

BIOLOGY AND
CONSERVATION OF
RIDLEY SEA TURTLES

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Understanding Human Use of Olive Ridleys

Implications for Conservation

OLIVE RIDLEY SEA TURTLES (*Lepidochelys olivacea*) are used widely by humans, on land and at sea, and the implications for olive ridley populations are considered in Chapters 12 and 13 of this book. Here I consider the context of olive ridley use, that is, its economic, political, social, and cultural aspects, and is based on published and unpublished results by researchers working in a variety of disciplines. Although understanding the context of use is increasingly recognized as important, there is relatively little published research related to sea turtles (Campbell, 2003). Here research is distinguished from project descriptions or reports that reflect on the context of sea turtle use rather than the study of the subject.

The purpose of this chapter is to (1) highlight some of the socioeconomic research on olive ridley use and, in so doing, draw attention to the contributions from a variety of social science disciplines and (2) look for common themes arising from what is most often site-specific research, which may inform attempts to conserve olive ridleys and sea turtles more generally. The chapter does not attempt to assess whether olive ridley use is biologically sustainable but rather considers economic, political, social, and cultural aspects of use that influence human response to conservation programs, be they designed to ensure use is sustainable or to eliminate use altogether.

The definition of conservation adopted in this chapter is that of the World Conservation Union: “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). In this definition, sustainable use is considered a legitimate component of a conservation strategy, and an assumption in this chapter is that if use is to be sustainable, the human context of it must be fully understood. In only one of the case studies discussed is there some agreement that use might be biologically sustainable (egg collecting at Ostional, Costa Rica), and biological sustainability will ultimately influence whether humans can or will continue to derive benefits from such use. The issues are clearly linked, however, and should biologically sustainable extraction rates be identified, then social, economic, political, and cultural issues will determine whether these rates will be respected by resources users. Thus, although this chapter considers only part of the use equation, it is an important part.

The IUCN definition of conservation is not shared by all sea turtle biologists, and the idea that turtles can be used consumptively in a sustainable manner, as opposed to nonconsumptively—for example, via tourism—has been a controversial one in the IUCN Marine Turtle Specialist Group (Campbell, 2002). The possibilities for use are different for olive ridleys than for other sea turtle species for two reasons. First, the olive ridley is the most abundant of all sea turtle species (Pritchard, 1997a). Second, some olive ridley populations have mass nesting behavior and gather to nest in the thousands in what are referred to as *arribadas* (see Bernardo and Plotkin, Chapter 4). On arribada nesting beaches, high nesting densities and related high levels of egg loss can justify egg collections; if eggs are not harvested, they are likely to be destroyed by later nesters. At sea, turtles aggregating for arribadas off the Pacific coast of Mexico were legally fished until 1990, with their dense concentrations making fishing relatively efficient (high catch rates per unit effort). Although few biologists would consider the capture of reproductively active females to be consistent with conservation, egg collecting on arribada beaches has received some support (Mrosovsky, 1983; Pritchard, 1984; Cornelius et al., 1991; Mrosovsky, 1997, 2001).

This chapter focuses on olive ridleys nesting in or aggregating offshore for arribadas (with one exception) at various locales in Latin America (including Suriname). The justification for this focus is twofold. First, although a second ridley species, Kemp's ridley (*Lepidochelys kempii*), is also known to nest in arribadas, the small numbers of Kemp's ridleys and their critically endangered status make it inappropriate to compare conservation options for Kemp's and olive ridleys. Furthermore, whereas Kemp's ridleys were exploited historically, existing nesters are protected, and human use of them is prohibited. Second, although olive ridleys nest in arribadas in other regions (and a particularly large aggregation nests in Orissa, India), the Latin American focus reflects the interests and expertise of the author and the geographic focus of the majority of published research on the human context of use.

The chapter is structured around case studies, the approach taken in most existing research. As a result, the descriptions below sometimes rely heavily on one piece of work, and basic information on methods used in the work is provided to the reader. There is an imbalance in the treatment of specific cases, based on the extent of the research conducted and its accessibility. For example, research published in graduate theses is described in more detail than that available in more readily accessible publications. The final section of the chapter outlines some of the common themes or lessons that emerge from the case studies.

Mexico: Economics of Turtle Fishing and Egg Collecting

Historically, olive ridley turtles nested in arribadas at several beaches along the Pacific coast of Mexico. Egg use has been illegal in Mexico since 1927, but use of olive ridley turtles was legal until 1990 (Trinidad and Wilson, 2000). Turtles were taken for both meat and leather, and there has been research on the impacts of harvesting on population numbers and responses since turtle capture was banned in 1990 (Márquez-M. et al., 1996; Ross, 1996; Godfrey, 1997; Pritchard, 1997b). Although many of the beaches no longer host arribada nesting, the phenomenon continues at Escobilla, Oaxaca, and illegal use of both

eggs and turtles is believed to be widespread. From 1995 to 1998, the Mexican enforcement agency, Procuraduria Federal de Protección al Ambiente (PROFEPA), seized approximately 1,000–8,000 kg of turtle meat, 100–1,800 units of turtle leather, and several hundred dead and live whole turtles each year in Oaxaca (species not specified). In the same period, approximately 300,000–600,000 turtle eggs were seized each year (Trinidad and Wilson, 2000). It can be assumed, given enforcement constraints described below, that these figures reflected only a portion of the actual take.

Trinidad and Wilson (2000) considered the economics of egg and turtle use in Mexico and its legislative context. They argued that traditional economic models for understanding illegal activities, both outside the legal fishery when it existed and generally since the ban, are insufficient. Such models are based on theories of crime and punishment and assume fishermen are “rational, amoral, and apolitical profit maximizers.” Rather, Trinidad and Wilson (2000) posed illegal behavior as a result of decoupling the political process of sea turtle conservation from the resource users themselves. To this end, they reviewed changes in legislation over time (for both conservation and industrial development) “to understand the economic history of the management failure” (Trinidad and Wilson, 2000). They also considered the economic context of egg harvesting and constraints on enforcement activities. Trinidad and Wilson (2000) relied on interviews conducted in the summer of 2000 with fishermen, egg collectors, government employees, egg and turtle consumers, and researchers (although details on methods—e.g., number of interviews, their structure, methods of data analysis—were not provided). In addition, they reproduced data published by Mexican researchers in technical reports to support their argument.

Turtle Fishing

Industrial fishing for turtles on the Pacific coast of Mexico began in the 1960s and focused on the olive ridley. Unlike commercial fishing, which refers to the sale of the products of fishing for cash, industrial fishing refers to large-scale, mechanized operations with centralized slaugh-

terhouses and processing plants. These fishermen worked in cooperatives, and the processing industry was centralized at a slaughterhouse in San Agustínillo. The valued commercial product was olive ridley leather, taken primarily from the flippers. There was considerable waste of other turtle parts, including meat, because of lack of developed markets, and Trinidad and Wilson (2000) suggested that waste was a result of underselling the full value of the resource to original concession holders. With only a few bidders for concessions, lack of competition meant there were no incentives for efficiency. By 1969, Mexican law stipulated that the entire turtle was to be used in exploitation (Cliffon et al., 1995).

By 1968, many Pacific olive ridley fisheries had dwindled, and Oaxaca remained predominant. Annual take was also declining in Oaxaca, however, which led to the total ban of 1971–1972 and to industry restructuring. From 1973 to 1980 a private firm, *Pesquera Industria de Oaxaca (PIOSA)*, controlled the reopened fishery. The shift to the private sector may have been designed to encourage more entrepreneurial management of the resource, as a long-term concession held as a monopoly can encourage more rational use of the resource because the exploiter has exclusive rights to it (Trinidad and Wilson, 2000). *PIOSA* did make fuller use of the olive ridley (Cliffon et al., 1995), selling meat for food; bone, blood, shell, and entrails for meal; and calipee for soup, thus decreasing waste. It also protected nesting beaches, an action Cliffon et al. (1995) cited as central to postponing the collapse of the turtle population. However, *PIOSA* also pressed the government for increased quotas, following initial acceptance of decreases, and olive ridley takes continued to dwindle. Trinidad and Wilson (2000) suggested that the terms of the original concession to *PIOSA* did not take into account the depreciation of the resource. Thus, *PIOSA* could over-exploit the resource, recover its initial investment, and sell when the industry no longer looked profitable. Indeed, the government purchased three *PIOSA* processing plants in 1980. Trinidad and Wilson (2000) pointed to failing profitability (because of decreased export markets and growing international pressure to stop the turtle fishery) to explain *PIOSA*'s departure from the industry. However, the legal difficulties

faced by PIOSA owner Antonio Suárez for exporting olive ridley meat disguised as river turtle to the United States may also have played a role in the transition. This deception was first exposed by Tim Cahill, a journalist, in his article "The Shame of Escobilla" in *Outside Magazine* in 1978. The article was reprinted and updated in his 1987 book *Jaguars Ate My Flesh* (Cahill, 1987).

When the government acquired PIOSA's processing plants, it created an agency, Productos Pesqueros Mexicanos (PROPEMEX), to be responsible for the turtle fishery and sold the fishing cooperatives 45% ownership. The cooperatives' share was to be paid for with turtles sold exclusively to PROPEMEX. The turtle take continued to decline, and, in 1986, the government attempted to sell the San Agustín slaughterhouse and an additional processing plant to the cooperatives. Again, debt was to be paid with product (67% of the price of each turtle), and cooperatives were obliged to sell to PROPEMEX. Five cooperatives agreed to this arrangement, but four did not (Trinidad and Wilson, 2000).

Based on interviews with members of one fishing cooperative, and using price data from 1989–1990, Trinidad and Wilson (2000) described the conundrum faced by fishermen. Membership in the cooperative went from 80 fishermen at its founding in 1975, to 250 during the peak harvesting years, to 35 by 2000. Although it is not surprising that there are few cooperative members now that the fishery is closed, decreases in membership began before the total ban was introduced in 1990. Fishing quotas were so low that profits did not cover fishing costs, which forced many members to move from the legal cooperative-based fishery to the illegal one. Fishermen working legally earned approximately 14% of what they could earn illegally in the black market.

Eggs

Turtle eggs have long been an important source of food for coastal peoples in Mexico, including some indigenous groups. Trinidad and Wilson (2000) collected basic socioeconomic data and conducted interviews in Escobilla, where illegal egg collecting was evident. For example, in 1988 an estimated 3 million eggs were collected illegally, with a value to collectors of

US\$64,430 (and an estimated final market value of US\$1,962,922) (Aridjis, 1990, cited in Trinidad and Wilson, 2000). (All values are in U.S. currency, converted from local currencies by the individual authors at the time of their research.) Trinidad and Wilson argued that the importance of egg collecting could be understood in the overall economic context of the region, where subsistence agriculture was important, there were few cash-earning jobs, and migration for employment was common. Although the income earned in egg collecting was significant, *acaparadores* received the most benefits. (*Acaparadores* derives from the verb *acaparar*, meaning "to monopolize." In this context, it refers to middlemen who buy eggs directly from collectors and resell them to distributors. In fact, the existence of many collectors and fewer buyers implies a monopsony rather than a monopoly.) These intermediaries paid egg collectors only after eggs were sold, and if the eggs were confiscated, collectors were unpaid. Villagers in Escobilla coordinated themselves to collect and sell eggs and took their own risks of injury and arrest.

Cahill (1987) relays a local man's description of the egg harvest: local people gather nightly to decide who will collect eggs, and 10 people are chosen to work in pairs. His informant was chosen to work four times that year and made about US\$300 to supplement his main income from growing corn (US\$500), all of which supports a family of 10. At the time Cahill was there (late 1970s), a driver transporting eggs could make up to US\$4000 per shipment. The differences in Cahill's and Trinidad and Wilson's (2000) descriptions of the harvest may be accounted for by the time difference, who they collected the information from, or site-specific differences in collection practices. Cahill, a journalist, acknowledges that his description is based on a conversation with one egg collector, whereas Trinidad and Wilson interviewed an unspecified number of people in Escobilla.

Because egg collection was illegal, it was difficult for collectors to organize to demand better prices and treatment from *acaparadores*. Trinidad and Wilson (2000) found that egg collecting was practiced mainly by women and children, although youths were often involved before the school year to earn money for fees and supplies. To sell the eggs sometimes required transportation, which increased chances of discovery and

decreased individual profit. If alternatives were available, villagers said they would harvest eggs only for home consumption.

In considering why turtle fishing and egg collecting have continued in spite of extensive legislative commitments, Trinidad and Wilson (2000) drew a number of conclusions, some relevant to turtles or eggs and others to both. All concerned the incentives for individuals to disregard the laws surrounding turtle use and the inability of the government to enforce such laws.

First, economic incentives for illegal harvesting were strong in both cases. In terms of turtle fishing, however, the contradictions between government policies for conservation and development had the consequence of increasing incentives to act illegally. As the olive ridley fishery appeared destined to fail because of falling catch rates and increased external opposition to the harvest, ownership was increasingly transferred to fishermen. Rather than reduce dependence on the turtle fishery, the government increased the cooperatives' stakes in it. Thus, when the fishery closed in 1990, the cooperatives had much to lose (the private sector having recouped its investment and disappeared). In this context, it is less surprising that the ban was resisted.

Second, alternatives to both egg collecting and turtle fishing did not materialize. Both fishermen and egg collectors cited the lack of alternative economic activities as a reason they continued to operate illegally, and egg collectors specifically said they would harvest only for household consumption if viable alternatives existed. One attempt at diversification was through ecotourism. In 1990, the World Bank supported a "campsite" program to develop basic services at arribada beaches with the intention of attracting ecotourists. A loan was provided with the aim of seeing campsites become self-sufficient in 7 years, a goal that was not reached. Trinidad and Wilson (2000) suggested further investments in exploring ecotourism as an alternative development strategy.

Third, the overall management of the fishing industry has been centralized, and existing social and cultural institutions have been ignored. Centralization has impacts on fishermen. The small number of concessions in the early years and the monopsony held by PIOSA in the 1970s meant buyers held market power over fisher-

men. When the government took over, market power was still centralized, and PROPEMEX was designated the only buyer to ensure that cooperatives would repay government loans (Trinidad and Wilson, 2000). Fishermen have been external to most decisionmaking, and they were not consulted on the development and implementation of the moratorium. Nor, in 1999, did fishermen or egg collectors attend meetings held in Escobilla to discuss the olive ridley, specifically enforcement, alternative economic development, and the possibility of reintroducing quotas (Trinidad and Wilson, 2000).

Having failed to facilitate alternative economic activities or to engage resource users in decisionmaking, the government has had to rely on regulatory incentives to pursue conservation. Such centralized enforcement policies may work when costs of enforcement are low and the likelihood of compliance is reasonable (Trinidad and Wilson, 2000). However, these criteria do not exist in the case of olive ridley use in Mexico. A PROFEPA inspector cited lack of personnel as a key constraint to effective enforcement (six inspectors, whose concerns are not restricted to turtles, for all of Oaxaca), along with other administrative constraints. Furthermore, corruption among government personnel was evident (Trinidad and Wilson, 2000).

In 2000, the Secretaría del Medio Ambiente Recursos Naturales y Pesca (SEMARNAP) pursued a legal initiative that would have changed the status of olive ridley protection. The initiative encouraged the sustainable exploitation of animals whose life cycles depend on water and provided the means to amend and repeal laws and agreements that prohibit sustainable exploitation. Also in 2000, amendments to the penal code that would remove prison terms for persons engaged in egg collection for subsistence, or for satisfying basic needs, were proposed. The proposed changes were "an attempt to provide some relief to members of the coastal communities already hard hit by the bans on turtle captures and egg collection" (Trinidad and Wilson, 2000). Although the proposed changes were defeated, and opposition was based on a number of concerns including definitions of subsistence and individual eligibility, the increase in olive ridley turtles nesting at Escobilla ensures that pressure to at least partially lift the

ban will continue. Increased nesting will also further affect illegal activities, as they make laws protecting eggs and turtles appear unjust.

Honduras: Economics of Olive Ridley Egg Collecting and Selling

Unlike other case studies considered in this chapter, olive ridley nesting around the Gulf of Fonseca is not in arribada concentrations. Lagueux (1989) estimated that, in 1987, 2,022 nests were laid at 46 beaches around the Gulf and cited earlier studies and interviews with long-time residents to suggest that nesting has never reached arribada levels. In 1987, Lagueux assessed the economic value of olive ridley turtle egg collecting by communities around the Gulf of Fonseca (Lagueux, 1989) and evaluated the contribution of egg harvesting to average cost of living in one village, Punta Ratón (Lagueux, 1991). She used a variety of data collection tools to measure value, including household surveys, interviews with collectors, cost-of-living surveys, and key informant interviews. Lagueux (1989) also assessed commerce in olive ridley eggs, focusing on relationships between egg collectors and sellers, and income earned along the market channel. Methods of data collection included interviews with egg sellers and buyers, regular surveys of primary egg buyers, market surveys of egg availability and pricing, and interviews with egg vendors.

Lagueux's (1989, 1991) approach was empirical, focused on describing economic value, with little reference to economic or other theory related to use and conservation of resources. This empirical approach contrasts with that of Trinidad and Wilson (2000), which relied heavily on existing data and applied economic theory to it. Both approaches offer insight into the respective case studies.

Egg Collecting

Based on a sample of households in seven communities, Lagueux (1989) found that the number of households involved in egg harvesting varied from a low of 20% of households to a high of 95%. When interviewees were asked about economic activities, fishing was the most frequently identi-

fied activity for both the rainy and dry season, and egg harvesting was the second most frequently identified rainy season activity. However, even during the rainy season, only 7 of 71 household interviewees identified it as the most important economic activity, compared to 35 interviewees identifying fishing. When asked about the perceived benefits of sea turtle eggs, the most frequent response by household interviewees was that there were no known benefits (28 of 71 interviewees), and 35 interviewees said they would be not be affected by the loss of the sea turtle resource.

In her case study of Punta Ratón, Lagueux (1991) found that 88% of egg clutches laid at Punta Ratón were collected (total eggs collected in 1987 = 63,798), worth the equivalent of approximately US\$10,000 to collectors. Collectors from Punta Ratón households earned US\$7,680 of the total. The remaining US\$2,320 was earned by collectors from outside of Punta Ratón, the majority (41%) of whom came from a town 10 km inland. Income earned by collectors from Punta Ratón was unevenly distributed. Of the 82 households (total households = 93) participating in egg collection, four households earned 23% of all income, and 15 households earned nothing. The average earned was US\$93.66 per household (range, US\$0 to US\$684.56), and 80% of households earned US\$160 per year or less. Because the focus of Lagueux's (1989) study was on the Punta Ratón households, the value of egg collecting to external collectors was not investigated. This value could have been higher because while in Punta Ratón, external collectors were dedicated to this activity.

Lagueux (1991) calculated basic cost of living expenses for Punta Ratón households as US\$1 per day per person and the average household size as six people. Based on these figures, and assuming net income equals net expenditure, she calculated that egg collecting contributed to 4.3% of the yearly expenditure of the average household. Given the unequal distribution of benefits, however, egg collection was clearly much more valuable to some households than to others, and the seasonality of egg collecting suggests the 4.3% contribution to expenses was concentrated during the collecting season. Lagueux (1989) identified cash earned by egg collecting as important, given that most households purchase the majority of staple and other

foods and that alternative income-earning activities were limited by geographic isolation and by lack of education and other social services. She also reflected on the social benefits associated with egg harvesting, which provided an opportunity to exchange information and news with friends and family.

Using past observations made by Carr (1948) and Pritchard (1979) and her own observations in 1987, Lagueux suggested that 100% of olive ridley eggs have been harvested from the beaches in the Gulf of Fonseca since at least 1940 and possibly since 1920. She predicted a steep decline in the population and argued that “unless an improved conservation effort is made . . . both the olive ridley sea turtle . . . and the economic benefit that human populations derive from collecting eggs will be known as a historical occurrence” (Lagueux, 1991). Because turtles are valuable, Lagueux argued, local people should be encouraged to conserve them. However, alternative interpretations of the results are possible; with an average of 4.3% of cost of living expenses generated through egg collecting, this activity could be characterized as relatively unimportant. If so, total protection might be pursued with small social and economic costs borne by collectors (although the uneven distribution of benefits suggests costs would be high for some households, and seasonality concentrates contributions to particular times of year). Or the small percentage of household income earned and the perception that loss of the turtle resource would have “no effect” for most households might mean that incentives for conservation would be lacking. Further research may be required to evaluate these potential outcomes, but the baseline economic data provided by Lagueux (1989, 1991) would be critical to any conservation planning for the region.

Egg Commerce

Lagueux (1989) found a variety of market channels in operation in coastal Honduras, composed of anywhere from two to five buyers and sellers. Most primary egg buyers (86%), those who purchased directly from the egg collector, were residents of the coastal communities, and the relationship between collector and primary buyers was constant (i.e., the same collectors sold to the same buyers, even if other buyers

were offering higher prices). This relationship provided security to collector and buyer, and collectors also accessed loans from buyers based on this relationship. A small number of primary buyers owned restaurants or other retail outlets and sold directly to consumers, but most sold to secondary buyers.

Secondary egg buyers came to the coastal communities to purchase eggs, and some bought other products at the same time (with the importance of turtle eggs varying across buyers). No buyers were dependent exclusively on turtle eggs. Lagueux calculated the average income earned by primary egg buyers in six communities, which ranged from US\$9.72 to US\$186.31 across communities. She also calculated price inflation from egg collector to final vendor and showed that price inflation varied from 62% to 262%, depending on the time of year. In her survey of markets, Lagueux (1989) found high availability of eggs in markets, though sometimes by few vendors. She concluded that because egg buying and selling is relatively easy with few entry costs, movement in and out of the business was fluid, and egg commerce potentially generated income for a large number of people. She argued that the varied form of the market channels and numbers of people involved in egg commerce would make management of such commerce difficult.

Lagueux's (1989, 1991) study showed how the context for egg use in Honduras must be considered at various scales, from the household to the village to the regional level. Although insights gained at any one level are useful, results are most interesting when combined. For example, access to income from egg selling might not be as important to egg collectors as access to loans from primary egg buyers. The importance of egg collector and primary buyer relationships is an issue Lagueux (1989) may not have uncovered had she focused only on household activities and ignored market channels and mechanisms.

Nicaragua: Politics and Economics of Egg Collecting at Chacocente and La Flor

Olive ridleys nest in arribadas at two beaches on the Pacific Coast of Nicaragua, Playa La Flor and

Chacocente, and managed egg collection projects exist at both. Chacocente has received some attention by analysts interested in environmentalism in Nicaragua, particularly as it relates to the country's political history (Faber, 1993). Research by Stewart (2001) and Hope (2000, 2002) is reviewed here; both conducted archival research in Nicaragua and undertook field site visits, interviews, and, in Stewart's case, participant observation. These methods were employed in very different theoretical contexts. Stewart was interested in the geopolitical context of conservation at Chacocente, whereas Hope attempted to assess the sustainability of egg collection regimens by applying an "Arribada Sustainability Framework" to four arribada beaches (Playa La Flor and Chacocente in Nicaragua and Ostional and Nancite in Costa Rica).

Chacocente

Faber (1993) and Stewart (2001) linked conservation activities in Nicaragua to the country's political history, and they traced prerevolutionary (pre-1979), revolutionary (1979–1990), and postrevolutionary (post-1990) views on environment. The history of olive ridley use at Chacocente is linked to this history, and Chacocente is an important case study for understanding it. As one of the protected areas established by the revolutionary Sandinista government, Chacocente has symbolic value. The Nicaraguan revolution was, in some ways, an environmental revolution, and environmentalists were key supporters of it (Weinberg, 1991; Faber, 1993). As a result of environmental degradation and control of resources by the ruling elite under Somoza, environmentalists "saw that only a fundamental transformation in the country's power structure could open the door to ecologically sound and socially beneficial development." So central was environment and control over natural resources to the aims of the Sandinista government that their revolution has been labeled an experiment in "ecological socialism" or "revolutionary ecology" (Faber, 1993).

Within weeks of the revolution, the Sandinista government established the Instituto Nicaragüense de Recursos Naturales y del Ambiente (IRENA). Under its initial leader, Jorge Jenkins, IRENA pursued productive conservation, that

is, conservation to benefit people. A plan was developed to create 36 national reserves, covering 17% of the country, where resources would be managed in a productive manner. As part of this plan, the 4,800-ha Chacocente–Rio Escaiente Wildlife Refuge was established in 1983 (Stewart, 2001). Its symbolic value is derived from three sources. First, according to Faber (1993), Chacocente was one of the only protected areas implemented of the intended 36. Once civil war between the Sandinistas and the Contras began, funds were scarce, and conservation activities were scaled back. Furthermore, the guerilla war tactics of the Contras were based in wilderness zones, many of which were intended for protection. Even if they were declared protected areas, operationalizing protection was infeasible. The 1993 UN List of Parks and Protected Areas shows 17 protected areas established in 1983, but few received adequate funding or support (IUCN, 1992). Chacocente, however, was geographically removed from most war activities, and it could feasibly be protected. Second, the Sandinista government turned its attention to sea turtles in general and, according to Faber (1993), the "most exemplary of IRENA's wildlife initiatives was the Sea Turtle Conservation Campaign." The campaign sought to reduce harvesting of green turtles on the Miskito Coast and to regulate egg collecting at Chacocente, and a national educational program was a critical component of the campaign. Third, as an arribada beach, Chacocente presented a good opportunity to implement the principles of productive conservation. As discussed below, the symbolic value of Chacocente has been an important factor influencing its management.

Each year between July and January, turtles nest in four or more arribadas at Chacocente (Stewart, 2001; Hope, 2002). There are four villages within the bounds of the refuge and 13 villages surrounding it. In the early 1980s, 350 families lived in these 17 villages. The area was one of extreme poverty, with high illiteracy rates, few educational or health services, limited access to potable water and sanitation, high fertility, and no electricity. Of the 350 families, 317 practiced slash and burn agriculture and cattle raising as their primary economic activity, 27 fished, and 19 worked in semiskilled labor (AID, 1991, cited

in Stewart, 2001). Subsistence farmers pursued wage labor on larger cooperative farms and migrated seasonally for agricultural work or worked as domestic servants in cities. During Stewart's research, wage labor paid a maximum of the equivalent of US\$2 per day but was rare, and unemployment was high. Communities within the refuge were some of the poorest in the province, relying on basic grain crops, fuelwood collection, and citrus cultivation (FUNDENIC-SOS, 1999, cited in Hope, 2002). Although this regional picture may be dated, Nicaraguan standards of living remain some of the poorest in the world. Nicaragua ranked 121 out of 175 countries on the 2003 UNDP Human Development Index and had an estimated GDP per capita of US\$2,450 (www.undp.org/hdr2003). The only country in the region to rank lower was Haiti (151).

Stewart (2001) described the communities around Chacocente as having their backs to the sea. With the exception of one village fishing cooperative, there were few sea-based economic activities. None of the villages were immediately proximate to the nesting beach; villagers (and others) traveled (sometimes short distances) to Chacocente to collect turtle eggs. The authorized egg harvest was theoretically for consumption only by the collector and immediate family, but eggs were almost always sold, as the market value (US\$0.60–0.90 per dozen: Stewart, 2001; Hope, 2002) outweighed their attraction as food, and profits from two nests exceeded what could be earned in a week by unskilled labor (Stewart, 2001). Hope (2002) suggests that families make decisions on whether to sell or consume eggs based on price, alternative food sources available, and size of egg allocation. Once collected, eggs were sold to traders, and collectors and traders may have long-term relationships. Traders transported eggs to urban markets, where they were resold to vendors who resold them to consumers and restaurants. A few extended families traditionally controlled much of the egg trade, and some traders interviewed by Stewart (2001) had been working as such for over 20 years. Stewart concluded that "the egg trade is deeply imbedded in the economic and social life of the area" and examined the political context of this trade and what it implied for conservation in prerevolutionary, revolutionary, and postrevolutionary time periods.

PREREVOLUTIONARY CHACOCENTE UNDER SOMOZA. Before the Sandinista revolution, egg collecting at Chacocente was unregulated. Eggs were an open-access resource that was important to the destitute majority in this rural hinterland, where the ruling elites controlled most land and resources. Although there were some attempts to control egg harvesting at Chacocente in the last years of Somoza's regime (e.g., a 2-month ban on harvesting was introduced in the late 1970s), rules were generally flouted by both local people and Somoza's National Guard (Stewart, 2001).

CHACOCENTE DURING THE REVOLUTIONARY SANDINISTA PERIOD. At the time of the revolution, egg collectors and sellers at Chacocente numbered in the thousands. The revolutionary government sought to "change the social ecology of egg harvesting, distribution, and consumption in ways consonant with the larger national transition toward socialism" (Stewart, 2001). Sandinista activities to achieve these goals at Chacocente can be divided into three phases.

Hope (2002) suggests that, before 1993, no access to the beach at Chacocente was permitted. The level of detail provided by Stewart (2001) on egg harvesting under the Sandinista government and reference to Chacocente's turtle program by Faber (1993), however, clearly indicate that egg harvesting was ongoing throughout the Sandinista period.

Following the revolution of 1979, and until 1982 (phase 1), IRENA, under the leadership of biologist Magali Ubina, faced egg collectors and sellers "involved in a sort of combined squatter's movement and nonagricultural land invasion laying claim to beaches, turtles, and nests in the absence of the controls exerted by . . . local manifestation of the Somoza dictatorship." People came from distant cities and neighboring countries and set up a temporary beachfront shantytown housing as many as 3,000 people (Stewart, 2001). An impromptu market was established to serve the needs of collectors, and competition in harvesting, an outsider-versus-insider divide, and alcohol all combined for a turbulent and sometimes violent collection (for both people and turtles).

Ubina and her students first set out to study the turtles and the human community. On the

human side, they found that declining social and economic conditions had changed collection activities; collecting had gone from being an extension of women's and children's domestic duties to a cash-generating activity undertaken by men. These men, many of them farmers, neglected farms during egg collection, which undermined production of staple foods. Collectors were "victimized" by the egg traders, intermediaries who transported the eggs from beach to market. Egg collectors received only 14–27% of final value (Stewart, 2001). Furthermore, profits were unevenly distributed among families. Based on Ubina's initial assessment of the economic and social situation, a scheme for productive conservation was developed and implemented in the second phase.

Productive conservation was operationalized from 1982 to 1987 (phase 2). IRENA established itself as the egg buyer and paid collectors twice what they had received previously. IRENA then set the sale price of eggs to be competitive with chicken eggs and used the profits from the sale to fund conservation at Chacocente. The number of people participating in the harvest was reduced, and 350 families with historical links to the egg harvest from the 17 surrounding villages were given collection permits and some role in decisionmaking. Egg collecting was restricted to the first three arribadas, and all nests laid in the final arribada were protected. Traders were not totally eliminated under IRENA's plan but rather had to organize in cooperatives of six or more members. Cooperatives would deposit money to buy eggs with IRENA, and IRENA would then buy eggs from collectors and transport them to market, where traders could sell to vendors (Stewart, 2001).

In his archival research, Stewart (2001) found only one remaining management plan for Chacocente during this period, written in 1985. The listed objectives included avoiding exploitation of collectors, restricting price speculation, increasing standards of living, keeping children in school, keeping collectors from abandoning their farms, and restricting collecting to the poorest women and the elderly. The wider and explicit revolutionary agenda in this plan is evident. It "envisioned far-reaching transformation of local communities in line with national scale revolutionary goals. The aim was not simply to

control access to turtle eggs but to dampen the destabilizing effects of unrestrained egg trade on the national society and to promote social order of a particular kind." Whether many of these objectives were achieved or even pursued is uncertain, but some activities did reflect revolutionary socialist thinking. First, IRENA operated a store where families licensed to collect eggs could buy goods at subsidized prices and avoid trips to distant markets. Second, it attempted to ensure that collectors received a higher proportion of the profit from the collection by restricting the role of intermediaries.

Revenues skimmed off egg sales by IRENA were used to support park guards, technicians, and staff (Stewart, 2001). The environmental claims of the program included reducing the total number of eggs collected by restricting access to nearby communities only (Faber, 1993), reducing the consequences of the collection itself by controlling activities on the beach, and investing in infrastructure, with a research station constructed in 1982 to house IRENA employees and serve as a base of operations during collections (Stewart, 2001). IRENA sponsored environmental education about turtles, focusing on the conservation of turtles in line with human interests (Faber, 1993; Stewart, 2001). A seasonal ban on commercial sale of eggs was implemented and supported by military patrols and roadblocks as well as inspectors in markets, restaurants, and bars (Stewart, 2001). Because of this combination of a charismatic wildlife phenomenon, strong state action, and local defense of livelihoods, Stewart (2001) labeled Chacocente a high-profile exercise in productive conservation during this period. However, financial support for Chacocente was under pressure. By 1985, IRENA's budget had been cut by 40%, and in 1986 it was reduced a further 10% (Faber, 1993).

Between 1988 and 1990 (phase 3), state funding was diverted increasingly to the war effort. In 1988, the program was shut down temporarily, and large-scale invasions of the beach by egg collectors recommenced (Stewart, 2001). By 1989, the government could not pay to guard Chacocente (Faber, 1993). Opposition from traders and collectors mounted during this period. Traders, unhappy that IRENA had taken a major role in egg selling, discouraged the idea of egg-

collecting cooperatives by convincing collectors that cooperatives were a ruse to conscript people to fight the Contras at the border. Traders also argued that IRENA's role as egg-selling intermediary "violated the traders' right under revolutionary ideology to a livelihood and to access to commonly held resources." This phase was marked by a change (and reduction) in personnel, the withdrawal of IRENA from egg selling, and the end of self-financing for Chacocente through the egg trade (Stewart, 2001). IRENA as a whole saw an 85% cut in personnel and was demoted to a subunit of the Ministerio de Agricultura y Reforma Agraria (MARENA) (IUCN, 1992).

POSTREVOLUTIONARY CHACOCENTE: CHAMORRO AND BEYOND. Violetta Chamorro's United States-supported coalition government defeated the Sandinistas in national elections in 1990. Following this, Stewart (2001) describes Chacocente as a "poster child of the vicious cycle of human desperation and environmental degradation," as clashes over access to the egg resource increased among squatters, park guards, police, and the army. A less powerful and autonomous IRENA, working under MARENA, at one point tried to reduce the number of communities that were licensed to take eggs from 17 to 9 (a decision soon reversed). MARENA was also criticized for failing to cooperate with student volunteers and nongovernment organizations (NGOs) interested in sea turtle conservation.

By 1993, some control at Chacocente was reestablished, and Chacocente was staffed seasonally by soldiers and permanently by a rotating MARENA staff of five (Stewart, 2001). The community representatives currently meet monthly with MARENA and army staff to discuss refuge operations (Hope, 2002). Any attempt to understand MARENA's management plan for turtle eggs from Chacocente (or La Flor) must be made in the wider national context. There is a national ban on collecting and selling eggs from all beaches between October 1 and January 31 of each year, but eggs from beaches outside of protected areas can be collected and sold at other times of the year. In Chacocente, the ban on egg collecting applies from July 1 to January 31, and sale of eggs from the Refuge is

not permitted. In spite of the July 1 ban, a managed collection of eggs occurs from July to October, but theoretically for consumptive purposes only.

The strategy for egg collection during this third phase has changed over time. An initial harvesting strategy allowed egg collecting in Chacocente (and Playa La Flor) from February 1 to June 30 (dry season) because of the high sand temperatures and related low hatching rates. In 1995–1996, the seasonal strategy was abandoned because of concerns about temperature-dependant sex determination in hatchlings and because the seasonal harvesting strategy may have biased the sex ratio. Production and reproduction zones were established on the beach; eggs were collected from the production zone (the lower half of the beach, where eggs were more likely to be washed out by tides and surf) and protected in the reproduction zone (upper half of the beach). Spatially, the 800 m of beach where most turtles converge to nest was divided into 17 sections (one for each village), and, during arribadas, communities sent a representative to help collect eggs and guard the beach in their section. Eggs were then distributed to families in 17 surrounding communities according to a quota of several dozen per family per season. Also in the 1995–1996 season, a Christmas quota of five dozen eggs was distributed to each child under 9 years of age from families involved in the collection (involving over 1,000 children) (Stewart, 2001).

In 1998, reproduction and production zones were abandoned. Instead, MARENA allowed unlimited collection during the first night of the arribada and protected the turtles and nests during subsequent nights. Unlimited collection was allowed on the outer perimeter of the refuge because of enforcement limitations, and on portions of beach likely to be washed out. This policy produced more than the number of eggs required to meet the quota of 10 dozen per family for that year. Excess eggs were used to pay designated communities' members and additional "hired" men who helped collect eggs. Women and children from nearby villages also showed up during collections and were given leftovers. Stewart (2001) calculated that the total of these payments and free eggs was about one-fifth of the harvest, representing "a significant

siphoning-off of eggs from the official (and more equitable) quota system of egg distribution to families.”

Hope (2002) and Stewart (2001) both refer to a “rotation” system in which different communities participate in turn in different arribadas. Neither provided details on how the rotation works. Does the rotation involve participating in collecting activities only while still receiving eggs for each arribada? Or do families receive eggs only during the arribada their community participates in? But both imply that it results in an equitable distribution of eggs.

The quota of eggs per family and the number of families involved in the harvest have also changed, with the quota decreasing as the number of families has increased. The quota fell from 15 dozen eggs per family in 1995 to 11 in 1997, 10 in 1998, and 2 or 3 in 1999–2000 (Hope, 2002). The number of families involved has increased from 350 families in the 1980s to 800 in 1995 and 1,036 in 1997 (Stewart, 2001). Hope (2002) identified 5,754 individuals with harvesting rights in 1999. Neither Stewart (2001) nor Hope (2002) discussed the implications of this change (decreased benefits to individual families but distribution to more families), but Hope did suggest that communities living closer to the nesting beach felt their use rights should take precedence of those living farther away. Stewart suggested that the social unrest resulting from large-scale invasions was often blamed on outsiders living far from the refuge.

In spite of the law that prohibits the sale of eggs from the refuge, eggs are quickly sold to traders and taken to market, where, according to Stewart (2001), they were easily found, even during the period of the national ban. Based on 1996–1997 figures, Stewart calculated that earnings from the egg trade were distributed as follows: US\$4,600 for collecting families, US\$11,600 for market vendors, and US\$46,000 for food vendors and restaurants. Hope (2002) reported a 32–33% price spread for eggs; that is, collectors received approximately one-third of the final sale price of eggs. Both Stewart (2001) and Hope (2000) saw problems arising from the large-scale collection of eggs from Chacocente, prohibition on all legal commerce of these eggs, but legal commerce from July to October in eggs from elsewhere. Given the longstanding com-

mercial nature of egg collecting, high levels of poverty in the region, and a powerful group of egg traders, prohibition of egg commerce would require considerable enforcement if implemented. From July to October, when commerce in eggs from other beaches is legal, the inability to determine the source of eggs is problematic (Stewart, 2001). Hope (2000) argued that this legal dichotomy leads to high price spreads; prices are inflated in the black market for eggs, but egg collectors, numbering in the thousands and acting illegally and as individuals, have little bargaining power with egg traders, who are fewer in number (a situation of monopsony).

Playa La Flor

Located farther south on the Pacific coast of Nicaragua, Playa La Flor is a 1.6-km arribada nesting beach (five to seven arribadas per year: Hope, 2002), and, as in Chacocente, limited egg collection is permitted. Hope (2002) included La Flor in his study of the economics of arribada nesting beaches, but there is little else published. Reports written by the Sea Turtle Restoration Project (Arauz, 1996) and Fundación Cocibolca (Cocibolca, 1997) provide background detail to supplement Hope’s (2002) analysis. Original research by Nicaraguan NGOs and researchers was cited in the Cocibolca report and is referred to in this chapter where appropriate.

Playa La Flor was declared a wildlife refuge in 1996 under General Environmental Law No. 216 (Hope, 2002). Prior protection had been facilitated by a private land owner (the Sequeria family) in cooperation with MARENA. Their agreement included a permanent military presence at La Flor from July to January, beginning in 1992. In 1993, this presence was supplemented with nine rangers contracted by MARENA from July to January, hired to conduct research, control the newly instituted egg-collecting program, and protect nests. A dormitory was built to house staff (Arauz, 1996). Currently, the refuge is managed by Fundación Cocibolca and MARENA, in consultation with communities and the army (Hope, 2002).

Arauz (1996) stated that egg collecting at La Flor was minimal before 1983. However, with the creation of Chacocente Wildlife Refuge in

that year, demand increased when people excluded from egg harvesting at Chacocente turned their attention to La Flor. In 1993, a collection program was initiated, and three communities participated. This number has increased; Hope (2002) suggested that the current egg harvesting benefits eight communities consisting of 598 families and 2,618 people, figures in line with the eight communities and 576 families identified by Cocibolca (1997).

The legal framework for egg collecting at Playa La Flor is the same as that described above for Chacocente. Approximately 4% of eggs laid at Playa La Flor are collected under the approved program (Arauz, 1996; Hope, 2002) from areas of the beach where highest nest loss is anticipated. Each community involved in the collection elects a Community Commission to organize the distribution of eggs. Commissions are made up of six or seven community members, and 98% of commissioners are male (Cocibolca, 1997). Commissioners participate in extracting the eggs and distributing eggs among families (seven to eight dozen per family per season: Arauz, 1996). Commissioners also participate in meetings with MARENA to discuss problems and to receive information. Commissioners receive two extra nests per season for their work, as do individuals who help with routine monitoring activities in the refuge (Cocibolca, 1997).

As at Chacocente, many families at La Flor sell their eggs to earn cash to purchase other products and services. However, the situation for collectors at La Flor is superior to that at Chacocente, as the proximity of the tourist town of San Juan del Sur and its transportation links to and from Managua promote easier access to markets. Outside the national ban on egg sales, collectors retained 37.5% of final price (Hope, 2002). There is a discrepancy between Hope's and Cocibolca's estimated value of egg collecting to the community. Whereas Hope suggested collectors make the equivalent of US\$38–63 per capita income per month, Cocibolca (1997) referred to recent (unspecified) studies showing that egg collection did not generate significant income and had a negligible effect on the precarious economy. However, Cocibolca did recognize that, given the ease of earning income via eggs, the community was unwilling to give it up.

Cocibolca (1997) reported "reproachable" acts by MARENA within the refuge, including alcohol abuse, illegal egg extraction, sexual violence against women, and excessive violence against apprehended poachers. The NGO Nixtayolero conducted community research at La Flor and found several points of local dissatisfaction and social unrest. Communication, availability of information, and function with process were all identified as problems. Local people complained about irregularities in the project's functioning and lack of transparency in decisionmaking. At the same time, Nixtayolero found that a high level of dependence on eggs, in addition to economic poverty, increased demands for eggs (Nixtayolero, 1997, cited in Cocibolca, 1997). Hope (2002), Arauz (1996), and Cocibolca (1997) all called for greater community participation at La Flor. Cocibolca saw this as essential for resolving problems experienced with MARENA staff. For example, if local people replaced MARENA staff as rangers (two local people were hired as rangers in 1996), social problems might decrease.

Few economic activities exist in the La Flor area. Arauz (1996) and Cocibolca (1997) both identified the need to develop alternatives and agreed that ecotourism was one option, calling for development of tourist services and training local people as tourism guides. They differed in their views of egg harvesting. Arauz argued that high quotas of eggs could be allowed if scientific research on productivity on the beach supported it. Some research has been done on this issue (von Mutius and van den Berghe, 2002). Cocibolca, however, aimed to convert egg collectors into ecotourism guides and to reduce extraction from the refuge, with a goal to eliminate egg collecting in 5 years. Their rationale: "As communities become more involved and sources of employment are created through ecotourism, they will see for themselves that this option is better than harvesting turtle eggs." Neither Arauz nor Cocibolca considered possible links between tourism and egg consumption, which may be indicated by the existence of markets for eggs in San Juan del Sur.

Conservation is always a political activity, involving decisions about who is allowed access to specific resources. The use of sea turtle eggs in Nicaragua, as described above, exemplifies this

reality. In the case of Chacocente, conservation was an overtly political activity tied to revolutionary ideology in the Sandinista era. There were, and still remain, implications of such overt linkages. Ideology dictated that price inflation through intermediaries should be avoided, and the Sandinistas ignored the long history of egg traders and their political power when they tried to eliminate them from the process. Not only did egg traders work to undermine the government's cooperative program as a result, but they waged a rhetorical battle, arguing that their rights to a livelihood were being denied, counter to revolutionary doctrine. Such problems show the difficulties of putting ideology into practice.

The political legacy of Chacocente will continue to dictate how it evolves. Although it has been more than 10 years since the Sandinistas were defeated, they remain a force in Nicaraguan politics, and local people will not easily be deprived of the sea turtle resource. Stewart (2001) commented that even as the collection program in the 1990s continued to regulate social access, seek an equitable distribution of eggs, and provide opportunities for local people to stay informed about management and influence it to some degree, egg collectors and traders continued to subvert the program through poaching, illegal trade, and occasional mass invasions of the nesting beach. "This combination of "participation" via cooperation with the Chacocente program and direct action via poaching and beach invasions has maintained pressure on state authorities to stick to a model of sea turtle conservation that is oriented toward serving the immediate economic needs of surrounding communities through egg harvesting" (Stewart, 2001). The political parties have changed, but the people's focus on productive conservation has remained.

The links between La Flor and Chacocente illustrate the need to consider the repercussions of local activities. The thousands of people engaged in egg collecting in Chacocente at the beginning of Sandinista rule were reduced to several hundred, and both Faber (1993) and Stewart (2001) identified this as a "success." Neither considered where the excluded collectors went: if Arauz (1996) was correct, protection at Chacocente accelerated egg harvesting at La Flor.

In both Playa La Flor and Chacocente, the absolute amounts earned by individual egg collectors may seem small, but these earnings need to be viewed in the overall context of high economic stress and few cash-earning opportunities. Combined with the political atmosphere and beliefs about rights to harvest, the absolute value of egg collecting is perhaps the least important measure for consideration in decision-making. Hope (2002) also argued that the key issue is who captures "rents" from egg collecting, that is, how profits are distributed. When a significant proportion of rents are captured by legitimate harvesters, they may be more likely to take a long-term view and work to ensure the sustainability of egg collecting, particularly if their rights are clearly outlined. At both Chacocente and La Flor, too much rent is siphoned off by intermediaries. This imbalance is supported by the illegal nature of the sale, as collectors cannot easily organize to challenge the monopsony power of traders, and the history of Chacocente shows that the traders, who earn more and are politically powerful, can effectively undermine organized egg collecting. Any effort to redistribute income that ignores traders will do so at its own peril.

The legal context of egg selling in Nicaragua is problematic. Stewart (2001) cites failure to address legal/illegal contradictions as illustrating a "lack of follow-through on the institutionalization of Chacocente program and the principle of productive conservation the program has historically embodied." If eggs sales were legal, the "productive" element of the program would be official. With eggs collected only for household consumption, the program looks like welfare. The distinction is not simply ideological. Stewart argued that this failure leaves the area vulnerable to land grabbing and the new "parquismo" movement. MARENA, for example, includes in its aims reducing social pressures for egg collecting through developing alternatives in the buffer zone, regardless of whether egg collecting is sustainable.

Both Stewart (2001) and Hope (2002) criticized the top-down nature of egg collecting and the failure to involve local people adequately in decisionmaking. Such externally enforced compliance decreases incentives for ownership or

stewardship, and the occasional invasions at Chacocente can be interpreted as the collectors' assertions of rights in a system that affords them few.

Costa Rica: Egg Collecting at Ostional

Ostional has received considerable attention over the years as the site of a widely publicized legal egg collection project (Pritchard, 1984) and because of conflicts that have plagued the project since the mid-1990s (Valverde, 1999). The discussion of Ostional is based on the author's research (Campbell, 1997, 1998, 1999), other published work (Arauz Almengor et al., 2001; Hope, 2002), and unpublished documents from the Asociación de Desarrollo Integral de Ostional (ADIO) and the University of Costa Rica. The egg harvest itself and its effects on national egg marketing are discussed below.

The Egg Project

Campbell's (1998) study was based on 8 months of residence in Ostional (11 months in Costa Rica) over the course of 1994–1995. She conducted in-depth interviews with community members, government employees, and biologists associated with the project, surveyed 91% of households, and analyzed unpublished management and consulting reports. Hope's (2002) methods are described above (Nicaragua section).

The arribada nesting beach at Ostional is protected in the Ostional Wildlife Refuge (established in 1985), where olive ridleys nest almost every month throughout the year. Arribada nesting varies from month to month, but in the rainy season (peak nesting season) of 2001, estimated numbers of turtles ranged from 20,000 to 130,000 turtles per arribada (Chaves, 2002). Eggs are collected by members of ADIO during the first 36 hours of each arribada, packaged in plastic bags stamped with the Ostional insignia, and transported throughout the country. One objective of the project is to saturate the national market for eggs, and the price of Ostional eggs is kept low to discourage illegal collection of eggs from other beaches. All aspects of the collection

and distribution are managed by ADIO, and although various government agencies have responsibilities for the refuge and egg collection, their involvement is often minimal. Profits are distributed among salaries paid to cooperative members (70%) and community development projects and expenses of the association (including the biologist's salary) (30%) (Campbell, 1998).

Campbell (1998) evaluated the social and economic aspects of egg collecting that contributed to its socioeconomic sustainability. She determined that 70% of households identified egg harvesting as their most important activity and that salaries earned in egg harvesting were superior to those earned in other available employment, with the exception of tourism (see below). Benefits of the project were well distributed in the village, although some large families with many associates earned more than the average household, and individuals holding egg-selling and distribution contracts (which theoretically rotate among community members) earned extra income. Households that did not participate in egg harvesting were also supportive of the project, as they received secondary economic benefits by selling goods and services to cooperative members. Social and environmental impacts of the project were believed to be primarily positive, although there was recognition of the need to diversify the economy and reduce dependence on egg harvesting, partly because egg harvesting, although lucrative, occurs for only several days each month.

Received and perceived economic benefits were critical to community support for the project. However, there were other important factors, including the legality of the project (thus legitimizing local livelihoods and removing fear of arrest), community management of the project by ADIO (rather than by an outside agency), and the establishment of the community's management role in law; Wildlife Conservation Law 6919, which allows for the egg collection, stipulates that a community development association be formed to manage the project. The combination of these factors provided security and encouraged wide distribution of benefits to both cooperative members and some nonmembers, reinvestment of profits into local development projects (lessening individual profit but increas-

ing community benefits), investment in conservation through both paid and unpaid activities (beach guarding, escorting hatchlings to the surf), and adoption of voluntary development restrictions to minimize interference with marine turtle nesting and habitat. Hope (2002) calculated that the Ostional project retained more profits locally than did egg harvesting projects in Nicaragua through control over marketing and distribution and linked this to the overall lower price spreads experienced in Ostional. Hope (2000) cited price spreads of 75% for Ostional but also noted the existence of regional price spreads: the farther eggs moved away from Ostional, the greater the price difference.

Campbell's (1998) conclusions regarding the importance of the legal nature of the project to ensuring community support for conservation activities have been tested over the past three years, as several legal challenges to the project have been instigated by biologist Anny Chaves, formerly director of marine turtle research at the University of Costa Rica. The many *recurso de amparo* (petitions) registered with Constitutional Court by Chaves have ranged in scope from challenging the definition of the dry season (and related nest location techniques) adopted in ADIO's management plan and questioning the responsibilities of the government to provide a clean environment to demanding the cancellation of permission for commercial sale of eggs from Ostional. The details of these legal debates are described by Monge Artavia and Jiménez Gómez (2001), and although the project has continued to function, the sense of security that Campbell (1998) deemed crucial to sustainability undoubtedly has been threatened. However, no research on the effects of this latest stage in Ostional's history has been conducted.

Campbell (1999) also evaluated the effects of tourism in Ostional and its potential to coexist or compete with the egg-harvesting project. At the time of the study, levels of tourism in Ostional were low but increasing. In 1995, there were an estimated 852 overnight stays in Ostional, generating approximately US\$6,500 for the two *cabins* (small motels, four to eight rooms) operators in that year. For those two households, tourism earned them four and seven times more than the egg-harvesting project, respectively. In-depth interviews revealed that people of Os-

tional perceived economic benefits of tourism but saw these as concentrated among a few families. Furthermore, there was a strong belief that tourism development could have negative impacts on the nesting turtles. Some saw tour guiding for turtle watching as a possible way to overcome these potential negative effects, but others saw limitations on guiding in Ostional. For example, there are many access points to the beach, it is easy to observe turtles during arrabadas, and there are few English-speaking residents to serve as tour guides. There was also an awareness of existing and potential social impacts, including increased land speculation and ownership by foreigners. In contrast, household surveys showed wide support for tourism and beliefs in the financial benefits. However, respondents had trouble identifying specific economic benefits or further economic opportunities to invest in tourism, and approximately half the surveyed respondents did not want to work in tourism. Thus, the contradiction between interview and survey responses may be linked to survey respondents' expressed desire for any type of additional development.

Campbell (1999) identified constraints to the community's ability to profit further from tourism. First, the existing accommodation sector was underutilized with occupancy rates at 12%, and the expense of investing in accommodations coupled with increasing land prices meant that investment in infrastructure (e.g., cabins) would be out of reach for many community members. Foreign ownership was already evident in the small tourism economy of 1994–1995. The opportunities for tour guiding were limited, although laws requiring that tourists be accompanied by a guide while on the beach (in operation at Tortuguero, Costa Rica) might change this if introduced. Most importantly, tourism, rather than merely offsetting dependence on the egg project, could conflict with it, as tourist and local uses of turtles (as spectacle and as food) may be incompatible. With a large number of people depending on the egg harvest and a small but relatively wealthy number on tourists, the potential for conflict is high and is complicated by the interests of foreign land owners investing in tourism. Hope (2002) noted that tensions existed around building restrictions, road maintenance, and lighting, and

at least part of this was linked to the desire by some residents for further tourism development (Ostional resident, personal communication).

National Markets

Because one of the objectives for legalizing the Ostional project was to flood the market with a legal supply of cheap eggs, thereby decreasing illegal collection elsewhere, the project's success in this area should be evaluated (Valverde, 1999). A study by Arauz Almengor et al. (2001) sought to "determine the demands and characteristics of turtle-egg marketing from Ostional Wildlife Refuge." The results are dated, as the study was conducted in 1991 when ADIO contracted the distribution of eggs to an outside party (associates of ADIO currently distribute eggs along a number of national routes). Nevertheless, their results are reviewed here. Arauz Almengor et al. interviewed ADIO executive members, two egg distributors, and two egg retailers in San José. In addition, they visited 64 establishments where eggs were sold. Although they did not say so explicitly, their data suggest they interviewed at least one person in these establishments.

Under the old distribution system, eggs were delivered to four distributors to cover six national routes, and 81 resellers (contractors, distributors, fish markets, street vendors, bar restaurants) were involved in resale (Arauz Almengor et al., 2001). When Campbell was conducting her research (1994–1995), eggs were distributed directly by ADIO, on nine national routes (Campbell, 1998). Under both systems, the Central Valley was well supplied with eggs, but the southern zone and Limón were inadequately supplied (Campbell, 1997; Arauz Almengor et al., 2001). Arauz Almengor et al. (2001) found major price variations in San José, and Hope (2002) found the geographic price spread described above.

The main market for eggs is bars, where approximately 90% of eggs were prepared raw in a red sauce as an appetizer. Although Arauz Almengor et al. (2001) reported that eggs were believed to hold aphrodisiac qualities, they also found that only 22% of persons interviewed favored eggs over other appetizers.

One conclusion of Arauz Almengor et al. (2001) was that ADIO should consider taking

over the distribution of eggs to minimize the number of intermediaries and resulting price inflation. ADIO did so (whether linked to this study or not is unknown), and although there are still issues of national coverage (Campbell, 1998; Hope, 2002), profits retained by egg selling and distribution were significant to project member households (Campbell, 1998).

Suriname: Culture and Resistance with Egg Collecting

Schulz's (1975) overview of use of sea turtles in Suriname included all species of turtles nesting in the country, but there was specific reference to the use and conservation of olive ridleys. He combined a review of historical documentation and anthropological research undertaken by Kloos (1971, cited in Schulz, 1975) with a description of management efforts. Published in 1975, it is an early example of attention to the human context of use and to a related anthropological study. It is worth noting that the management plan, one that allowed for continued exploitation of sea turtle eggs in Suriname, was devised before the contemporary sustainable use dialogue began; it was based both on a belief in the potential to rationally exploit sea turtles and on the recognition of the infeasibility of a total ban, given human demand.

Schulz (1975) cited records of turtle use in historical documents dated as early as the late 1600s. The people involved in the harvest of turtles and eggs in Suriname were primarily the Kali'na, indigenous peoples residing in coastal areas. In Schulz's work, the Kali'na are referred to as Carib. These Amerindians, who live on both sides of the Marowijne/Maroni river that separates Suriname and French Guiana, have been given various names over time (Carib, Galibi, and Kali'na). Kali'na is the name they currently adopt for themselves (Collomb and Tiouka, 2000). Although both turtles (primarily greens, *Chelonia mydas*) and eggs (greens, leatherbacks [*Dermochelys coriacea*], and olive ridleys) were used historically, meat was not consumed by the Kali'nas (but was traded nationally and internationally). Green turtles were the targeted species for meat export, but olive ridleys were also included (Schulz, 1975). Before the 1900s, it is not clear whether eggs were used only

by Kali'nas or traded with other peoples, but by 1945, Geijskes (1945, cited in Schulz, 1975) reported that egg harvesting had increased to meet non-Kali'na demand. At the time of World War II, most olive ridley (and green turtle) eggs laid in Suriname were collected and distributed to national markets and to French Guiana (Schulz, 1975).

Following World War II, meat exports stopped. Because there was little internal demand for meat, attention turned to egg collecting. In 1954, the Game Ordinance and the Nature Preservation Ordinance came into force, and some of the nesting beaches were protected. Because of high levels of beach erosion, however, some of Suriname's initial attempts to protect nesting beaches were undermined. The first nesting turtle population protected in 1954 had shifted outside the protected zone by 1973. The main nesting beaches for olive ridleys were originally outside the areas subject to the wildlife laws and outside the limits of protected areas. In 1964, about 750,000 green and olive ridley eggs were harvested from around the Marowijne Estuary and sold in national markets. This represented about 90% of the production from the beach. When Eilanti Beach was identified as the most important olive ridley nesting beach on the Atlantic, efforts to stop egg collecting began. In 1967 and 1969, money from the World Wildlife Fund was used to purchase eggs from collectors for reburial in hatcheries. In 1969, the area was declared a nature reserve, and by 1970, a complete ban on collecting olive ridley eggs was enforced. Some compensation was provided through a limited collection of green turtle eggs established and run by the government. Kali'nas would eventually be paid approximately double the amount they previously had received from intermediaries, and yet the project initially met with resistance and became highly politicized. "The 'turtle affair' was even made an issue in electoral tactics in 1969–1970" (Schulz, 1975).

The basis of Kali'na disagreement included their challenge to the notion that turtle populations were decreasing, that compensation was too low, and that they did not want interference in their territory. Anthropologist Kloos (1971, cited in Schulz, 1975), however, found that more was at stake and that the issue of money was not as important as the issue of freedom. Only a small number of individuals participated in

olive ridley egg collecting and were to be affected by the ban, but the issue became important for all Kali'nas. Meetings held around the creation of the nature reserve became hostile, and threats of violence were made, in spite of Kali'na cultural preferences to avoid open disagreement. Although the Kali'nas eventually yielded to official regulations, Kloos believed the process was misunderstood. The conservation project remained incompatible—and ultimately irreconcilable—with Kali'na visions of freedom, but as the Kali'nas and their leaders continued to yield to official pressure, officials failed to understand this problem. This yielding was linked to the cultural preference to avoid open disagreement, a preference that also meant Kali'na dissatisfaction with their leaders was hidden from officials.

Schulz (1975) concluded that, regardless of their reasons, the Kali'nas cooperated with the conservation program beginning in 1970. His account of this process highlights two important issues. First, a more complete understanding of the culture of the Kali'na people from the outset could have avoided some of the problems experienced in the initial stages of the project and may have changed the entire approach of the government in creating the project. Kali'na values of freedom might have been better accommodated if Kali'na leadership had been involved initially and consulted in the establishment of the plan. Second, Schulz's summary highlighted the limited use to which the results of social science research are sometimes put. Schulz was interested in explanations of Kali'na dissatisfaction, but as the ultimate goal of ensuring Kali'na cooperation with the ban on olive ridley egg collecting was eventually secured, his interest waned. What Schulz did not discuss were the ramifications of these events for the Kali'na people. For example, the effects of the challenge to Kali'na leadership and the erosion of freedom were unexplored. These issues are both of general interest to the anthropologist but also could have had further long-term implications for conservation efforts.

Discussion and Conclusions

Given the limited research on the human aspects of use of sea turtles in general and olive ridleys specifically, it is not surprising that the research

described above is in the form of case studies. Case study research is common in social sciences, particularly when one is trying to understand contextualized problems about which little is known. The case studies discussed here provide data that can be used to understand specific scenarios and inform the design of conservation or development interventions. For example, further research similar to that of Arauz Almengor et al. (2001) could identify remaining problems with Ostional egg distribution and pricing and shape policies designed to address these. Case-specific information can advise against the application of "blind" theory. For example, eliminating intermediaries is theoretically a good way to increase rents retained by local people (Hope, 2002), but in the case of Nicaragua, it would be politically difficult if not inappropriate (Stewart, 2001).

One of the weaknesses of case studies is that they provide a snapshot in time, and the specific details can change (e.g., numbers of people involved in harvesting, the laws guiding harvesting). Another shortcoming relates to the site specificity of findings. For example, Hope (2002) compared egg harvesting in Costa Rica favorably with that in Nicaragua, but it is clear that the Costa Rica model is not directly transferable. For one thing, the number of people involved varies; approximately 220 people from one village have rights to harvest in Ostional, versus 600 families from 8 villages in Playa La Flor and 1,070 people from 17 villages in Chacocente. Although it is not impossible that 17 communities could cooperatively manage a commercial egg harvest, the structure of such management would undoubtedly look different from what is in place at Ostional. Nevertheless, there are lessons to be learned in contrasting case studies. For example, Hope argued that one of the reasons Ostional fared better than Nicaragua is the larger proportion of rents retained by collectors. The objective of increasing rents for collectors (while keeping the powerful traders in mind) could be pursued in Nicaragua.

With the strengths and weaknesses of case study research kept in mind, findings from the site-specific research contain several general themes:

- Legal frameworks were important in several case studies, some of them supporting con-

servation (Costa Rica) and some confusing the situation (Nicaragua, Mexico). Campbell (1998), Hope (2002), and Trinidad and Wilson (2000) all promote implementation of legal frameworks to guide use and establish community participation in decisionmaking in order to maximize incentives for conservation and socioeconomic benefits.

- The economic value of olive ridleys to communities was a focus in many of the case studies (Lagueux, 1991; Campbell, 1998; Trinidad and Wilson, 2000; Hope, 2002). However, absolute values are only one piece of information needed to understand incentives for use, and perhaps not the most important. Relative monetary value compared to other livelihood activities, contributions to cash versus subsistence income, economic return on effort expended, and seasonality of livelihoods are other important issues to assess. If absolute monetary value of use is the only information collected, the overall value of use might be underestimated with distorted implications for both conservation and development. Furthermore, many of the case studies highlighted explicitly or implicitly the need to look beyond economic assessment. Political (Stewart, 2001), social (Campbell, 1998), cultural (Schulz, 1975), and legal (Campbell, 1998; Trinidad and Wilson, 2000) structures provide an important context for understanding use and conservation. Hope's (2002) economic analysis recognized how legal and social structures influence economic incentives for conservation and act as incentives or disincentives on their own.

- Lack of alternative development opportunities was stressed in several studies (Campbell, 1998; Trinidad and Wilson, 2000; Stewart, 2001; Hope, 2002), and conservationists interested in reducing stress on resources are often told to look for, promote, and even provide such alternatives. However, in almost all case studies, communities involved in the use of olive ridleys were marginalized economically, and in such scenarios, opportunities for income substitution through alternative activities may be limited. If people are living in poverty, the point at which income can be effectively substituted for (rather than added to) may be distant. If so, the expressed willingness of people to reduce use if other opportunities become available (e.g., Trini-

dad and Wilson, 2000) should be treated with caution. Ecotourism in particular was promoted (Arauz, 1996; Cocibolca, 1997; Trinidad and Wilson, 2000; Hope, 2002) or existed (Campbell, 1999) as an alternative economic development strategy in several cases. Further research on ecotourism, the structure of the industry, the potential for local people to participate in it, and its compatibility with other economic activities is needed.

- Participation of local people and communities influences conservation outcomes. With the exception of Ostional, Costa Rica, levels of participation by resource users in decision-making about conservation are deemed inadequate in the case studies (Schulz, 1975; Arauz, 1996; Cocibolca, 1997; Stewart, 2001; Hope, 2002). Repercussions of this linkage varied; in Nicaragua, Stewart (2001) categorized beach invasions at Chacocente as an expression of rights that are mostly denied in the management regime, and Cocibolca (1997) suggested that increased participation would reduce specific conflicts related to the presence of MARENA staff members, who were considered outsiders. In Ostional, Campbell (1998) concluded that community participation was a critical component of socioeconomic sustainability in the egg-collecting project. These calls for participation reflect wider thinking about conservation (Western and Wright, 1994; Ghimire and Pimbert, 1997; Agrawal and Gibson, 2001; Hulme and Murphree, 2001).

Ultimately, if lessons learned regarding the context of use are to contribute to conservation programs, they will have to be combined with biological research. When the goal is sustainable use, there is limited utility in ensuring that profits from olive ridley use are equitably distributed if that use undermines the survival of the turtle population. Nevertheless, use, whether it contributes to conservation or threatens it, is ongoing in many parts of the world, and understanding the context of use is critical to managing it.

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