consumptively. From a microeconomic perspective, consumptive use may still generate higher income for fishermen and coastal dwellers than non-consumptive use, at least over the short term. Future analyses of net per capita income would shed light on this issue. Each user evaluates personal costs and benefits of use options before deciding which use to pursue. Creation of local economic incentives is crucial to convert consumptive users to non-consumptive users. Those that traditionally have used marine turtles in a consumptive manner need to see direct and tangible economic benefits from non-consumptive use to change their use patterns.

Non-consumptive use can be promoted by increasing the cost of consumptive use through regulation, enforcement, fines and other penalties or by increasing the benefits that user groups receive from non-consumptive use. Governments, international agencies and conservation organizations can create economic incentives by providing policies, subsidies, funding and microcredits that facilitate the investment necessary to initiate non-consumptive marine turtle use and offset the cost of production for user groups. The retraining and compensation of tortoiseshell artisans in Seychelles demonstrates that the potential economic benefits from marine turtle tourism can convince governments to take difficult policy decisions regarding marine turtle use. It also shows that the cost of converting consumptive marine turtle users is relatively low when compared to the potential economic benefits from marine turtle tourism. In Seychelles, the retraining and compensation program cost less than

the annual gross revenue from a large marine turtle tourism project (Table 5, Appendix 1).

Maintenance of perverse government subsidies is another reason for continued ecosystem and species decline (Balmford *et al.* 2002). For example; before green turtle fishing was banned in Costa Rica, some of the fishermen involved in illegal take of green turtles received subsidized gasoline that made it cheaper for them to travel to Tortuguero National Park and pursue illegal use (pers. obs.). Perverse subsidies that stimulate continued overexploitation of marine turtles must be eliminated.

In order to ensure that funds are available for needed regulation and enforcement of marine turtle use regimes, sustainable funding mechanisms have to be established. Concessions and use fees are two possible means to raise funds needed for management. A novel approach to generate funds for marine turtle conservation could be the sale of marine turtle credits by local communities, government agencies or NGOs, similar to credits for carbon sequestration or protection of watersheds (Daily *et al.* 2000).

Fisheries by-catch represents a major threat to marine turtle populations (Lewinson *et al.* 2004, Lutcavage *et al.* 1997). It also represents a market failure (Perman *et al.* 2003). Direct and passive marine turtle uses are affected when marine turtles drown in shrimp trawls or are caught on longlines or in gillnets but the market does not currently recognize the economic impacts of such activities. As a result, fisheries continue to cause marine turtle mortality without assuming responsibility for the economic repercussions on society, including the negative economic consequences for countries and communities investing in marine turtle use and conservation. Marine turtle values can be included in the market by incorporating them into fines for illegal killing of turtles, incidental or not. For example; in Costa Rica, an Ecuadorian pirate fisher was caught for illegally catching sharks and turtles in a National Park. The fine was set in excess of US\$300,000 and was based on the environmental damage caused, including direct and passive use values of US\$1,142 for each marine turtle killed (C. Castro pers. comm.).

Creation of local economic incentives is crucial to convert consumptive users to non-consumptive users.

Passive use

Organizations that work on a local or national level have the ability to create more employment per US dollar invested than organizations working on an international or global level (Table 8). Conservation organizations can provide direct local economic incentives most efficiently by employing those that use marine turtles consumptively. If users can earn more money from conserving marine turtles, consumptive use may become the less attractive economic alternative. Creating local incentives by employing consumptive turtle users can be done relatively cheaply in Africa, Asia, Latin America and the Caribbean (Table 8). Projeto TAMAR in Brazil is a good example of creating local economic incentives in favour of marine turtle conservation by employing fishermen, former egg collectors and their families. Approximately 50% of Projeto TAMAR expenditure is spent at a local level (M.A. Marcovaldi, pers. comm.).



Turtle tours, Brazil.

Cost of marine turtle loss

The recent evaluation of the green turtle status (Seminoff 2002) illustrates the global trend experienced by marine turtles with a mosaic of nesting populations and trends. Although some nesting populations have increased in recent years, the overall global trend has been one of dramatic decline. Some nesting populations under strict protection may continue to increase but the current levels of consumptive use, fisheries by-catch and habitat degradation mean that global marine turtle populations will continue to decline if there is no change in human induced mortality. Continued marine turtle decline will have negative economic consequences, particularly for coastal communities in developing countries. People that use marine turtles for meat, eggs, shell and other products will see their income from consumptive use reduced. In the short term, local scarcity of marine turtles can be substituted by marine turtle capture in more distant waters. There are examples from Vietnam and Indonesia of catch effort being transferred to other areas once local marine turtle stocks become depleted (Adnyana in prep., TRAFFIC Southeast Asia 2004, Troëng 1997). In the long term, the effect on consumptive use will be more severe. There are already cases, particularly in Southeast Asia, where tortoiseshell artisans and traders are going out of business due to the difficulty of obtaining raw material from dwindling hawksbill populations (C. Shepherd pers. comm.).

For 69 developing countries, tourism revenues were one of the five largest sources of foreign currency between 1995 and 1998 (Diaz 2001). Tourism to watch marine turtles in the wild will suffer as the probability of encountering turtles decreases. Tourism may change to other nesting beaches or nature attractions if a marine turtle population is eradicated or reduced to low levels. Movement of tourism activity to other parts of a country or to neighbouring countries results in loss of tourism revenue at local or national levels as exemplified by Rantau Abang, Malaysia (Appendix 1). Places like Tortuguero, Costa Rica where marine

Although some nesting populations have increased in recent years, the overall global trend has been one of dramatic decline.

turtle nesting attracts sufficient tourists to create a second high season would no doubt be severely affected if marine turtle populations were to plummet. Continued decline of marine turtle populations will also reduce the opportunities to develop new marine turtle tourism projects.

Other options will also be lost as future direct and passive uses fail to materialize. The current risk of extinction is a threat to the long-term economic benefits provided by marine turtles. Loss of the marine turtles' ecological functions will impact economic sectors that depend on healthy marine and coastal ecosystems.

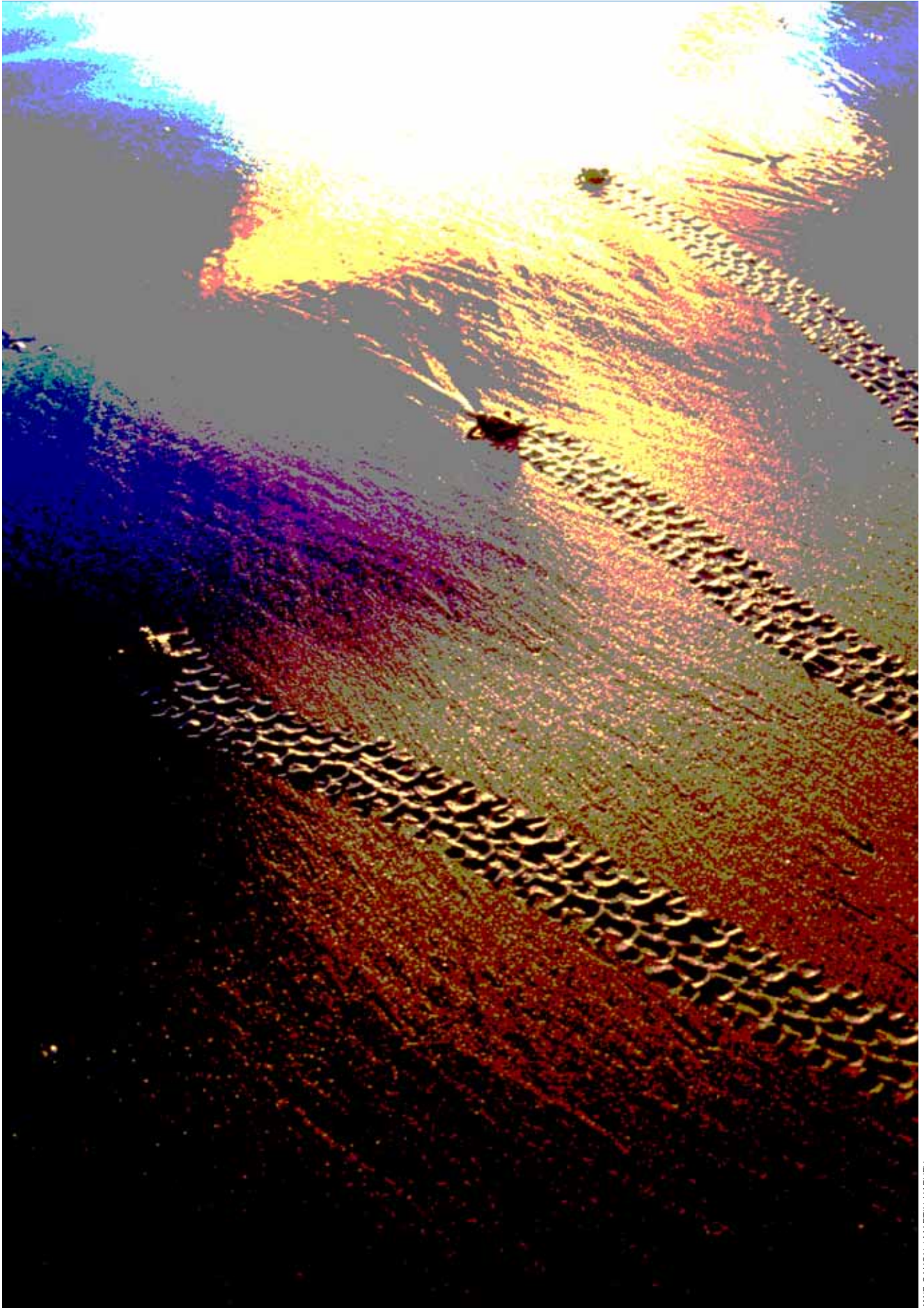
Replacement cost

Conservation of marine turtles in the wild is a much less costly strategy than captive breeding to maintain the flow of marine turtle goods and services. Marine turtle conservation expenditure could be increased manifold and still remain a cheaper option than replacing wild turtles with captive-bred individuals (Tables 8 and 9).



Marine turtle tour guide in Tortuguero, Costa Rica

Conclusions



It is clear that marine turtle use and conservation generate revenue and create jobs in developing countries throughout the world. Historically, consumptive use of marine turtles for meat, eggs and shell generated most revenue but such use also contributed to marine turtle declines. In recent decades, non-consumptive use in the form of tourism to observe marine turtles in-water and on nesting beaches has gained popularity throughout the world. The case studies we have compiled suggest that non-consumptive use can generate much greater gross revenue and at the same time have less impact on marine turtle populations than consumptive use. We acknowledge that economic development and conservation issues are complex and advise that careful evaluation of economic, environmental and socio-cultural consequences are necessary when considering use options at a particular site.

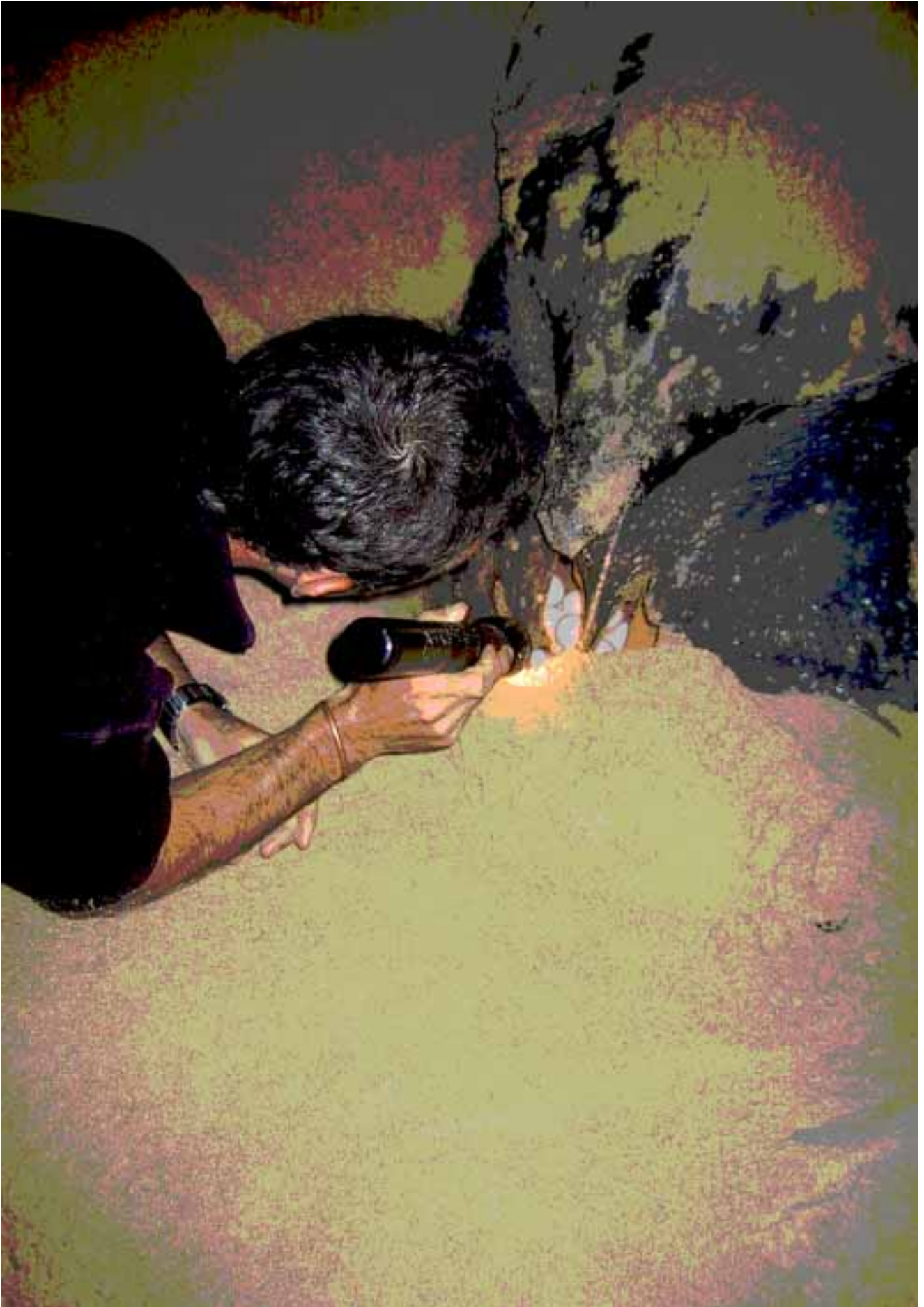
Evidently, threats to marine turtle survival must be reduced to avoid the negative economic consequences of marine turtle declines. Our estimate of global conservation expenditure confirms that human societies are concerned and willing to invest to recover marine turtle populations. Also, most marine turtle values can be maintained concurrently. However, consumptive use has often resulted in overexploitation of marine turtle populations with negative effects on marine turtle values at other sites. Replacing such consumptive uses of marine turtles with non-consumptive uses where feasible, will ensure continued economic benefits and simultaneous marine turtle recovery.

Governments, international agencies and non-governmental organizations can reduce over-exploitation of marine turtles by creating local economic incentives in favour of effective conservation. Such economic incentives, once in place, will add value to the marine turtles and thereby encourage measures to mitigate additional threats, such as habitat destruction and fisheries by-catch. Actions should be aimed at conserving marine turtles in the wild as it is a less costly strategy than captive breeding. Financial support conservation action should come, at least partly, from the economic benefits derived from marine turtle use. Revenue from non-consumptive use is already being reinvested into marine turtle conservation at some sites, thus pointing at a promising avenue to consolidate such funding.

Economic considerations are likely to persist as the driving force behind local decisions concerning marine turtle use in coastal communities of developing countries. Therefore, conservation strategies to recover marine turtles must envision and include tangible, local economic benefits. The economics of marine turtle use and conservation illustrate one approach to reverse the positive feedback mechanism between poverty and environmental degradation.

Conservation strategies to recover marine turtles must envision and include tangible, local economic benefits.

Recommendations



Decision-makers and government officials

- Promote policies to regulate marine turtle use.
- Promote policies that address the economic impacts of fisheries by-catch and directed take of turtles e.g. fines for impacting turtles or tax breaks for using "turtle-friendly" technologies.
- Establish sustainable funding mechanisms, including partial allocation of revenue generated by use, to cover continuous marine turtle management costs.
- Eliminate perverse subsidies and tax breaks that make it profitable to continue overexploiting marine turtles.
- Offer subsidies, funding and microcredits to encourage those that overexploit marine turtles to instead develop marine turtle tourism or other non-consumptive uses, where feasible.
- Generate local economic incentives in favour of marine turtle conservation.
- For cost-efficiency, promote conservation of marine turtles in the wild rather than through captive breeding.
- Incorporate potential economic returns as an additional argument for governments to invest in marine turtle conservation.

Development assistance agencies

- Provide training, funding and microcredits to create alternative livelihoods that encourage those overexploiting marine turtles to instead develop marine turtle tourism or other non-consumptive uses, where economically, ecologically and culturally feasible.
- Provide funding and technical support to projects that create local economic incentives in favour of marine turtle conservation, and contribute to community development.
- Consider and mitigate the negative impacts that development assistance projects may have on marine turtle use options and populations.
- Support the establishment of sustainable funding mechanisms to cover continuous marine turtle conservation and management costs.

Tourism developers and operators

- Employ and train people involved in marine turtle overexploitation to create alternative livelihoods through tourism, where feasible.
- Mitigate negative cultural, economic and ecological consequences of tourism at marine turtle nesting and feeding sites.
- Carry out an informed and participative consultation

process, as well as a comprehensive feasibility analysis, before promoting community based ecotourism.

- Minimize leakage of profit in favour of maximizing both, community benefits and economic incentives in favour of conservation.

Fisheries industry

- Recognize the economic impacts of fisheries by-catch on marine turtle uses in-water and on nesting beaches.
- Adopt turtle-friendly gear and fishing practices.
- Consider compensating affected sectors of society, including coastal communities that use marine turtles, for the economic impacts of marine turtle by-catch.

Conservation practitioners

- Involve stakeholder groups and employ local community members, in particular marine turtle users, in conservation projects.
- Promote best practices among marine turtle users through technical advice and training.
- Monitor the economic impacts of their marine turtle conservation projects.
- Explore the economic potential and social feasibility for marine turtle tourism initiatives in coastal communities of developing countries.
- Carry out an informed and participative consultation process, as well as a comprehensive feasibility analysis, before promoting community based ecotourism.

Tourists

- Participate in responsible marine turtle tours led by local guides and support tourism businesses that benefit local people (including hotels, restaurants, handicrafts and curios, etc.).
- Do not buy any marine turtle products as this is an economic incentive for illegal use and may lead to overexploitation.

Researchers

- Conduct research aimed at quantifying cost of production and consumer surplus, as well as per capita net income for direct use of marine turtles.
- Conduct research aimed at quantifying the distribution of costs and revenue from marine turtle uses.
- Conduct research aimed at quantifying the causal linkage between marine turtle uses and population trends.
- Conduct research aimed at quantifying the supply and demand function for marine turtle goods and services.

Appendices



Appendix 1

Case studies: marine turtle use and conservation

Case study 1: green turtle consumption in Bali, Indonesia

Bali, Indonesia is one of the world's largest markets for marine turtles. Many Moslems in Southeast Asia do not consume the meat from marine turtles. However, green turtle meat and products are often used in Hindu rituals and for communal meals in Bali. Green turtles are caught elsewhere in Indonesia and brought to Bali for sale.

As a result of fishery and egg collection, Indonesian green turtle populations have declined severely over the past decades (Troëng 1997). Fishermen now have to travel further in pursuit of large turtles that bring in the highest price (Troëng 1997). Green turtle consumption in Bali peaked in the late 1970's when more than 30,000 green turtles were landed each year (Adnyana in prep.). Between 56 and 101 boats are engaged in the Bali green turtle trade (Adnyana in prep.). On Bali, green turtles are sold whole or as meat packages known as *karang* (Adnyana in prep.). In 1994, the retail price for one green turtle varied with turtle size and sales format (whole or package) with an average price of US\$146.2- US\$268.4 in Balinese markets (Adnyana in prep.). In 2002, landings are estimated at 684 green turtles per month (Adnyana in prep.). Gross revenue from the green turtle fishery to fishermen, traders and their employees is estimated at US\$1,199,629- US\$2,203,027.

Case study 2: industrialized processing of olive ridleys in Mexico

In Pacific Mexico, olive ridleys were exploited for meat, leather and bone meal (Woody 1986). The take of olive ridley turtles on a large scale began in the 1960's (Trinidad & Wilson 2000). The fisheries take peaked in 1968 when at least 218,000 turtles were caught (Mack *et al.* 1995). Probably as a result of the fishery, *arribazón* events disappeared from Playa Mismaloya in Jalisco, Playa El Tlalcoyunque in Guerrero and Chacahua in

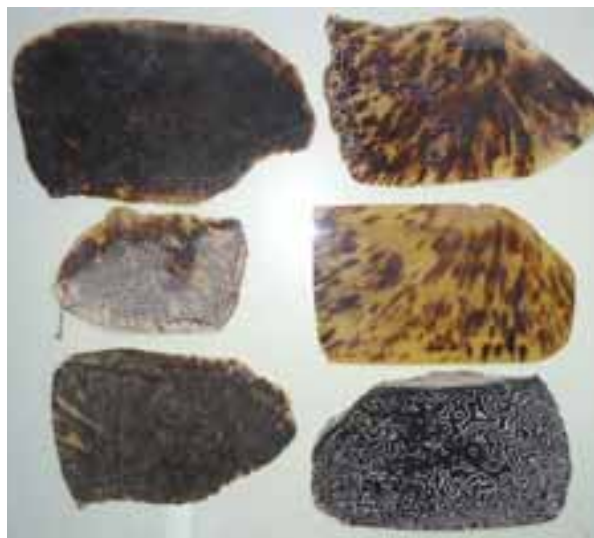
Oaxaca (Trinidad & Wilson 2000). Pesquerías Industriales de Oaxaca, S.A. (PIOSA), a private company, continued exploiting olive ridleys at the remaining *arribazón* site at Playa Escobilla. In Mexico, a total ban on the taking of marine turtles, eggs and also on trade in marine turtle products was proclaimed in 1990 (Aridjis 1990). Olive ridley nesting at Escobilla has since increased (Marquez *et al.* 1996).

It is estimated that 28,000 olive ridleys were caught in 1985 (Woody 1986). Fishermen landing olive ridley turtles at Puerto Angel could sell them for US\$8.42 per turtle (Woody 1986). The same year, meat, leather and bone meal from one processed olive ridley turtle would bring in US\$25.26 to the wholesaler (Woody 1986). Gross revenue from the fishery to fishermen, the wholesaler and his employees is estimated at US\$707,280.

Case study 3: fishery of hawksbill turtles in Cuba for international tortoiseshell trade

Hawksbill turtles have been fished in Cuba for food and tortoiseshell at least since the 1500s (Carrillo *et al.* 1999). Now, tortoiseshell stocks have been accumulated by the government, and Cuba has repeatedly presented proposals to the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) to export the tortoiseshell stock to Japan (e.g. ROC 2002). Those proposals have not been adopted.

An estimated 168,781 hawksbill turtles were taken between 1935 and 1994 (Carrillo *et al.* 1999). The hawksbill population was significantly reduced over this period (Carrillo *et al.* 1999). The fishery was reduced from an annual take of approximately 5,000 hawksbill turtles in 1990 to 500 hawksbill turtles per year after 1994 (Carrillo *et al.* 1999). Fishing is now only allowed in two traditional fishing areas by fishermen from five communities (Carrillo *et al.* 1999). It has been argued that hawksbill abundance has increased after the



Hawksbill scutes – Cuban stockpile.

reduction of the fishery (ROC 2002). The current annual average take of 406 turtles by Cuba brings in approximately 650 kg of tortoiseshell (ROC 2002). The average amount of shell per Caribbean hawksbill turtles has been reported at 1.34 kg/turtle (Meylan & Donnelly 1999). Cuba's fishery takes hawksbills from a mixed foraging stock, whose origin is from several countries in the Caribbean.

At an export price of US\$490/kg, the fishery could generate gross revenue of US\$318,500 per year, should Cuba succeed to export the tortoiseshell on a regular basis. In 1995, there were 234 registered manufacturers of *bekko* items from tortoiseshell in Japan (JWCS 2000). The final sales price of tortoiseshell products in Japan is estimated at US\$1,655 per kg (TRAFFIC 1994). The gross revenue for the Government of Cuba, Japanese tortoiseshell artisans and salesmen from the sale of Cuban tortoiseshell, should international trade be resumed is estimated at US\$1,075,455 per year.

Case study 4: diverse and widespread marine turtle use in Costa Rica

Marine turtle use is important in several communities in Costa Rica. Non-consumptive use is the most prevalent. It includes the communities of Tortuguero, Parímina and Gandoca in the Caribbean, as well as Tamarindo and Matapalo (Playa Grande) on the Pacific

coast. Illegal consumptive use is also widespread. However, the collection of olive ridley eggs at Ostional, on the Pacific coast, is the only legally sanctioned consumptive use (Legislative Assembly 2002).

On the Caribbean coast, Tortuguero National Park hosts one of the largest green turtle rookeries in the world (Troëng & Rankin, in press). Caribbean Conservation Corporation has undertaken marine turtle research and conservation efforts in Tortuguero since 1959. Nesting turtles were collected by the thousands for export and local consumption until a presidential decree in 1963 placed restrictions on the take (GOC 1963). Subsequent Costa Rican legislation has resulted in complete protection for green turtles and their eggs and a total ban on trade in Costa Rica (GOC 1969, GOC 1970, Legislative Assembly 1975, Legislative Assembly 2002). In the 1980s, tourists began to visit Tortuguero to observe nesting turtles and other wildlife (Figure 4a). The green turtle nesting season from June through October is outside the tourism high season in Costa Rica. However, nesting green turtles attract enough visitors to effectively provide a second tourism high season in Tortuguero.

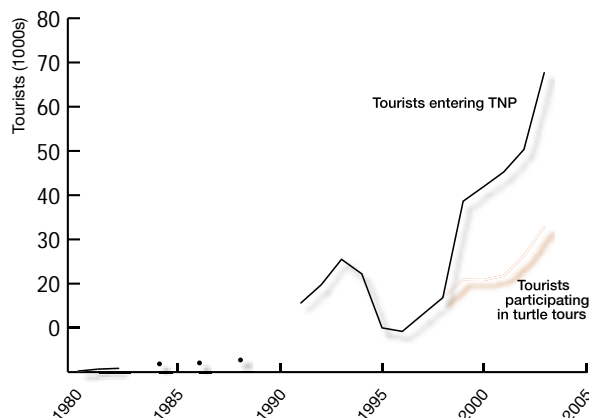
There are 235 tour guides with license to conduct marine turtle tours in Tortuguero National Park. In 1999, local guides from Tortuguero village (526 inhabitants⁷) conducted 72% of all turtle tours (Peskin 2002). Women made up 20% of local tour guides in 1999 (Peskin 2002). Hotel owners, tour operators, boat captains, hotel employees, local hostels, as well as small business owners benefit from marine turtle tourism in Tortuguero (pers. obs.). There are 25 hotels and hostels with an estimated 441 rooms available in Tortuguero (Harrison *et al.* 2003). At 0.6 direct jobs per room (Costa Rican Tourism Institute pers. comm.), the number of jobs generated by tourism in Tortuguero can be estimated at 265.

In 2002, a total of 50,339 people paid park entrance fees and tour guides were given permits to take 26,292 visitors on nightly walks to observe nesting turtles (Figure 4a). The cost for a turtle tour varies between US\$5-US\$25 per person (pers. obs.). Average spending is estimated at US\$255.38 per visitor (Costa Rican Tourism Institute pers. comm.). Gross revenue of

⁷ INEC – 2000 national census

⁸ INEC – 2000 national census

Figure 4a Tortuguero National Park – tourism trend
(source: Tortuguero Conservation Area)

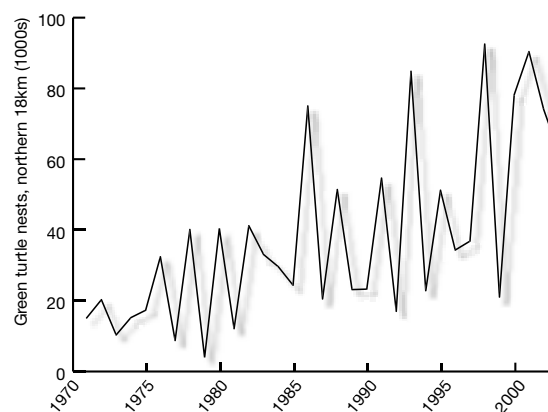


marine turtle tourism in Tortuguero is estimated at US\$6,714,483 from board, lodging, and transportation services, as well as souvenir sales, national park and guided tour fees. The presence of scientists, tour guides and tourists on the nesting beach deters illegal take of turtles and eggs and facilitates reporting of such activities to the authorities. Green turtle nesting at Tortuguero National Park has increased an estimated 417% since 1971 (Figure 4b).

Gandoca, a village of 264 inhabitants⁸, is located further south along the Caribbean coast, 125 km from Tortuguero National Park. In the early 1990's, the NGO Asociación ANAI in cooperation with the local community and the Ministry of Environment and Energy established a volunteer program in Gandoca (Chacón *et al.* 2003). Volunteers are housed at the project camp or in locally provided accommodation (Chacón *et al.* 2003). In addition to paying for participation in the conservation project, volunteers contribute to the local economy by paying for accommodation, food, transport and miscellaneous purchases at the local store and bar (Chacón *et al.* 2003).

In 1986, when Asociación ANAI initiated conservation efforts in Gandoca, approximately 95% of all leatherback eggs deposited on the beach were illegally collected (Chacón *et al.* 2003). In 2003, only 2.3% of leatherback nests were illegally taken (Chacón pers. comm.). Between 1996 and 2003, the number of volunteers participating in the project increased from 328 to 460 per year (Chacón *et al.* 2003). During the same time period the number of leatherback nests

Figure 4b Tortuguero National Park – nesting trend
(source: Troëng & Rankin in press)



deposited increased with a mean of 2% per year (Chacón 1999, Chacón pers. comm.).

In 2003, 460 volunteers and 150 tourists visited Gandoca during the leatherback nesting season (Chacón *et al.* 2003). Each person spent an estimated US\$151.3 in the Gandoca community (Table 5). Tour guides, taxi drivers, 6 local conservation project employees, owners of 7 hostels and their employees, a shop and bar owner and employees earn direct income from services and goods for the volunteer program (Chacón *et al.* 2003). The direct income for the Gandoca community from the project is estimated at



Local tour guide showing tourists a nesting green turtle – Tortuguero, Costa Rica.

US\$92,300 in 2003 (Chacón *et al.* 2003). The direct income for the Gandoca community from the leatherback conservation project can be translated into US\$506 per leatherback turtle, US\$135.5 per nest or US\$1.7 per leatherback egg deposited on the beach (Chacón *et al.* 2003). This income per egg is 680% higher than the potential income from selling the egg on the black market (Chacón *et al.* 2003).

On Costa Rica's Pacific coast, the premier marine turtle tourism attraction is the leatherback population that nests at Playa Grande. It represents one of the main leatherback rookeries in the Eastern Pacific (Spotila *et al.* 1996), and it has been a major tourism site since the early 1990's. Playa Grande and nearby nesting beaches form part of Leatherbacks National Park. Tourists staying at Tamarindo and other nearby locations travel to Playa Grande to observe leatherback nesting under the supervision of local tour guides. Tourists also come for the beach and to surf (R. Piedra, pers. comm.). Gutic (1994) estimated that a third or US\$1,350,960 of the gross tourism revenue for the area adjacent to the national park was generated by the leatherback turtles and the natural resources of the estuary at the southern end of Playa Grande. The leatherback population alone generated two thirds of that revenue, corresponding to US\$900,460 in 1993 (Gutic, 1994). Converted to 2002 values, Gutic's (1994) estimate equals current gross revenue of US\$1,121,057 from leatherback tourism.

The number of nesting leatherback turtles declined from 1,367 in 1988 to 117 in 1998, arguably because of incidental capture in fisheries (Spotila *et al.* 2000). Marine turtle tourism at Playa Grande peaked during the 1999/2000 season when 7,355 tourists went on tours to observe marine turtle nesting (R. Piedra pers. comm.). Visitation decreased to 4,234 visitors in 2001/2002 and remained at a similar level in 2002/2003 (R. Piedra pers. comm.). Most recently, a larger number of nesting leatherback turtles during the 2003/2004 season has resulted in an increase in the number of visitors (R. Piedra pers. comm.).

An official tour guide training program began in 1994 and 41 persons now work with tourism related activities within the National Park (R. Piedra pers. comm.). During the 2001/2002 leatherback nesting season, 4,234 tourists (82% international visitors) spent an estimated



Olive ridley in Ostional, Costa Rica.

US\$81,276 on fees and tours to observe leatherback nesting (R. Piedra pers. comm.). Average spending for all services associated with the visit to see the leatherback turtles is estimated at US\$338-US\$676 per visitor (Table 5). Gross annual revenue to tourism operators, business owners and their employees in Leatherbacks National Park is estimated at US\$2,113,176.

To the south of Playa Grande, Ostional Wildlife Refuge hosts one of the largest marine turtle nesting populations in the world (R. Morera pers. comm.). Olive ridley *arribadas* normally take place monthly with the largest aggregations emerging to nest in September and October, when tens of thousands of females come ashore during a few days (R. Morera pers. comm.). A proportion of eggs is collected for sale at the beginning of each *arribada*, when the probability of excavation by nesting females is greater than for nests laid towards the end of the *arribada*. The egg take is justified biologically by the belief that high nesting densities cause nest destruction, build-up of bacteria and other microorganisms which reduce hatching success (Valverde 1999).

Local people report that *arribadas* have occurred at least since the 1940's (Campbell 1998). In 1983, the Ostional Wildlife Refuge was created. In 1987, the Comprehensive Development Association of Ostional

(ADIO) was formalized (R. Morera pers. comm.). Members of ADIO have since collected and sold olive ridley eggs. Campbell (1998) reviewed the egg collection and commercialization process in detail. Hope (2002) suggested that more flexible seasonal and regional pricing policies might increase profits from egg sales and also recommended community egg marketing cartels with urban selling points. It is believed that olive ridley nesting at Ostional is increasing (R. Morera pers. comm.). Sale of an unquantified volume of illegally collected eggs from beaches other than Ostional takes place in Costa Rican markets behind the cover of the legal egg sale system.

ADIO currently has 235 members (R. Morera pers. comm.). The project should be commended for achieving an impressive level of local participation and equitable distribution of profits between ADIO members including men and women (pers. obs.). In 2003, ADIO sold eggs to intermediaries for US\$0.05 per egg (R. Morera pers. comm.). The eggs are later sold to the consumers at markets and by seafood merchants for US\$0.12-US\$0.37 per egg (pers. obs.). There are approximately 66 intermediaries selling eggs from Ostional throughout Costa Rica (R. Morera pers. comm.). In 2001, 4,137,000 olive ridley eggs were collected for sale at Ostional (Chacón 2002), a village with 208 inhabitants⁹. Gross revenue from the consumptive use of olive ridley eggs benefiting villagers, inter-mediaries and market salesmen is estimated at US\$1,011,615 per year.

By looking at rural, coastal communities in the same country we can reduce the number of confounding factors to explain differences. We chose to compare the two marine turtle use sites with the greatest gross revenue, Tortuguero and Ostional. The comparison suggests that non-consumptive use generates much greater revenue than consumptive use (Tables 3 and 5). But does non-consumptive use generate more revenue and social development locally? Hope (2002) estimated that the members of ADIO earned on average US\$70-US\$100 per month in 2000 (39-56% of the minimum wage in Costa Rica¹⁰) from egg collection. A tour guide in Tortuguero can make as much as US\$100 per tour. In 1999,

Peskin (2002) estimated that each local tour guide in Tortuguero took 351 tourists on turtle tours. At a tour fee of US\$5-US\$10 per person, each guide earned on average US\$1,755-US\$3,510 during a five month period, corresponding to 2.1-4.1 times¹⁰ the minimum wage. Guides also undertake other activities such as canal tours and hence the mentioned sum only represents part of their income. Since 1999, the number of tourists joining turtle tours has increased and guides now earn more.

We also compared indicators of social development for Ostional, Tortuguero and Barra del Colorado, a coastal community without marine turtles but with similar characteristics to Tortuguero in terms of location (rural, isolated, Caribbean coast) and infrastructure (no direct road access). Data on Basic Needs Not Satisfied were provided by the National Institute for Statistics and Census (INEC) and were collected as part of the Costa Rican National Census in 2000. INEC's data show that people in Tortuguero had lower values for Basic Needs Not Satisfied and hence a higher index of social and economic development than both, Ostional and Barra del Colorado (Table 10).

Table 10 Basic needs not satisfied for coastal populations in Costa Rica in 2000
(Source: INEC).

Location	Marine turtle use (in 2000)	Proportion of population with basic needs not satisfied*
Barra del Colorado	None	41%
Ostional	Egg sales	39%
Tortuguero	Tourism	28%

*Higher value indicates less social and economic development

In addition to generating more revenue and social development at a local level, non-consumptive use also appears to have a higher potential for economic growth. On average, recorded visitors to Tortuguero National Park increased at a rate of 16% per year between 1988 and 2002 (Figure 4a). The number of eggs collected at Ostional has remained fairly constant in recent years (R. Morera pers. comm.).

⁹ INEC – 2000 national census

¹⁰ <http://www.mideplan.go.cr/sides/economico/03-11.htm>

Case Study 5: fishing green turtles for the domestic market along the Nicaraguan Caribbean coast

The continental shelf of the Caribbean coast of Nicaragua hosts the most extensive seagrass beds in the Caribbean. In Nicaragua, turtle grass (*Thalassia testudinum*) is the main staple for juvenile and adult green turtles from the Tortuguero green turtle rookery in neighbouring Costa Rica (Mortimer 1981). Tag returns (Carr *et al.* 1978), genetic analysis (Bass *et al.* 1998) and satellite telemetry (Troëng & Evans in review) show that the majority of green turtles nesting at Tortuguero migrate to feeding grounds in Nicaragua. Green turtles are fished primarily with nets but a few fishers still use harpoons (Lagueux 1998). Although some are sold in neighbouring countries, green turtles are mainly caught for consumption within Nicaragua (Nietschmann 1976).

Miskitu Indians have probably caught marine turtles in the waters off Caribbean Nicaragua for at least 400 years (Parsons 1962). Cayman Island fishermen caught turtles in Nicaragua until the mid-1960s (Nietschmann 1973). Green turtle processing plants for the export market operated between 1968 and 1977 (Lagueux 1998).

Green turtle take probably decreased during the civil war 1980-1988 but has since increased (Lagueux 1998). Green turtle nesting at Tortuguero increased during the 1971-2002 period (Troëng & Rankin in press). Lagueux (1998) estimated the annual take to at least 10,166 green turtles. Fishers from at least 12 communities participate in the green turtle fishery (Lagueux 1998). Turtles are consumed or sold in local communities or sold to butcheries in coastal towns for final sale (Lagueux 1998). Approximately 50% of captured turtles are sold outside the turtler's community (Lagueux 1998). Most green turtles caught are in size classes corresponding to large juveniles, and the average weight is 80.6 kg (=178 lb) (Lagueux 1998). A time delay in the impact of the Nicaragua green turtle fishery on the number of adult females nesting at Tortuguero can be expected (Campbell 2003). Lagueux (1998) suggested there were indications of overexploitation of green turtles in Nicaragua but that overharvest could not be conclusively proven.

In 2003, prices for an approx. 175 lb green turtle at the Bilwi (Puerto Cabezas) dock varied between US\$9.8 and US\$26.0 and an approx. 300 lb green turtle sells for US\$19.5-US\$52.1 (C. Lagueux pers. comm.). Prices for a live turtle vary throughout the year depending on the number of turtles available for sale. In Awastara, one of the Miskitu turtle fishing communities, a 50 lb live green turtle sells for approx. US\$16.3 and a 150 lb green turtle for approx. US\$32.6 (C. Lagueux pers. comm.). If 50% of turtles are sold in towns and 50% are sold in the turtler communities, gross revenue to the turtle fishers in 2003 can be estimated at US\$215,101-US\$297,832.



Green turtles tied-up for the meat sale at the market in Bluefields, Nicaragua.

Case Study 6: from tortoiseshell to tourism attraction: hawksbill turtles in the Seychelles

Hawksbill fishing to export shell has a long history in the Seychelles. At least 83,221 kg of raw shell were exported between 1894 and 1982 (Mortimer 1984). Export of shell declined between 1925 and 1940, partly as a result of decline in the price of shell (Figure 5, Mortimer 1984). Increasing international prices caused an increase in exports from the 1960s onwards (Figure 5, Mortimer 1984).

In 1982, 591 kg of raw shell corresponding to 1,182 hawksbill turtles was exported at a price of ~US\$148.7/kg for a gross revenue of US\$87,878

(Mortimer 1984). The major hawksbill shell importer, Japan, banned imports of tortoiseshell in December 1992¹¹ (Meylan & Donnelly 1999) but sale of tortoiseshell items continued domestically in Seychelles. After 1992, gross revenue from domestic sale by tortoiseshell artisans is estimated at US\$264,091 (Seychelles Ministry of Industry Statistics as reported to the author by J.A. Mortimer). Approximately 40 tortoiseshell artisans (representing 0.15% of the Seychelles workforce at the time) were active in 1993 (Seychelles Ministry of Industry Statistics as reported to the author by J.A. Mortimer).

The overexploitation of nesting turtles for shell resulted in negligible hawksbill reproduction outside of effectively protected areas until the early 1990s (Mortimer 2001). In 1993-1994, the Government of Seychelles took the decision to reverse the decline of marine turtle populations (Mortimer 2001). Through a Global Environment Facility (GEF)-Seychelles Government funded program, 37 hawksbill shell artisans were compensated (at an average of US\$15,000 per artisan), trained in other trades and subsequently agreed to sell all their tortoiseshell stocks to the Government (Mortimer 2001). The 2.5 tons of tortoiseshell was ceremoniously destroyed and a ban on all consumptive use and harassment of marine turtles was declared in 1994 (Mortimer 2001). The total cost of the program, approx. US\$805,000, was split between the Seychelles Government and the GEF (Mortimer 2001).

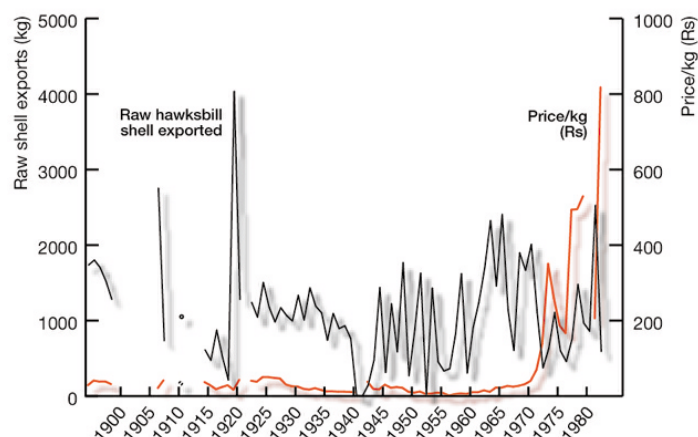
Now, tourism is the major economic sector of Seychelles, with gross revenues totalling US\$750 million per year. The spectacular natural scenery, clean beaches and ample marine life are used to attract tourists to Seychelles. Marine turtles are mentioned repeatedly in the in-flight magazine of the flag carrier Air Seychelles. Hotels and tour operators use marine turtles in their advertising and logos. The ten rupees bill features a marine turtle and all Seychelles bills carry a marine turtle emblem. Although marine turtles are not marketed as a specific attraction, they are mentioned as one important component enhancing Seychelles' natural charm. Tourists can see marine turtles on glassbottom boat tours, during dives and whilst the turtles nest on some of the resort islands.



Day-time emergence of hawksbill, Bird Island, Seychelles.

Today, efforts are underway to quantify the economic value of Seychelles marine turtles (H. Cesar pers. comm., J. Mortimer pers. comm.). There are also endeavours to place a market value on marine turtles in order to create local incentives for conservation (J. Nevill pers. comm.). Nesting beach protection has resulted in increased nesting within some Seychelles protected areas (Mortimer & Bresson 1999). It is hoped that as marine turtle populations recover, increased abundance will result in greater sighting probabilities that will facilitate the marketing of specific marine turtle tours in-water and on nesting beaches (J. Neville pers. comm., N. Shah pers. comm.).

Figure 5 Tortoiseshell exports from Seychelles and price/kg
(source: Mortimer 1984)



¹¹ Although the hawksbill turtle was included in Appendix I of CITES in 1975 (Atlantic population) and 1977 (Pacific population), Japan did not adopt a zero quota on its reservation until December 1992.

The Government of Seychelles has been cautious not to develop specific marine turtle tours until local capacity to control such non-consumptive use is adequate. However, to create incentives in favour of marine turtle conservation at a local level it may be necessary to develop activities through which marine turtles provide direct economic benefits. For local people, it is not enough that greater gross revenue is generated by non-consumptive use. Each individual, particularly those who used to benefit economically from consumptive use, needs to receive economic benefits from non-consumptive use. The potential for specific marine turtle tours appears tremendous as hawksbill turtles nest mainly during the daytime in Seychelles thus allowing for more comfort to visitors and the taking of photographs (Mortimer & Bresson 1999).

Case Study 7: divergent uses at the Philippines and Sabah, Malaysia Turtle Islands

The Philippines and Sabah, Malaysia Turtle Islands are geographically so close that you can see from one island to the next. Three of the islands are located in Sabah, Malaysia and six belong to the Philippines. Marine turtle uses on the different sides of the border are very different and make the islands a useful case study for comparing consumptive and non-consumptive use.

Collection of marine turtle eggs at the Turtle Islands, Tawi-Tawi in the Philippines is a traditional source of livelihood for local people (Palma 1997). Since 1996, the islands form part of the Binational Turtle Islands

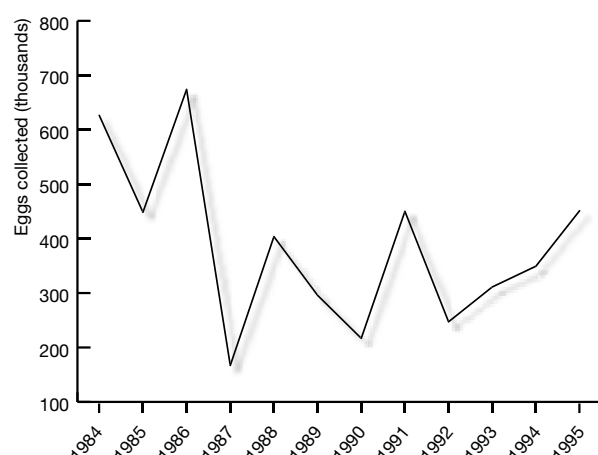
Heritage Protected Area (Palma 1997). Eggs are collected under permits and either sold in the Philippines or smuggled to nearby Sabah, Malaysia.

Between 1984-1995, a total of 1,562 egg collection permits were issued to qualified residents on Taganak, Lihiman, Langaan and Bakkungan islands (Palma 1997). Egg sales prices vary. Currently, illegal sale prices are lower (US\$0.18 per egg, pers. obs.) in markets in Sandakan, Malaysia, close to the Turtle Islands than in more distant Kota Kinabalu, Malaysia (US\$0.26 per egg, Khan 2003). On average 386,714 eggs per year were collected between 1984-1995 (Figure 6, Palma 1997), representing 31% of all eggs laid. Gross revenue of the consumptive egg use to egg collectors and traders is estimated at US\$85,078.

In 1972, the Sabah, Malaysia state government purchased the three islands on the Malaysian side of the border (Basintal 2002). The islands were first pronounced a Game and Bird Sanctuary and in 1977 declared as the Turtle Islands Park (Basintal 2002). Green and hawksbill turtles nest on the islands that are managed by Sabah Parks. Before the Sabah state government purchased the islands, egg collection was the dominant use. Since 1972, egg take has been prohibited. Tourists have been allowed to visit one of the islands, Pulau Selingaan, since 1982. The Turtle Islands Park is now one of the major tourism attractions of Sabah's east coast. In 1998, the running of tourist accommodation and the restaurant on Pulau Selingaan was turned over to private operators (Basintal 2002). Although there is a defined peak in nesting in July, a major promotional point is made of the fact that nesting turtles can be seen any night of the year. Tourism visitation has grown from the modest 431 overnight visitors in 1982 to a peak of 10,131 in 2000 (Figure 7a).

Tour operators and an estimated 54 boat captains, guides, resort staff and rangers benefit from the marine turtle tourism (pers. obs.). Sabah Parks receives fees for the use of the facilities and conservation fees collected from tourists. Funds collected from tourism activities remain with Sabah Parks and help offset the cost of conservation activities in the Turtle Islands Park. In 2002, a total of 506 national and 7,944 foreign tourists visited Pulau Selingaan (Figure 7a). Average spending is estimated at US\$113.7 for national visitors and US\$115.5 for foreign

Figure 6 Marine turtle eggs collected in Philippines Turtle Islands
(source: Palma 1997)



tourists (pers. obs.). Gross revenue from tourism to visit Turtle Island Park in 2002 is estimated at US\$975,044.

In conclusion, the gross economic revenue from non-consumptive use on the Sabah Turtle Islands is now one order of magnitude greater than revenue from consumptive use of marine turtle eggs on the Philippines Turtles Islands (Table 3 and 5). In terms of use trends, the number of eggs collected on the Philippine Turtle Islands declined at a rate of 3.2% per year between 1984 and 1995. During the same time period, tourism visitation to the Sabah Turtle Islands Park grew at a rate of 28% per year. The impact of each use on the breeding population contrasts sharply: a drop of 82% in eggs available for extraction has been recorded in the Philippines Turtle Islands since 1950s due to egg collection (Palma 1997), whereas green turtle nesting in the Sabah Turtle Islands Park increased at a rate of 15% per year between 1984-1995 (Figure 7b).



Promotion of marine turtle tourism, Sabah, Malaysia.

Figure 7a Turtle Island Park, tourism trend
(source: Sabah Parks, P. Bastinal pers. comm.)

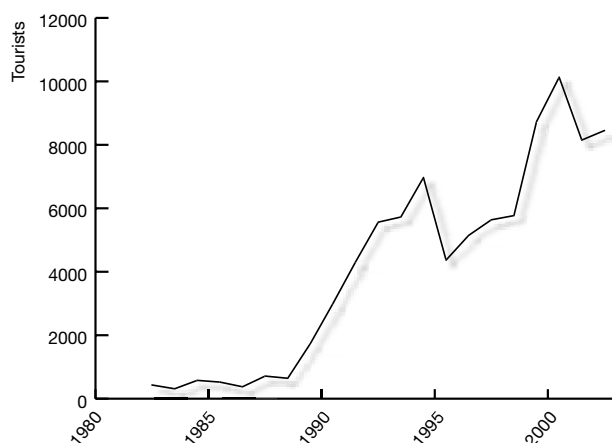
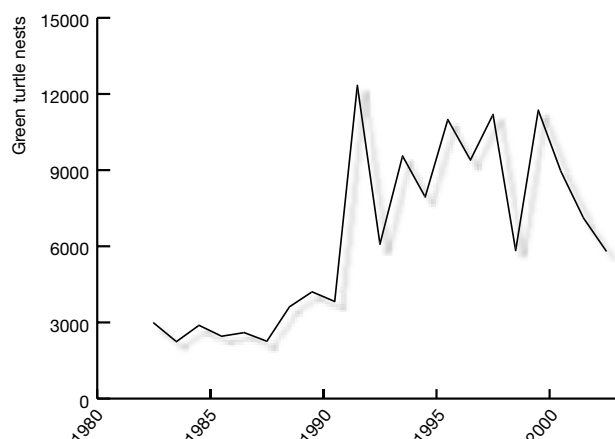


Figure 7b Turtle Island Park, Sabah nesting trend
(source: Sabah Parks, P. Bastinal pers. comm.)



Case Study 8: egg collection for local consumption and sale in Maldives

Marine turtles and their eggs have been used for food in the Maldives for centuries (Frazier *et al.* 2000). Consumptive use initially focused on eggs, as many Moslems consider marine turtle meat unclean (Frazier *et al.* 2000). A different interpretation of meat use by a religious leader caused an expansion of use from the 1950's (Frazier *et al.* 2000). Since January 1996, there is a ban on turtle and turtle product sales but tortoiseshell items are still available in souvenir shops in Male (pers. obs.). Collection and sale of marine turtle eggs remains legal (Hussein 2000). Eggs are consumed locally or sold at the market in Male (pers. obs.).

Maldives marine turtle populations are thought to be much depleted from previous levels (Zahir 2000). Increased prices of tortoiseshell stimulated export of large quantities of shell in the early 1970's, followed by a subsequent decline in exports in the late 1970's (Frazier *et al.* 2000). Between 1988-1995, the number of eggs exploited declined with an average of 4.9% per year for green turtle eggs and 3.1% for hawksbill eggs, as a likely consequence of fewer females coming ashore to nest (Zahir 2000).

Current egg sales price is US\$0.24 per egg (pers. obs.). Local authorities are compiling data on the number of green and hawksbill turtle eggs collected each year but

the quality and consistency of the information are questionable (Zahir 2000). If we assume that the reported egg numbers reflect the levels of use in Maldives then an average of 147,927 green turtle and 15,906 hawksbill eggs were collected annually in the Maldives during 1988-1995 (Zahir 2000). Gross revenue to egg collectors and traders from egg sales is estimated at US\$38,731.



Green turtle eggs for sale - Male, Maldives.

Case Study 9: simultaneous egg collection and tourism at Rantau Abang, Malaysia

The right to collect leatherback eggs laid at Rantau Abang, Malaysia is limited through a concession system. The Terengganu State Government issues concession rights to preferred bidders through a tender process. Only holders of a concession may collect marine turtle eggs. The system is very different from an open-access situation where anyone may exploit wildlife resources and which is often considered a major explanation for overexploitation (Hutton *et al.* 2001).

Since the 1950's, close to 100% of leatherback eggs were collected and either consumed locally or sold at markets. Efforts to incubate a small proportion of the leatherback nests in hatcheries began in 1961 (K. Ibrahim pers. comm.). Egg collection continues but all leatherback eggs must now be sold to the Fisheries Department and incubated in hatcheries for subsequent release (K. Ibrahim pers. comm.). It is estimated that in 1956 over 10,000 leatherback nests were deposited at Rantau Abang (Siow 1989). Between 1956 and 2002, leatherback nesting at Rantau Abang declined by over 99% (Chan & Liew 1996, K. Ibrahim pers. comm.). Overexploitation of eggs and mortality in fisheries activities are thought to be the major causes of the decline (Chan & Liew 1996, K. Ibrahim pers. comm.). In 2002, only three leatherback nests containing an estimated 240 eggs were deposited on Terengganu beaches (K. Ibrahim pers. comm.). The current egg sales price is estimated at US\$0.66 per egg. The gross revenue to egg collectors from the sale of leatherback eggs to the Fisheries Department is estimated at US\$158, down from an estimated gross revenue of US\$54,867 in 1984.

Rantau Abang was also one of the first sites in the world with marine turtle tourism. Tourism to observe nesting leatherback turtles began as early as in the 1960s. In 1988, the Terengganu state declared the Rantau Abang Turtle Sanctuary (TUMEC, K. Ibrahim pers. comm.). The Sanctuary extends along 13 km of coastline and includes waters up to 3 nautical miles offshore (TUMEC, K. Ibrahim pers. comm.). Tourism visitation peaked in 1994 when a total of 68,800 Malay and international tourists visited the Sanctuary (Figure 8a). In 2002, 12,259 visitors came to Rantau Abang (Figure 8a and 8b).

Figure 8a Rantau Abang Turtle Sanctuary tourism trend
(source: TUMEC, K. Ibrahim pers. comm.)

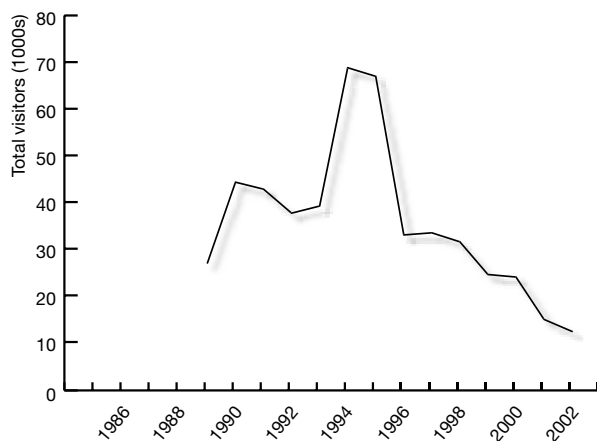
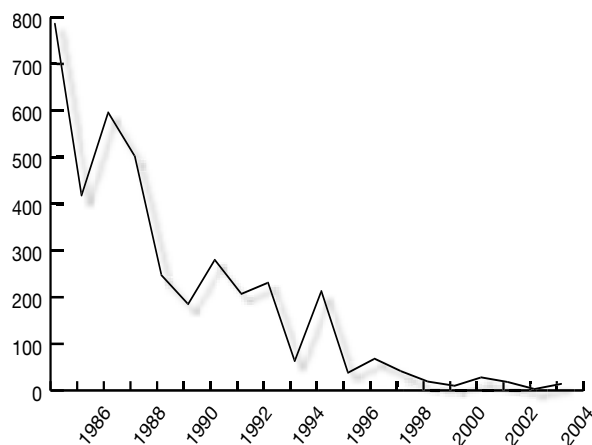


Figure 8b Rantau Abang Turtle Sanctuary nesting trend
(source: TUMEC, K. Ibrahim pers. comm.)



Not all tourists visiting Rantau Abang stay overnight locally. Many prefer accommodation in the adjacent towns of Kuala Terengganu and Dungun. To calculate average spending, we assume an average stay of one day and spending per tourist equal to the average spending of US\$26.3 for Malay and US\$65.4 for international tourists in Malaysia (Malaysia Tourism Board pers. comm.). These assumptions are probably conservative as tourists would travel from Penang, Kuala Lumpur and Johor Bahru to observe nesting leatherback turtles (K. Ibrahim pers. comm.). Concession holders, business owners and their employees benefit from marine turtle tourism. For 2002, gross revenue from tourism is estimated at US\$480,149.

Rantau Abang provides an example of the negative effect marine turtle population decline can have on tourism. Between 1994-2002, Malaysian visitation to the Sanctuary declined on average 21% per year and international visitors declined with a rate of 20% per year as the probability of seeing a leatherback turtle diminished (Figure 8a). In 2001, the fisheries sector in Malaysia employed 145,100 or 1.5% of the total employed population whilst 589,400 or 6.2% of the employed population worked in tourism (Malaysia National Bank M. Rizwan pers. comm.). In this context, it is likely that more livelihoods are affected in the tourism sector by lack of effective conservation action, than in the fisheries sector.

Had a complete stop to egg collection in 1984 been enough to sustain the leatherback population, and

consequently maintain tourism at 1994 levels, gross revenue from tourism in 2002 would have been \$2,933,407 ie six times greater than actual revenue¹² from egg sales and tourism in that year. Had visitation continued to increase at the 1989-1994 rate, gross tourism revenue in 2002 would now be \$7,031,335, ie more than 14 times the actual revenue. The estimate illustrates the cost of failing to adequately manage a marine turtle population, which was generating revenue from multiple uses. It suggests that it would be worth to invest considerable resources to recover the Rantau Abang leatherback population and associated tourism. In addition, the case demonstrates the difference of several orders of magnitude, between gross revenue from consumptive use of marine turtle eggs and that of non-consumptive use through tourism.

Rantau Abang also provides a good example of the costs of raising leatherback turtles in captivity. In general, leatherback turtles are considered very difficult to raise in captivity and one of few, if not the only successful example is the effort of the Turtle and Marine Ecosystem Centre (TUMEC) in Rantau Abang (K. Ibrahim pers. comm.). From a handful of hatchlings kept in captivity, one survived to 8.5 years of age (K. Ibrahim pers. comm.). The cost of raising the leatherback amounted to approximately US\$132 per month during the first year and approximately US\$658 per month for each subsequent year (K. Ibrahim pers. comm.). If we assume age of maturity at 10 years, the cost of raising one adult leatherback turtle amounts to US\$72,632.



Production of souvenirs with marine turtle motifs - Praia do Forte, Brazil.

Case Study 10: Projeto TAMAR, Brazil

Brazil's marine turtle conservation program Projeto TAMAR was founded in 1980 (Marcovaldi & Marcovaldi 1999). As part of its marine turtle conservation efforts, Projeto TAMAR has organized productive groups in coastal communities. At locations with little or no tourism, the productive groups manufacture items with marine turtle themes such as T-shirts, hats and souvenirs that are sold in Projeto TAMAR's visitors centres (de Andrade Patiri 2002, pers. obs.). The visitor centres serve the dual purpose of raising funds and awareness through education of the predominantly Brazilian visitors. The centres also generate local employment to attend visitors, maintain facilities and care for the marine turtles.

Total sales from Projeto TAMAR's productive chain increased with an average of 30% per year between 1998 and 2002 (L. Guardia pers. comm.). Projeto TAMAR now employs 1,280 people of which 60% are women (M.A. Marcovaldi pers. comm.). On many of the

beaches where Projeto TAMAR is present, the program is the primary source of direct and indirect income to the local community (Marcovaldi & Marcovaldi 1999). Projeto TAMAR's production and sales activities generated a gross revenue of US\$2,635,656 in 2001 (de Andrade Patiri 2002). Profits from sales are used for marine turtle conservation work (de Andrade Patiri 2002). At least at some sites in Brazil, marine turtle nesting has increased since the late 1980's (Marcovaldi 2001).

Case Study 11: Ras Al Hadd and Ras Al Jinz, Oman

Ras Al Hadd and Ras Al Jinz, Oman hosts annual nesting of 6,000-18,000 green turtles (Salm 1991 cited in Mendonça *et al.* 2001). In 1996, a turtle reserve of 120 km² including 70 km of coastline was established at Ras Al Hadd and Ras Al Jinz (Chomo & Grobler 1998). Green turtle nesting at Ras al Hadd is thought to have remained stable between 1977-79 to 1988 (Seminoff 2002).

Since 1991, visitors have observed marine turtle nesting under the guidance of park rangers (A. Al Kiyumi pers. comm.). Between, 1991-1996, the number of visitors increased from 3,631 to 11,558 (Chomo & Grobler 1998) corresponding to an average increase of 19.9% per year. Visiting Omani residents increased with an average of 24.7% and international visitors with 14.9% per year during the same time period. Visitation has continued to increase since 1996 (A. Al Kiyumi pers. comm.). During a religious holiday in November 2003, the turtle nesting beaches had over 3,000 visitors in a single week (R. Baldwin pers. comm.).

Tour companies organize visits to the turtle reserve (Chomo & Grobler 1998). In 1996, a total of 11,558 persons visited the Ras Al Hadd Turtle Reserve (Chomo & Grobler 1998). Entrance fee to the reserve is US\$2.6 (A. Al Kiyumi pers. comm.). In 1997/1998, average expenditure per visitor is conservatively at US\$98.3 (Chomo & Grobler 1998). Gross revenue is estimated at US\$1,136,151. Tour company workers and owners benefit economically from marine turtle tourism.

¹² In 2002, we estimated gross revenue at \$158 from consumptive use (Appendix 1) and \$480,149 from non-consumptive use (Appendix 2a).

Case Study 12: Matura, Trinidad & Tobago

The north and east coasts of Trinidad hosts the third largest leatherback nesting population in the world. In 1990, the Matura Beach was declared a protected area in an effort to conserve the nesting leatherback turtles and their nests. Nature Seekers Inc., a local NGO, patrols the beach and provides guiding services for visitors. Leatherback nesting is reportedly increasing in Trinidad (Spotila *et al.* 1996).

Tourism in Matura creates employment for beach monitors, turtle taggers and tour guides (M. Ramjattan pers. comm.). Tourism also provides income to tour operators that bring tourists from hotels and yachts on other parts of Trinidad and to those that operate bed and breakfasts, restaurants and handicraft sales (M. Ramjattan pers. comm.).

In 2001, a total of 10,693 visitors paid to participate in marine turtle tours (M. Ramjattan pers. comm.). Fees are higher for foreign tourists than for locals (M. Ramjattan pers. comm.). Those who want to participate in tagging tours also pay a higher fee (M. Ramjattan pers. comm.). Adults pay more than children (M. Ramjattan pers. comm.). Fees vary between US\$0.8-US\$15 per person (M. Ramjattan pers. comm.). Gross revenue is estimated at US\$559,014.

Case Study 13: Rekawa, Sri Lanka

Five species of marine turtle come to nest at Rekawa on Sri Lanka's southern coast. Since 1996, the Turtle Conservation Project has employed former egg collectors to patrol the nesting beach at night in an effort to reduce illegal take of eggs (TCP 2003). In 2002, TCP, the Sri Lanka Tourism Board and the Sri Lankan Hotel School established a training program for local guides (TCP 2003). A total of 17 guides were trained (TCP 2003).

Guides, local businesses, 13 guesthouse and resort owners and employees benefit from marine turtle tourism in Rekawa (TCP 2003). During the 2002/2003 tourism season, 1,710 visitors participated in tours to observe marine turtle nesting (TCP 2003). Average spending associated with the visit to the turtle nesting beach is estimated at US\$24.5 per visitor (TCP 2003). Gross revenue is estimated at US\$41,925.

Case Study 14: Barbados

Few tourists travel to Barbados with the explicit purpose of observing marine turtles. However, marine turtle tours on nesting beaches and in-water are becoming increasingly popular (J. Horrocks pers. comm.). In-water tours began in 1997 and organized beach walks to observe nesting marine turtles started in 2003 (J. Horrocks, pers. comm.). The Barbados Sea Turtle Project run by the University of the West Indies manage nesting beach tours and collaborate with tour operators organizing in-water observation of marine turtles (J. Horrocks, pers. comm.). Some hotels located adjacent to nesting beaches have staff members that conduct nesting beach tours for hotel residents (J. Horrocks, pers. comm.). Hawksbill nesting is increasing in Barbados (J. Horrocks pers. comm.).

In 2003, an estimated 1,000 tourists took part in scuba diving tours, which specifically advertise marine turtles as one of the underwater attractions and some 400 tourists participated in guided beach walks (J. Horrocks, pers. comm.). Dives cost an estimated US\$100 and tours to observe marine turtle nesting are US\$20 (J. Horrocks, pers. comm.). In 2003, marine turtle tourism generated an estimated gross revenue of US\$108,000 to dive operators, tour guides, the Barbados Sea Turtle Project, business owners and employees. Also, marine turtles provided an additional means to attract tourists to Barbados, as evidenced by the promotional materials of the Barbados Tourism Authority.

Case Study 15: Maputaland, South Africa

The coast of Maputaland, South Africa hosts nesting by loggerhead and leatherback turtles. Scuba diving and game tourism are the major reasons for tourists visiting Maputaland and marine turtle tours can only be considered an additional attraction. In the past, marine turtles were used consumptively but today marine turtles are mainly used for ecotourism purposes (R. Nel pers. comm.). At Kosi Bay, local guides have been licensed to offer marine turtle tours since the 1994/1995 nesting season. Tenders to conduct turtle tours are given to communities and tour operators. Communities are given preference in the tender process (M. Bower pers. comm.). The only hotel with two tenders is 49% owned by the local community. Part of the proceeds from the hotel goes directly to a community trust fund. The tender fees paid by the concessionaires are reinvested in marine turtle monitoring and protection. The nesting season extends for five months from mid-October to mid-March with most tours undertaken during the November-January period (W. Baard, pers. comm.). Both loggerhead and leatherback nesting numbers have increased since monitoring began in 1963 (Nel & Hughes, in prep.).

In 2003, four hotels and tour operators paid US\$863-US\$2,039 per month and car to conduct turtle tours in four wheel drive vehicles. In addition, the Kosi Bay community offers turtle tours on foot. There are also a couple of minor operators conducting turtle tours on foot. Approximately 1,750 tourists participate in marine turtle nesting tours each year (W. Baard pers. comm., P.



Author Sebastian Troëng on turtle tour, Sodwana bay, South Africa.

Boddam-Whetham pers. comm., M. Bower pers. comm., pers. obs.). The price for a turtle tour varies from US\$7.1 for a beach walk to US\$94.1 for a vehicle tour with meals and transport included (W. Baard pers. comm., M. Bower pers. comm., D. Morton pers. comm., pers. obs.). Gross revenue from tour fees is estimated at US\$45,597.

Case Study 16: Praia do Forte, Costa de Sauipe and Fernando do Noronha, Brazil

Projeto TAMAR organizes tours to release hatchlings and observe nesting turtles. Tours are conducted to raise funds and create awareness in the states of Bahia and Pernambuco. In Fernando do Noronha, tourists can pay to participate in nightly monitoring of nesting turtles (TAMAR 2002). In Praia do Forte and Costa de Sauipe, Projeto TAMAR offers "tartarugas by night". After two years of pilot efforts, the project became a regular program during the 1995-1996 nesting season (Vieitas & Marcovaldi 1997). Participants take part in a hatchling release event and also have the chance to see a nesting female.

In 2002, at least 71,870 overnight visitors came to Praia do Forte, site of the headquarters and largest visitor centre of Brazil's marine turtle program Projeto TAMAR (G. Rostan pers. comm., Bahiatursa pers. comm.). Marine turtles are a central theme in the streets of Praia do Forte. When asked about what they enjoyed most during their stay in Praia do Forte, 5.5% of visitors mentioned Projeto TAMAR. Tourism in Praia do Forte provides an estimated 550-613 direct and 3,025-3,371 indirect jobs (de Andrade Patiri 2002).

The "tartarugas by night" program is organized with a tour operator that benefits economically from the tours. In 2002, a total of 260 tourists took part in Projeto TAMAR's "tartarugas by night" and nightly monitoring programs (TAMAR 2002). Prices vary from US\$13.6 for nightly monitoring to US\$45.9 for the "tartarugas by night" program (TAMAR 2002). Nightly monitoring in Fernando do Noronha and the "Tartarugas by Night" program in Praia do Forte and Costa de Sauipe generate an estimated gross revenue of US\$9,031. The

income from marine turtle tours is small in comparison with gross revenue from Projeto TAMAR's other activities (see Case Study 10, de Andrade Patiri 2002, TAMAR 2002).

Case Study 17: Cape Verde

Tours to observe nesting loggerhead turtles *Caretta caretta* at the islands of Cape Verde have been conducted since 1998 (L.F. Lopez pers. comm.). Approximately 300 visitors participate in marine turtle tours each year (L.F. Lopez pers. comm.). The cost for a tour in 2003 was US\$11.5 (L.F. Lopez pers. comm.). A total of 10 tourism operators benefit from marine turtle tourism. The turtle tours in Cape Verde generate an estimated gross revenue of US\$3,451 per year.



Tartarugas-by-night - Praia do Forte, Brazil.

Case Study 18: green turtle production at Ferme CORAIL, Reunión

Ferme CORAIL was founded in 1977 to produce marine turtle meat and scale for export. Increased restrictions on international trade resulted in production being reoriented towards the domestic market in 1985. Commercial exploitation of marine turtle stopped in 1997. Ferme CORAIL is now the Sea Turtle Survey and Discovery Centre and activities are focused on creating awareness and conducting research and monitoring. The cost of raising a green turtle is based on the cost of food items, water, medicine and personnel (S. Ciccione pers. comm.). If we assume age of maturity at 15 years, the cost of raising one adult green turtle amounts to US\$1,672 (S. Ciccione pers. comm.).

Appendix 2

Sites with non-consumptive marine turtle use

Country	Location	Annual visitors	Reference
Australia	Mon Repos	23,485	Tisdell & Wilson 2001
Barbados	Various	~1,400	J. Horrocks pers. comm.
Benin	Grand-Popo		J. Fretey pers. comm.
Brazil	Costa de Sauipe	114	TAMAR 2002
	Fernando do Noronha	90	TAMAR 2002
	Praia do Forte	56	TAMAR 2002
Cameroon	Campo Ma'an		H. Angoni pers. comm.
Cape Verde	Boa Vista Island	300	J.-L. Lopez pers. comm.
Cayman Islands	Gran Cayman		Pers. obs.
Costa Rica	Gandoca	610	Chacón <i>et al.</i> 2003
	Ostional		Pers. obs.
	Pacuare		Pers. obs.
	Parismina		Pers. obs.
	Playa Grande	4,234	R. Piedra pers. comm.
	Tortuguero	32,854	Pers. obs.
Ecuador	Galapagos		P. Zarate pers. comm.
Equatorial Guinea	Corisco Island		J. Fretey pers. comm.
French Guiana	Awala-Yalimapo	~10,000	L. Kelle pers. comm.
Gabon	Mayumba		A. Formia pers. comm.
Ghana	Various beaches		E. Owusu pers. comm.
Greece	Crete		Archelon pers. comm.
	Zakynthos	~20,000	Archelon pers. comm.
Grenada	Carriacou		Kido team pers. comm.
	Levera Beach	175	C. Lloyd pers. comm.
Guinea-Bissau	Bijagos Archipelago		J. Fretey pers. comm.
Guyana	Almond Beach		A. Arjoon pers. comm.
India	Galathea, Nicobar		K. Shanker pers. comm.
	Goa		K. Shanker pers. comm.
	Rushikulya, Orissa		K. Shanker pers. comm.
Indonesia	North coast of Bali		Pers. obs.
	Sanggalaki		R. Holland pers. comm.
Kenya	Watamu		R. Zanre pers. comm.
Madagascar	Various	~10,000	S. Ciccione pers. comm.
Malaysia	Lankayan Island		Pers. obs.
	Melacca		C. Shepherd pers. comm.
	Rantau Abang	12,259	K. Ibrahim pers. comm.
	Redang Island	125	HC Liew pers. comm.
	Sipadan		Pers. obs.
	Turtle Islands, Sabah	8,450	P. Basintal pers. comm.

Appendix 2 – continued.

Country	Location	Annual visitors	Reference
Maldives	Various		Pers. obs.
Mayotte	Various	~10,000	S. Ciccione pers. comm.
Mexico	Akumal		Centro Ecológico Akumal 2001
	Campeche		M. Medina pers. comm.
	Jalisco		V. Guzmán pers. comm.
	Michoacan		V. Guzmán pers. comm.
	Nayarit		V. Guzmán pers. comm.
	Mazunte		V. Guzmán pers. comm.
Moheli	Various	~2,000	S. Ciccione pers. comm.
Mozambique	Southern beaches		Off 2 Africa 2003
Oman	Ras Al Hadd Ras Al Jinz	11,558	A. Kiyumi pers. comm. A. Kiyumi pers. comm.
Panama	Playa Bluff, Isla Colon San San		Pers. obs. Pers. obs.
Puerto Rico	Culebra		Puerto Rico Planner 2003
Sao Tome & Principe	North and southeast beaches		J. Fretey pers. comm.
Senegal	Delta du Saloum		J. Fretey pers. comm.
Seychelles	Various		Pers. obs.
Sierra Leone	Sherbro Island		J. Fretey pers. comm.
South Africa	Maputaland	~1,750	Pers. obs.
Sri Lanka	Rekawa	1,710	TCP 2003
St Lucia	Grande Anse Beach		Anon. 2004
St Vincent	Bequia		Bequia Dive Adventures 2004
Suriname	Galibi		L. Kelle pers. comm.
Tanzania	Zanzibar		H. Fazakerley pers. comm.
Trinidad & Tobago	Matura, Trinidad Tobago	10,693 5,500	M. Ramjattan pers. comm. W. Herron pers. comm.
USA	Georgia Hawaii Florida (21 locations) North Carolina South Carolina	8,579	G. Appleson pers. comm. G. Balazs pers. comm. G. Appleson pers. comm. G. Appleson pers. comm. G. Appleson pers. comm.
Yemen	Ras al Sharma		S. Wilson pers. comm.
Total 43 countries	>92 sites	>175,942	

Data correspond to information from 1996-2003

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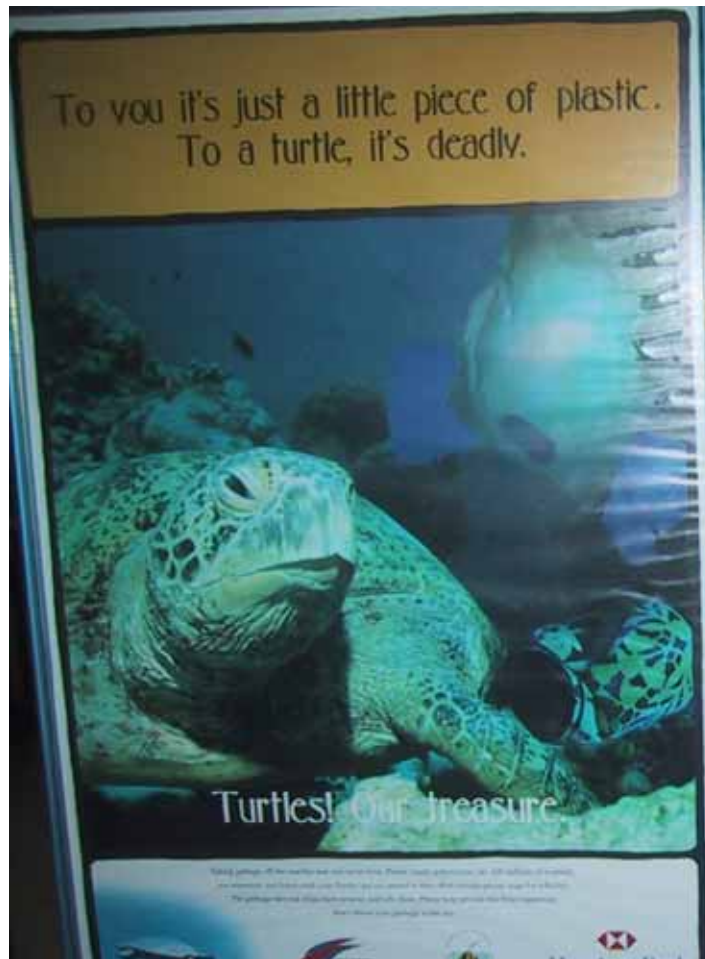
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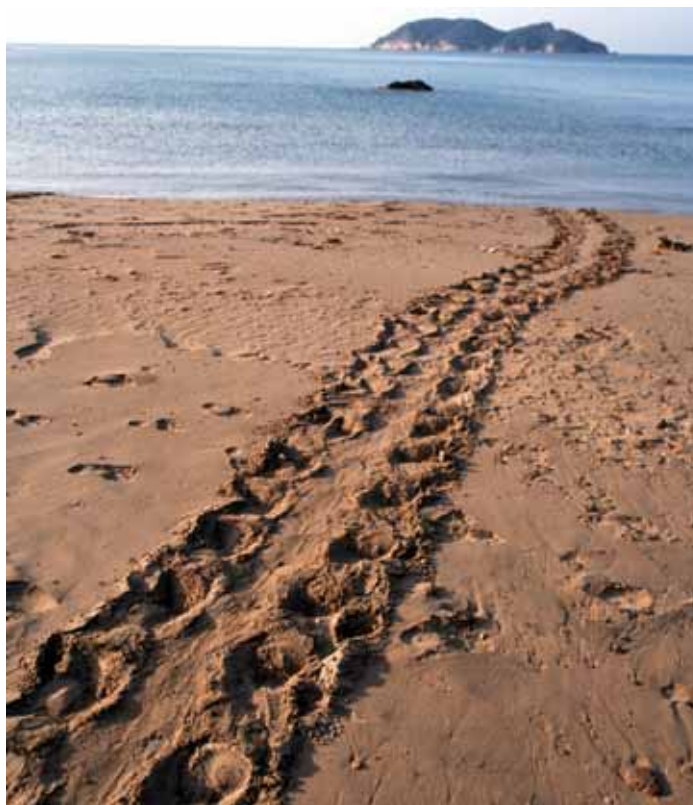
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