

Use them or lose them? Conservation and the consumptive use of marine turtle eggs at Ostional, Costa Rica

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Summary

'Sustainable use' of wildlife resources and 'community based conservation' are two themes recurrent in contemporary statements of wildlife conservation policy, and their use is in response to a perceived 'deep conservation crisis' which has in part arisen from exclusionary and restrictive conservation practices. The extent to which the legal harvest of marine turtle eggs in Ostional, Costa Rica, is an example of sustainable use and community based conservation is evaluated in this paper. Field research using in-depth interviewing and a household questionnaire was undertaken in Ostional during 1994 and 1995, to investigate local perceptions of the egg harvesting project, both positive and negative. Socio-economic benefits from, and legal and administrative structures supporting, the project were found to be fundamental to community support for a limited egg harvest and allowed for community participation in, and control of, resource use. Participation and control were key to local support for conservation of nesting marine turtles and their eggs. Attempts to use wildlife sustainably must be considered on a case by case basis, to account for the biological nature of the wildlife resource and environment in question and for local socio-economic, political and historical conditions. Nevertheless, some of the lessons learned from the attempt to implement sustainable use and community based conservation in Ostional may be more widely generalized, and may help inform other efforts to reconcile wildlife conservation objectives with local development needs.

Keywords: community conservation, Costa Rica, marine turtles, wildlife conservation, harvesting

Introduction

'Sustainable use' is a popular catch-phrase in contemporary wildlife conservation (Frazier 1997) and has gained increased acceptance in the World Conservation Union (IUCN) over the past 20 years (IUCN 1980; IUCN/UNEP/WWF 1991).

It is a key element of the IUCN's definition of conservation, i.e. 'the management of human use of organisms or ecosystems to ensure such use is sustainable. Besides sustainable use, conservation includes protection, maintenance, rehabilitation, restoration, and enhancement of populations and ecosystems' (IUCN 1980, p. 1). The sustainable use concept, under various labels, has long been part of management strategies for renewable natural resources, particularly for forests and fisheries (Rosenberg *et al.* 1993). The focus of this paper is on its application to wildlife and, while acceptance of sustainable use as a potential conservation tool by the IUCN and other wildlife conservation organizations is comparatively new, it is increasingly evident in policy documents (e.g. IUCN/UNEP/WWF 1991; Freese 1994, 1996; IUCN/SSC 1996*a*).

Wildlife can be used in many ways, for example through fishing, hunting, capturing, trapping, gathering and viewing (IUCN/SSC 1996*b*). Use can be consumptive or non-consumptive and can provide subsistence and/or commercial benefits to users. Consumptive use occurs when 'the entire organism or any of its parts is deliberately killed or removed either as a goal in and of itself . . . or for a product' (Freese 1996, p. 7). Non-consumptive use does not involve direct removal and is best typified by wildlife viewing and photography. The subject of this paper is the consumptive, commercial use of marine turtle eggs at Ostional, Costa Rica. Non-consumptive use was also occurring at Ostional (Campbell 1997).

When sustainable use is included as part of a conservation strategy, there are often both environmental and socio-economic goals (Westing 1996). However, sustainability is difficult to determine in both areas. Biological sustainability is theoretically achieved when human extraction rates match the bounds dictated by the resource, such that extraction is low enough to ensure long-term survival of the resource (Shaw 1991; Ludwig 1993; Mangel *et al.* 1993; Rosenberg *et al.* 1993). Socio-economic sustainability is theoretically achieved when users are provided with adequate incentives (economic, social, legal, institutional, political, and so on) to respect extraction rates dictated by the biology and life history of the species in question. Sustainability is by no means guaranteed when implementing use regimes and, in this paper, the term 'sustainable use' refers to a desired state rather than to a given reality.

The promotion of sustainable use by wildlife conservation organizations is in part based on the 'deep conservation cri-

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sis' resulting from exclusionary and restrictive conservation practices, particularly as employed in developing countries (Pimbert & Pretty 1997, p. 1). These practices have often failed to protect wildlife, while simultaneously alienating local people. While there are various motives behind the move towards sustainable use (e.g. changing ideas about human environment relations, and recognition of the biological limitations on rigidly defined protected areas), its application to wildlife conservation is often couched in economic terms. Sustainable use programmes are deemed necessary in order to imbue wildlife with 'value'. By allowing people to use wildlife resources, i.e. giving wildlife market value, sustainable use regimes attempt to ensure that wildlife conservation can compete with other land and habitat uses (Robinson & Redford 1991; Swanson & Barbier 1992; Holdgate & Munro 1993). This is often referred to as the 'use it or lose it' argument and it assumes that unless local human populations (particularly poor ones) benefit economically from wildlife, they will not be encouraged, induced, nor coerced into protecting it. If wildlife or its habitat requirements threaten or compete with human livelihoods, people may even take action against it.

In spite of the support for sustainable use at an institutional level, there are few cases of wildlife use in practice that are proven to be sustainable (Freese 1994, 1996). Both the IUCN and World Wide Fund for Nature are working to develop guidelines or principles for evaluating sustainable-use projects (Freese 1994, 1996; IUCN/SSC 1996*a*), but sustainable use, like sustainable development, can be interpreted in different ways to serve the needs of the interpreter (Sunderlin 1995; Frazier 1997). While biologists interested in wildlife, and social scientists and aid workers concerned with human development, use the common language of sustainability, they continue to prioritize their respective halves of the sustainable-use equation (Campbell 1997; Frazier 1997). Opponents of the application of sustainable use to wildlife are many and their concerns include those of the ethics of using wildlife as a resource, the co-opting of the use concept to veil continued resource exploitation, the ability of a free market economy adequately to regulate wildlife use, and the real difficulties associated with determining biologically feasible extraction rates (e.g. Ehrenfeld 1992; Robinson 1993; Geist 1995). The last concern is of particular relevance in this paper, as the difficulties associated with harvesting long-lived, late-maturing, migratory species such as marine turtles are many (Ehrenfeld 1974, 1981; Congdon *et al.* 1993, 1994; Robinson 1993).

Regardless of opposition to sustainable use and of the many problems arising from the term's ambiguity, it is one possible approach to rectifying the problems associated with traditional exclusionary conservation and it may offer an alternative to complete exploitation. While the biological definition of sustainable use does not imply community involvement or participation, policy statements from conservation organizations increasingly include reference to the rights and roles of local people in using and managing wildlife as a resource. Participation in, and/or control of, use

regimes by local people can provide a sense of economic and social security and of resource 'ownership', and can help to convince users that it is in their interests to sustain a wildlife resource into the future (Robinson & Redford 1991; Parry & Campbell 1992; Heinen 1993; Freese 1994, 1996; Mangel *et al.* 1996). Redclift and Sage (1994, p. 11) would turn 'poachers' into 'stewards' by assigning 'management responsibilities to local institutions, strengthening community-based resource management systems, and introducing a variety of property rights and land tenure arrangements'. Where monetary incentives for conservation have been provided without a corresponding devolution of control to local people, incentives have sometimes failed to gain support for conservation activities (Parry & Campbell 1992; Heinen 1993) and can encourage increased exploitation of resources. The importance of involving local people in conservation schemes has led to the concept of 'community based conservation,' which according to Little (1994, p. 350) implies 'at least some of the following: local-level, voluntary, people-centered, participatory, decentralized, village based management'.

'Community based conservation' has also arisen in response to criticisms levelled at both conservation and development organizations for the ways in which they marginalize local people in decision-making. The failure of traditional, centrally-planned, capital-intensive aid projects to alleviate poverty or reduce income disparity in developing countries has inspired many development practitioners to call for 'grassroots development', 'bottom-up' approaches, 'community participation' and 'local empowerment' (e.g. Blaikie & Brookfield 1987; Chambers 1987, 1993, 1997; Atkinson 1991; Cox & Elmqvist 1991; Ekins 1992). These same calls are made by conservation practitioners (e.g. Wells & Brandon 1992; Little 1994; Western & Wright 1994). Wildlife conservation has been particularly exclusive, often involving the prioritization of Western aesthetic values over those of local people living and interacting with wildlife (Bell 1987; Mackenzie 1988; McCormick 1989; Bonner 1993). Thus, there is a justice issue at stake that community based conservation has the potential to address.

This paper evaluates marine turtle egg harvesting at Ostional, Costa Rica, which, in spite of the difficulties associated with using long-lived, late maturing animals, many marine turtle biologists agree appears justified on both biological and socio-economic grounds (e.g. Pritchard 1984; Cornelius *et al.* 1991; Mrosovsky 1996; see Campbell 1997). This paper focuses on the legal, social and economic aspects of the egg harvesting project that provide for and enhance community control of the resource and the community's sense of security regarding the project and its continuance. It also considers those aspects detracting from overall sustainability. While the specifics of resource-use schemes are often unique and unreplicable, the roles of legal, social and economic provisions in increasing (and decreasing) the likelihood that the egg harvesting in Ostional will prove sustainable may be more widely generalized.

The need for research on the socio-economic aspects of the egg-harvesting project is evident in the mainly biological literature on Ostional's marine turtles (e.g. Richard & Hughes 1972; Hughes & Richard 1974; Cornelius 1986; Cornelius *et al.* 1991; Araúz & Mo 1994). There has been little socio-economic work done in Ostional and none of it has been published. While Ostional has been cited as a successful example of the integration of wildlife conservation and local development (e.g. Ordoñez & Zuñiga 1989; Ballesterio *et al.* 1995), the extent to which this is true has been untested. As the existence of economic benefits is not always enough to secure local support for conservation efforts, this paper examines the extent to which the project meets the needs of community members as defined by them.

The Ostional egg harvest project (hereafter the project) is complex and results of fieldwork can only be understood with a basic understanding of the project's history, structure and function. Thus, the first half of this paper provides the required background, while the second half presents results of research undertaken to gauge community perceptions of the project.

Background on the egg harvest project

The marine turtle resource

The Ostional Wildlife Refuge (hereafter the Refuge) was established in 1983, to protect nesting marine turtles, particularly olive ridleys (*Lepidochelys olivacea*), one of the eight species of marine turtles. The Refuge is part of Costa Rica's protected areas system and is located on the Pacific Coast of Costa Rica, on the Nicoya Peninsula, 60 km southwest of Santa Cruz (10° 00'00"N and 85° 45'50"W) (Bonilla 1990; Cordero 1992). The Refuge extends 200 m inland along 14 km of coastline and, while the entire 14 km is designated as protected, the vast majority of nesting takes place on the beach in front of Ostional village, 1 km south of the Refuge's northern boundary (Fig. 1) (Cordero 1992). Here, an 800 m stretch of beach acts as an olive ridley *arribada* beach. *Arribada* is the Spanish word for 'arrival' and during *arribadas* olive ridleys congregate for mass nesting, which lasts from 3–10 days. This contrasts with the nesting strategies of most other species of marine turtle (and of olive ridleys at other sites), which nest individually (Hughes & Richard 1974). Ostional's *arribada* beach is one of the nine known in the world, and the second largest (other *arribadas* occur or have occurred in Nicaragua, Panama, Surinam, Mexico and India [NMFS/USFWS 1996]).

Arribadas at Ostional occur more or less monthly, with some months missed during the dry season (December–May) and with sometimes more than one *arribada* per month during the wet season (June–November). Estimates range from 20 000 to 60 000 turtles nesting a month during the dry season and from 90 000 to 180 000 during the wet season (Richard & Hughes 1972; Ballesterio 1994). Current estimates are calculated via a method and formula devised by Cornelius and Robinson (1982) and a second method devised by Gates

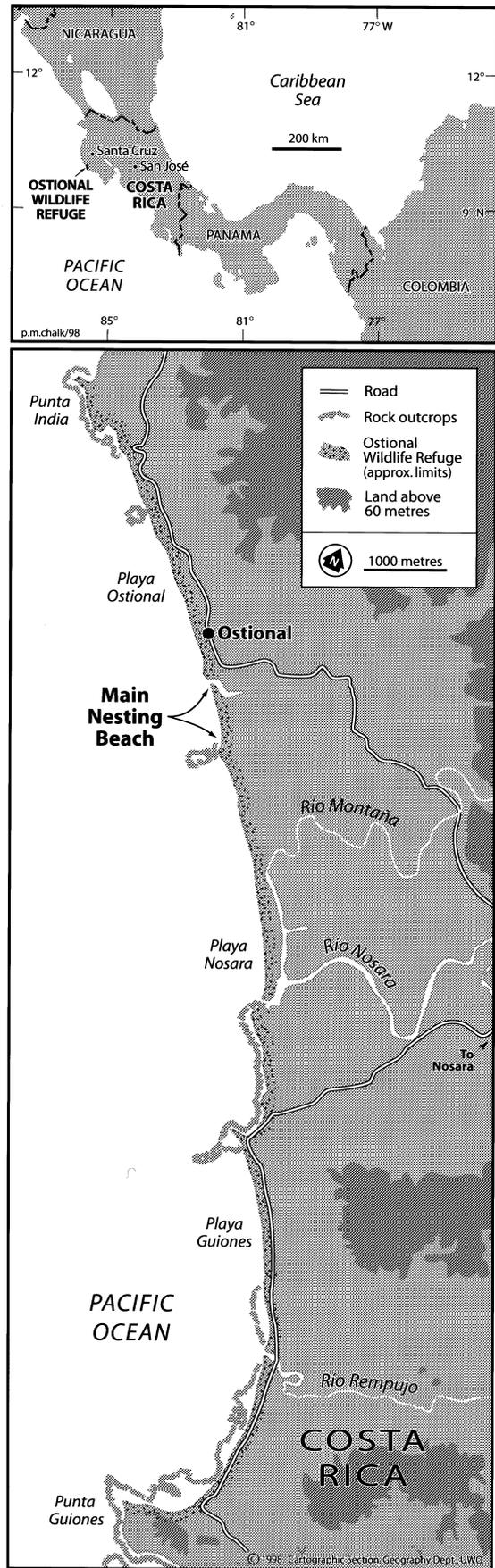


Figure 1 Location of the Ostional Wildlife Refuge in Costa Rica.

et al. (1996). However, as most results are unpublished and the logistical difficulties of counting thousands of turtles at night on a dark and crowded beach are many, numbers should be treated only as broad estimates.

Little is known regarding why arribada nesting occurs or what conditions trigger it and Cornelius (1991) reported no link between external factors (wind speed, temperature, and so on) and arribada timing. While it is assumed that mass nesting and production of hatchlings are designed to swamp predators and increase chances of individual survival (Hughes & Richard 1974), there are density-dependent nesting factors that detract from overall productivity and may ultimately undermine the success of arribada beaches (Cornelius 1986; Cornelius *et al.* 1991). The most obvious of these factors is that when thousands of turtles emerge on the same stretch of beach to nest over several days, the beach soon becomes saturated with nests. Thus, later nesters dig up and destroy previously laid eggs (Cornelius 1986; Cornelius *et al.* 1991). Furthermore, because arribadas usually occur monthly on the same stretch of beach and eggs take at least 45 days to hatch (Cornelius 1986), arribada nesters often dig up the previous month's nests, thus destroying eggs in the late stages of development.

The natural egg loss associated with arribadas was a key argument in favour of a legalized egg harvest at Ostional, but evidence of low hatchling success rates (i.e. per cent of eggs hatching from each nest) was perhaps more persuasive. A five-year comparative study of hatching success rates at Nancite, a protected and isolated arribada beach in Santa Rosa National Park, Costa Rica, and at Ostional, a historically human-predated beach, was undertaken. It revealed that, while hatching success rates were low at both beaches, rates were lower at Nancite, which had an average hatching success rate of 1–4%. During the August and September arribadas of the study period, peak nesting months at both beaches, the hatching success rate at Ostional was 17 times greater than that at Nancite (Cornelius & Robinson 1983, 1985; Cornelius *et al.* 1991). Cornelius (1986) also concluded that a greater percentage of Ostional nests survived to term and that a greater percentage of nests were partially successful, i.e. they experienced some hatching. Later studies by Araúz and Mo (1994) estimated that the hatching success rate at Ostional was approximately 8%.

Based on their observations, Cornelius and Robinson (1985) speculated that rather than reduce the olive ridley population, egg harvesting may actually increase hatching success rates by reducing the number of eggs decomposing in the beach. They suggested that macroinvertebrates, formed in the biomass of the unearthed eggs, spread and contaminated other 'safe' nests, and that the removal of eggs before destruction reduced the level of contamination (Cornelius 1986). While their evidence was not conclusive, and other factors may account for differing hatching success rates, it was more supportive of continuing the egg harvest than of stopping it. Due to delayed sexual maturity of marine turtles (i.e. the 10–30 year lag time between turtle hatching and

entry into the reproductive population [Bolten & Bjorndal 1993]), conclusive evidence regarding the impacts of harvesting on the nesting population remains unavailable.

The human community at Ostional

The contemporary human settlement at Ostional dates from the 1940s (Arauz 1992; March 1992) and a discernible village evolved in the 1950s (Bonilla 1990). Until the 1970s, the population of Ostional grew slowly (Arauz 1992; March 1992) and in 1955 there were only six resident families practising subsistence agriculture (Arauz 1992). March (1992) labelled this the first phase of settlement. Agricultural production was reportedly good and residents claim that there was no distinct dry season (March 1992).

In the early 1970s, a road from Santa Cruz to Ostional was built. This marked the beginning of Ostional's second settlement phase (March 1992), one characterized by population growth. A second factor contributing to growth was the changing regional agricultural landscape. Large-scale livestock ranching began in Guanacaste in the 1950s, but only came to the Ostional region in the 1970s (Edelman 1992). By this time, subsistence farming had suffered from poor planning, lack of technical assistance and soil exhaustion, and many of the small farmers had moved out of the hills and down to the beach (Ordoñez & Zuñiga 1989). Thus, when livestock ranchers arrived, the land was easily transferred into the hands of a few people. Large tracts of trees were cut down and a distinct dry season became visible (March 1992). While the expulsion of *campesinos* (peasants) was a feature of the conversion to ranching throughout Guanacaste province (Edelman 1992), March's (1992) analysis of the origins of Ostional residents suggested that movement to Ostional was part of the campesino expulsion from other places within Guanacaste. Agricultural land had also been converted to livestock ranches in Ostional by the 1970s, but there was a feature attraction to immigrants: the nesting olive ridley turtles and the then illegal egg harvest (March 1992). Population growth slowed in the 1990s, probably due to restrictions on participation in the egg harvest (discussed below). From 1992 to 1993, population growth was 1%, a figure below the national average, and the current population of Ostional is approximately 390 people, in 84 households (Campbell 1997).

Creation of the Refuge and legalization of the project

While long time residents recall arribada nesting in the 1940s, it was unknown to the outside world until 1969, when a US Peace Corps volunteer reported the arribada phenomenon (Richard & Hughes 1972; Ordoñez & Zuñiga 1989; Barboza 1990). In 1970, Richard and Hughes confirmed mass nesting activity via an aerial survey (Richard & Hughes 1972) and the University of Costa Rica set up a research station in Ostional in the early 1970s (Cornelius 1981), run initially by Douglas Robinson. While Pacific Coast residents of Costa Rica do not generally eat turtle meat, they do prize eggs as a source of protein and as aphrodisiacs (Groombridge & Luxmoore

1989). Thus, when nesting at Ostional was 'discovered', egg collection was already a 'time honoured tradition' (Cornelius 1981, p. 215). Villagers were harvesting eggs for sale on the black market, and domestic pigs were let loose on the beach to feed on eggs (Cornelius 1981, p. 215).

Efforts to prohibit illegal egg harvesting at Ostional were made following the 1969 'discovery.' The extreme human poverty in the area and inadequacy of law enforcement made these attempts ineffective, even when members of the *guardia rural* (civil police force) began patrolling the beach in 1979 (Cornelius & Robinson 1983; Cornelius 1985). While the presence of the *guardia rural* failed to stop illegal harvesting, it was successful in enraging the community. Guards allegedly poached eggs themselves and accidentally shot and killed an elderly woman. Resentment was also directed at Robinson and his students, who, local people believed, were tagging turtles on the beach for eventual relocation. Tensions between the community and scientists heightened and climaxed when Robinson's house was burned down (Campbell 1997).

While they resented outside intervention, most local people were unhappy with the illegal harvest, a chaotic activity with individuals scrambling to get the most eggs in the shortest time possible and which resulted in unequal distribution of benefits. Once eggs were collected, egg sellers were commissioned to transport eggs to markets and, if sellers returned claiming their eggs had been confiscated, collectors had no recourse (and no income). Furthermore, the danger of arrest was always lurking, especially post-1979 (Campbell 1997). Thus, in 1981, a small group of residents formed a committee determined to find a rational and scientific argument for a legalized egg harvest (Ordoñez & Zuñiga 1989; Barboza 1990). By this time, Robinson had seen the extent of egg loss at the beach which was as high as 30% due to direct destruction of nests by other turtles (Cornelius 1981). Robinson had proposed a regulated egg harvest in 1977, but was defeated after a lengthy debate in national newspapers (Cornelius 1981). In 1984, biologist Peter Pritchard sought the opinions of international marine turtle biologists on Ostional and almost all who responded were in favour of a regulated harvest (Pritchard 1984). Thus, by 1985, the local community and national and international scientists were eager to find a mutually satisfactory solution.

Ostional was designated a protected area in 1981 ('Executive Decree' 13200-A. 15 December 1981) and declared a Wildlife Refuge in 1983 ('Wildlife Conservation Law' 6919. 17 November 1983) (Salazar 1991). Law 6919 allowed for a limited, commercial sale of animal products from the Refuge provided that: (1) scientific study justified use; and, (2) community members formed a legal development association. The scientific justification for the harvest is described above. In November 1994, the community met the second criteria, when the 'Association for the Specific Development of the Rational and Scientific Exploitation of Marine Turtle Eggs at Ostional, Santa Cruz, Guanacaste' was formed (Cordero 1992). Recognizing the need to reduce

economic dependence on the egg harvest, the Association broadened its mandate in 1987 to include all development issues and shortened its name to the 'Integrated Development Association of Ostional' (hereafter the Association) (Alvarado 1987).

Legal, administrative and membership structure of the project
 'Wildlife Conservation Law' 6919 is the principal law guiding egg harvesting in Ostional and in Costa Rica. However, once the two criteria outlined in it were fulfilled, other laws had to be changed to allow for legalized egg collection, distribution and sale, to regulate the harvest and the distribution of profits, and to assign administrative responsibilities. Thus, the first entirely-legal egg harvest took place in October 1987 (Salazar 1991). Laws pertaining to marine turtle conservation and use in Costa Rica are summarized in Table 1.

Three national institutions have responsibilities related to the project. The Wildlife Directorate of the Ministry of Environment and Energy (MINAE) is responsible for the Ostional Wildlife Refuge (and for all wildlife refuges protected nationally). The Institute of Marine Fisheries (INCOPECA), which is part of the Ministry of Agriculture and Livestock (MAG), is responsible for overseeing the administration of the project, while the Association for Rural Economic Development (DINADECO) is the government liaison with the Ostional Association. During the course of this research, none of these agencies maintained a presence in Ostional. A MINAE ranger was stationed in Ostional as of early 1996, in order to charge the National Wildlife Refuge entrance fee to visiting tourists.

The day-to-day running of the project is managed by a *Junta Directiva* ('Board of Directors', hereafter the Junta) of the Association. Associates elect eight Junta members at the Annual General Assembly. Any associate can run for a Junta position regardless of age or sex, and men and women covering a range of ages have filled these positions successfully. Individual Junta members can only serve two consecutive terms and the Junta is elected for a four-year period. However, a new election can be called at the Annual General Assembly if associates are unhappy with leadership. Throughout this research, the Junta was plagued by turmoil, and accusations of embezzlement, incompetence and favouritism were rife. As a result, the Junta changed three times and special arrangements were made with DINADECO to facilitate this. While the level of intracommunity conflict appeared unreasonably high, it was apparently normal and the Junta is often re-elected annually (Campbell 1997).

Mechanics of the egg harvest and associated activities

By law (Table 1), commercial egg harvesting is permitted at the main nesting beach (Fig. 1) during the first 36 hours of wet season arribadas (May to November). In effect, harvesting takes place for approximately four hours on the second and third mornings of an arribada. During the dry season, harvesting is unlimited, as local reports and subsequent

Table 1 Legal framework for marine turtle protection and use in Costa Rica. Sources: Salazar 1991; Cordero 1992.

<i>Law</i>	<i>Function & attributes</i>
<i>Laws pertaining to marine turtle protection in Costa Rica</i>	
'Fish & Maritimes' Law 190, Article 28 28 September 1948	Prohibits commercial capture and sale of marine turtles and their eggs, and the destruction of nests
'Wildlife Conservation' Law 4551 1966	Prohibits non-commercial collection of marine turtles and their eggs
<i>Laws pertaining to the project</i>	
'Wildlife Conservation' Law 6919 17 November 1983	Allows for legalized egg harvest at Ostional provided it is scientifically justified, and that the community form a legal development association under the 'Association for Rural Economic Development' (DINADECO) Project can be halted with new scientific evidence, or due to mismanagement Gives Wildlife Directorate of Ministry of Environment and Energy (MINAE) authority over the Ostional Wildlife Refuge
Decree 15403-MAG 10 April 1984	Authorizes egg harvesting in Ostional Gives the Institute of Marine Fisheries (INCOPECA) within Ministry of Agriculture & Livestock (MAG) authority over the project
DINADECO Registration 3-002-087421-29 24 November 1984	Registers the Ostional Association as a legal community development association
'Promotion of Agricultural Production' Law 7064, Article 55 29 April 1987	Exempts Ostional from Law 190, provided that the commercial collection and sale of eggs is undertaken in accordance with a management plan supported by scientific investigation, and is renewed yearly Requires that all harvesting be overseen by a biologist
'Commercialisation' Law 17802-MAG 13 October 1987	Outlines distribution of project profits (80% to the Association, 20% to MAG) Outlines regulations for harvest, re: times of collection, area of collection, and so on
Decree 20007-MAG 1 November 1990	Revises regulations for harvest outlined in Law 17802-MAG
Creation of Wildlife Refuge at Tamarindo, Law 7149, Article 3 1991	Revises distribution of project profits outlined in Law 7064 (60% to the Association, 40% to MAG)

studies indicate negligible hatchling success rates due to high sand temperatures (M. Alvarado Ulloa, letter to MAG 24 November 1988; C. Schwarten, personal communication January-March 1995). Following the commercial collection, associates harvest eggs for personal consumption (100 per family) and a limited number of collection permits are given to non-members and to families from outside of Ostional. The number of eggs harvested under the project is less than the number harvested before legalization; Hartshorn (1982, p. 41) put the number of eggs taken illegally as 'practically all of them'. Although this seems inconceivable given the volume of eggs laid, Robinson predicted that continued illegal and irrational exploitation would reduce the number of nesting turtles by 50% in 10 years (Hartshorn 1982). Under the legal harvest, approximately 20-30% of the eggs laid are harvested in the dry season, and 3-15% in the wet season (Ballesteros & Ordoñez 1991).

Egg harvesting occurs under the supervision of a biologist, as required by law (Table 1), although during the course of this research, the biologist was sometimes absent. Work is organized around single-sex groups of ten, headed by an appointed chief, who changes yearly. Once harvested, eggs are stored at the egg collection centre, a structure built by the

Association, until packaging begins. Eggs are packaged on the beach, in bags of 200. These are labelled Ostional bags, which theoretically helps to distinguish their contents from illegal eggs collected at other beaches; undermining of the black market for eggs at the national level is an additional objective of the project.

Eggs are distributed nationally by the Association. There are nine routes, each worked by an egg seller and a driver. Egg selling contracts are awarded yearly, traditionally to associates from the most needy families. Contracts are highly lucrative, as sellers purchase bags of eggs from the Association for 800 *colones* each (equivalent to US\$6.15; US\$1=130 *colones* in March 1995) and re-sell them for 1200 *colones* (US\$9.23). Profits range from 40 000 *colones* (US\$308) to 90 000 *colones* (US\$693) per *arribada*, which are split between the seller and the driver. Driving contracts are also theoretically rotated, but the few people with suitable vehicles tend to keep them from year to year.

As part of the project, associates undertake activities to help ensure the long-term presence of the turtles. Firstly, garbage is collected from the beach once a month, to reduce barriers encountered by emerging hatchlings on their crawl to the sea and to reduce plastic ingestion by adult nesters.

The overall value of this activity is undermined by the lack of garbage disposal in Ostional. Secondly, hatchling 'liberation' occurs approximately 45 days after an arribada when eggs hatch and hatchlings enter the sea. Associates patrol the beach during this time and 'escort' hatchlings to the surf, thus keeping predators (mainly vultures and ghost crabs) at bay. The environmental value of this activity is questionable, however, due to the manner in which it is carried out. 'Escorts' grow impatient and, once there are signs of emergence, they dig up nests and carry hatchlings to the water to speed the process along. This is problematic, as nest emergence is a temperature-regulated activity requiring the coordinated digging of the hatchlings and taking place over several days (Carr 1981), and 'liberation' activities short-circuit this natural process. The local biologist has tried to modify 'escort' behaviour, with limited success. However, very few hatchlings emerging in daylight would survive if left alone, due to high levels of daytime predation on land and in water (Cornelius 1985). Thus, the activity probably does little harm.

The Association also undertakes activities to discourage illegal harvesting of eggs. Local male associates are paid to guard the beach during peak nesting periods and illegal harvesting by community members is punished via fines or temporary suspension from the project. As part of the agreement legalizing the project, local people keep domestic animals off the beach.

Participation and distribution of benefits

When the Association was formed, any man or woman who had been resident in Ostional for five years and who was over the age of 15 was allowed to join. To discourage immigration, a stipulation was made that people moving to Ostional could only join after living there for 5 years and paying a membership fee of 10 000 colones (US\$77). Children of associates could also join when they turned 15 and a membership ceiling of 150 associates was set. Once the ceiling was reached, membership was supposed to be closed to outsiders and open to children of existing associates only if they were replacing a dead parent. The membership maximum was increased to 200 in the 1991 Management Plan (Ballesterio 1991), at which point 40 of the 200 spaces remained (i.e. the original 150 had already been exceeded by 10). These remaining spaces were reserved for children of members only, with outside membership closed. Nevertheless, as of December 1994, 220 associates existed. Most associates now joining are children of existing ones, but exceptions have been made for spouses of associates.

Profits from egg harvesting are divided as follows. Firstly, 40% of profits are paid to the government (INCOPECA). Thirty per cent of the remaining profits are used to cover Association operating-expenses and to finance community projects. All associates are paid equally for hours worked on the beach from the remaining profits. Associates who become too old or too infirm to work on the beach retain their membership and are paid half salaries. Pregnant women are

excused from heavy work on the beach and are paid their full salaries. Associate wages are deducted for failure to comply with rules or to complete work. Fines include showing up for work late or drunk, gossiping or fighting on the beach, and fighting while leaving the beach. Fines are set by the Junta, and while the need to penalize people for behaviour such as fighting undermines the often-promoted image of the 'happy community co-operative' (e.g. Ordoñez 1994; Ballesterio *et al.* 1995), the system appears to work. During the present study, rules were accepted and fines treated as a fact of life.

Community buildings financed by project profits include an egg packing centre, a laboratory and living quarters for the biologist, a house for schoolteachers, a health and nutrition centre, a multi-purpose community building and a kiosk for tourism guides. Project profits are also used to purchase food for the health and nutrition centre, which provides hot lunches for school-age children, and the Association paid for the extension of electricity to Ostional in 1993.

Summary of the egg harvest project

The above description of the project outlines several features that increase the likelihood that egg harvesting in Ostional will prove sustainable. There is an overall legal framework in which the harvest takes place, and which enhances and protects environmental, economic and social benefits of the project. During this research, there were problems with almost all areas of the project, i.e. the value of some of the protection activities was questionable, there was pressure to increase membership, there was some inequity in distribution of profits, and there were seemingly high levels of intracommunity conflict. Nevertheless, the established controls in the project appear to go far in contributing to its sustainability.

Community perceptions of the project

Whether or not the established controls actually do go far in contributing to the project's sustainability, and whether or not the cited problems detract from sustainability, however, will be influenced by community perceptions of both benefits and disadvantages associated with the project. The present study therefore sought information on the community's perceptions of the project and its impacts.

Methods

Field research was undertaken from October 1994 through March 1995 and July/August 1995 inclusively. The results presented in this paper are based primarily on data obtained via in-depth interviews as well as via a household questionnaire, although observations based on living and working in Ostional for eight months are included where relevant.

In-depth interviews

In-depth interviews (interviews) were conducted in November/December 1994. Nineteen Ostional residents

(representing 10% of the adult population) were interviewed in order to, firstly, identify issues of current importance in the project, and secondly, to explore qualitatively a range of perceptions and priorities regarding the project. Interviews also informed the development of the household questionnaire.

Individual interviewees were selected primarily because of their prominent roles in the project (e.g. current or past members of the Junta). Other interviewees included community members active in tourism, an additional facet of this research described elsewhere. Finally, individuals less involved in both the project and tourism were interviewed to cover a range of possible views. In total, 16 project associates and three non-members were interviewed. Seven interviewees were currently or had been members of the Junta and two received additional income from the project as egg sellers/drivers.

Interviews were undertaken after the author had been resident in Ostional for five weeks and the community had been informed of the purpose of the research at a general community meeting. Interviews were semi-structured and participants were guided by broad questions on topics including: the positive and negative aspects of the project, who benefits from the project and how these benefits can be increased, future visions of the project, and how the project impacts on the community and the turtles. Interviews were also a source of general background on the project. Interviews were conducted in Spanish, with the assistance of a non-local translator, and lasted from 20–75 minutes. All interviews were taped, and later translated and transcribed. They have been thematically mapped to allow for analysis of individual argument structure and contradictions and for comparison between interviews.

Household questionnaire

Due to the small size of Ostional village, a survey of all households was attempted in February and March 1995. According to local definitions of Ostional's geographic boundaries (which define household eligibility to participate in the project), the Ostional community is made up of 84 households. Fifty-two of these are grouped together in the village (within 1 km of the town centre) and 32 lie along the main road in either direction from Ostional and in outlying farms. Of the total 84, 76 were surveyed (91%). Households were missed due to unavailability of the occupants at the time of surveying. While households in the village could be revisited, those outside were visited only once. One household in, and seven out of, the village were missed.

Households were defined by physical dwelling. With an average household size of 4.5 people per dwelling (mode=5), this definition was appropriate. Questionnaires were conducted with either the female or male household head, and the sex ratio of respondents was 2:1, women to men. The average age of respondents was 38, and the average education level was five years of primary school. Respondents had lived in Ostional for an average of 24 years, although this varied

greatly, with the longest residing respondent having lived there for 55 years and the newest for less than one year. The majority of respondents (90%) were members of the project.

Questionnaires were administered in Spanish with the assistance of a bilingual research assistant who recorded answers. Household questionnaires were conducted to: (1) acquire general household socio-economic data; (2) rank opinions on the economic social and environmental impacts of the project; (3) measure perceptions of sea turtle protection activities; and (4) determine opinions on Ostional's economic future. For ranked opinion questions, respondents were given choices of 'very good', 'good', 'neutral', 'bad', 'very bad' and 'don't know' and were asked to explain their answers qualitatively. Other specific questions relevant to this paper included those asking respondents to: (1) identify the 'best' and 'worst' things about the project, (2) comment on future levels of egg harvesting, and (3) comment on membership in the project.

Statistical analysis of questionnaires was restricted predominantly to calculating response percentages. This was done to get an overall impression of community perceptions and, as will be seen in the discussion of results, there was a high level of agreement on most issues. Systematic differentiation in the community according to sex, age and socio-economic indicators was not evident in analysis of questionnaire results.

Results

Impacts of the project on the economy

While Ostional's economy was originally based on subsistence agriculture (March 1992), egg harvesting is now the most important economic activity. Project legalization had the effect of distributing the benefits of egg harvesting more widely and of providing increased income security. In 1992, 60% of households identified egg harvesting as their most important economic activity and 31% identified agriculture (March 1992). In 1995, 70% and 22% of questionnaire respondents thus identified egg harvesting and subsistence agriculture, respectively, and most respondents (62%) reported a total of three economic activities important to the household economy (including subsistence agriculture), 7% of respondents reported one, and 32% reported two.

Salaries paid to associates ranged from 5000 colones (US\$39) to 10 000 colones (US\$77) per arribada during the present study, for approximately 12–15 hours worked in the harvest and four hours worked in additional project activities. These salaries were greater than the wages paid in agriculture (700 colones [US\$5.40] for five hours labour) and construction (2200 colones [US\$17] and 1500 colones [US\$11.50] for 10 hours skilled and unskilled labour respectively) during the 1995 field season. Employment in these activities was seasonal, fluctuating and available only to men, and only 12% and 3% of questionnaire respondents (often, but not always, non-members) identified these as their most important economic activities. Thus, the value of the egg harvest to

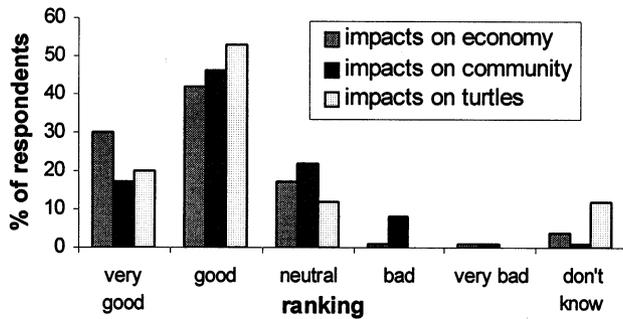


Figure 2 Perceptions of impacts of the project on the economy, the community and the marine turtles.

households, particularly those with multiple associates, was substantial. While most households had two associates (average = 2.2), one household had six associates.

Support for the project as expressed in both interviews and questionnaires was high and not surprising given the extent of economic dependence reported by households. Seventy-two per cent of questionnaire respondents ranked the impacts of the project on the economy as positive ('good' and 'very good') (Fig. 2) and most (61%) justified this in terms of the project as a source of income and work. Positive perceptions of the economic impacts were reaffirmed when 24% of respondents identified money or work as the 'best' thing about the project. Seventeen per cent of respondents ranked impacts as 'neutral' (Fig. 2) and justified this because they felt that the amount paid to associates was not enough, or just adequate. The few respondents (3%) ranking impacts as negative (Fig. 2) were concerned about dependence on the project and the small amount of time spent in actual labour.

It was expected that non-members would be more critical of the project's economic impacts than associates. This was not the case, however, and all non-members ranked the impacts as positive. The primary reason cited for this was that money in the village as a result of the project supported the economy in general and that this impacted positively on them.

Impacts of the project on the community

Interviewees emphasized the distribution of benefits throughout the community, and five interviewees referred to generally-increased standards of living as the key benefits of the project. Specific community-linked advantages cited were public works paid for by the Association, the village's independence from the government, the social aspects of working together, the opportunities for village improvement, and the sense of unity and history in the village. Two interviewees also identified negative community impacts, firstly, that including college-age children in the project discouraged continued schooling, and secondly, that by paying young adults a considerable salary for work requiring little time, the project negated incentives to find other work and the free time encouraged anti-social behaviour. A more general com-

plaint was made regarding the use of money to purchase alcohol.

Community benefits of the project were key for 20% of questionnaire respondents who listed community-related impacts (unity in the village, equitable distribution of benefits, construction of community buildings) as the 'best thing' about the project. Given the importance of community aspects of the project to interviewees and the identification of these as the 'best thing' about the project by questionnaire respondents, respondents' justifications for positive rankings of community impacts were surprisingly vague. While 63% of respondents ranked the project as impacting positively on the community (Fig. 2), most respondents were non-specific in justifying their answers. While 30% of respondents referred simply to 'unity' to explain their positive rankings, 24% identified 'lack of unity' and 'problems with the Junta', i.e. negative impacts, sometimes in spite of a positive ranking. These conflicting views suggested that community control over the project was a 'double-edged sword.' While independence and control over the project were highly valued, they also contributed to internal turmoil.

Impacts of the project on the turtles

Eighteen interviewees suggested the project was good for the turtles, although, in most cases, this had to be prompted (e.g. does the project have any impact on the turtles? Does it do anything good or bad for the turtles?). As evidence, five interviewees offered scientific justification based on natural egg loss and hatchling success rates, and three interviewees identified the care the village extends to the turtles via beach cleaning and hatchling liberation. Two interviewees insisted the project must be good for the turtles, as there are presently more turtles than there were in the past. Two respondents also identified the diversion of project profits to support biological research as impacting positively on the turtles. Only one interviewee, a non-member, opposed the harvest and specifically did not believe the scientific arguments for harvesting.

Household questionnaires revealed a high level of awareness regarding protection activities. When asked what the community does to protect the turtles, only 9% of respondents were unable to identify any activities. Seventy-nine per cent identified hatchling liberation, 24% beach guarding, 18% beach cleaning and 17% predator control. Respondents were also willing to undertake further protection activities. Sixty-seven per cent thought the community should be doing more to protect the turtles, while only 5% believed protection activities should decrease. The high level of support for increasing protection should be seen in the context of project regulations. Associates are not paid extra for these activities, but they are fined if they fail to show up for work assignments. Thus, willingness to do more work was not based on a desire for more money. Rather, respondents justified their answers in terms of the importance of the turtles to them and the need to care for the turtles to ensure continued nesting.

Household questionnaire results revealed overwhelming agreement in the community as to the impacts of the project on the nesting marine turtles (Fig. 2). However, while well over the majority of respondents identified the project as 'good' for the turtles (73%), far fewer (28%) identified specific protection activities to justify their opinions. That respondents identified activities when asked specifically what they did to protect the turtles, but failed to associate activities with positive impacts of the project on the turtles, suggested that a full understanding of the links between project activities and the health of the turtle population was lacking.

Future levels of egg harvesting

The possibility of increased egg harvesting was raised independently by five interviewees and justified in terms of membership pressures. Eighty-seven per cent of questionnaire respondents supported an increase and, given the high level of economic dependence on the harvest and the generally positive attitudes towards its impacts, this support was expected. Justification was described mainly in terms of monetary benefits and increasing these for each member (56% of respondents). Any hesitation about increasing harvesting levels was expressed in terms of market and legal restrictions on doing so, rather than on environmentally necessitated restraint. On the contrary, environmental factors were used to support more collecting and, to this end, 20% of respondents cited the continued destruction of eggs by nesting turtles and low levels of dry season hatchlings. Support for increased collection was also justified in terms of membership pressures (11% of respondents).

Discussion

Interview and questionnaire respondents perceived economic, community and environmental benefits of the project. While individuals also identified problems with the project, these were presented in the context of overall and overwhelming support for it, with few exceptions. Positive perceptions enhance the likelihood that the project will prove sustainable from both an environmental and socio-economic perspective.

From an environmental perspective, existing scientific evidence supports the harvest. This research did not attempt to evaluate the scientific justification, however, being more concerned with the socio-economic components of the project that contribute to the overall goal of environmental sustainability. To this end, there are three key points. Firstly, associates undertake and fund protection activities and thus there is a direct link between profits from egg harvesting and marine turtle conservation. Secondly, associates identify and are proud of protection activities and link them to the long-term survival of the marine turtle population. Thirdly, the project's legal framework requires continuous scientific evaluation of the harvest and its impacts and allows for suspension/cancellation if new evidence proves the harvest is

damaging the olive ridley population (although enacting this would prove difficult, if not impossible).

In terms of socio-economic sustainability, which was the key concern of this paper, there was substantial support for the project throughout the community. Support resulted primarily from the significant monetary benefits derived from egg harvesting. Other elements that complemented economic benefits and enhanced support for the project included the legal and administrative frameworks and the high level of community participation. The positive and negative features of these three elements are discussed in-depth below.

Legal structure

Neither interviewees nor questionnaire respondents were asked directly about legal aspects of the project. Nevertheless, it became evident that the legal framework was critical to the community's sense of security regarding the project. This security in turn allowed for reinvestment of profits into both community development and marine turtle conservation. Legal issues were raised independently in both interviews and questionnaires, particularly by respondents who were, or had served, on the Junta. For example, a former Junta president emphasized the security of income provided via legalization and the important role legalization played in legitimizing livelihoods in the eyes of the community. In questionnaires, 5% of respondents identified the project's legality as the 'best' aspect of it, 4% explained their positive rankings of the project's economic impacts in terms of the legal source of income it provided, and 1% believed the legality of the project protected it from outside opposition. The low level of explicit attention to legal issues may have resulted because the legal structure was taken for granted. Nevertheless, some respondents expressed concern regarding problems with the Junta and how the government might respond to these in the long term.

Administrative structure

The legally-mandated role of the community, and specifically of the Junta, in administering the day-to-day operations of the project was key to providing a sense of project ownership. This in turn encouraged adherence to rules and community self-policing, reinvestment of profits into community development, and increased management capabilities in both individual associates and in the community as a whole.

The administrative role of national agencies with responsibilities in Ostional was less obviously beneficial. Responsibilities were spread out between agencies, there was little sign of coordination between them, and none of them maintained a permanent presence in Ostional throughout this research. MINAE has since increased its involvement in Ostional, via provision of a ranger to work in the Refuge. The potential benefits from this include: additional resources for Refuge protection, an outside authority figure at which to redirect and thus diffuse internal community conflict, and the introduction of a by-law requiring that tourists be accompanied by paid local guides when viewing the turtles.

Such by-laws are used at other Costa Rican nesting beaches, i.e. Las Baulas de Guanacaste National Park (Naranjo & Arauz 1994) and Tortuguero National Park (Jacobson & Robles 1992).

Whether or not benefits will arise from increased government presence and how they would be traded-off against loss of independence remains to be seen. Independence in the management of the project was highly valued by the Ostional community. A sense of pride in the community's self-reliance was expressed in interviews and questionnaires, as was disdain for government representatives who visit Ostional sporadically and take credit for the project's success. Nevertheless, some local people did blame problems arising with management on the absence of a government representative. The role of government in addressing internal problems was illustrated when DINADECO was called in to Ostional to organize a special session of the General Assembly, as described above.

Lack of government involvement in Ostional has existed in spite of the 40% of project profits paid as tax. Originally under Law 7064 (Table 1), this tax was to fund conservation efforts in Ostional and elsewhere, including Ostional's research station and beach guards (Cornelius 1985). While Law 7149 (Table 1) removed this stipulation, there was evidence that taxes were never used in Ostional. Interviewees and questionnaire respondents denied receiving any aid from the government and the Association's financial records supported this. Expenditure accounts for 1991 included the biologist's salary and house, research station maintenance, and guard salaries (Ballesteros & Ordoñez 1991). The government has proposed a further revision that would require taxes to be paid before Association expenses are deducted (C. Niven, personal communication 14 September 1996). At the time of this research, only three community members were vocally critical of the tax paid to the government. If the new revision is passed, community dissatisfaction with this tax is likely to increase.

Community participation and control

Community participation in the project is ensured via law, and Ostional's Association has operated as an inclusive, democratic organization, which treats its associates more or less equally. March (1992) concluded that, because of the Association, the Ostional community enjoyed unusually high levels of participation and democracy, in contrast to other rural Costa Rican villages. Nevertheless, inclusion goals could pose problems for the project in the long term. Firstly, the Association has proven reluctant to close project membership. Rather than enforce existing regulations, its policy has changed as membership capacity has been reached. At the time of the present study, there were 37 children of associates between the ages of 11 and 14. Twenty-eight per cent of questionnaire respondents thought that their children would join the Association, 39% said they might join, and only 9% said they could not join because membership was full. Those who felt their children would join believed it would be unfair

to exclude children reaching membership age due to the lack of employment alternatives. Increased membership will mean either less money per associate or an increase in the number of eggs collected. The former might be resisted by community members and the latter by biologists and government officials.

The hesitancy to close membership was also a reflection of the high level of economic dependence on egg harvesting. Eighty-seven per cent of questionnaire respondents believed that egg-harvesting levels should increase to provide more money per associate and to allow more associates to join the project. The problems of dependence were acknowledged explicitly by some interviewees and questionnaire respondents and implicitly by over two-thirds of the latter; 67% of questionnaire respondents identified additional economic activities they would like to see in Ostional, and 20% emphasized that any additional activity would do. The Association has tried unsuccessfully to diversify activity, for example through attempts to purchase land for communal farming (Ordoñez 1991). Tourism was considered a potential development option by interview and questionnaire respondents, but it is unlikely to have the same community-wide benefits and that could impact negatively on the turtles and on the community (Campbell 1997). Due to a severe oceanic undertow and lack of fishing vessels, exploitation of other marine resources had not been considered.

While there were many complaints about the Junta based on the problems which were continuing at the time of this research and described above, these must be seen in context. Firstly, there was a high level of overall support for the project and only one of the interviewees believed the project should be stopped. Secondly, dissent in the community was common and generally accepted. Most respondents described dissent as 'natural' when dealing with more than 200 people; this theme was commonly raised and the phrase 'every head is its own world' was popular. The way in which tensions rose and were then diffused was beyond the scope of this research. The community also exercised considerable control over the project, its regulations, and how profits from it were spent. Thus, willingness of associates to comment on difficulties may have reflected beliefs that these could be solved, or at least that there was no danger in expressing them. In this light, conflict was a reflection of empowerment rather than a portent of disaster.

Regardless of how 'normal' intracommunity conflict was in Ostional, a practical drawback was that the job of a Junta member was increasingly seen as thankless. This, combined with restrictions on individuals holding a Junta position for more than two terms, meant it was becoming difficult to find competent associates willing to stand for election. There were several community leaders who had proven themselves in project management and whose names were mentioned time and again by interviewees and questionnaire respondents, but who had served their maximum terms on the Junta. In the long term, it might be best to allow these leaders to continue to work on the Junta, provided that the community is willing

to elect them. However, this would reduce the element of equity in the project and would challenge the romanticism attached to community-based conservation and community participation dialogues.

Conclusions

In spite of the many difficulties with egg harvesting in Ostional, three main strengths were identified. Firstly, the project provided secure and significant benefits to local people and local people perceived these as such. Secondly, it contributed directly to wildlife conservation, through voluntary and paid conservation activities. Thirdly, it empowered local people in resource management and use, which had spin-off effects in other areas, for example reinvestment of project profits in community projects, general respect for rules of harvesting, and community-led efforts to diversify the Ostional economy.

As stated at the outset, attempts to use wildlife must be considered on a case by case basis, to account for the biological needs of the species in question and for the socio-economic, political, historical and cultural features of the user community. Nevertheless, four general conclusions can be made based on the Ostional experience, which may be more widely applicable to attempts to reconcile conservation and development objectives.

(1) This research reinforces the importance of providing substantial and secure economic benefits to communities when implementing wildlife use regimes. In Ostional, these characteristics have combined to allow for reinvestment of profits into community development, have promoted an equitable approach to profit distribution, and encouraged respect for rules as individual and collective stakes in the project are high enough to discourage illegal harvesting and to encourage community self-policing;

(2) While security is crucial to the socio-economic health of the project, it has not been provided through resource ownership. The Ostional case demonstrates that there are alternative arrangements for providing security when dealing with common property resources, which are equally effective in encouraging individuals to respect rules of harvesting and to work communally towards common goals. In this case, security is provided via an extensive legal structure that mandates the participation of the local community. Project rather than resource 'ownership' was important, and many interviewees and questionnaire respondents stressed that the turtles were not their property.

(3) More in-depth consideration of catch-phrases like 'community based conservation' is needed. Community participation and community based conservation are terms which have now proliferated in the conservation literature, but are ill-defined (Wells & Brandon 1992; Little 1994; Western & Wright 1994) and have arguably been romanticized and over-simplified. Communities are seen as either working together or not, projects are successful or not. The present study has revealed a complex community, which is

both empowered and disrupted by the egg harvest project. These findings do not invalidate the project or undermine conservation activities, but rather provide a more accurate and realistic vision that can help in management decision-making.

(4) This research re-emphasizes the importance of integrating the scientific and socio-economic aspects of wildlife conservation programmes. Further and more rigorous scientific assessment of Ostional's egg harvest and its impacts on hatching success rates in particular is desired by many marine turtle biologists (Campbell 1997). To believe that such study could ever stop the egg harvest would be naïve, as there would be extreme local opposition. Halting the harvest would also be undesirable, as the socio-economic impacts would be intolerable; even if an alternative income generating activity became available it would be unlikely to have the same community-wide benefits or to encourage the high level of community empowerment. Nevertheless, improved understanding of the dynamics of Ostional's arribada beach could lead to more effective management. For example, evidence that hatching success rates have improved could support increased egg collection. Alternatively, evidence suggesting that one part of the beach was more productive of hatchlings than another might lead to a spatially-differentiated harvesting strategy. Thus, increased study could in fact solidify scientific support for the project and increase project security.

The ultimate test of the overall sustainability of egg harvesting in Ostional will be whether or not marine turtles continue to nest in arribadas, although other factors beyond the immediacy of the project, such as turtle drownings in shrimp trawls, may influence this. Thus, in the absence of environmental sustainability, the socio-economic aspects of egg harvesting in Ostional become irrelevant. Much of the debate in the IUCN regarding sustainable use, and the main source of resistance to it, has been based on the biological difficulties with determining species- and population-specific harvesting rates (S. Edwards, personal communication 26 February 1996; Prescott-Allen *et al.* 1994). To this end, many marine turtle biologists argue that Ostional cannot be replicated elsewhere because of the uniqueness of arribada nesting (Campbell 1997). These concerns are valid and the focus of this paper on socio-economic aspects of egg harvesting is in no way meant to deny this environmental reality. Nevertheless, as with traditional, exclusionary conservation efforts, socio-economic issues may prove equally if not more important than biological aspects when dealing with wildlife use regimes. In many instances, strict preservation is not an option, due to practical and/or philosophical constraints, and understanding what socio-economic elements can contribute to increasing the likelihood that harvesting regimes will prove sustainable remains critical.

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