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SCIENCE AND SUSTAINABLE USE: VIEWS OF MARINE TURTLE CONSERVATION EXPERTS

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Abstract. Sustainable use is central to contemporary conservation policy as espoused by many of the major wildlife conservation organizations and is one indicator of a shift in policy away from exclusionary practices restricting access toward more inclusive ones that involve some form of resource use. As with many policies, sustainable use in theory may encounter problems in transition to practice. Problems arise based on the biology of the species or system in question and on the dynamics of the economic, social, political, and cultural systems that guide or regulate use. As a result of these problems, and of other moral and philosophical objections, opponents of applying the concept of sustainable use to wildlife are many. Based on in-depth interviews conducted with 38 conservation experts in 1995, this paper examines the views of a specific group of conservation experts (those interested in marine turtle biology and/or conservation) on the commercial consumptive use of marine turtles and their eggs. Results reveal a variety of positions on use, all of which were justified on scientific grounds. Key characteristics distinguishing between interviewees were how they dealt with uncertainty and their assumptions about economics and commerce. While denying the role of ''other'' issues in influencing their own opinions, experts saw opposing views as influenced by emotions. Beyond the immediate world of marine turtle conservation, results presented and conclusions reached may be indicative of the wider challenges posed by commercial use of wildlife, regardless of the species in question.

Key words: *conservation policy; marine turtles; science; sustainable use.*

INTRODUCTION

Sustainable use is central to contemporary conservation policy as espoused by many of the major wildlife conservation organizations, including the one of interest in this paper, the World Conservation Union (IUCN). The roots of sustainable use can be found in the *World Conservation Strategy* (IUCN 1980) and, two decades later, IUCN has a Sustainable Use Initiative and more than a dozen regional sustainable use specialist groups. Working from the premise that ''the survival of human life on earth depends on the continued use of wild fauna and flora'' (Jenkins and Edwards 2000:3), the Sustainable Use Initiative adopts the definition of sustainable use from the Convention of Biological Diversity:

> . . . the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

Sustainable use is one indicator of a shift in conservation policy, away from exclusionary practices of restricting access towards more inclusive ones that involve some form of resource use. As with many policies, sustainable use in theory may encounter problems in the transition to practice. Problems arise based on the biology of the species in question and on the dynamics of the economic, social, political, and cultural systems that guide or regulate use. As a result of these problems, and of other moral and philosophical objections, opponents of applying the concept of sustainable use to wildlife are many. Nevertheless, sustainable use is an issue that must be addressed. From an optimist's perspective, utilization may contribute to wildlife conservation. From a more cynical perspective, given that many resources are going to be used, making use as sustainable as possible is preferable to uncontrolled use and is often more ''sellable'' than exclusionary protection.

This paper examines the views of a group of conservation experts—those interested in marine turtle biology and/or conservation—on the commercial consumptive use of marine turtles and their eggs. Views of experts on nonconsumptive use and on small-scale consumptive use by local people are discussed elsewhere (Campbell 1997, 2000). Given the April 2000 defeat of Cuba's proposals to the Convention on International Trade in Endangered Species (CITES) to transfer hawksbill sea turtles from Appendix I to II to allow for annual harvest and sale of hawksbill shell to Japan, the nature of objections to the proposals, and the controversy surrounding their discussion (Richardson 2000), it is timely to examine the basis of the various positions on commercial consumptive use.

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While a commercial fishing operation with an international trade component nears the extreme of commercial consumptive use, there are parallels between positions taken on the Cuban proposals and expert views on more limited forms of consumptive use. Beyond the immediate world of marine turtle conservation, results presented and conclusions reached may be indicative of the wider challenges posed by commercial consumptive use of wildlife, regardless of the species in question.

Background

Sustainable use

The predecessors of sustainable use include maximum sustainable yield and sustainable yield, concepts that attempt to match levels and rates of harvest with maximum rates of species production (see McEvoy 1988, Rosenberg et al. 1993). Sustainable use is a broader concept than sustainable yield; while biological concerns are central to sustainable use, the concept gives equal attention to the social, economic, and political components of use regimes. It arose in part based on the failures in resource use based on biological models alone and from the argument that political and socioeconomic frameworks for harvesting limit sustainability (see *Ecological Applications*, 1993 [4(3):445–589] and Ludwig 1993). Bennett and Robinson (2000) list three criteria for sustainability of hunting wildlife in tropical forests: (1) harvests must not exceed production; (2) the management goals must be clearly specified; and (3) the biological, social, and political conditions must be in place that allow an appropriate use and an effective management. ''Sustainability requires that all of these expressions be solved simultaneously—in effect solving a complex multinomial equation'' (Bennett and Robinson 2000:9). It is attention to points 2 and 3 that sets sustainable use apart from it predecessors.

In the context of wildlife, particularly species of international interest, the argument to pursue sustainable use is made usually due to social, political, or economic reasoning, and consists of some or all of the following elements:

1) Wildlife requires habitat, and as such, its conservation is often in conflict with alternative habitat uses. Thus, wildlife must be ''valuable'' enough to compete successfully.

2) In developing countries, political will, economic ability, and sociocultural norms may not support exclusionary protection. Host countries and communities may be unwilling and/or unable to meet the direct and opportunity costs of protecting wildlife.

3) The combination of points 1 and 2 leads to the argument that, in order to survive, wildlife must be valued by the people living with it. While this value does not have to be economic, the reality of poverty in many of the areas where wildlife exists and the expansion of the global capitalist system suggest that economic gains are critical. Refusal to put a price tag on wildlife may result in wildlife being treated as valueless. Furthermore, those opposed to pricing wildlife are often ''free riders,'' people who gain from the existence of wildlife yet pay none of the costs of protection (Freese 1994). Thus, there is a justice issue at stake in sustainable use debates.

4) Money earned from sustainable use programs can fund conservation programs. While wildlife viewing via tourism, often labeled nonconsumptive use, is one way of bestowing economic value, there is danger in putting all conservation eggs into the tourism basket. First, not all countries or wildlife spectacles will attract tourists (Wells and Brandon 1993). Second, experience with so-called ecotourism suggests that its theoretical benefits are difficult to realize in practice (Yu et al. 1997, Campbell 1999, Ross and Wall 1999). Finally, tourism is a difficult industry to control, and subject to fluctuations based on the whims of consumers. If conservation is best achieved via a wide array of tools (Jenkins and Edwards 2000:4), then commercial consumptive use of wildlife should be considered.

Critiques of sustainable use.—The commercial exploitation of wildlife has a poor overall track record (Ludwig 1993, Ludwig et al. 1993, Geist 1995, Freese 1998), and this alone fuels arguments of use opponents. Other categories of arguments against use are biological, socioeconomic, and moral or philosophical.

Opposition to consumptive use may be based on the biology of the species in question, and initial attempts by the Sustainable Use Initiative to develop guidelines for use were resisted, and eventually failed, partly because the guidelines did not differentiate between species (Jenkins and Edwards 2000). Long-lived animals with slow reproductive rates and low levels of density dependence pose particular challenges for use regimes (Robinson 1993). Density dependence refers to the compensatory response of species to off-take. Responses include increased fecundity and survival of young, decreased natural mortality, or both (Shaw 1991, Mangel et al. 1993, Rosenberg et al. 1993). For some species, data availability and quality are low, and population dynamics are poorly understood, and these gaps contribute to uncertainty in predicting the impacts of any management efforts. Uncertainty is also linked to the complex nature of ecosystems themselves (Rosenberg et al. 1993, Salwasser 1993, Mangel et al. 1996), and large levels of natural variability can mask actual impacts (Ludwig et al. 1993). Both the understanding and exploitation of wildlife are made difficult by these limitations. (A recent special section in *Conservation Biology* [2000 (14:5):1240–1316] deals explicitly with uncertainty in marine conservation, with emphasis on marine mammals.)

Resistance to commercial use of wildlife can also arise from lack of faith in the dominant free-market economy through which wildlife products are com-

TABLE 1. Socioeconomic debates around commercial utilization.

Issue	Pro-utilization	Anti-utilization
Competition	Commercial use of wildlife provides economic value that allows wildlife to compete with alternative use of habitat.	Danger in assigning economic value, as all value is relative and more profitable uses may appear. Economic rational dictates that long-lived organisms should be harvested and profits invested in something with higher rate of return.
Demand	Commercial production fulfills existing demand that is otherwise filled illegally.	Commercial production will increase demand via direct and indirect marketing. Incentive to increase profits will entice producers to meet increases in demand.
Illegal harvests	Legalized trade and associated price controls and/or market saturation reduce incentives for poaching by lowering price.	Expense of commercial projects (produced via ranches and farms) means prices for goods will remain high, and so will incentives for poaching.
Enforcement	Profits from commercial use can be channeled to enforcement and monitoring.	Enforcement difficult if not impossible, as legal products cannot be differentiated from illegal products.
Luxury goods	Luxury goods provide most profit, allow easier control.	Luxury use drives up prices and increases incentives for poaching.
Local people	Local economies and people derive benefits from use and are encouraged to support conservation.	Expense of commercial operations means they will be out of reach for local people as anything other than laborers, as will luxury goods they produce.

Notes: Constructed from reviews and case studies of use across a variety of species (e.g., Clark 1973, Swanson and Barbier 1992, Freese 1994, 1996, 1997, 1998, Bulte and Van Kooten 2000, Robinson and Bennett 2000) and related specifically to turtles (e.g., Ehrenfeld 1974, 1981, Reichart 1981, Donnelly 1994, Fosdick and Fosdick 1994, Campbell 1998, Ross 1999).

mercialized (Ehrlich and Daily 1993, Meyer and Helfman 1993*a*, Rosenberg et al. 1993), a system often characterized as causing much environmental degradation (Ehrenfeld 1992). As the inclusion of socioeconomic variables distinguishes sustainable use from its predecessors, the main socioeconomic arguments for and against commercial utilization are summarized in Table 1.

Moral and philosophical arguments against using wildlife are linked to the animal rights and Romantic movements. The former suggests that it is morally wrong to kill animals, as they are sentient and sometimes intelligent beings with rights to life (see Adams 1994). The latter echoes the romanticism of Emerson, Thoreau, Marsh, and Muir, who saw nature in general as a purifier of the human spirit and who endorsed preservation in the United States (see McCormick 1989, Nash 1989). While animal rights and Romantic arguments rarely appear in ''scientific'' positions for or against sustainable use, they have played a role in some wildlife use issues, notably sealing and whale hunting (Freese 1998). The role of such arguments in informing views of experts will be discussed further in this paper.

Marine turtle biology, conservation, and the IUCN Marine Turtle Specialist Group

There are seven species of marine turtles: olive ridley (*Lepidochelys olivacea*), Kemp's ridley (*Lepidochelys kempi*), green (*Chelonia mydas*), loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbridcata*), and flatback (*Natator depressus*). There is debate over the existence of an eighth species of marine turtle, the Pacific black turtle (*Chelonia agassizii*). Common names are used in this paper. Most species are widely distributed throughout the globe (see Bolten and Bjorndal 1993) and, according to the IUCN, three species are critically endangered (Kemp's ridley, hawksbill, and leatherback), three are endangered (green, loggerhead, and olive ridley), and one is vulnerable (flatback). The Convention on International Trade in Endangered Species (CITES) lists all seven species in Appendix I, thus prohibiting international trade in wild turtle products by treaty signatories. Acquisition of data on marine turtle populations is hampered by limited access to large segments of the population, but three aspects of marine turtle biology that impact on conservation are that they are slow to mature, migratory, and long lived (Bjorndal 1981). For further detail on marine turtle biology see Bjorndal (1995) and Lutz and Musick (1997).

The Marine Turtle Specialist Group (MTSG, established 1966) of the IUCN has >200 members, employs a program officer in Washington, and meets informally each year at the annual symposium on marine turtle biology and conservation. Like all IUCN specialist groups, members are invited to join a loose network that works predominantly in a volunteer capacity. Over the past 10 years, the MTSG has produced an *Action Plan* (Bolten and Bjorndal 1993), a *Global Strategy for the Conservation of Marine Turtles* (MTSG 1995), and a manual of *Research and Management Techniques for the Conservation of Sea Turtles* (Eckert et al. 1999). The MTSG's influence extends well beyond its im-

mediate membership and it is the key organization concerned with marine turtle biology and conservation.

The MTSG's current position on using marine turtles is a cautious one, as reflected in the introduction to the 1995 Strategy:

> Too frequently . . . wide use by a growing human population, coupled with the migratory nature and slow rates of natural increase of these animals, has resulted in most utilization being non-sustainable. . . . Although this Strategy recognizes that utilization of marine turtles occurs in many areas and does not oppose all use, it does not support non-sustainable use.
>
> —Marine Turtle Specialist Group (1995:3)

The Strategy (MTSG 1995) is most supportive of non-consumptive use, but it does suggest that small-scale localized egg harvesting might be done sustainably. While the Strategy calls for the provision of guidelines for egg harvesting in a techniques manual (in substrategy 2, *Integrated management for sustainable marine turtle populations*), such guidelines are absent from the MTSG's recent *Research and Management Techniques for the Conservation of Sea Turtles* (Eckert et al. 1999). Sustainable use is also defined narrowly by Donnelly (1994:213), MTSG Program Officer from 1994 to 2001: Sustainable use programs are those ''. . . designed to promote controlled and renewable use of wildlife for the benefit of indigenous people and endangered species.'' While Donnelly does not define indigenous, the term carries associations of very small-scale subsistence use (Campbell 2000).

Currently, there are few examples of consumptive use of marine turtles that are widely accepted as contributing to conservation, and even fewer that are commercial. Two examples of commercial consumptive use undertaken as part of a conservation program are egg collection in Suriname (Mohadin 2000) and at Ostional, Costa Rica (Cornelius et al. 1991, Campbell 1998). While not discussed in this paper, these are the examples cited most commonly by marine turtle experts as being sustainable (Campbell 1997). However, large-scale commercial exploitation of marine turtles was one of the first issues addressed by the MTSG, specifically the overexploitation of adult marine turtles to serve North Atlantic luxury markets. Rather than seek to close markets, science-based management was deemed the solution through which trade could be perpetuated, and research into commercial breeding and rearing was called for (MTSG 1969). Thus, initial debates in the MTSG about sustainable use concerned marine turtle mariculture, i.e., farming and ranching marine turtles to produce large volumes of products for international trade. The MTSG supported mariculture in the 1960s, but this policy stance dissolved in the 1970s and the official stance of the MTSG regarding mariculture is cautious (Donnelly 1994, MTSG 1995). Donnelley (1994:5) highlights biological uncertainty and problems with trade controls as the foundation of this caution, rather than ''any philosophical opposition to using the species,'' but Ross (1999) concludes that ranching/farming remains neither proved nor disproved as detrimental to sea turtle populations. Two cases, turtle farming in the Cayman Islands in the 1970s and Cuba's proposals to the Convention on International Trade in Endangered Species (CITES) for trading hawksbill turtle shell with Japan in 2000, illustrate the evolution of arguments adopted by opponents and proponents of commercial operations, and highlight the prominence of nonscience issues in the debates (Table 2; while the Cuban proposals in 2000 did not suggest ranching would be undertaken, a previous submission to CITES [Conference of the Parties 10, 1997] did, and was defeated).

CITES guidelines for ranching operations are also cautious. In 1981, via Resolution Conf 3.15, the Conference of the Parties (CoP) to CITES stipulated that in order to transfer a species from Appendix I to Appendix II for the purpose of ranching, ''the operation must be primarily beneficial to the conservation of the local population.'' Several ranching proposals submitted in 1983 and resubmitted in 1985 were rejected and new ranching guidelines were approved in November 1994 (CITES 1994). (In the 1980s, CITES tentatively accepted a proposal to ranch green turtles in Suriname contingent on presentation of adequate marking mechanisms. The outbreak of civil war prevented a representative from Suriname from attending the next CITES meeting and acceptance was revoked.) The preamble to the guidelines states that turtles have not yet been used sustainably; turtles suffer from habit loss, pollution, and incidental catch; their biology imposes special constraints on their exploitation; illegal exploitation exists, regional cooperation is required for their conservation; and states home to nesting beaches have an obligation to protect beaches and nesters during the breeding season. It also recognizes that ''sustainable use may have potential benefits for the conservation of marine turtles and their habitats.'' The specific guidelines to be met by would-be ranchers are many and detailed. Ranch proposals should include information on the population distribution, population status and trends (including abundance at each life stage, and age/size structure), reproduction rates, and population mortality—data that exist for few, if any, populations. Ranch operators are required to take the lead in establishing regional management plans for the species in question.

Ross (1995:2) heralded the adoption of the guidelines as a ''surprise to many observers familiar with the long history of polarization and acrimony that this topic has attracted.'' Since the guidelines were approved, the unexpected closure of a ranch at the French island of La Réunion was announced. Though closure of the ranch was not directly related to the guidelines, France had already applied for and been

TABLE 2. From the Cayman Islands to Cuba: evolution of arguments for and against large-scale commercial exploitation.

Argument aspect	Cayman Islands	Cuban proposals
Market/trade controls		
Pro	Market exists; high quality, legal, reliable supply of products will saturate market, reduce prices, reduce poaching; international trade will not be stopped by punitive measures.	Harvest and market already exist; trade between two countries only; elaborate registration system will ensure exported hawksbill scutes are obtained legally.
Anti	Legal trade will stimulate demand, and market will expand; expense of rearing long-lived animals necessitates high price, and incentives to poach remain; legal trade will hide illegal trade.	Harvest will stimulate demand and market will expand; lack of confidence in trade controls; reopening trade will encourage stockpiling in other countries.
Conservation benefits		
Pro	Job creation and foreign exchange gains local and national support for conservation; excess hatchlings released in the wild to supplement stocks.	Dependence on wild turtles provides incentives to protect populations; percentage of revenue to go to local communities and conservation; Cuba harvesting fewer turtles under proposal than they were in 1995; education center; money for regional and national studies.
Anti	No evidence released hatchlings will survive, and mixed genetic makeup of hatchlings made this undesirable; farm's closed system, i.e., production of its own stock through captive breeding, reduces incentives for conservation in the wild; disease from captive turtles may spread in wild.	Undermine regional conservation efforts.
Scientific contribution		
Pro	Scientific study advanced through research on captive turtles.	Learn about species response to harvesting.
Anti	Scientific contributions have limited applicability; captivity leads to disease in turtles.	
Scientific rationality		
Pro		Hawksbills are not regionally endangered; argument regarding status of population, where they are going to and coming from; scientifically cautious and adaptive management proposal.
Anti		Uncertainty regarding status of Caribbean hawksbills; 58% originate elsewhere; quality of the science underlying proposal questionable; premature to delist hawksbills/precautionary principle should apply.

Notes: Arguments for and against mariculture in general and the Cayman Islands specifically are taken from Ehrenfeld (1974, 1981), Reichart (1981), Donnelly (1994), and Fosdick and Fosdick (1994). Arguments for and against Cuba's 2000 proposals are constructed from the CITES proposals (11.40 and 11.41), Caribbean Conservation Corporation (2000*a*, *b*), Meylan and Donnelly (1999), Richardson (2000), Mrosovsky (2000*b*).

denied a CITES exemption for La Réunion ranch products in 1983, 1985, and 1987 (Anonymous 1995). Cuba has twice presented proposals to CITES to transfer hawksbills from Appendix I to II in order to allow for limited trade in hawksbill shell with Japan. In 1997, Cuba included ranching in its proposal, while in 2000 ranching was dropped, and Cuba proposed a limited harvest of wild hawksbills and sale of stockpiled shell (Prop 11.40), and the sale of stockpiled shell alone (Prop 11.41). Cuba presented biological studies of its hawksbill population (Carrillo et al. 1999, Moncada et al. 1999), and the proposals included scientific justification of the management strategy, description of a registration system, mechanisms for channeling some profits to local communities, and mechanisms for adapting the harvest in the face of evidence of population decline. Under an approved Prop 11.40, Cuba would continue to harvest 500 individual hawksbill turtles, a voluntary reduction implemented in 1990 from the 2000 turtles harvested annually.

Both proposals were defeated at the CITES CoP (only Prop 11.41 was voted on as Cuba withdrew Prop 11.40) based on arguments detailed in Table 2. The MTSG's official position was that it supported the critically endangered listing (Meylan and Donnelly 1999), but there was opposition to this view (Mrosovsky 2000*b*) and debates at the CITES CoP were acrimonious (Richardson 2000). While Mrosovsky does not support the critically endangered listing, he is equally concerned with the transparency of the listing process (see Mrosovsky 1997, 2000*a*). The Meylan and Donnelly (1999) justification, for example, was published three years after the listing was made. In the calm after

the storm of CITES, it is timely to consider the general views of experts on consumptive use—and more specifically on commercial consumptive use—and what these views are based on.

Views of Marine Turtle Experts on Sustainable Use

Forty-two experts in marine turtle biology and/or conservation were interviewed over the period January to November 1995, and the analysis in this paper is based on 38 interviews for which transcripts or detailed notes exist. Hard copies of the interview transcripts are held by the author. In-depth interviewing is a qualitative research technique employed to explore the depth and complexity of views on a subject (Dunn 2000, Winchester 2000), and allow for examinations of feelings and opinions in a way a survey, for example, does not (Kitchen and Tate 2000). Expert interviews are conducted with individuals expected to have specialized insight into, and some level of influence on, an issue (in this case, marine turtle conservation; Lindsay 1997). Thus, selection of interviewees was based on several criteria (rather than random sampling) and the analysis presented here does not claim to be representative of all marine turtle experts.

The most important practical criterion for, and constraint on, interviewee selection was their location. All interviews were conducted in the interviewee's home environment to facilitate their free commentary on controversial issues. This necessitated extensive travel, and all interviewees were based in various locations in the eastern and southeastern USA, in Ontario, Canada, and in Costa Rica (where fieldwork associated with this research was undertaken). While there is a clear North American bias to the group, this may be appropriate as the membership directory available at the time of this research showed 98 of 186 members of the Marine Turtle Research Group (MTSG) were based in the USA. (There have been efforts to diversify national representation in the MTSG, and membership is currently being reviewed.) Interviewed experts were associated with academic, government, private, and nongovernment organizations, and many of the interviewed experts were influential in marine turtle policy development at a variety of levels (local, national, international). Interviewees were leading and up-and-coming research scientists, programmers for a variety of conservation organizations, current and previous MTSG executive committee members, editorial board members of the *Marine Turtle Newsletter* and *Journal of Chelonian Conservation and Biology*, and organizers of the International Symposium on Sea Turtle Biology and Conservation. To preserve anonymity, only MTSG membership and activity in research and policy/practice are indicated in Table 3. Almost all of the interviewees, whether they were active as research scientists or working in nongovernment or policy-making organizations, had backgrounds in the natural sciences. Most experts were members of the MTSG, although nonmembers were included to gauge whether or not their views differed greatly from those of members, and they were selected based on their location and because of their influence (and potential influence) in their own organizations and fields. All experts who were approached agreed to participate (no one self-eliminated), and their individual attributes are summarized in Table 3. Table 4 summarizes characteristics of the group as a whole.

Table 3. Characteristics of interviewees.

No.	Affiliation	MTSG member	Scientist†	Policy/practice‡	Publications§	Residence‖
B1	university	no	yes	no	20–29	NA
B2	NGO	no	no	yes	0–9	NA
B3	university	yes	yes	yes	30–39	NA
B4	university	yes	yes	yes	50–59	NA
B5	NGO	no	no	yes	0–9	NA
B6	NGO	yes	no	yes	20–29	NA
B7	NGO	yes	yes	yes	30–39	NA
B8	government	yes	no	yes	0–9	NA
B9	NGO	yes	yes	no	20–29	NA
B10	university	yes	yes	no	60–69	NA
B11	government	no	yes	yes	0–9	NA
B12	government	yes	yes	yes	0–9	NA
B13	government	yes	no	yes	0–9	NA
B14	university	yes	yes	no	20–29	NA
B15	university	yes	yes	no	30–39	NA
B16	university	yes	yes	yes	0–9	NA
B17	government	yes	yes	yes	70–79	NA
B18	government	yes	no	yes	10–19	NA
B19	government	yes	yes	yes	40–49	NA
B20	government	yes	yes	yes	40–49	NA
B21	university	yes	yes	yes	50–59	NA
B22	university	yes	yes	no	50–59	NA
B23	NGO	yes	yes	no	130–139	NA
B24	university	yes	yes	yes	130–139	NA
B25	NGO	yes	no	yes	0–9	NA
B26	university	yes	yes	no	60–69	NA
B27	NGO	yes	no	yes	0–9	NA
B28	NGO	yes	yes	yes	0–9	NA
B29	university	yes	yes	no	20–29	NA
B30	university	yes	yes	yes	120–129	NA
B31	university	yes	yes	yes	10–19	CR
B32	university	no	yes	yes	10–19	CR
B33	government	no	no	yes	0–9	CR
B34	government	no	no	yes	0–9	CR
B35	NGO	no	no	yes	0–9	NA
B36	NGO	no	yes	yes	10–19	CR
B37	NGO	no	yes	yes	10–19	CR
B38	NGO	no	yes	yes	0–9	CR

† Scientist refers to those individuals actively engaged in research activities. Many of the individuals not currently conducting research have advanced degrees in the natural sciences.

‡ Policy/practice refers to individuals holding executive positions, past and present, in the MTSG, with direct influence on policy development and implementation in their current occupations, and those who are directly involved in implementing conservation projects at the field level.

§ Number of items listed on University of Florida's marine turtle bibliography. Numbers have been rounded to preserve anonymity.

‖ NA indicates Canada and USA; CR, Costa Rica.

TABLE 4. Summary of interviewee characteristics.

Affiliation	*N*	Area	*N*	MTSG status	*N*	Residence	Total
Academic	15	research	9	member	27	USA/Canada	31
Government	10	policy/practice	11	nonmember	11	Costa Rica	7
NGO	13	both	18				
Total	38		38		38		38

Interviews were semistructured, with experts asked to address a variety of general topics (see Dunn 2000, Kitchen and Tate 2000). Topics relevant to this paper included (1) constraints on and opportunities for using marine turtles, (2) views on commercial vs. noncommercial use of marine turtles, (3) ranching and farming, and (4) the MTSG's stance on use. Analysis focused on common themes and areas of agreement and disagreement (further details are described in Campbell 1997, 2000). While the strength of in-depth interviewing is the provision of detailed qualitative data, there has been some quantification of interview results in order to provide an indication of the similarity of views among experts (Table 5 summarizes results, and Tables 6 and 7 show distribution of results according to affiliation and MTSG membership). To preserve ano-

TABLE 5. Expert views on consumptive use of marine turtles.

Topic/Subtopic	*N*	Respondents
Opportunities for and limitations on using marine turtles		
Long generations/delayed sexual maturity	16	E1, E3, E4, E6, E7, E8, E9, E11, E12, E15, E16, E17, E24, E29, E35, E37
Marine turtle migrations	12	E3, E6, E14, E15, E16, E17, E19, E24, E29, E31, E35, E36
Data limitations	12	E3, E8, E9, E14, E16, E18, E19, E21, E24, E31, E32, E35
General biology/life history characteristics	7	E7, E8, E15, E19, E26, E32, E36
Declining populations	5	E3, E8, E10, E13, E37
Views on use: adults vs. eggs		
Adult harvest is difficult.	7	E7, E10, E11, E15, E20, E31, E32
Adult marine turtles can be harvested.	6	E1, E6, E16, E23, E26, E30
Adult marine turtles cannot be harvested.	5	E9, E12, E13, E24, E37
Egg harvesting is possible.	20	E1, E2, E3, E6, E7, E8, E9, E10, E11, E12, E16, E20, E23, E24, E26, E30, E31, E32, E36, E37
Egg harvesting is questionable/difficult.	5	E3, E13, E14, E24, E25
Economics and wildlife conservation		
Economic value is convincing argument for conservation, wildlife ''pays for itself.''	15	E4, E8, E9, E11, E12, E14, E15, E17, E18, E19, E20, E21, E23, E35, E37
Current economic system, specifically demand and competition, will not lead to conservation, even if wildlife is ''valued.''	12	E3, E5, E14, E17, E18, E19, E23, E26, E27, E28, E29, E31
Not all wildlife values can be measured economically.	6	E11, E14, E15, E17, E27, E35
Mariculture		
Opposed to mariculture	5	E6, E12, E13, E15, E29
Ranching doable	6	E1, E3, E5, E9, E16, E30
Farming doable	3	E1, E4, E5
Positions on uncertainty		
Uncertainty dictates caution, err on side of nonuse.	19	E3, E4, E6, E7, E8, E9, E10, E11, E12, E13, E14, E19, E20, E21, E25, E27, E33, E35, E36
Make do with information that exists, experiment with use.	9	E1, E5, E16, E18, E23, E26, E28, E30, E34
Would rather not have use, but uncertainty should not be used for nonaction.	3	E31, E32, E37
Uncertainty not an issue. Marine turtles cannot be used.	3	E15, E17, E29
Scientific vs. other values		
Both pro- and anti-use factions exist in MTSG.	12	E9, E10, E12, E14, E15, E19, E21, E23, E25, E31, E35, E36
MTSG is opposed to use.	9	E1, E4, E5, E16, E18, E26, E30, E32
MTSG is not opposed to use.	4	E3, E6, E8, E24
Views of MTSG based on emotion.	8	E1, E4, E5, E16, E26, E30, E31, E32
Views of MTSG based on science.	4	E3, E6, E8, E24

TABLE 6. Positions on uncertainty by institutional affiliation.

Positions on uncertainty	NGO	University	Government
Uncertainty dictates caution, err on side of nonuse.	5 (1)	7 (1)	7 (1)
Make do with information that exists, experiment with use.	3 (2)	5 (2)	2 (2)
Would rather not have use, but uncertainty should not be used for nonaction.	2 (3)	2 (3)	0
Uncertainty not an issue. Marine turtles cannot be used.	0	2 (3)	1 (3)

Notes: Values are number of respondents. Rank is in parentheses.

nymity of experts, interviews are referred to by number (E1–E38). All direct quotes used in this paper represent general sentiments rather than extreme views, unless otherwise indicated. Results are presented under two general headings: science and sustainable use, and wildlife in the marketplace.

Science and sustainable use

Most experts stressed that conservation programs must be based on good science. From this starting point, views on the biological limitations on and opportunities for using marine turtles varied.

Limitations on and opportunities for using marine turtles.—Regardless of their ultimate position on use, experts agreed that marine turtle biology constrains opportunities for use. Limitations on using marine turtles relate to basic biology and life history characteristics, data availability, and status of marine turtle populations (Table 5).

Long generation times/delayed sexual maturity and marine turtle migrations were the features of general biology and life history characteristics identified most often as impeding consumptive use of marine turtles. Long generation times/delayed sexual maturity of marine turtles were identified as problematic due to the resulting time lag between taking action and seeing results and due to their impacts on recruitment to the reproductive class. First, long generation times make it difficult to evaluate the impacts of conservation measures. E29 described it as ''like being an astronomer and looking at the light from Alpha Centauri, and saying what's going on on Alpha Centauri.'' Mortimer (1995) has graphically illustrated the time lag problem as applied to egg and adult harvesting, and the limitations on determining the impacts of harvesting as a result of time lags were most frequently cited. Second, delayed sexual maturity was linked to low recruitment to the reproductive class. This makes use of marine turtles difficult to justify and is further complicated by a limited ability to age marine turtles.

> We know that it takes them a long time—no one knows how long—to reach reproductive maturity, and once they reach that they produce a whole lot of eggs but they have very low survival to maturity again.
>
> —E11

Marine turtle migrations were seen as an equally problematic life history characteristic, because (1) all threats along the migratory route may not be known and thus the cumulative impacts on turtles may be underestimated or even ignored; (2) the migration itself makes it difficult to determine the magnitude of individual and cumulative threats; and (3) national user groups, types of use, management techniques and objectives along the route may be conflicting. Direct harvesting throughout the migratory range of turtles was the most frequently identified threat.

> From the time they hatch to the time they become adults they pass through incredible expanses of water and so the possibility for exploitation in each area that they cross is incredible. And the sum of those threats are *[sic]* really daunting.
>
> —E3

E17 believed that ''the cumulative pressure on that reproductive part of the population is just phenomenal. I don't know why there are any turtles left.'' As a result she rejected any consumptive use of marine turtles. Other experts saw migrations as less problematic, but certainly as an extra complication in managing for use: ''. . . you only have access to one portion of the life history. Somebody may be doing something completely different and they may or may not be compatible'' (E7).

Indirect threats along migratory routes were cited less frequently, but included habitat degradation, pollution, sea level change, and stochastic events. Impacts of such threats were deemed unknown, and made it ''very, very difficult to predict reasonable levels of use'' (E16). E19 and E6 also stressed how potential but unknown future threats limit options for sustainable use, as ''the threats along the way are changing rather rapidly'' (E19).

Experts were highly concerned with lack of data for marine turtle populations. While good data were believed to exist for some populations, E6 pointed out that ''in many of these places where there is an interest in harvesting, no, the information isn't available.'' Lack of data and associated knowledge gaps were seen as problematic for conservation in general and for designing sustainable use schemes in particular. For six experts, the most important gap was that regarding population regulation:

> The biggest gap we have is we still don't have a very satisfactory model for sea turtle life history. . . .

> Fundamentally we do not know what affects recruitment because it happens at the end of this ghastly dispersal. First pelagic dispersal which is impossible to deal with, and then there must be some sort of recruitment from that pelagic dispersal stage into the smallest class of settled juvenile stage. We just don't know what affects that.
>
> —E16

With such information, ''we could begin to really assign reproductive value of each class'' (E24), and thus know which classes are more ''harvestable.'' E35 and E8 agreed that in general the information provided by marine turtle science to date is ''not great'' (E8). The importance of lack of data as an argument against use is reflected in the following quote:

> I think that most people who have given it [sustainable use] serious thought know that it's something that we can't really evaluate because of our lack of data. . . . I mean clearly in the context of modern conservation science, and modern resource utilization, one has to assess the area of sustainable use. . . We're all just kind of saying ''yeah, boy, it would be great. Gee, I wish we knew more so that we could really talk about it knowledgeably.''
>
> —E26

The overall status of marine turtle populations was a concern for five experts. E3 described the general status of sea turtle populations as ''they're all declining'' and E6 supported her own preference for subsistence use because ''there are few enough turtles right now that if they're going to be utilized at all, they should be utilized locally and on a subsistence basis.'' E10 agreed:

> The problem now for most sea turtle populations is that they've undergone such an extreme decline that in essence . . . the populations probably have to be protected for a long while, until they rebound, and then a sustained yield would be possible after the populations have recovered and are healthy again.
>
> —E10

E4 believed that further research is required to ''find out how many turtles you actually have in the world, which would be many fewer turtles than we think there are at the moment, because we're overestimating our population sizes in most cases.''

Four experts believed the overall status of populations is unknown, and saw signs of both decline and increase. Referring to leatherbacks, E1 stated, ''In some places, like Malaysia, it's clear that they're declining. In other places they're increasing, like in Surinam.'' Specific populations were also identified as increasing, for example, green turtles in Tortuguero, Costa Rica, and loggerheads and greens in Florida. However, E19 called for ''cautious optimism'' in interpreting results:

> Yes, it looks like for the number of nests the trend is upwards, both for green turtles and for loggerheads. But it's a very short time period. You never know what's going to happen in the next decade.
>
> —E19

Consumptive use: eggs or adults.—Experts were asked specifically about the feasibility of harvesting adult marine turtles vs. their eggs. While only five marine turtle experts rejected adult harvesting under any circumstances, seven agreed that harvesting adults is problematic and the least acceptable form of marine turtle use (Table 5). Experts saw harvesting adults as ''difficult'' due to their value to the overall population:

> When you get something that reaches that stage of development, it's already made it through so many factors, you know, mortality factors, and survived all of those threats that I have a problem when you start taking mature adults and reproducing animals.
>
> —E13

E20 identified adult harvest, particularly of nesting females, as the best road to extinction: ''there's no doubt about it.'' The lack of population data was also seen as particularly problematic for adult harvesting: ''There's no way to know how many males, how many females there are, and how many can be taken. You can't give a harvest target. . . . Biologically, there's no way to justify it'' (E31). E9 agreed that lack of knowledge ''makes it pretty hard to come up with a harvest scheme that makes sense as an adult.'' Thus, given these unknowns, ''the harvest of adults on a nesting beach is difficult to support anywhere, and certainly not as a conservation tool'' (E9).

Six experts believed adult harvesting could be done. E6 pointed to ''some populations in the world which can sustain harvests because they've been protected for long periods of time, and never really heavily exploited.'' E26 identified overall good health of a population as a criterion for harvesting, which can be determined by looking at the ratio of neophyte to nonneophyte nesters, an indicator of adult recruitment. He explicitly rejected the ''too many unknowns'' argument against

TABLE 7. Assessment of MTSG according to MTSG membership.

	Member	Nonmember
Both pro- and anti-use factions exist in MTSG.	10 (1)	2 (2)
MTSG is opposed to use.	7 (2)	3 (1)
MTSG is not opposed to use.	4 (3)	0

Notes: Values are number of respondents. Rank is in parentheses.

PLATE 1. Olive ridley arribada nesting at Ostional, Costa Rica. Photograph by the author.

adult use. Harvesting scenarios suggested by this group included male-targeted and temporally and regionally delineated harvesting to reduce overall impacts and allow for better/easier enforcement of regulations. These experts saw adult harvesting as problematic but not impossible.

Marine turtle experts were generally more tolerant of egg harvesting, and saw eggs as ''reproductively designed to take a hit'' (E12). In some places eggs are naturally ''lost.'' This is exemplified by highly eroding beaches in Surinam:

> You have a certain percentage of eggs that are doomed by geological cycles rather than human or even animal action . . . this is a takable surplus. Either let it wash out to sea or you can take it. And if by taking them, and selling them in town, and using that money to make sure that eggs above the high tide line are marked off and are saved, you're better off than if you kept everyone away and didn't do anything. So you can apply a straight logic in cases like that.
>
> —E23

A second ''straight logic case'' with egg loss occurs with mass nesting by ridleys (called arribadas in Spanish; see Plate 1) that results in such high nesting density eggs are destroyed by the turtles themselves. E11 described this as ''an ideal situation to compromise with use.'' While mass nesting is specific to Kemp's and olive ridleys, E31 extrapolated the principle to other cases:

> In areas with intensive nesting, a moment arrives as the nesting curve goes up. A moment arrives in the season that the beach is saturated. So those nests, at that moment, are the ones to be exploited. It depends on the behavior of each colony when we're talking about eggs.
>
> —E31

When there is no such obvious natural loss or destruction of eggs, harvest levels were seen as more difficult to calculate. Nevertheless, due to the relatively low value of eggs compared with adults to population maintenance, experts were more willing to compromise ''if one does have to make choices'' (E7).

> What is one female worth over the span of her lifetime, in terms of egg production? Does she produce 8000 eggs? Does she produce 15 000 eggs? And so if you can offer people the opportunity to harvest hundreds and maybe even thousands of eggs instead of taking an adult turtle, haven't you done something good for the species?
>
> —E6

E20 suggested that without obvious levels of loss ''you have to consult the demographers, and say 'work out the equation for us. How many eggs can we take? What sort of jeopardy are we putting this population in?''' A modeler responded:

> You can construct demographic models based on life-stage matrix; age-specific models that will tell you in essence whether the population trajectory is going to be positive or negative with a given harvest at a given level. Usually you can sustain a fairly large harvest of eggs because of the high mortality

> of the hatchlings anyway—they're not worth very much to the population—so you can eat some.
>
> —E10

Other suggestions for setting egg-harvesting levels included determining yearly nesting numbers and hatching success rates (E13). E12 referred to the U.S. marine turtle recovery plans that set the hatching success goal as 50% of nests, although she felt this is too low. Nevertheless, if natural hatching success is known, and if it is higher than identified recovery goals, then the difference can be harvested. Finally, E4 argued that sometimes common sense is enough and criticized attempts at egg harvesting for not using it:

> Given the biology of sea turtles where you get two adults produced from thousands of eggs, if you reduce the number of eggs to a tenth of that [via harvesting] you will be producing one tenth of two adults, which is less than one. So it won't work.
>
> —E4

Three experts questioned the general preference for egg harvesting over adult harvesting. For example, E26 believed that monitoring the impacts of adult harvesting is easier than those of egg harvesting, and decisions on adult harvests can be more easily reversed. E23 used a specific example of adult harvesting combined with egg protection that has not resulted in extinction, although this may be specific to ridley mass nesting. For 20 years there were:

> . . . several hundred turtles a day being killed. The world's biggest turtle slaughterhouse operating for two decades. . . . Finally it was stopped. And big arribadas appeared. And it's a sort of embarrassing situation, but it does require some contemplation.
>
> —E23

Five experts questioned the ''straight logic'' cases for egg harvesting. First, the time lag between harvesting eggs on the beach and seeing any impact on the population was problematic:

> Why are there still animals returning to [place]? There shouldn't be. All the eggs have been eaten. . . . We're sitting here at this precipice and then—boom—there's not going to be anymore.
>
> —E14

Second, the notion that turtles ''overproduce'' eggs was questioned: ''The more produced the better . . . because we need to have as many out there because of the reproductive strategy that these animals have put in place'' (E13). E24 questioned current assumptions about early life stage mortality in marine turtles and suggested the estimated one in 1000 hatchling survival rate may be an underestimate. Thus, egg harvesting might not be substituting for presumed hatchling mortality. The reverse argument, that reduced estimates of mortality might allow for more flexibility in adult harvesting, was not made. Third, some experts were concerned with harvesting the ''right'' eggs in overproduction scenarios:

> You can't guarantee that this clutch that you're allowing to be harvested would have been destroyed. This may have been the clutch that would have survived . . . you may actually be harvesting more than would have been destroyed by these sequential arribadas. . . . Or maybe the egg clutch you allowed to be taken was the fittest, . . . that had the better genes . . .
>
> —E14

E30 expressed frustration with arguments about which eggs are ''best'' to take and suggested those who make them would like to have it both ways. On the one hand, they argue that nature should be allowed to take its course, with the consequent destruction of doomed eggs and survival of the best ones. Thus, collecting eggs for consumption may be removing ''good'' eggs, and transplanting eggs to hatcheries may be passing on ''bad'' genes. However, in places like Surinam, 30–40% of eggs are lost to erosion. If these are bad eggs, as reflected by females failing to nest in safe places, then they should be allowed to wash out to sea, or alternatively, collected. Few people would agree with this, however, and would rather see a portion of eggs transplanted. E30 believed people use the good and bad egg scenario varyingly to suit their purposes.

Wildlife in the marketplace

Just as most experts stressed the importance of science to informing their views on sustainable use, most discounted the role of ''other'' issues. However, for many experts, their views of economics and commerce were prominent in their arguments about use. Five experts felt that commercial use of marine turtles was unacceptable, and 14 expressed a strong preference for noncommercial localized use of marine turtles if use is to occur at all. Expert views on the role of economics in wildlife conservation, and more specifically on large-scale commercial operations, are discussed below.

Economics and wildlife conservation.—The need to attach monetary value to wildlife to ''get people on side'' was identified by 15 experts as a key motive for considering sustainable use as a conservation tool (Table 5). Even when they disagreed in principle, for example E11 criticized human ''selfishness'' as necessitating monetary valuation of wildlife, experts perceived a need for ''more creative ideas as incentives to protect these places and animals'' (E17). These experts saw resistance to wildlife conservation by the general public as the movement behind sustainable use:

> I don't think that very many people see the preservation of the natural world for its own sake. Whether

> they believe it or not, they don't see it as a sellable idea.
>
> —E4

Selling wildlife conservation to the general public was seen varyingly as desirable, necessary, and lamentable. Two quotes illustrate the diversity of positions:

> It [monetary value] is the hard and fast value that people want demonstrated today. If you have that hook, you should demonstrate it, and you should flaunt it and use it to your advantage.
>
> —E20

> You are . . . confronted implicitly, if not explicitly, with the fact that [if] you can't prove that it's economically beneficial in the narrow sense, then it's not important. And there's a time when the proper response to that is ''oh yes I can'' and you go ahead and prove it. There's another time when the response to that is ''no, it's important for another reason.'' And I think that we have rolled over a little, we—the whole big conservation group—have rolled over a little too easy [*sic*] on this.
>
> —E27

Specific concerns regarding monetary valuation of wildlife, and particularly of marine turtles, varied. Six experts were concerned about the ability of the market to accommodate all types of values. Some wildlife functions cannot be measured in dollar terms:

> Because they have a social value. . . . The old idea of just knowing that they're there, having people be able to look and see them. . . . It's a tough concept to grasp. It's really intangible. But there is value to those things.
>
> —E35

The extended value of a species to its ecosystem was also deemed difficult to estimate, not only due to market functioning, but because the full function of species in complex ecosystems is unknown:

> If you lose this animal, one individual, or this family, these related individuals or even the whole species at this local level, what does that do to the ecosystem? I don't think that it's possible to put an economic value on it.
>
> —E14

Other experts raised the problem of human preference:

> Who's going to do spade-foot toads? Who's going to do legless lizards? They have no constituency. . . . I don't think people are smart enough to choose what animals they want to keep around.
>
> —E17

A second group of experts was concerned with the economic system itself, rather than its ability to accommodate wildlife. E15 captured the general concerns of these experts when he reflected on the nature of the capitalist system. He suggested that arguments for sustainable use rest on a false assumption:

> . . . that you can put an economic value on an animal and thereby you are going to conserve it because it is economically in your interest to do so. It's the assumption that you won't just exploit it to extinction and then just go on to something else. Which is what's happened with whales.
>
> —E15

Twelve experts expressed specific concerns about the roles of demand and competition in capitalist systems. With regard to demand, experts believed commercial use is seldom sustainable under a capitalist system, because the act of supplying a product will increase demand and profit motives will dictate that demand is met. Experts were also in disagreement regarding which type of demand to meet, luxury vs. basic needs. Four experts opposed luxury use on principle and because high prices create incentives for illegal harvesting. Others saw some value in luxury use as a means to gain wider support and to generate greater sums of money for conservation. With regards to competition, five experts were wary of entering wildlife into competition via economics due to the ''slippery slope'' of relative values. For example, E19 pointed to land values in overpopulated areas as an increasing economic threat to marine turtle nesting beaches. As property prices increase, government incentives to sell off publicly owned and protected land will increase, and protecting wildlife will no longer be the rational economic choice.

Mariculture.—Sixteen experts commented on the feasibility of farming or ranching marine turtles (Table 5.) Given general concerns related to consumptive use of marine turtles and reservations about commercial use of wildlife, resistance to mariculture operations was expected. However, six experts felt that they could theoretically support ranching, and three felt they could support turtle farming, although almost all of these experts held reservations. Six experts expressed opposition to both farming and ranching. Concern and resistance were based on biological and other issues related to consumptive use in general, as well as on some issues specific to mariculture. Specific concerns include the morality of domesticating wild animals, barriers to controlling trade, and implications of the capital-intensive nature of mariculture operations for supply management and for possibilities of local ownership. Arguments in favor of mariculture included opportunities to control and monitor legal trade, funding for conservation efforts, and poverty reduction in less developed countries.

Six experts commented specifically on the CITES ranching criteria, and only one felt that they could be met. The other five experts saw the criteria as overly stringent and difficult, but three of these five deemed such stringency a ''good thing'':

> I see a little more merit in the ranching criteria, in that honest people contemplating ranching will read these criteria and say ''my god, I don't think I'll try this. I've got to organize the whole hemisphere before I can run my little ranch.'' So it served the purpose of discouraging a lot of people, a lot of conscientious people, from trying ranching.
>
> —E23

The remaining two experts were critical of the stringency, and one of these felt the focus on biology was misplaced:

> . . . we know the biology is a massive constraint, but the solution here is not to get all the answers on the biology. The solution here is probably not to address the biology at all. The solution is probably to really restrict the trade. The trade controls are going to be much more important . . .
>
> —E16

Discussion

The results presented show that experts express a range of views on the possibilities for using marine turtles in a commercial, consumptive, and sustainable manner. Three issues arise for discussion. First, science was the main influence on individual views, and yet views across experts were different. Second, evidence suggests that it is not ''just science'' that informs expert views, and other values clearly play a role. Third, ''consumption'' appears to be the more problematic element of commercial consumptive use.

Interpreting science: the role of uncertainty

A key distinguishing feature among experts is how they dealt with the issue of scientific uncertainty. Four distinct groupings emerge (Table 5).

First, 19 experts could not support consumptive use of marine turtles due to the lack of scientific knowledge. E3 is a good example of experts in this group:

> And no one really understands the population regulation, how these populations regulate themselves. . . . And until you really understand that, I wouldn't, I wouldn't advocate any kind of use.
>
> —E3

This is an important trade off; E3 stated definitively that she considered sustainable use a valid wildlife conservation tool, and she also accepted ranching. Yet in the above quote she cannot ''advocate any kind of use.'' Thus, for experts in this group, scientific certainty takes precedence over other considerations. Most experts in this group suggested that if the data were available, they would have ''no problem'' with consumptive use and they expressed optimism regarding the potential to collect data through DNA analysis, satellite tracking, and improved modeling. Others in the group were less optimistic:

> I mean, sure, if you throw enough billions of dollars at it. . . . I suppose there's all kinds of technology out there that's way beyond me . . . But, I mean, we don't know where they go.
>
> —E14

Second, a group of 10 experts recognized biological knowledge gaps, but advocated making the best of information that exists. They saw knowledge gaps as equally problematic for any conservation effort, including efforts to make consumptive use sustainable. E16, for example, argued against getting ''bogged down'' in the notion of sustainability:

> Sustainability is very much like scientific truth. It's not something you can prove. It's something that you . . . accept on a contingent basis until you disprove it. A definition is a handy way to think about it. . . . But in point of fact you're never going to be 100 percent sure that it's sustainable. What you're looking for [is to] increase the probability that it's sustainable and reduce the probability . . . that it's unsustainable. And that's as far as you're going to get.
>
> —E16

E16 was willing to act in the face of uncertainty, because he saw it as a superior alternative to doing nothing. Similarly, E28 worried about defending a no-use position based on uncertainty:

> We want to take the precautionary approach and we want to err on the side of conservation because we don't know enough. But that's not very scientific either. . . . We keep reinforcing this position that we don't know enough to manage and I think that that's something that backfires on us all the time.
>
> —E28

E16 saw appeals to uncertainty in a more sinister light:

> The proposition that the only way to proceed is to first study and know everything, and once you've studied and known everything you choose the correct solution and implement it, I think is just not a real world solution. And I believe it's used now to in fact obstruct progress.
>
> —E16

Other experts pointed out that uncertainty works both ways. E1, for example, cited examples of long-standing harvests that have not eliminated populations as evidence that populations may be more resilient than expected. Experts in this group believed that there will never be perfect data on marine turtle populations and that, even when good data exist, use schemes fail or succeed on socioeconomic issues. These experts saw trade-offs between socioeconomic needs of humans and biological needs of turtles as necessary, and believed that conservation in the real world requires risk taking and adaptive management.

Third, a group of four experts fell somewhere be-

tween the first two positions. Experts in this group were highly concerned about the biological limitations on using marine turtles and less accepting of uncertainty than experts in the second group. Their preferences would be to limit consumptive use of marine turtles and all four of them were actively involved in doing so at specific sites. However, the reality of socioeconomic need ultimately overruled their concerns and they could accept consumptive use when other alternatives were unfeasible. More than all others, these experts took the approach of making use ''tolerable.''

A fourth group of three experts represented the extreme of the no-use side. For them, information was not a limitation on sustainable use; the information exists to confirm that turtles cannot be used, certainly not as adults and even questionably as eggs. For this group, biology is everything:

> I'm considered an uncompromising kind of a person and rigid. But again for me the bottom line is does the resource exist . . . I don't really care about the political aspects of it. I don't even care about the cultural or social aspects of it. I just know what's feasible and what isn't feasible.
>
> —E29

One possible division in expert positions on uncertainty could be along the lines of institutional affiliations, reflecting their primary professional activity. While in-depth interviewing is not intended to test this type of causation, and there are limitations based on the sample size, some initial observations can be made. Table 6 shows no obvious relationship between positions on uncertainty and institutional affiliation (for example, the ranking of categories is the same across affiliation).

Beyond science: aesthetics, other values, and conservation

Due to the uncertainty associated with marine turtle biology, experts can couch their arguments for and against use in scientific terms, and in turn downplay the role of other values they attach to marine turtles in influencing their views. Interviewees were not asked directly about their ''feelings'' for turtles, but some volunteered them, unprompted. First, many experts talked about the aesthetic appeal of turtles to the public—a cuteness or huggability factor—but only four admitted that aesthetic, emotional, or other values impacted on their own views of conservation, including utilization (Table 5). As E15 put it: ''I don't want to see sea turtles butchered.'' Second, a group of five experts explicitly pointed out that their views were not based on emotion, and that they would have ''no problem'' with consumptive use of marine turtles if the data could support it:

> I don't have a problem with use. I mean, I'm not a vegetarian . . . If it were really a sustainable use . . . I don't have a strong doctrine against ''no sea turtle shall be killed.''
>
> —E24

Three of these five experts felt that data do not exist currently to support utilization, and one felt the data support a strict nonutilization approach.

While only nine experts commented on their own feelings for turtles, interviewees were asked where the MTSG stood on consumptive use of marine turtles and what this position was based on. It is in reflecting on the views of others that experts raised the issues of aesthetics and values. Nine experts felt the MTSG was anti-use, and all but one of them characterized the basis of resistance as ''emotional'' (see Table 5). All but one of these nine experts were also in the group advocating making do with information that currently exists and experimenting with use. A second group of four experts thought the MTSG was open to the idea of use, and all four felt the MTSG position was based on science. They also felt that lack of data currently prohibits use, and as individuals these four experts fell into the category of those unwilling to experiment in conditions of uncertainty. A third group of 12 experts believed that the MTSG was divided on the issue of sustainable use and that both emotion and science influence this division. They also felt that the expansion of the MTSG to include more members from developing countries had expanded the debate on sustainable use, and their individual views ranged from being anti-use to pro-experimentation. Table 7 shows assessment of the MTSG position on use according to MTSG membership. While there are some differences in ranking (e.g., most nonmembers saw the MTSG as opposed to use) comparisons are severely limited by the sample size. As Table 7 suggests, many nonmembers were unwilling to comment on the MTSG stance, as they felt they lacked insight into the organization.

A final point of interest regarding the intersection of science and other values is how experts deal with the views of those who do not agree with them. While experts saw their own views as based on science, they saw alternative views as based on ''something else,'' i.e., emotion. For example, five experts felt that nonscientific ''conservationists'' were emotional about turtles, while they were not: ''I wouldn't say it's really the biologists that are in that group. It's more like the conservationists without the biological training'' (E6). This research suggests this is not necessarily the case: three of the four experts who acknowledged their emotional responses to turtles were active research scientists. Similarly, those who opposed consumptive use either due to uncertainty or because they acknowledged aesthetic values of turtles characterized their opponents as greedy and exploitative. Since there are few certainties in marine turtle conservation science, experts do not have to engage with the science-based arguments of their opponents.

Sticking points: consumption or commercialization?

Many experts expressed concern with commercial use of marine turtles because they lacked faith in the dominant free-market system through which commerce is regulated. While the views of marine turtle experts on nonconsumptive use of marine turtles via wildlife viewing and ecotourism are not discussed here, it is worth noting that almost all of the experts preferred nonconsumptive use to consumptive use (Campbell 1997, 2000). Concerns about commercialization, however, were rarely mentioned when considering options for nonconsumptive use, in spite of the fact that tourism is perhaps the industry of capitalism, globalization, and supply and demand. That people are willing to purchase turtle walks or travel the globe to experience an ecotourism adventure was accepted almost unanimously as a ''good thing'' and as preferable even to small scale noncommercial use (Campbell 1997, 2000). This suggests that the consumptive aspect of commercial consumptive use is more problematic for experts than the commercial aspect.

Conclusions: Implications for Conservation

Several conclusions can be reached from the results and discussion detailed above. First, the diversity of views among interviewed experts regarding the potential for using marine turtles in a consumptive manner is surprising given the MTSG's unenthusiastic position on use. While interviews show that there are individuals who believe consumptive use is a possible conservation tool, few have published their views (Mrosovsky [1983, 2000*b*] is a notable exception). Two explanations may account for the differences in individual views and MTSG policy. The first is that during interviews some experts may have been unwilling to oppose utilization because of its prominence in current policy statements, and thus paid lip service to it. Alternatively, those in favor of experimenting with use may not feel free to express their views in the wider marine turtle conservation community. Some experts implied this was the case.

Second, in spite of increasing recognition in the IUCN of the importance of economics, politics, culture, and society in determining the success or failure of conservation efforts, science remains the privileged language of the interviewed experts, pro- or anti-use. This has implications for conservation in practice. Biology is the starting, and for some the stopping, point on sustainable use, and this suggests that many species experts have not been convinced of the importance of other issues listed above, i.e., the basis of the argument to pursue sustainable use. While many of the interviewed experts recognized that human need is a legitimate argument for pursuing use, they returned to exclusionary protection as a preferred conservation tool due to the exceptional nature of marine turtles (Campbell 2000). The IUCN has had difficulty in developing guidelines for use, and has turned the task over to regional specialist groups, and, to a lesser extent, species specialist groups. To date, the MTSG has not established guidelines for any kind of use, though there was an opportunity to provide egg harvesting guidelines with publication of the techniques manual (Eckert et al. 1999) as the ground was laid in the Strategy (MTSG 1995). Thus, there is some discordance between IUCN and MTSG policy.

Third, this research highlights the sometimes-fuzzy line between conservation science and environmental advocacy, one enhanced by lack of data on marine turtle populations. Bowen and Karl (1999) have raised this point, and criticize the ''schizophrenic nature of conservation biology'' in debates over whether or not the Pacific black turtle is a separate species, a distinction their genetic analysis does not support:

> . . . we have felt considerable pressure to downplay or ''reinterpret'' genetic data on the evolutionary distinctiveness of the black turtle. This pressure came from members of the international sea turtle research community, U.S. wildlife management agencies, several nongovernmental conservation agencies, and members of the World Conservation Union. . . . This pressure was very real.
>
> —Bowen and Karl (1999:1014)

Bowen and Karl (1999) see this pressure arising from the need to maintain a ''crisis'' narrative in the war of conservation. They call for a one-way relationship between science and advocacy, in which the former is used to influence the latter, but not vice versa. In a similar vain, Mrosovsky (1997, 2000*a*, *b*) has criticized the IUCN in general and the MTSG specifically for blurring the line between science and advocacy in its categorization of hawksbill turtles as critically endangered. Mrosovsky's argument can be more easily dismissed, however, as it relies on interpretation of existing field data (acknowledged as incomplete) and lacks the ''hard'' data that can be generated by laboratory testing (e.g., analyzing DNA). When experts claim that the merit of CITES ranching criteria is that they are impossible to meet, advocacy is clearly playing a role. Reflecting on the most recent CITES meeting, Richardson (2000:2) laments that, ''It soon became clear to me that the CoP [Conference of the Parties] would not be a forum for objective discussion, debate and compromise regarding trade in hawksbill turtles. It was obvious that the battle lines had been drawn. . . ''

A common theme in discussions of sustainable use and marine turtles is that the case is unique. Marine turtle experts accept sustainable use at a general level but many then exempt marine turtles due to their life history characteristics and lack of data (Campbell 1997, 2000). Many experts also point out the differences between marine turtles and other reptiles that are used, e.g., alligators and crocodiles. There are clearly biological challenges to using marine turtles, but other

species also face challenges. For example, Bennett and Robinson's (2000) edited volume on hunting and sustainability in neotropical forests lists the limitations on setting harvest levels due to lack of data, difficulties in accounting for cause and effect in ecosystem dynamics, inadequate understanding of recruitment, and so on. Peres (2000:32), for example, states that ''the effects of different cull regimes on population dynamics cannot be explored because detailed demographic information is not available for any large-bodied tropical forest vertebrate'' and Leeuwenberg and Robinson (2000) point out that density dependent responses to harvesting have not been shown in any neotropical mammal. While the scale may be different, the problems are similar. Hill and Padwe (2000:81) recommend adaptive management, which ''emphasizes the need for continual monitoring and appropriate adjustments in harvest regulation to accompany any steady-state population management policy.'' While the biological differences in species will clearly impact management practices, there are lessons that can be shared across species regarding institutional arrangements, social and economic costs and benefits, and cultural change, all of which can impact on the sustainability of any conservation efforts. It could also be argued that the same life history characteristics (e.g., migration) that make marine turtles difficult to use from a biological perspective, make them candidates for use: marine turtles are widely dispersed (they are impossible to protect throughout their ranges), and migrate through and nest in areas of high economic need (most nesting sites are concentrated in developing countries). Furthermore, marine turtles are widely used. In Latin America and the Caribbean, for example, turtles and their eggs are used consumptively throughout the Caribbean (Frazier, *in press*), in Nicaragua (Lagueux 1998), Costa Rica (Cornelius 1991, Campbell 1998), Cuba (Carrillo et al 1999), Honduras (Lagueux, 1991, Ruiz 1994), and Suriname (Mohadin 2000). While some experts believed there is a need to make such use sustainable, others preferred to attempt to eliminate it.

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