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Documenting the Value of Volunteer Effort for Sea Turtle Conservation in South Carolina

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ABSTRACT. – We recorded total hours spent by volunteers who carried out conservation and management activities on loggerhead turtles (*Caretta caretta*) in South Carolina, including nest protection and data gathering. We ascertained a monetary value of the volunteer effort and estimated the resulting increase in hatchling productivity. In 2001, 15 nest protection projects provided work effort of 15,000 man-hours by 520 volunteers, with an estimated value of about $105,000, and an estimated ten-fold increase in hatchling production on their beaches.

KEY WORDS. – Reptilia; Testudines; Cheloniidae; *Caretta caretta*; sea turtle; conservation; management; volunteerism; monetary value; South Carolina; USA

The loggerhead turtle (*Caretta caretta*) is found in temperate and tropical waters worldwide. One of this species' major nesting concentrations is in the southeastern USA (National Marine Fisheries Service and U.S. Fish and Wildlife Service, 1991). Recent genetic evidence shows that loggerhead females return to nest on the same region of coast where they were hatched. In the western North Atlantic there are at least five loggerhead sub-populations based on the genetics of nesting females at the beach. These sub-populations are located at the Yucatan peninsula in Mexico, the Florida panhandle, the Dry Tortugas, south Florida, and a northern sub-population from Amelia Island, Florida, to North Carolina (Encalada et al., 1998).

The loggerhead was listed as a threatened species in 1978 under the U.S. Endangered Species Act. Given the high site fidelity of nesting females to their natal region and low gene flow between nesting assemblages, most western North Atlantic loggerhead nesting assemblages are vulnerable to extirpation. Should an assemblage be extirpated, regional dispersal will not be sufficient to replenish the depleted one even over thousands of years (Bowen et al., 1993).

The south Florida sup-population averages about 64,000 nests yearly, whereas the northern sub-population averages only about 6200 nests a year, a ten-fold difference (Turtle Expert Working Group, 2000). South Carolina's nesting females comprise about 56% of the northern sub-population nesting effort (Turtle Expert Working Group, 2000). Thus, South Carolina beaches are a significant area for the continued survival of the northern sub-population of the loggerhead turtle. Studies in the late 1970s on five of the state's major nesting beaches showed that without management, erosion, predators, and human poaching destroyed more than 90% of the nests that were laid (Hopkins and Murphy, 1980; Stancyk et al., 1980). Obviously, the species could not recover with hatchling production so low, but how was conservation to be implemented over a 300 km coastline with limited state staff and funding?

Nest protection projects began as an outgrowth of the Sea Turtle Standing and Salvage Network. While patrolling the beaches to record data on sea turtle carcasses, volunteers noticed that predators and erosion were also destroying many nests on their beaches. They asked the South Carolina Department of Natural Resources (SCDNR) if they could begin protecting nests, since they were already on the beaches each day. In 1981, there were 5 volunteer projects; twenty years later there were 15.

Studies have been done on the consumptive and non-consumptive economic value of sea turtles; for a comprehensive review, see Witherington and Frazer (2003). As a subset of this, there have also been studies to quantify the value of sea turtles in the ecotourism business. Two studies conducted at the nesting beach at Mon Repos, near Bundaberg, Queensland, Australia, showed that there is substantial economic potential for this type of tourism, if well managed, which can result in the long-term conservation of wildlife resources (Tisdell and Wilson, 2001; Wilson and Tisdell, 2001). These authors also suggested that *in-situ* ecotourism is likely to be a more powerful force for fostering pro-conservation attitudes and actions among visitors than *ex-situ* wildlife-based tourism, such as in aquaria and zoos.

While there is economic benefit to be extracted from sea turtles (ecotourism), there is also an economic component that involves the input of monetary value for sea turtle conservation (volunteerism). Community science (of which volunteer monitoring is an important subcategory) is a rapidly developing field that remains loosely defined. Community science is usually practiced by groups of volunteers in their own localities who sometimes work in partnership with government agencies, museums, universities, or other non-governmental organizations on issues typically related to environmental restoration and management (Carr, 2004).

In South Carolina many sea turtle research and management activities are carried out entirely by volunteers or by volunteers assisting paid staff biologists (Tambiah and Hoyle, 2000). Their donated time represents value, but the actual monetary value for many projects has not been quantified. Nest protection projects provide an invaluable service by safeguarding the majority of the nests laid in South Carolina.

The purpose of this study was to attempt to document just how valuable these volunteer efforts were, both in monetary terms and for the conservation of the species. The goals of this study were: 1) to document the total hours spent by volunteers (both in nest protection activities and in data gathering on dead, stranded carcasses), 2) to ascertain a monetary value of this volunteer effort, and 3) to estimate the increase in hatchling productivity resulting from their conservation efforts.

METHODS

Each spring, prior to the loggerhead nesting season, permitted volunteers attend a training workshop hosted by the SCDNR. Guidelines for data collection and management activities are reviewed and questions are addressed. In addition, two site visits by SCDNR staff are made during the season (once during nesting and again during hatching) to provide hands-on field experience training, and to assure that the guidelines are being followed. SCDNR also produced a 14-minute video on nest protection methodology and distributed it to all projects. This video could then be used whenever needed, such as for new volunteers after the season starts.

During the 2001 annual spring training workshop, the authors proposed this study to the 15 nest protection volunteer project leaders. Leaders were provided with time sheets (one for each month, May through November). The types of activities were broken down into the following categories:

Beach Patrolling. — Surveying the beach each morning at dawn to locate loggerhead tracks where the turtle had emerged the previous night to nest. This is done by walking, use of an All Terrain Vehicle, or by a 4-wheel drive pickup truck.

Nest Protection/Relocation/Inventory. — Locating the egg chamber with a wooden dowel probe stick, constructing predator-proof cages, screening nests, staking and marking nests, clearing away debris prior to hatching, removing heavily accreted sand from nests or from over screens, installing ghost crab traps, monitoring nests for predation, monitoring nests for emergence, and providing crowd control at emerging nests. Nests laid in areas prone to erosion involve constructing a new egg chamber in a safer location and transferring the eggs to the new site. A post-emergence inventory involves counting the number of hatched eggs and dead or live hatchlings in the nest to calculate the percent hatchling emergence.

Strandings. — Collecting biological data on sea turtle carcasses that wash ashore. The person must be able to correctly identify the species, interpret field signs for the presence of boat strikes, other human interaction or shark wounds, and take accurate measurements of the carcasses.

Administration/Organizational. — Filling in application forms for a state permit, scheduling volunteer work times, summarizing year-end data and preparing a final report to the state, as well as presenting public education programs.

For each of these activities on the timesheet, a column was assigned to number of hours spent and one for number of people involved. Each row of the data sheet was a day of the month with a total row at the bottom. The last column was the total hours for all activities and the total number of people involved on each day. Individuals kept a daily record of donated time. Project leaders filled out and mailed a summary of the volunteer timesheets each month. At the end of the season, beach/island totals were summarized in a spreadsheet and returned to each project leader for verification.

To avoid criticism for overstating volunteer value, it was decided to use the minimum wage ($5.15/hr) for those who simply patrolled the beach. Anyone who was trained to do the other more technical tasks (move nests, inventory nests, or work in an administrative capacity) would be valued at $10.00/hr. The valuation process was simplified by using only two skill levels. Some of the projects received support, such as the cost and upkeep of vehicles and administrative staff time, but we do not include these.

To calculate the increase in hatchling productivity, data were summarized from the annual reports prepared by project leaders and compared to productivity estimates from the two previous nest depredation studies in South Carolina (Hopkins and Murphy, 1980; Stancyk et al., 1980).

Table 1. Number of volunteers by skill level for 15 sea turtle projects in South Carolina, 2001. S.C.U.T.E. = South Carolina United Turtle Enthusiasts, a project covering Horry and northern Georgetown counties except for Myrtle Beach State Park.

Project	# Vols. Beach Patrol	# Vols. Nest Protection/ Relocation/Inventory	# Vols. Strandings	# Vols. Administrative	Total # People
Myrtle Beach State Park	12		1		13
S.C.U.T.E.	9	28	0	5	42
Cape Romain		26			26
Dewees Island		2			2
Isle of Palms-Sullivans	4	3	3	1	11
Folly Beach	4	4	3	2	13
Kiawah	62	48	2	9	121
Seabrook	36	29		2	67
Edingsville	1	2			3
Town of Edisto Beach	5	15		2	22
Harbor Island	9	7		1	17
Hunting Island State Park	52	50		8	110
Fripp Island		28		1	29
Pritchards Island/St. Phillips	4	36			40
Hilton Head				4	4
Total	198	278	9	35	520

RESULTS AND DISCUSSION

Volunteer Effort. — Fifteen separate projects participated in this study. The size of each group varied from only a few, to over a hundred on two of the beaches, for a total of 520 volunteers (Table 1). Table 1 also shows the number of volunteers assigned to each activity according to their highest level of skill (no volunteer was duplicated in other activities). The number of volunteers was not directly related to the number of nests laid on a beach each summer, but was more an indication of the enthusiasm generated by the project.

The results by month are shown in Table 2. These numbers reflect the cycle of the sea turtle season. In May and June, volunteer time is spent finding nests and relocating them when necessary. As the nesting effort increases in June, a higher percentage of volunteer activity is seen. In July, nesting continues and nests have begun to hatch, with nest inventory added to volunteer schedules. It is in this month during the season that the highest percent of time (26.0% and 28.2% for man hours and people effort, respectively) is spent. In August, nesting has slowed but the number of nests to be inventoried is high. This results in a slightly lower percentage of time and effort. In September, nesting is over, but inventories continue; and in October, only a few inventories remain. November is the time of year when project leaders are preparing final reports, but some monthly time sheets were not received, probably due to burnout. As a result, the time in November is under-reported. But this was not the case the rest of the season.

The total hours, volunteer effort, and monetary values for the season by each individual project are shown in Table 3. The figures do not include any salaried staff (such as employees at state parks), but only the volunteer effort. The monetary value for Beach Patrol and Management are similar due to the higher number of hours in patrolling at the lower rate, versus the lower number of hours in management at the higher rate. Both came in at over $50,000. The total for the season ($104,964) was much higher than anticipated.

Independent Sector, a coalition of leading nonprofits, foundations and corporations, reported that the value of volunteer time in 2001 was $16.05/hr (http://www.independentsector.org/). This is based on the average hourly earnings of all nonagricultural workers as determined by the Bureau of Labor Statistics. Independent Sector then takes this figure and increases it by 12% to estimate for fringe benefits. If our volunteers' time were calculated at $16.05/hr, it would have been worth $245,083 for the season. Whether one uses the Independent Sector value or our more conservative two-tiered system (our dollar amounts did not include fringe benefits) the monetary value of volunteers' time is surprisingly high, which makes acknowledging their efforts even more important.

There are some disadvantages to using volunteers. There may be problems with consistency of the data and turnover of volunteers. And to the extent that volunteer organizations have high turnover among their volunteers, they require ongoing training and retraining capacities (Romero, 1986). We have addressed these issues in several ways: 1) there are written guidelines, 2) there are at least 2 site visits by SCDNR personnel to each project every year, 3) we produced a video as a training guide that can be used by the projects for training as needed, and 4) we provide an electronic spreadsheet for data recording that has imbedded formulas to calculate nest success and hatching success automatically, so they are calculated the same way for all projects.

Hatchling Productivity. — There were 45,859 hatchlings produced from the 15 projects involved in this study. Given the two total monetary values above, the cost per hatchling in terms of volunteer effort is $2.29 and $5.34, respectively.

Data from two previous studies on five South Carolina beaches with no management (Hopkins and Murphy, 1980; Stancyk et al., 1980) showed that the number of nests that survived to hatch was 7.4% and 6.2%, respectively. Of the 5 beaches (South, Sand, Cape, Cedar, and Kiawah islands) only 2 (Cape and Kiawah) were involved in this study. Without management, the hatching success was 3.0% for Cape Island

Table 2. Seasonal distribution of volunteer man-hours (MH) and people effort (PE) for 15 sea turtle projects in South Carolina, 2001.

	May		Jun		Jul		Aug		Sep		Oct		Nov		Season Total	
Project	MH	PE	MH	PE	MH	PE	MH	PE	MH	PE	MH	PE	MH	PE	MH	PE
Myrtle Beach	32	32	56	56	47	45	13	11	0	0	0	0	0	0	148	144
S.C.U.T.E.	317	139	458	210	540	249	487	184	246	93	35	18	0	0	2083	893
Cape Romain	87	56	199	96	217	108	376	140	64	48	0	0	0	0	944	448
Dewees Island	38	38	69	69	67	68	58	74	1	1	0	0	0	0	233	250
Isle of Palms	351	295	516	486	560	522	361	293	289	175	43	47	11	4	2130	1822
Folly Beach	254	254	361	362	397	380	415	368	128	107	0	0	0	0	1555	1471
Kiawah	237	123	425	258	688	538	751	720	434	488	97	131	0	0	2631	2258
Seabrook	123	107	147	165	147	165	150	169	100	107	0	0	0	0	667	713
Edingsville	34	33	54	53	41	47	59	60	50	51	0	0	0	0	237	244
Edisto Beach	382	322	430	357	539	465	411	38	327	30	48	18	0	0	2138	1230
Harbor Island	87	90	90	125	100	111	73	85	47	46	12	11	0	0	409	468
Hunting Island	285	220	456	312	503	357	292	205	26	14	0	0	0	0	1562	1108
Fripp Island	111	142	62	223	64	223	80	18	45	18	0	0	0	0	362	624
Pritchards Island	0	0	30	45	33	47	20	25	0	0	0	0	0	0	83	117
Hilton Head	8	10	24	8	27	9	27	9	3	1	0	0	0	0	89	37
Total	2346	1861	3377	2825	3969	3334	3573	2399	1760	1179	235	225	11	4	15,270	11,827
Percent of Total	15.4	15.7	22.1	23.9	26.0	28.2	23.4	20.3	11.5	10.0	1.5	1.9	0.1	0.0	100.0	100.0

Table 3. Total hours and monetary value of volunteer time for 15 sea turtle projects in South Carolina, 2001.

Project	Beach Patrol $5.15/hr # Hours	Beach Patrol $5.15/hr Value	Management $10.00/hr # Hours	Management $10.00/hr Value	Total for All Skill Levels # Hours	Total for All Skill Levels Value
Myrtle Beach	128	$659	20	$200	148	$859
S.C.U.T.E.	509	$2621	1574	$15,740	2083	$18,361
Cape Romain	338	$1741	605	$6050	944	$7791
Dewees Island	190	$979	43	$430	233	$1409
Isle of Palms	1293	$6659	837	$8365	2130	$15,024
Folly Beach	1052	$5418	503	$5025	1555	$10,443
Kiawah	1922	$9898	710	$7105	2632	$17,003
Seabrook	611	$3147	56	$555	667	$3702
Edingsville	155	$798	82	$818	237	$1616
Edisto Beach	1859	$9574	279	$2790	2138	$12,364
Harbor Island	316	$1627	93	$930	409	$2557
Hunting Island	1295	$6669	268	$2680	1562	$9349
Fripp Island	137	$706	225	$2250	362	$2956
Pritchards Island	39	$201	44	$440	83	$641
Hilton Head	0	$0	89	$890	89	$890
Total	9844	$50,697	5427	$54,267	15,270	$104,964

and 6.2% for Kiawah. With management, the hatching success was 84.4% and 88.0%, respectively (Table 4). Factors that contributed to nests being destroyed included: predation by raccoons, foxes, and ghost crabs, invasion by roots, human poaching, and erosion and inundation from normal spring tides and from storm events. Poaching was a larger problem when the loggerhead was first listed. While it is less so now, a few nests are still taken each year on some project beaches. Again to be conservative, we used the higher of the values (7.4% nest survival with no management) for comparison. Although it may be questionable to use this figure for all beaches, 7 of the 15 beaches have similar habitat with regard to predators, and the entire coast is subjected to the forces of erosion and storm events. One complicating factor is beach renourishment where sand is pumped from an offshore source to rebuild an eroded beach. In these cases, fewer nests would be lost to erosion if nest protection management were not implemented. However, the new sand is naturally removed over time and the amount of management needed increases concurrently. Folly Beach, Hilton Head Island, and Hunting Island State Park were the only beaches that had major renourishment done over the course of this analysis. We felt that without management, many of the project beaches would have nest survival fairly close to this 7.4% number.

The potential difference in hatchling productivity between no management and with management was at least tenfold on all the beaches (Table 4). Crouse et al. (1987) in their stage-based model noted that larger benthic juvenile loggerheads were the most "valuable" to the population. However, no one disputes the need to protect nests and hatchlings on the beach in order to provide a source for future turtles.

The estimated age to sexual maturity for the loggerhead is 21–35 years (Frazer and Ehrhart, 1985; Frazer et al., 1994). Given the time over which the conservation effort in South Carolina has been sustained (six beaches for over two decades and one for three decades), hopefully

Table 4. Summary of historical data comparing hatchling productivity with and without beach management by volunteers. Total length of coverage (203.7 km) represents 67.2% of the total South Carolina coast (303 km).

Location	Length (km)	# Yrs w/ Mgt.	Total # Nests Laid	Nest Survival: Without Mgt. %	Nest Survival: Without Mgt. # Nests	Nest Survival: With Mgt. %	Nest Survival: With Mgt. # Nests	Mean Clutch Size	Egg Survival: Without Mgt.	Egg Survival: With Mgt.	Mean Emergence %	Hatchlings to the Sea: Without Mgt	Hatchlings to the Sea: With Mgt
Myrtle Beach	3.2	12	31	7.4	2	91.7	28	120	275	3,411	74.4	205	2538
S.C.U.T.E.	80.5	13	1,101	7.4	81	90.4	995	116	9451	115,455	76.2	7202	87,977
Cape Romain	12.9	23	22,122	7.4	1637	84.4	18,666	123	201,354	2,295,886	67.4	135,713	1,547,427
Dewees Island	4.0	3	26	7.4	2	94.4	25	120	231	2,945	79.3	183	2336
Isle of Palms	17.7	8	247	7.4	18	94.2	233	116	2120	26,990	77.9	1652	21,025
Folly Beach	12.0	8	292	7.4	22	94.6	276	111	2398	30,662	77.3	1854	23,702
Kiawah	14.5	31	4622	7.4	342	88.0	4067	117	40,017	475,881	68.6	27,452	326,454
Seabrook	8.0	11	237	7.4	18	87.2	207	111	1947	22,940	67.7	1318	15,530
Edingsville	2.4	12	558	7.4	41	74.7	417	116	4792	48,370	55.0	2635	26,603
Edisto Beach	7.6	21	1618	7.4	120	84.7	1370	114	13,649	156,231	70.9	9677	110,768
Harbor Island	4.8	10	416	7.4	31	78.3	326	116	3571	37,784	65.1	2325	24,598
Hunting Island	6.4	21	1508	7.4	112	95.4	1439	119	13,279	171,197	75.1	9973	128,569
Fripp Island	3.2	22	1496	7.4	111	78.1	1168	123	13,617	143,710	62.7	8538	90,106
Pritchards Island	4.0	21	2126	7.4	157	83.0	1765	116	18,250	204,691	72.5	13,231	148,401
Hilton Head	22.5	22	2316	7.4	171	84.4	1955	114	19,538	222,836	68.5	13,383	152,643
Total	203.7		38,716		2,865		32,936		344,490	3,958,990		235,340	2,708,677

this increased productivity in hatchlings will become apparent in the near future.

The Loggerhead Recovery Plan (National Marine Fisheries Service and U.S. Fish and Wildlife Service, 1991) listed 6 major actions needed to achieve recovery of which one was "ensure at least 60 percent hatch success on major nesting beaches." Of the total nesting effort for the state in 2002, 64.3% occurred on the 15 beaches in this study and all but one had hatching success above 60%. Another 13.8% of the nesting effort was on state-owned property or projects using privately funded staff that did not involve volunteers. It is clear from these numbers that recovery goals could not be met without the management provided by volunteers.

Conclusions.— As government-funded monitoring programs continue to decline, there is an increasing opportunity for volunteer monitoring and other community science projects to "take up the slack" (Carr, 2004). The total SCDNR budget for nesting beach management is $30,000 as a grant in aid from the U.S. Fish and Wildlife Service. It is clear that the state of South Carolina could neither afford to pay for the services provided by volunteers nor implement management over our entire 300 km coastline.

Not only have the volunteer projects increased in number, but also the scope of their work has expanded into education and outreach. Many have their own printed brochures, tee shirts, and lights-out switch plate stickers. In the course of conducting their daily patrols, volunteers teach thousands of tourists and residents about sea turtles and their conservation. Although this paper places a dollar value on the hours spent by volunteers, the public's education and serendipitous exposure through involvement in sea turtle conservation is invaluable and cannot be measured in dollars. As a state agency it would be impossible to implement such a coast wide effort without their assistance.

To quote Frazier (2003), "clearly, there is adventure and excitement involved in turtle work, spiced with varying amounts of hardship, risk and discomfort. The amount of devotion, dedication, motivation, and yes, passion, that is commonly part and parcel of marine turtle work is remarkable." The volunteers involved in these projects are indeed remarkable, and sea turtle conservation efforts in South Carolina are greatly enhanced by the unselfish dedication of these individuals.

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