2000

Partners in conservation education : scientists teachers students and sea turtles in Costa Rica

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PARTNERS IN CONSERVATION EDUCATION: SCIENTISTS, TEACHERS, STUDENTS, AND SEA TURTLES IN COSTA RICA

By

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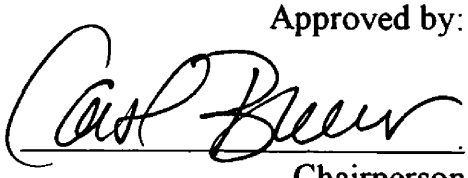

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Partners in Conservation Education: Scientists, Teachers, Students, and Sea Turtles in Costa Rica

Director: Carol A. Brewer 

The educational program developed in this thesis was created as a model for ecological education partnerships between scientists, teachers, and high school students to address critical conservation issues in the U.S.A. and abroad. The model brings high school students from the United States and developing countries together to conservation hot spots where they work alongside scientists to learn about and help protect threatened species or habitats. The key elements include formation of advisory committees, training for teacher and scientist participants, authentic site-based research where students and teachers work with scientists, and post-program assessment and follow-up. This model was pilot tested in Costa Rica in May, 2000, in a program called Sea Turtle Ecology Program (STEP). Educational, conservation, and cultural goals of STEP were achieved as a result of a shared vision fostered by the program. STEP participants learned sea turtle ecology and conservation, applied the scientific method, worked alongside professional biologists, and collected accurate data that may help protect endangered leatherback sea turtles. Moreover, this program fostered a dialog based on sea turtle conservation between the Pacuare Nature Reserve and the neighboring community of Matina, Costa Rica. Located on the Caribbean coast of Costa Rica, the Pacuare Nature Reserve has hosted international student groups for the last five years; but this program was the first time that Costa Rican student groups from the neighboring communities had participated in assisting the reserve with their on-going sea turtle monitoring programs.

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I wish to thank John Denham in London and Carlos Fernandez in Costa Rica, both from the Endangered Wildlife Trust. Their financial and intellectual support allowed me the freedom to dream at their fabulous reserve in Costa Rica.

In September 1999, a taxi dropped me off at the dusty sun-beaten entrance of the Matina School in Costa Rica. I arrived with nothing but a crazy new idea, and was greeted by the welcoming smile of the school's director, Iris Barahona. I believe that her commitment to education and creativity will help fulfill the dreams of all the students of the Lincoln and Matina Schools. Thanks to Enia Chavarria, Belinda Dick, Gerardo Zuniga, and Miguel Madrigal who shared their passion for conservation and the natural world with me and all of the student participants.

Finally, I must thank my mother and father—Lorraine and Ben—who provided an "anonymous" donation that helped to bring students to the reserve. In addition, they gave me the ability to Think Big.

Chapter One: Executive Summary

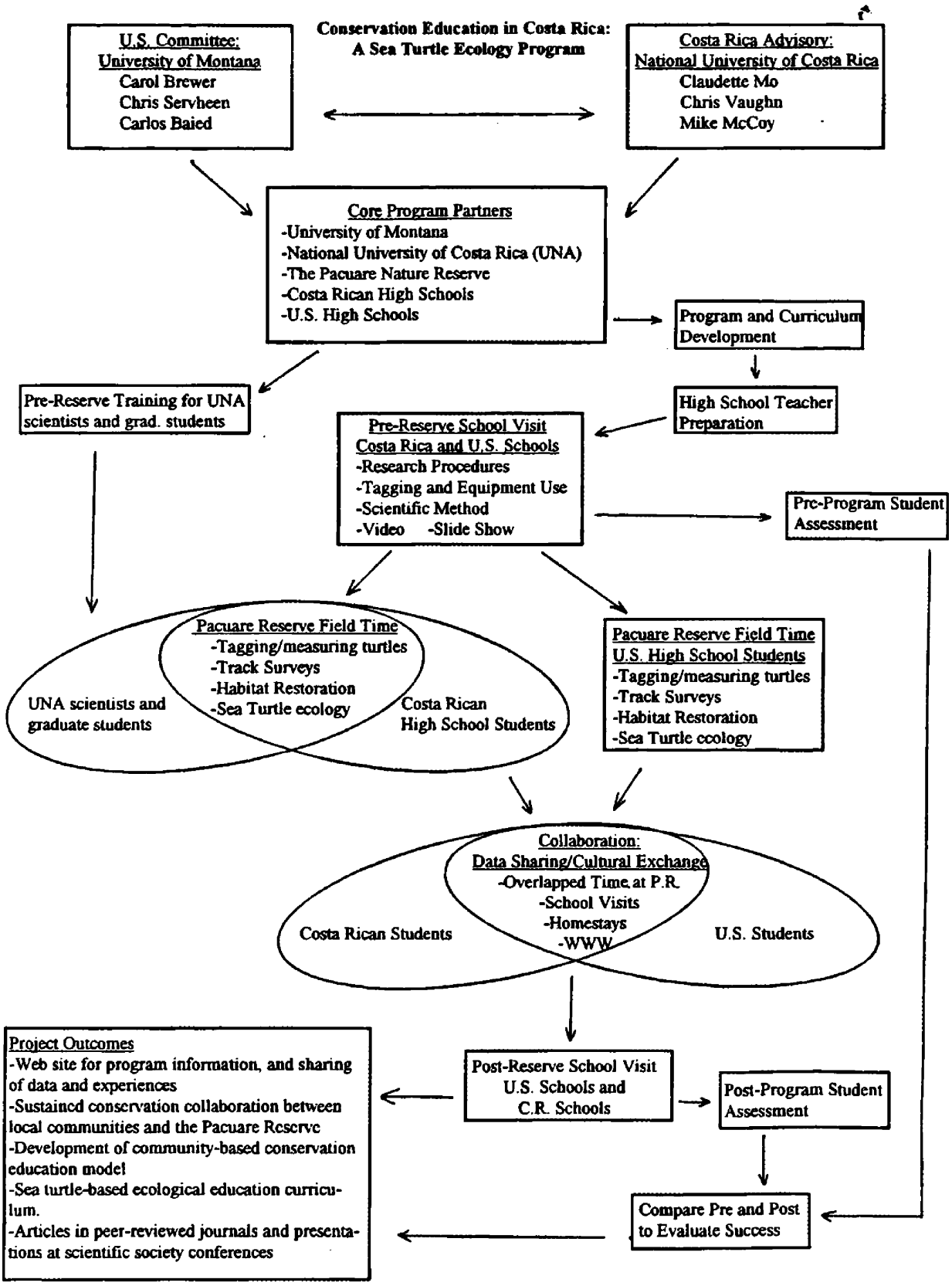
Scientist-Teacher-Student Partnerships

The educational program developed in this thesis was created as a model for ecological education partnerships between scientists, teachers, and high school students to address critical conservation issues in the U.S.A. and abroad. The model brings high school students from the United States and developing countries together to conservation hot spots where they work alongside scientists to learn about and help protect threatened species or habitats. This model was pilot tested in Costa Rica in May, 2000, in a program called Sea Turtle Ecology Program (STEP). A conceptual diagram of the model, as it applied to STEP is shown in Figure 1.1. The key elements include formation of advisory committees, training for teacher and scientist participants, authentic site-based research where students and teachers work with scientists, and post-program assessment and follow-up.

Advantages of Site-based Student Research

- Solutions to regional and international conservation issues require global vision, cultural sensitivity, and ecological literacy. Local action, cultural awareness, and global vision are skills that have broad application beyond the research experience.
- Through foreign exchange and ecological education, this approach impacts knowledge, attitudes, and skills.
- This approach addresses the need for collecting long-term ecological data by enlisting the assistance of high school students, and taking advantage of the inherent institutional stability and permanence of high schools.

Figure 1.1 STEP Program for Site-Based Research and Education



- This educational model is a non-confrontational, collaborative method for initiating dialog between scientific researchers and communities located within or adjacent to ecosystems being studied.

The first stage of STEP development was the formation of advisory committees in the U.S.A and abroad. These experts helped to formulate the program and provide input to both curricular and logistical program components. The advisory committees corresponded with each other and core program partners. The core program partners included affiliated universities and/or scientists in the U.S.A. and abroad, the agencies responsible for management of the land where the research project took place, and high school students participating in the educational program (Table 1.1). Core program partners were included early in the development stage of STEP to foster ownership among the diverse interests they represented.

Table 1.1 STEP Core Program Partners

- Division of Biological Sciences and Environmental Studies Program at the University of Montana
- Regional Program for Neotropical Wildlife Management and Conservation at the Universidad Nacional Autonomous in Heredia, Costa Rica.
- The Endangered Wildlife Trust, holder of the Pacuare Nature Reserve, based in London England
- The Pacuare Nature Reserve, Costa Rica.
- Lincoln School in San Jose, Costa Rica
- Academic School of Matina in Matina, Costa Rica.

Common goals were established among university, high schools, biologists and participating non-governmental organizations; this led to an educational vision that would be the central theme of the curriculum. After curricular materials were developed, two training sessions were held—one for scientists and a one for high school teachers.

Teachers may lack the knowledge or resources to implement an inquiry-based research program at their school. This program modeled successful experiential science education that can be incorporated into school and classroom-based learning projects. A residential program with inquiry-based curriculum was a new experience for the participating teachers. The pre-program training allowed them to preview the curriculum, clarify their roles, and assemble information to prepare themselves and their students. The participating scientists had little previous experience with high school students; this pre-program training was designed to improve their effectiveness as mentors to the participating student-scientists. These pre-program meetings gave the program coordinators insight into the concerns and priorities of the participating teachers and scientists.

After the teacher and scientist training sessions, the educational programming began. First was a pre-site visit to all participating schools to prepare the students for their research expedition. This visit provided a forum to review research protocols, discuss educational highlights, and answer questions. The goal of the visit was to motivate and prepare the student and teacher participants, give them a sense of their potential contribution on an important conservation project, and emphasize that this was a working trip—not a vacation. While high school students loved to get away from the classroom, and enjoyed doing the research, it was important to set the expectations high from the

start. Students were told that the scientists would be counting on them to work hard and collect reliable data for their project. We spoke about the importance of responsible behavior, teamwork, enthusiasm, and hard work. The students were told about the sea turtle research project and the relevance of the data they would be collecting.

During this initial classroom visit, pre-program assessment questionnaires were given to all student participants. The questionnaires covered general science, sea turtle ecology and coastal ecology; attitudes towards sea turtles, conservation, science and university study; and research skills related to field ecology.

The second phase of educational programming was the visit to the field research site. Each student group stayed at the research site for three days and two nights to work with the scientists and learn about local ecology. The conservation issues and associated research project were the focal point of the curriculum, data collection, and scientist-student interactions. The site and research project were chosen carefully to provide a tangible local focus with regional or global ramifications. During the STEP pilot program, students patrolled ten kilometers of beach to tag and collect data on nesting leatherback sea turtles. Sea turtles forage and migrate through international waters, but depend on specific nesting beaches to survive from generation to generation; hence, there is a direct link between local ecosystem change and regional (or global in this case) sea turtle survival. This local/regional link can be applied to nearly any animal species, as many animals depend on a variety of ecological communities throughout the year in order to maximize shelter, food, water, and other factors that determine reproductive success.

Students worked with scientists on real projects: local and visiting students collected data that were directly relevant for the conservation of a threatened habitat and endangered species. As part of the program, host-country scientists from universities mentored students as they developed a research question, collected and analyzed data, and gave presentations related to sea turtle ecology. Students learned about techniques for sampling ecological data, as well as the care and use of sampling equipment. Through an authentic research process, students gained knowledge and skills that allowed them to participate fully in the scientists' research project. On the final day of the program, all students completed a post-program assessment questionnaire. The teachers and scientists also completed an assessment that reviewed programmatic elements such as organization, leadership, safety, academic content, and logistics.

Rational for Site-based Research Programs

Site-based research programs allow for a unique foreign exchange, where high school students can meet and spend time together working toward a common purpose; a purpose in which they have participated fully, and a purpose that extends beyond them. Through working with scientists and students from different countries in the protection of threatened species, cultural education is concurrent to scientific collaboration.

Local community members may have very direct connections to the endangered species and habitats studied. Educational programs such as this one provide a non-confrontational portal through which a dialog can begin between scientists and community members. For this reason, community members living within or adjacent to the ecosystem being studied are the primary target audience for this educational program.

Case Study: Sea Turtle Ecology Program (STEP) in Costa Rica

Program Justification

Costa Rica has enjoyed the stability of democratic governance since 1889, and abolished its military in 1949. Approximately 25% of the country has been set aside in reserves, and Costa Rica's economic and political status create an ideal location for experiential education programs. The Costa Rican government has shown strong support for ecological preservation and education. Costa Rica has a strong middle class, booming tourism economy, and continued international awareness and capital influx (U.S.S.D., 1999). For example, Intel constructed a $400 million computer plant in Belen, Costa Rica in 1998. This unique history, in terms of political and economic development, sets Costa Rica apart from all other Latin American countries, and provides a safe and accommodating site for this type of educational program.

The leatherback sea turtle has been widely studied and monitored since the mid-1960's along the northern portion of Costa Rica's coastline near Tortuguero. Even with on-going and intensive research on leatherback ecology under the auspices of the Caribbean Conservation Corps (CCC), leatherback populations continue to decline (Spotila et. al. 1996a, 1996b). An article in *Chelonian Conservation and Biology* (1996) recently stated, "Leatherbacks are on the road to extinction and further population declines can be expected unless we take action to reduce adult mortality and increase survival of eggs and hatchlings" (Spotila et. al. 1996a).

While biological research must continue, conservation efforts must expand beyond the narrower scientific focus, and into the social context. Information collected by the large body of (mostly international) scientists that have studied Costa Rica's sea turtle

populations must reach local communities. The CCC has an educational program that brings paying volunteers (primarily from the USA) to work with research assistants who are tagging and monitoring leatherback and green sea turtle populations along 18 miles of coastline at Tortuguero. While this program funds a critical long-term population study, educating local communities has been beyond the scope of this and most research programs in the area.

Experiential education programs for Costa Rican high school students are limited. Though few in number, the conservation education projects that are available have been quite successful in terms of student enrollment. For example, in Northwest Costa Rica, the Guanacaste Conservation Area's (ACG) '*Programa de Educacion Biologica*' is entering its 14th year. Enrollment for 1997 included 2113 students from 49 schools (*Programa de Educacion Biologica*, 1997).

Education programs fit well into nationally valued conservation efforts. Costa Rica has vigorously promoted a lasting and lucrative approach to natural resource use—tourism. Sea turtles bring thousands of tourists annually to northeastern village of Tortuguero. Despite the income generated by sea turtle ecotourists and the fact that Costa Rican law forbids the sale and possession of sea turtle meat and eggs, *hueveros* (egg poachers) take thousands of turtle eggs from Caribbean beaches and sell them in the markets, on the street, and to local bars; sea turtles are not relied upon as a primary food source in Costa Rica. Typically, poachers make little money selling the eggs, and bar patrons looking for an aphrodisiac end up with food containing three times the cholesterol of an average chicken egg. Because intact rainforest ecosystems and nesting sea turtles have economic value via ecotourism, other communities along the Caribbean

coastline are beginning to recognize the benefits of wise stewardship. Programs such as the ACG's *Programa de Educacion Biologica* and STEP may provide communities with the ecological knowledge to better integrate this development trend.

The Pacuare Nature Reserve has monitored a population of nesting leatherbacks for over eight years (and possesses necessary permits to conduct research on this IUCN Red Listed endangered species). Currently, an on-site biologist, assisted by the reserve's guards manages the monitoring and tagging program. Volunteers, primarily European or North American college-aged students who are travelling through Costa Rica, arrive in weekly shifts to help with the nightly tagging efforts from mid-March through the end of May. Leatherback sea turtles nest at the reserve through the end of June, but paying tourist groups from the U.S.A. replace volunteers during the month of June. The volunteers have no formal training prior to arrival and are trained at the reserve. Volunteers will continue to be an integral part of the reserve's programming, but over time, the integration of local students into monitoring efforts will be expanded.

STEP Goals

1. To increase student's ecological knowledge of sea turtles and lowland rainforest ecosystems, and to develop student awareness of their role in and connection to these ecosystems.
2. To increase knowledge about conservation of endangered Caribbean sea turtles through local (community based) channels of knowledge and empowerment.
3. To create a sustainable community-centered conservation education program for the communities around the Pacuare Nature Reserve.

4. To facilitate partnerships between Costa Rican students and research mentors, and encourage students to consider studies in biological sciences at the university level.
5. To develop an approach for experiential conservation education that can be implemented at other sea turtle nesting beaches and supporting ecosystems, as well as in totally different ecosystems.
6. To disseminate project information via the World Wide Web, applicable peer reviewed journals, and presentations at scientific society meetings.

Implementation

In May 2000, the approach shown in Figure 1.1 was pilot-tested at the Pacuare Nature Reserve, a sea turtle nesting ground in Costa Rica. The Pacuare Nature Reserve is owned and managed by the Endangered Wildlife Trust, a charitable trust in London, England. Acquired in 1989, the Trust has worked diligently to monitor and protect nesting turtles and their eggs. The reserve consists of 800 hectares of lowland rainforest and 10 km of shoreline on the Caribbean coast of Costa Rica; it is located at the mouth of the Pacuare River, about 30 km north of Puerto Limon. Leatherback turtles come ashore to nest at the Pacuare Nature Reserve from late March through June. The Pacuare Nature Reserve, Tortuguero National Park, and Gandoca-Manzanillo Wildlife Refuge are the three major nesting beaches for the leatherback sea turtle (*Dermochelys coriacea)* on the Caribbean coast of Costa Rica (see map in Appendix I). In addition to sea turtle conservation and habitat restoration, the reserve had expressed interest in involving local communities in their conservation mission. This program was the first realization of that idea.

This pilot program in the spring of 2000 varied from the suggested model in that it involved only Costa Rican students, and no international student exchange or collaboration took place. The STEP curriculum focused on the endangered leatherback sea turtles and lowland rainforest ecosystem of Costa Rica's Caribbean coastline. The curriculum we implemented was developed through collaboration with the participating Costa Rican schoolteachers, Pacuare Nature Reserve biologists, and scientists from the National University of Costa Rica (Universidad Nacional Autonomous, UNA).

Table 1.2 Summary of participation in STEP 2000

School	Dates	# of Students	# of Professors
Lincoln	5/9 - 5/11	16	2
	5/15 - 5/17	17	2
Matina	5/11 - 5/13	11	5
	5/13 - 5/15	5	3
Total		**49**	**12**

Forty-nine students and 12 teachers from public and private schools in Costa Rica participated in the field experience (Table 1.2). The Academic School of Matina (Matina School) is a public rural school located less than 10 miles from the Pacuare Reserve. While 86% of the Matina students reported seeing sea turtle eggs for sale in their communities—located less than five miles from the sea—none of the 16 students had ever seen a live sea turtle. The Lincoln School is a private school in Costa Rica's central valley near the capital city of San Jose. San Jose is an urban center located approximately 75 miles from the Pacuare Reserve. Five of the 33 Lincoln School participants had seen a live sea turtle before coming to the reserve. During nightly beach

patrols, students measured and tagged leatherback sea turtles, counted and weighed their eggs, and relocated nests as necessary to protect them from poachers. During their two nights at the reserve, every student saw—and worked with—at least one leatherback sea turtle. Participants attended three science classes at the reserve during the three days, assisted biologists in collecting field data during the two nights, and found time to enjoyed the Caribbean coast during their free time.

Plans for the future

Following the successful pilot implementation of STEP, a new non-profit educational organization, Ecology Project International (EPI), has been started. The mission of EPI is to develop international ecological education partnerships between scientists and high school students to address critical conservation issues. EPI resulted directly from this thesis work, and will work to continue the efforts at the Pacuare Nature Reserve in Costa Rica. In 2001, we hope to have eight Costa Rican school groups visit the reserve (about 120 Costa Rican students) and five student groups from the United States (about 75 U.S. students).

By including U.S. students in the program, we hope to foster collaboration and cultural understanding among international student peers as they work together at the research site, exchange perspectives, and share experiences. In addition to overlapping time at the research site, partnerships can be further enriched through school visits, home-stays in the community, and via the internet.

EPI staff hope to use communication technology to strengthen cultural awareness and conservation partnerships. Through the use of the internet, research sites and students

will be connected before and after their site visit. Moreover, students will be able to follow the work of others throughout the field season, and communicate with participants and scientists.

EPI organizers believe strongly that site-based research programs are effective in conservation education, and are transferable to other countries and different ecosystems. In addition to the work in Costa Rica, additional host-countries and research sites will be added as the organization grows. For example, we currently are talking to scientists using satellite telemetry in their work with migratory red-tail hawks. Data are needed from Mexico detailing the raptor's winter habitat use. In addition to on-the-ground site work, students from around the world could follow migration routes of these raptors using satellite telemetry data and the internet.

Chapter Two: Partnerships in Ecological and Conservation Education

The heat at 10:00 a.m. is noticeable, but tempered by the steady breeze off the Caribbean sea. Research assistants transcribe data collected from the previous night's beach patrol onto a whiteboard affixed to the screened in walls of the dining room. Sitting on the cement patio in a rough "C" shape, all eyes scan the tables on the whiteboard for missing measurements or miscalculated weight averages. One research group had looked at the relationship between the size of leatherback sea turtles and the average weight of their eggs. Everybody is curious to see how the data collection was proceeding. When the lead biologist approached to review recapture data from the previous night, she was intrigued by these new data points and requested a copy. What is unusual about this scene? At this particular meeting, the research assistants were sixteen year-old Costa Rican high school students.

Student-scientist partnerships have the potential for significant contributions to both the scientist and the student. Several studies have suggested that creating successful student-scientist partnerships help students enjoy and engage in science learning because the students recognize the impact and context of their learning (Alper, 1994; Hays 1994; National Research Council [NRC], 1996, 1997; Caton et. al., 2000). Engaging students is paramount to learning, but in terms of rewards, successful collaborations have deeper impacts. In this article, I describe how successful ecological and conservation education partnerships can benefit *both student and scientists* in terms of education, cultural exchange, and conservation.

By participating in authentic site-based research, students can learn about the local ecology, be involved in conservation efforts at the site, and develop skills that are needed

to make a positive difference in conservation efforts. Field-based partnerships are an ideal strategy to improve knowledge, attitudes, and skills for both students and teachers; and these attributes are important for any conservation or ecological education program (Iozzi, 1989; Hungerford and Volk, 1990; van Matre, 1993; Orr, 1994; Booth, 1999).

Moreover, these site-based partnerships can forge cultural connections between scientists and students. Students learn first hand *what* scientists do, *how* they do it and *why* they do it. My experience suggests that in a traditional science course, students often view the material in science textbooks as boring, rote, and not applicable to their lives. The reality is much different! The culture of science is rich in humanity, wonder, *and* information. Indeed, for students to develop ecological literacy, they need to experience the wonder and humanity of science, in addition to factual information (Orr, 1989).

Such exchanges also are important for scientists. A successful conservation program for small populations of threatened species must address social as well as biological factors (Servheen, 1998). These social factors include (Servheen, 1998) local economic impact, public support for conservation of species, cultural relationships, and threats perceived by local people. Through partnerships with pre-college students, conservation biologists can learn valuable information regarding local resident's relationships with and attitudes about threatened species and habitats. Collaboration, based on common goals and cultural sensitivity, between scientists and citizens of local communities can further the impact of any conservation project (Yaffe and Wondolleck, 2000).

In this case study, we learned that trained and motivated high school students have the ability to collect quality data. In some cases, students may even increase the scientists' capacity to collect additional data points. Some long-term monitoring

programs require time commitments beyond the typical 4-8 year graduate program. By working with high schools, scientists benefit with a long-term source of inexpensive, but eager, research assistants.

Case Study: Sea Turtle Ecology Program (STEP)

STEP Goals

The STEP program was designed to facilitate partnerships between Costa Rican students and research mentors. The curriculum introduced these future scientists to the methods and issues of conservation science, including data collection, field work, and presenting conclusions

The educational goals of STEP focused on teaching participants about ecology and developing the necessary skills to conduct a scientific investigation. This included increasing students' ecological knowledge of sea turtles and knowledge about the conservation of endangered Caribbean sea turtles in general. Participants learned the application of science by developing their own research question and project. To collect the data necessary to answer their research question, students learned how to use and care for the tools of a field scientist. At the end of their stay at the research site, the participants prepared and delivered a presentation of their results

The main cultural goal of STEP was to initiate a dialog on the conservation of sea turtles between the Pacuare Nature Reserve staff and the adjacent community of Matina. This was accomplished by bringing Matina high school students to the reserve where they interacted with and worked alongside the entire reserve staff. This was the first inclusion of local students in the reserve's sea turtle monitoring work.

Conservation goals included participating in the sea turtle monitoring project at the reserve, inspiring students, and providing them with training in the field of conservation science. During the students' work at the reserve, it was important that they collect high quality ecological data that would help to further the mission of the Pacuare Nature Reserve.

Turtle Nesting Reserve

The Pacuare Nature Reserve is held by the Endangered Wildlife Trust, a charitable trust based in London, England. The Endangered Wildlife Trust acquired the reserve in 1989 and has worked diligently to monitor and protect nesting turtles and their eggs. The reserve consists of 800 hectares of lowland rainforest and 10 km of shoreline on the Caribbean coast of Costa Rica; it is located at the mouth of the Pacuare River, about 30 km north of Puerto Limon. The Pacuare Nature Reserve, Tortuguero National Park, and Gandoca-Manzanillo Wildlife Refuge are the three major nesting beaches for the leatherback sea turtle (*Dermochelys coriacea)* on the Caribbean coast of Costa Rica (see maps in Appendix I). Leatherback turtles come ashore to nest from late March through June. In addition to sea turtle conservation and habitat restoration, the reserve had expressed interest in involving local communities in their conservation mission. This project was the first realization of that idea.

On the outskirts of Matina sits the Academic School of Matina, a four building, 24 room school that hosts about 450 students from the surrounding area. Ironically, in order to reach the Pacuare Nature Reserve, or the more popular turtle watching area of

Tortuguero, you must leave the center of Matina, and pass the Matina school before entering the banana fields that are the gateway to the inland canal system and the coast.

In September 1999, I visited the Matina school and met with the director, three science teachers, and a student group. The exchange was welcoming and enthusiastic. I also met with the mayor of Matina, and received his enthusiastic support as well. Two of the visiting groups (see Table 1.2) in May 2000 were from the Matina school, and it was the students' first opportunity to experience the place where the buses of tourists traveled after passing the Matina school.

Monitoring Sea Turtles at the Reserve

In May, 2000, 49 students and 12 high school teachers came to the Pacuare Nature Reserve in Costa Rica, to participate in a scientist-student partnership program at a sea turtle nesting grounds. Participants from local public and private schools took part in a unique experiential field ecology program where they attended three science classes during the three days at the reserve, assisted biologists collecting field data during two nights at the reserve, and explored the Caribbean coast in their free time. The three classes focused on the scientific method, sea turtle ecology, and sea turtle migration.

During this time, two biologists were on site overseeing the monitoring program, Belinda Dick and Jose Gerardo Zuniga; they were assisted by a biology undergraduate from the United States and a professional Costa Rican naturalist, who was on-site during the Matina school visits. STEP staff included myself and Julie Osborn, a global change and energy scientist who works for the United States government; she received her

masters in Ecology from Stanford. This diverse staff allowed students the opportunity to spend time learning about the different opportunities available for scientists to pursue.

The curriculum focused on the endangered leatherback sea turtles and the lowland rainforest ecosystem along part of Costa Rica's Caribbean coastline. Curriculum development was accomplished through collaboration with the participating Costa Rican schoolteachers, the Pacuare Nature Reserve biologists, and scientists from the National University of Costa Rica (Universidad Nacional Autonomous; UNA). This residential pilot program consisted of eight nights and nine days of field work by Costa Rican students. These eight nights were covered in two-night shifts by each of four student groups. During the nightly beach patrols, students measured and tagged leatherback sea turtles, counted and weighed their eggs, and relocated nests as needed to protect them from poachers.

During the students' three night stay, all student and teacher participants were trained in using and reading measuring tapes, stopwatches, tagging pliers, sea turtle tags, red low-light flashlights, and scales. In addition, all participants engaged in actual use of this equipment (with the exception of tagging pliers) for data collection on nesting leatherback sea turtles.

Student research groups pursued a variety of research questions (see Table 2.1), and had to work under the constraints of limited resources at a remote location—a dilemma faced by every field researcher at one time or another. Through this process, the students also learned that scientific equipment does not necessarily need to be complex and difficult to use, and that ingenuity and creativity are important aspects of effective tool design and implementation. One example of this discovery process occurred when

students realized that the lightweight, flexible measuring tape (which was used for measuring round sea turtle carapaces) was ineffective at measuring a one-meter deep nest cavity. After pensive considerations and no luck finding a rigid measuring device, one student declared "aha" and picked up a meter-long slender stick that was laying near his feet. This tool proved to be quick, effective, disposable, and readily available along the beach. This type of experience can help to engage students in field-based science learning.

Table 2.1 STEP Expert Group Student Hypotheses

Egg Hypotheses

- Turtles that nest farther from the ocean will have shallower nests and few eggs.
- Bigger turtles lay more eggs.
- Bigger turtles dig bigger nests and lay more eggs that weigh more.
- Bigger turtles will lay bigger eggs; multiple visits will result in more vanos

Turtle Hypotheses

- The size of the fin will determine the depth of the nest.
- Smaller turtles travel farther from the ocean.
- Turtles will nest on beaches with gentler slopes.
- Turtles with bigger fins will nest farther up the beach.

In addition to learning about the ecology and conservation of sea turtles, students learned the scientific method and then used the method to develop their own biological research project. Students also prepared and delivered a presentation of their results. From the 49 student participants, a total of 12 expert groups were formed in which each group developed their own research question and hypothesis (Table 2.1). The students developed and practiced their methods before going on the night-time beach patrol, and then collected data during their two nights at the reserve. At the end of three days at the reserve, every student participated in the presentation of their group's research project;

this included discussion about their data analysis, whether or not their hypothesis was supported, and why. All groups used graphs, tables, or other visual aids in their report. Presentations were given late morning on the third day, just prior to the students' departure. All students and their teachers, STEP program staff, reserve staff, biologists, hosts, and park guards were invited to attend these presentations.

Assessment

Assessment was incorporated at all levels and with all participants in this program. Program assessment tools focused on the value of the program to the scientific and academic partners and identified successful components of the curriculum as well as where improvements could be made. An overview of how the assessment tools addressed specific educational goals and objectives is shown in figure 2.1. This matrix relates specific goals and objectives on knowledge, attitudes, and skills to assessment tools, and indicates if a tangible product was produced.

Assessment data included information on student enrollment (e.g. demographic information), examples of work produced by program participants, and interviews with program participants. We also evaluated the data that students collected (number of turtles tagged and nesting data), and the presentation of their research results.

All program participants, including reserve staff, biologists, teachers and students completed a questionnaire focused on project impacts. Formative evaluation documented and reviewed the implementation of project activities to assess the organization, management and content of the program. The summative evaluation focused on the quality and breadth of program accomplishments to determine the impacts on knowledge, attitudes, and skills of participants.

Evaluation of student knowledge and attitudes took place before the field component of the program began and was repeated upon program completion. Short answer and Likert scaled questions addressed basic ecological knowledge and sea turtle ecology, interest in university study and pursuing biology careers, knowledge of local conservation issues, and current conservation involvement. Reserve staff and participating school teachers were asked for their perceptions of the quality, breadth, and benefits of participation. They were also be asked how the program could be enhanced and improved.

Data are based on pre- and post-visit questionnaires, interviews (recorded with audio and video tape), student products, and student presentations. At the end of each groups' stay at the reserve, they were asked, "What did you learn while you were here and what did you enjoy the most about the experience?" Appendix III has the complete transcripts from the video record of student responses.

The pre- and post-program short answer and numerical questionnaires (Appendix IV) were used to assess impact to the following desired learner outcomes:

- ecological knowledge
- sea turtle ecology and conservation
- interest in conservation
- interest in ecology and biology, and
- interest in science and research

Because the same population of students took the pre and post-tests, I used the paired sample t-test statistical analysis to determine significant change in each in each question. When comparing the mean post-program test scores of the urban and rural students (Lincoln and Matina respectively), the Mann – Whitney U Test was used to determine significance.

Figure 2.1 STEP Assessment Matrix

This matrix breaks down each STEP goal into specific objectives. The "Impact to:" column shows if the objective is designed to change students' knowledge (K), attitude (A), or skill (S); in addition, the objective may produce some tangible product (P) (e.g. data, charts, presentations, etc.) The final two columns indicate whether the impact was assessed by the short answer or numerical questionnaires.

			Question	
Goals	Objectives	Impact to:	Short Ans.	Numerical
Ecological Principles				
	Energy Flow / Food Webs	K	13-15	
	Interdependence	K	13-15	
	Communities	K	10-12,14,15	
Conser-vation				
	Interest in Conservation	A		18-21,23,24
	Contribution to a conservation project	S, P		
	Importance of long term data/monitoring	K		
	Personal Impacts on ecosystem health	A, K, P		20, 21
	Options for conserving resources	A, K		
Research/ Science				
	Interest in biology / science / research	A, K		6-8,10,15-17
	Interest in ecology	A, K		9, 14, 22
	Scientific Method	K, S, P		
	Tools of scientists	S, P	16	
	Use of data sheets	S, P		
	Protocol for working with endangered species	S, P		
Sea Turtles and Sea Turtle Ecology	Species found on Caribbean coast of Costa Rica	K	1	
	Status	K	3	5
	Life Cycle	K	2, 4-8	
	Personal connection/relationship/impact	A		1-4

The primary educational goal of this program was to increase students' general ecological knowledge, and knowledge of sea turtle conservation and ecology. The short answer assessment questionnaire in Tables 2.2 – 2.4 was the primary evaluation tool for this goal. These questionnaires were administered before program implementation and then again after STEP completion. The response to each question was then graded from 1 (no answer) to 5 (answer suggests mastery) according to the grading rubric in Appendix IV.

The Matina students showed significant improvement ($p < .05$) in all questions that addressed sea turtle ecology and conservation (Table 2.2). In addition, they showed significant improvement all but two questions that addressed ecological knowledge. The two questions on which the Matina students did not improve significantly were questions that addressed conceptual or relatively more complex ecological knowledge. I found that the Matina students did not possess formal training in ecology before their participation in STEP, and I focused their curriculum towards sea turtle ecology and basic ecological concepts. During our two nights and three days together, I did not have time to teach them the concepts of coastal communities and food webs.

The Lincoln students showed significant improvement ($p < .05$) in all but one of the questions that addressed sea turtle ecology and conservation (Table 2.3). In addition, they showed significant improvement all but one of the questions that addressed ecological knowledge. The Lincoln students arrived at the reserve with some formal knowledge of ecological concepts, and when answering the basic question of "what is an ecosystem?", no statistically significant improvement was apparent because a majority of the Lincoln students learned this concept before STEP participation. In contrast to the

Table 2.2 STEP Short Answer Assessment, Matina Students

This questionnaire was completed by all participants before and after STEP programming. Each response to short answer questions was assigned a number from 1 (no answer) to 5 (answer suggest mastery). See Appendix IV for the grading rubric. N = 14 for all of Table 2.2. Data are means ± standard error. P-values are of paired sample t-test.

Sea Turtle Ecology and Conservation

	Pre – Test	Post – Test	p-value
What species of sea turtles nest along the Caribbean shore of Costa Rica?	2.1 (0.1)	5.0 (0.0)	<0.0001
What time of year do they nest?	1.2 (0.1)	4.0 (0.1)	<0.0001
What is the current status of these turtle's populations?	1.4 (0.1)	3.4 (0.1)	0.001
How many weeks do the eggs of the leatherback sea turtle stay in the sand before hatching?	1.3 (0.1)	4.5 (0.1)	<0.0001
Where do hatchlings go after they first make it to the sea?	1.1 (0.1)	2.0 (0.1)	0.005
How far do adult leatherback sea turtles migrate?	1.1 (0.0)	3.2 (0.1)	0.0003
How often does an adult female leatherback lay eggs?	1.0 (0.0)	3.7 (0.1)	0.0001
How many times does a female leatherback lay eggs during a nesting season	1.0 (0.0)	4.1 (0.1)	<0.0001
On a simple diagram, show the required measurements taken for sea turtle monitoring projects.	1.0 (0.0)	4.9 (0.0)	<0.0001

Ecological Knowledge

	Pre – Test	Post – Test	p-value
What is an ecosystem?	1.9 (0.1)	2.7 (0.1)	0.02
Name four communities in the coastal ecosystem	1.0 (0.0)	1.3 (0.1)	0.3
Name four species of plant or animal in each of these coastal communities	1.6 (0.1)	1.9 (0.0)	0.05
Draw a food web with the coastal ecological communities and plants and animals that live there	1.4 (0.1)	1.6 (0.1)	0.3
Will the coastal ecosystem be affected if one of these ecological communities is gone? Why?	1.7 (0.1)	2.3 (0.1)	0.07
Why is the coastal ecosystem important to the Ocean ecosystem?	1.2 (0.1)	2.5 (0.1)	0.0006

Table 2.3 STEP Short Answer Assessment, Lincoln Students

This questionnaire was completed by all participants before and after STEP programming. Each response to short answer questions was assigned a number from 1 (no answer) to 5 (answer suggest mastery). See Appendix IV for the grading rubric. N = 30 for all of Table 2.3. Data are means ± standard error. P-values are of paired sample t-test.

Sea Turtle Ecology and Conservation

	Pre – Test	Post – Test	p-value
What species of sea turtles nest along the Caribbean shore of Costa Rica?	2.6 (0.0)	4.0 (0.0)	<0.0001
What time of year do they nest?	3.0 (0.0)	3.3 (0.0)	0.1
What is the current status of these turtle's populations?	3.6 (0.0)	4.2 (0.0)	0.02
How many weeks do the eggs of the leatherback sea turtle stay in the sand before hatching?	3.3 (0.0)	4.2 (0.0)	0.03
Where do hatchlings go after they first make it to the sea?	1.4 (0.0)	3.0 (0.0)	<0.0001
How far do adult leatherback sea turtles migrate?	2.2 (0.0)	4.6 (0.0)	<0.0001
How often does an adult female leatherback lay eggs?	1.1 (0.0)	3.5 (0.0)	<0.0001
How many times does a female leatherback lay eggs during a nesting season	1.0 (0.0)	3.5 (0.0)	<0.0001
On a simple diagram, show the required measurements taken for sea turtle monitoring projects.	1.4 (0.0)	4.4 (0.0)	<0.0001

Ecological Knowledge

	Pre – Test	Post – Test	p-value
What is an ecosystem?	3.0 (0.0)	3.4 (0.0)	0.1
Name four communities in the coastal ecosystem	1.5 (0.0)	3.0 (0.0)	0.0008
Name four species of plant or animal in each of these coastal communities	1.4 (0.0)	2.4 (0.0)	0.0004
Draw a food web with the coastal ecological communities and plants and animals that live there	1.5 (0.0)	2.2 (0.0)	0.003
Will the coastal ecosystem be affected if one of these ecological communities is gone? Why?	2.6 (0.0)	3.1 (0.0)	0.03
Why is the coastal ecosystem important to the Ocean ecosystem?	2.6 (0.0)	3.1 (0.0)	0.08

Table 2.4 STEP Short Answer Assessment, All Students

This questionnaire was completed by all participants before and after STEP programming. Each response to short answer questions was assigned a number from 1 (no answer) to 5 (answer suggest mastery). See Appendix IV for the grading rubric. N = 44 for all of Table 2.4. Data are means ± standard error. P-values are of paired sample t-test.

Sea Turtle Ecology and Conservation

	Pre – Test	Post – Test	p-value
What species of sea turtles nest along the Caribbean shore of Costa Rica?	2.5 (0.0)	4.4 (0.0)	<0.0001
What time of year do they nest?	2.1 (0.0)	3.6 (0.0)	<0.0001
What is the current status of these turtle's populations?	2.5 (0.0)	3.9 (0.0)	0.003
How many weeks do the eggs of the leatherback sea turtle stay in the sand before hatching?	2.5 (0.0)	4.1 (0.0)	0.001
Where do hatchlings go after they first make it to the sea?	1.3 (0.0)	2.1 (0.0)	0.003
How far do adult leatherback sea turtles migrate?	1.5 (0.0)	4.2 (0.0)	<0.0001
How often does an adult female leatherback lay eggs?	1.0 (0.0)	3.1 (0.0)	<0.0001
How many times does a female leatherback lay eggs during a nesting season	1.0 (0.0)	3.6 (0.0)	<0.0001
On a simple diagram, show the required measurements taken for sea turtle monitoring projects.	1.2 (0.0)	4.4 (0.0)	<0.0001

Ecological Knowledge

	Pre – Test	Post – Test	p-value
What is an ecosystem?	2.3 (0.0)	3.2 (0.0)	0.01
Name four communities in the coastal ecosystem	1.2 (0.0)	2.1 (0.0)	0.02
Name four species of plant or animal in each of these coastal communities	1.5 (0.0)	2.3 (0.0)	0.004
Draw a food web with the coastal ecological communities and plants and animals that live there	1.3 (0.0)	1.8 (0.0)	0.01
Will the coastal ecosystem be affected if one of these ecological communities is gone? Why?	2.1 (0.0)	2.9 (0.0)	0.02
Why is the coastal ecosystem important to the Ocean ecosystem?	1.7 (0.0)	2.7 (0.0)	0.001

Matina students, the Lincoln students showed significant improvement in the conceptual questions that addressed ecological communities and food webs. Because of the Lincoln students' understanding of some ecological concepts, I was able to include more ecology in their STEP curriuculum. Additional differences between the two schools' groups are discussed later in this chapter (Tables 2.8 and 2.9).

Table 2.4 shows that when the scores of all STEP participants are grouped together, there is a significant change in questions that address knowledge of sea turtle ecology and conservation, and ecological knowledge. It is interesting to note that while there are small differences between the participating schools, when all students are considered together, there was a significant positive change in knowledge in all questions.

The quantitative assessment tool focused on changes in attitudes of STEP participants towards sea turtle ecology and conservation, interest in conservation, interest in ecology and biology, and interest in science and research (Tables 2.5 – 2.7). Attitudes towards sea turtle ecology and conservation showed some interesting features. The first two questions dealt with personal options for sea turtle conservation, specifically asking whether the students might remove sea turtle eggs from a beach, or if they thought that it would be ok to remove the eggs. Pre-program means ranged from 4.0 – 4.8, and post-pogram test means ranged from 4.6 - 4.8 (with a "5" meaning "completely disagree").

In a question that stated, "there are lots of sea turtles in the ocean," the Lincoln pre-program response was a fairly high mean of 4.2, (with a "5" meaning "completely disagree") and did not change significantly (post-test mean of 4.1, $p = .7$) after the program. The Matina students' mean score for this question stayed fairly low, changing from a pre-program mean of 2.1 to a post-program mean of 2.7 ($p = .1$). Table 2.8 shows

Table 2.5 STEP Quantitative Assessment, Matina Students

This questionnaire was completed by all participants before and after STEP programming.
N = 14 for all of Table 2.5. Data are means ± standard error. P-values are of paired sample t-test.

Sea Turtle Ecology and Conservation

Values closer to 1 suggest agreement, while values closer to 5 suggest disagreement.

	Pre – Test	Post – Test	p-value
If I was at the beach at night and saw a nesting sea turtle, I might take its eggs to eat or sell.	4.7 (0.1)	4.7 (0.1)	1.0
On a beach where there are several sea turtle nests, it would be okay to take the eggs from one nest to sell or eat.	4.0 (0.1)	4.6 (0.1)	0.3
Pollution is not really a big problem in the oceans because they are so big.	4.4 (0.1)	3.8 (0.1)	0.3
There are lots of sea turtles in the ocean	2.1 (0.1)	2.7 (0.1)	0.1

Interest in Conservation

Values closer to one suggest negative attitudes, while values closer to 5 suggest positive attitudes.

Protecting the Costa Rican rainforest	4.9 (0.0)	4.9 (0.0)	0.6
Protecting sea turtles	5.0 (0.0)	4.9 (0.0)	0.3
Conservation issues in your community	4.4 (0.1)	4.6 (0.1)	0.3
Pollution in the area where you live	4.4 (0.1)	4.7 (0.1)	0.1
Biodiversity in Costa Rica	4.5 (0.1)	4.6 (0.1)	0.8
Preserving Costa Rica's coastal communities	4.7 (0.0)	4.9 (0.0)	0.2

Interest in Ecology and Biology

Becoming a biologist	3.7 (0.1)	3.9 (0.1)	0.6
Coastal ecosystem structure and function	4.1 (0.1)	4.5 (0.1)	0.2
Understanding the science of ecology	4.5 (0.1)	4.5 (0.1)	1.0
Working with wildlife biologists	4.8 (0.0)	4.5 (0.1)	0.3
Designing a wildlife conservation project	4.6 (0.1)	4.8 (0.0)	0.1
Knowing the ecology of the area you live	4.5 (0.1)	4.7 (0.0)	0.3

Interest in Science and Research

Field studies outside the classroom	3.6 (0.1)	3.7 (0.1)	0.7
Applied science projects	3.9 (0.1)	3.9 (0.1)	0.8
Scientific research	4.1 (0.1)	4.4 (0.1)	0.8
Learning how to do scientific research	4.4 (0.1)	4.9 (0.0)	0.2

Other

Spending time outside	4.1 (0.1)	4.3 (0.1)	0.5
Attending a university after high school	5.0 (0.0)	4.7 (0.1)	0.2
Learning about nature	4.8 (0.0)	4.9 (0.0)	0.6
Foreigners who visit your country	3.6 (0.1)	3.6 (0.1)	0.4

Table 2.6 STEP Quantitative Assessment, Lincoln Students

This questionnaire was completed by all participants before and after STEP programming.
N = 30 for all of Table 2.6. Data are means ± standard error. P-values are of paired sample t-test.

Sea Turtle Ecology and Conservation

Values closer to 1 suggest agreement, while values closer to 5 suggest disagreement.

	Pre – Test	Post – Test	p-value
If I was at the beach at night and saw a nesting sea turtle, I might take its eggs to eat or sell.	4.8 (0.0)	4.8 (0.0)	0.3
On a beach where there are several sea turtle nests, it would be okay to take the eggs from one nest to sell or eat.	4.7 (0.0)	4.8 (0.0)	0.1
Pollution is not really a big problem in the oceans because they are so big.	4.7 (0.0)	4.2 (0.0)	0.04
There are lots of sea turtles in the ocean	4.2 (0.0)	4.1 (0.0)	0.7

Interest in Conservation

Values closer to one suggest negative attitudes, while values closer to 5 suggest positive attitudes.

Protecting the Costa Rican rainforest	4.7 (0.0)	4.6 (0.0)	0.7
Protecting sea turtles	4.6 (0.0)	4.6 (0.0)	0.7
Conservation issues in your community	4.3 (0.0)	4.5 (0.0)	0.2
Pollution in the area where you live	4.5 (0.0)	4.5 (0.0)	1.0
Biodiversity in Costa Rica	4.6 (0.0)	4.5 (0.0)	0.4
Preserving Costa Rica's coastal communities	4.7 (0.0)	4.6 (0.0)	0.3

Interest in Ecology and Biology

Becoming a biologist	3.3 (0.0)	2.8 (0.0)	0.02
Coastal ecosystem structure and function	3.2 (0.0)	3.0 (0.0)	0.4
Understanding the science of ecology	4.2 (0.0)	3.7 (0.0)	0.01
Working with wildlife biologists	3.4 (0.0)	3.4 (0.0)	0.9
Designing a wildlife conservation project	3.7 (0.0)	3.4 (0.0)	0.2
Knowing the ecology of the area you live	4.4 (0.0)	4.3 (0.0)	0.5

Interest in Science and Research

Field studies outside the classroom	3.5 (0.0)	3.5 (0.0)	0.8
Applied science projects	3.7 (0.0)	3.7 (0.0)	1.0
Scientific research	3.7 (0.0)	3.7 (0.0)	1.0
Learning how to do scientific research	4.0 (0.0)	3.5 (0.0)	0.1

Other

Spending time outside	4.0 (0.0)	4.0 (0.0)	0.9
Attending a university after high school	4.8 (0.0)	5.0 (0.0)	0.4
Learning about nature	4.3 (0.0)	4.2 (0.0)	0.6
Foreigners who visit your country	3.9 (0.0)	4.1 (0.0)	0.4

Table 2.7 STEP Quantitative Assessment, All Students

This questionnaire was completed by all participants before and after STEP programming.
N = 44 for all of Table 2.7. Data are means ± standard error. P-values are of paired sample t-test.

Sea Turtle Ecology and Conservation

Values closer to 1 suggest agreement, while values closer to 5 suggest disagreement.

	Pre – Test	Post – Test	p-value
If I was at the beach at night and saw a nesting sea turtle, I might take its eggs to eat or sell.	4.7 (0.0)	4.7 (0.0)	0.9
On a beach where there are several sea turtle nests, it would be okay to take the eggs from one nest to sell or eat.	4.2 (0.0)	4.7 (0.0)	0.1
Pollution is not really a big problem in the oceans because they are so big.	4.5 (0.0)	4.0 (0.0)	0.1
There are lots of sea turtles in the ocean	2.9 (0.0)	3.4 (0.0)	0.1

Interest in Conservation

Values closer to one suggest negative attitudes, while values closer to 5 suggest positive attitudes.

Protecting the Costa Rican rainforest	4.7 (0.0)	4.8 (0.0)	0.4
Protecting sea turtles	4.8 (0.0)	4.8 (0.0)	0.7
Conservation issues in your community	4.2 (0.0)	4.4 (0.0)	0.03
Pollution in the area where you live	4.3 (0.0)	4.4 (0.0)	0.4
Biodiversity in Costa Rica	4.6 (0.0)	4.4 (0.0)	0.4
Preserving Costa Rica's coastal communities	4.7 (0.0)	4.7 (0.0)	0.7

Interest in Ecology and Biology

Becoming a biologist	3.4 (0.0)	3.4 (0.0)	0.9
Coastal ecosystem structure and function	3.5 (0.0)	3.7 (0.0)	0.3
Understanding the science of ecology	4.3 (0.0)	4.0 (0.0)	0.2
Working with wildlife biologists	4.1 (0.0)	4.1 (0.0)	0.9
Designing a wildlife conservation project	4.0 (0.0)	4.2 (0.0)	0.3
Knowing the ecology of the area you live	4.3 (0.0)	4.3 (0.0)	0.8

Interest in Science and Research

Field studies outside the classroom	3.4 (0.0)	3.6 (0.0)	0.4
Applied science projects	3.5 (0.0)	3.7 (0.0)	0.5
Scientific research	3.7 (0.0)	3.9 (0.0)	0.7
Learning how to do scientific research	4.0 (0.0)	4.2 (0.0)	0.5

Other

Spending time outside	4.0 (0.0)	4.2 (0.0)	0.2
Attending a university after high school	4.8 (0.0)	4.8 (0.0)	1.0
Learning about nature	4.4 (0.0)	4.6 (0.0)	0.3
Foreigners who visit your country	3.7 (0.0)	3.7 (0.0)	0.8

a significant difference ($p = .001$, Mann Whitney U test) in the post-program scores on this question when comparing the rural Matina school (2.7 mean post program score) and the urban Lincoln school (4.1 mean post program score). The Matina students' change in knowledge on this particular question seemed to contrast with their response to the short answer question of "What is the current status of these turtles' populations?" in which their was a significant change from 1.4 to 3.4 ($p = .001$, Table 2.2). This apparent anomaly may be due, in part, to the wording of the questions.

I believe that this first group of questions, "sea turtle ecology and conservation," might have been confusing to the students because the high score of '5' suggested disagreement, while the low score of '1' suggested agreement. This might have caused some intuitive confusion, especially given that the next (longer) section of the quantitative assessment was written with opposing correlations where a response of '1' suggested a negative attitude and '5' suggested a positive attitude towards the given topic.

Level of interest in conservation for both Matina and Lincoln groups was found to be very high before STEP—mean pre-test score > 4.3 for all questions ('5' suggesting positive attitudes)—and did not change significantly for either of the student groups after the program (Tables 2.5 and 2.6). Table 2.7 shows the only significant increase in conservation interest; for "conservation issues in your community" the mean for all students increased from 4.2 to 4.4 ($p = .03$).

Interest level in ecology and biology was also found to be high before STEP, and did not increase significantly for any segment of the student population after the program (Tables 2.5 – 2.7). The scores from the Lincoln group showed a significant drop in

scores for two questions, interest in "becoming a biologist" which changed from 3.3 to 2.8 ($p = .02$), and interest in "understanding the science of ecology" which changed from 4.2 to 3.7 ($p = .01$, Table 2.6). This difference was most likely tempered by the reality of field work. The long hours of walking on the beach at night and waiting for turtles to lay their eggs (sometimes in the pouring rain) led one Lincoln student to say,

> "It was a very different experience, I think it was eye-opening for most of us because most of us came here thinking it was such a romantic thing to do. 'Oh we're going to go save the little turtles, going to get the eggs.' Once we were there to get the eggs, it wasn't as romantic as we thought."

The urban students seemed to be more affected by the long nights of patrol work and the rustic living conditions of the Pacuare Nature Reserve than the Matina students. They showed less enthusiasm for the long nights, and expressed a keen interest in returning home after their time at the reserve. I believe that this might account for the difference in the level of interest in ecology, biology and science between the rural and urban students (Table 2.8). Five of six questions that pertained to interest in ecology and biology showed a significant difference in the post-program scores of the rural students vs. the urban students. While talking about science and field work, one Lincoln student stated, "it was different then reading it in the book—it's really different. When you are walking out there at one [o'clock] in the morning you wish you were really with a book only."

Many of the students from the Lincoln School are from middle or upper class backgrounds and live in a very urban setting. For them, the reserve visit was a much larger change in surroundings and lifestyle than for the rural Matina students. The difference between the Matina and Lincoln students is also reflected in the quantitative

Table 2.8 STEP Quantitative Assessment, Comparison of Rural and Urban Schools
This questionnaire was completed by all participants before and after STEP programming. "Rural" refers to Matina School participants, "Urban" refers to Lincoln School participants. P-values are of Mann-Whitney U test of ranks.

Sea Turtle Ecology and Conservation
Values closer to 1 suggest agreement, while values closer to 5 suggest disagreement.

	Rural Post-Test (n=14)	Urban Post-Test (n=30)	p-value
If I was at the beach at night and saw a nesting sea turtle, I might take its eggs to eat or sell.	4.7	4.8	0.8
On a beach where there are several sea turtle nests, it would be okay to take the eggs from one nest to sell or eat.	4.6	4.8	0.4
Pollution is not really a big problem in the oceans because they are so big.	3.8	4.2	0.4
There are lots of sea turtles in the ocean	2.7	4.1	0.001
Interest in Conservation			
Values closer to one suggest negative attitudes, while values closer to 5 suggest positive attitudes.			
Protecting the Costa Rican rainforest	4.9	4.6	0.4
Protecting sea turtles	4.9	4.6	0.3
Conservation issues in your community	4.6	4.5	0.9
Pollution in the area where you live	4.7	4.5	0.3
Biodiversity in Costa Rica	4.6	4.5	0.4
Preserving Costa Rica's coastal communities	4.9	4.6	0.1
Interest in Ecology and Biology			
Becoming a biologist	3.9	2.8	0.02
Coastal ecosystem structure and function	4.5	3.0	0.002
Understanding the science of ecology	4.5	3.7	0.02
Working with wildlife biologists	4.5	3.4	0.004
Designing a wildlife conservation project	4.8	3.4	0.001
Knowing the ecology of the area you live	4.7	4.3	0.2
Interest in Science and Research			
Field studies outside the classroom	3.7	3.5	0.8
Applied science projects	3.9	3.7	0.5
Scientific research	4.4	3.7	0.2
Learning how to do scientific research	4.9	3.5	0.003
Other			
Spending time outside	4.3	4.0	0.6
Attending a university after high school	4.7	5.0	0.2
Learning about nature	4.9	4.2	0.06
Foreigners who visit your country	3.6	4.1	0.3

Table 2.9 STEP Short Answer Assessment, Comparison of Rural and Urban Schools

This questionnaire was completed by all participants before and after, STEP programming. Each response to short answer questions was assigned a number from 1 (no answer) to 5 (answer suggest mastery). See Appendix IV for the grading rubric. This questionnaire was completed by all participants before and after STEP programming. "Rural" refers to Matina School participants, "Urban" refers to Lincoln School participants. P-values are of Mann-Whitney U test of ranks.

Sea Turtle Ecology and Conservation	Rural Post-Test (n=14)	Urban Post-Test (n=30)	p-value
What species of sea turtles nest along the Caribbean shore of Costa Rica?	5.0	4.0	0.003
What time of year do they nest?	4.0	3.3	0.05
What is the current status of these turtle's populations?	3.4	4.2	0.1
How many weeks do the eggs of the leatherback sea turtle stay in the sand before hatching?	4.5	4.2	0.5
Where do hatchlings go after they first make it to the sea?	2.0	3.0	0.06
How far do adult leatherback sea turtles migrate?	3.2	4.6	0.001
How often does an adult female leatherback lay eggs?	3.7	3.5	0.6
How many times does a female leatherback lay eggs during a nesting season	4.1	3.5	0.2
On a simple diagram, show the required measurements taken for sea turtle monitoring projects.	4.9	4.4	0.2

Ecological Knowledge	Rural Post-Test (n=14)	Urban Post-Test (n=30)	p-value
What is an ecosystem?	2.7	3.4	0.03
Name four communities in the coastal ecosystem	1.3	3.0	0.005
Name four species of plant or animal in each of these coastal communities	1.9	2.4	0.3
Draw a food web with the coastal ecological communities and plants and animals that live there	1.6	2.2	0.1
Will the coastal ecosystem be affected if one of these ecological communities is gone? Why?	2.3	3.1	0.008
Why is the coastal ecosystem important to the Ocean ecosystem?	2.5	3.1	0.1

assessment questions related to "interest in science and research"; all the mean post-program scores for the rural students were higher than the urban students (although not statistically significant, Table 2.8).

The differences in short answer post-program scores of the rural and urban schools (Table 2.9) appear to reflect the difference between the formal knowledge that each group possessed prior to program participation. Because of the Lincoln groups' more solid knowledge of biology and prior introduction to ecology, they showed significantly higher post-program scores on questions addressing advanced or conceptual ecological concepts. Previous knowledge allowed them to advance further in the STEP curriculum, and allowed for a deeper exploration of abstract ecological concepts.

Nearly all STEP participants planned on attending university after high school. When students were asked to rate their interest in attending university after high school from 1 (not interested) to 5 (very interested); the mean response was 4.8 ± 0.0 ($n = 44$). The mean response to this question remained unchanged after STEP (Table 2.7).

Due to logistical and time constraints at the reserve, it was not possible to conduct individual interviews with students. The transcripts in Appendix III are from the closing circle held at the end of each group's visit to the reserve. I believe that these transcripts may be useful in determining interest level and enthusiasm of STEP participants, but they cannot be considered statistically significant indicators of success in meeting program goals. Because the "interviews" were done in a discussion format with the entire group present, many students gave similar answers as other group members, or made slight additions to thoughts previously expressed. Therefore, it would not be accurate to look at, for example, the numbers of students that expressed interest in becoming a biologist,

or the number of students that expressed interest in field work. In the future, I would like to conduct individual interviews with students to better utilize this assessment technique.

The second conservation goal of STEP (in addition to increasing awareness of conservation science) was to collect quality ecological data during the students' stay at the reserve. All data collected met the reserve's scientists expectations, and appeared to be accurate based on comparing student measurements of recaptured turtles with previously recorded measurements (Table 4.2). We found that that student measurements of carapace length differed an average of 1.6 cm (n=24, SD=2.12), or 1.0% (n=24, SD=1.3), from measurements of the same turtles that had been taken within the two months of the students' recapture. Student measurements of carapace width varied an average of 2.0 cm (n=24, SD=1.7), or 1.8% (n=24, SD=1.6), from measurements of the same turtles that had been taken within two months of the students' recapture. This pilot program suggested that the data collected were consistent with previous measurements, but that research needs to continue to evaluate the ability of high school students to collect consistent and reliable data in field-based research projects.

The primary cultural goal of STEP was to involve local residents in the research program at Pacuare Nature Reserve, and initiate a dialog of sea turtle conservation between the Matina community and the reserve. Visiting school and student groups from the U.S.A. have arrived to the Pacuare Nature Reserve to participate in the sea turtle monitoring program during the last five season. The extraordinary importance of the student group visits in May, 2000, is that these were the first Costa Rican school groups ever to stay at the reserve and participate in the monitoring program. The Endangered Wildlife Trust of England has owned the 800 hectares of the Pacuare Nature Reserve for

eleven years, but had little previous contact with the residents of Matina, the nearest city to the reserve. This program was a landmark event in opening a line of communication between the community of Matina and the Pacuare Nature Reserve. A teacher from the Matina school stated,

> As one of the teachers and in this case a student of yours, I want to thank you truthfully. Infinite thanks for having taken us into account. Because there's a lot of scientists in this country, but they think to work with young people it is hard. But you have demonstrated that it is possible. To have offered us your patience, and to have offered us the opportunity to know about the conservation of the turtle. I had only seen them on TV. And it seemed to me to be incredible to see their size, to see them laying eggs, to know about the temperature that influences, to find out about the quality of the eggs, to know in reality what the turtle is. I thank you. Any time you can come visit us and maybe you can explain to the other students at the school the obligation that we have as Costa Ricans to conserve what God has given us. I thank you.

The second major cultural goal of STEP was to facilitate partnerships between Costa Rican students and research mentors, and for professional biologists to work with each group of visiting students during their stay at the research site. A student commented,

> We were here two days; now we're hoping to get to our houses and sleep some, and you guys are here and you're going to stay here I don't know how much time. People have been here for months, and they still go out at night. That's incredible, and it's an attitude that I hope I can have in the future.

The Lincoln School and the Matina School worked with the biologists and guards from the Pacaure Reserve for at least ten hours of formal work or study, and had other informal opportunities to talk with staff and learn about their work. Miguel, one of the park guards told the group of Matina students,

> I hope that you pass this experience on to others; what we have here belongs to everybody. I am very grateful to you. You are very educated, full of spirit, of conservation, and very pleasant. I hope that we will have you here again very soon. Thank you.

This dialog will ensure the success of both the sea turtle conservation program at the reserve, and the educational programming with the local schools. The students are learning about the reserve, it's mission, and it's staff; and the reserve guards and biologists are learning about the residents of Matina. Six weeks after I left Costa Rica, I received news that students had already heeded Miguel's word, and returned to the reserve. In late June, Pacuare Reserve staff members arranged for a group of 15 Matina students to return to watch leatherback sea turtle hatchlings emerge from their nests and scramble to the sea.

Program Review

Program reviews from both teachers and scientists were, with few exceptions, overwhelmingly favorable. The reviews from the 12 teachers for organization and instructional sequence, leadership and group management, preparation of the instructors, and safety (questions 1-4 from Figure 2.4) consisted of *only* positive comments. Teachers commented that, "instruction was excellent and well organized"; "instructors related well to the students, group management was not a problem for you"; and, "the student lab book [the journal] was clear, well organized and useful."

We received several useful comments regarding logistical aspects of the program. Some students and teachers, especially the vegetarians, would have preferred more variety in the diet. With one of the Lincoln groups, there was some confusion about the pick-up time for the boat ride out to the reserve, and they waited a few hours at the dock for the Pacaure Reserve boat to pick them up. In 2001, we will allow ourselves more time between departure of one group and the arrival of the next, this should alleviate transportation issues between incoming and outgoing groups.

All 12 teachers had positive comments on the academic content of STEP. One teacher from Matina said, "with respect to the content, depth, and relevance, I believe that our Ministry of Public Education needs to include this type of experience for all schools. This type of learning is very important for our country."

Figure 2.2 STEP Teacher Program Review

Please provide opinions and comments on the following topics:

1. Organization and instructional sequence
2. Leadership and group management
3. Preparation of the instructors
4. Safety
5. Logistics (food, lodging, transportation, etc.)
6. Academic content (depth, relevance to class curriculum, etc.)

Three of the reserve scientists, Belinda, Gerardo, and Belinda's assistant (Marija), provided program feedback (Figure 2.5). Belinda commented, "excellent leadership and involvement of group," and that the STEP staff were, "well prepared, and flexible enough to work with last minute changes." All three thought that small group size (3-4 students) was ideal for patrolling.

Belinda suggested including habitat restoration as an additional activity for future student groups. This work may include picking up trash, and clearing debris from the nesting beach. We plan to include this in 2001 programming.

Belinda commented that, "This was a wonderful experience to work with the kids of Costa Rica and I hope it continues in the future."

Figure 2.3 STEP Scientist Program Review

Please provide opinions and comments on the following topics:

1. Organizational and instructional sequence
2. Leadership and group management
3. Preparation of the instructors
4. Safety
5. What would be your ideal group size and length of stay?
6. Academic content (depth, relevance to class curriculum, etc.) Any additional suggestions for material to cover?
7. Were there issues with student behavior? Were the groups managed effectively? What could be improved?
8. What additional data points could these student groups monitor? Both on and off patrol.
9. What additional activities (outside of data collection) could students do to contribute to conservation at the reserve?

Chapter Three: Sea Turtle Ecology Program and Curriculum

By participating in authentic site-based research, students can learn about the local ecology, be involved in conservation efforts at the site, and develop skills that are needed to make a positive difference in conservation efforts. Field-based student-teacher-scientist partnerships are an ideal strategy to improve knowledge, attitudes and skills for both students and teachers, and these attributes are important to any conservation or ecological education program (Iozzi, 1989; Hungerford and Volk, 1990; van Matre, 1993; Orr, 1994; Booth, 1999).

Student-teacher-scientist partnerships have the potential for significant contributions to both the scientist and the student. Several studies have suggested that creating successful student-scientist partnerships help students enjoy and engage in science learning because the students recognize the impact and context of their learning (Alper, 1994; Hays 1994; National Research Council [NRC], 1996, 1997; Caton et. al., 2000). Engaging students is paramount to learning, but in terms of rewards, successful collaborations can have deeper impacts. Students learn first hand *what* scientists do, *how* they do it and *why* they do it. These partnerships increase the public's understanding of biologists' work, help to create a scientifically literate population, and provide training and inspiration to future ecologists, researchers, and scientists.

My experience suggests that in a traditional science course, students often view the material in textbooks as boring, rote, and not applicable to their lives. The reality is much different! The culture of science is rich in discovery, humanity, wonder, *and* information. Indeed, for students to develop ecological literacy, they need to experience the wonder and humanity of science, in addition to factual information (Orr, 1989). In

the spirit of capturing many elements of the culture of science, the Sea Turtle Ecology Program (STEP) was designed to promote ecological literacy through authentic research experiences at a nature reserve in Costa Rica.

In May, 2000, 49 students and 12 high school teachers came to the Pacuare Nature Reserve in Costa Rica to participate in a scientist-student collaboration at a sea turtle nesting grounds. These participants from local public and private schools took part in a unique experiential field ecology program where they attended three science classes during their three days at the reserve (covering research, sea turtle ecology, and sea turtle migration), assisted biologists in collecting field data at night, and explored the Caribbean coast in their free time.

The curriculum focused on the endangered leatherback sea turtles and the lowland rainforest ecosystem of Costa Rica's Caribbean coastline. Curriculum development was accomplished through collaboration with the participating Costa Rican schoolteachers, the Pacuare Nature Reserve biologists, and scientists from the National University of Costa Rica (Universidad Nacional Autonomous; UNA). This residential pilot program consisted of eight nights and nine days of field work by Costa Rican students. These eight nights were covered in two-night shifts by each of four student groups. During the nightly beach patrols, students measured and tagged leatherback sea turtles, counted and weighed their eggs, and relocated nests as needed to protect them from poachers.

Turtle Nesting Site

The Pacuare Nature Reserve is held by the Endangered Wildlife Trust, a charitable trust based in London, England. The Endangered Wildlife Trust acquired the reserve in

1989, and during the last ten years has worked diligently to monitor and protect the nesting turtles and their eggs. The reserve consists of 800 hectares of lowland rainforest and 6 km of shoreline on the Caribbean coast of Costa Rica; it is located at the mouth of the Pacuare River, about 30 km north of Puerto Limon. The Pacuare Nature Reserve, Tortuguero National Park, and Gandoca-Manzanillo Wildlife Refuge are the three major nesting beaches for the leatherback sea turtle (*Dermochelys coriacea)* on the Caribbean coast of Costa Rica (see map in Appendix I). Leatherback turtles come ashore to nest from late March through June. In addition to sea turtle conservation and habitat restoration, the reserve had expressed interest in involving local communities in their conservation mission. This project was the first realization of that idea.

Students as researchers

Sea turtle population monitoring programs require relatively simple data collection over long periods of time. This type of monitoring has great potential for scientist-student partnerships. STEP took advantage of a long term monitoring program at the Pacuare Reserve to develop a curriculum based on the scientific method as a baseline for promoting inquiry. In the STEP model, students were responsible for developing their own question, research approach, and data collection techniques. Through this process, the student was at the center of the discovery process, with teachers and scientists available when guidance was requested or needed.

Shortly after their arrival to the Pacuare Nature Reserve, students were issued STEP journals and introduced to the history and goals of the monitoring program. The student journal was a key piece of STEP curriculum. This journal (Appendix II) is divided into

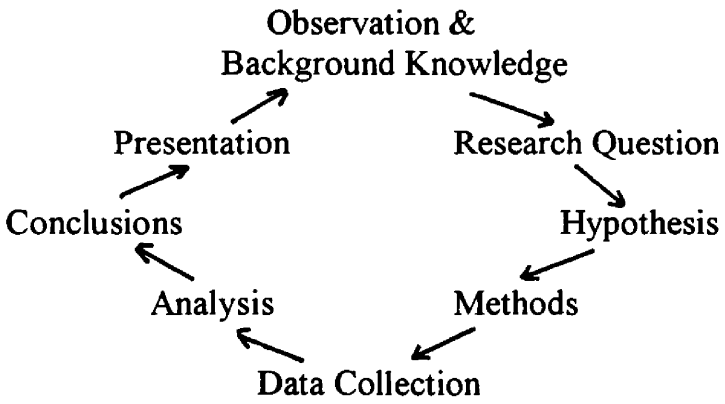
three main sections: The Pacuare Nature Reserve, Sea Turtles, and Research. The first section had maps, tidal and lunar information, species lists of common plants and animals, and areas for the students to fill in information about the ecology of the reserve. The Sea Turtle section had information on all of the sea turtles of the world, scientific classification, nesting behavior, and threats to survival. The research section was devoted to the student-centered research project. During all lessons, patrol work and group activities, the journal was the STEP participant's constant companion. In addition to giving the student a place to record information and take notes, the journal was a resource that the students could refer to throughout their stay, and after leaving the reserve.

The goal of the first meeting with students was to prompt thinking about sea turtles, turtle research and conservation efforts at the reserve, and present information that the students needed to develop their research questions. In our first discussion with students, it became apparent that students already had some background knowledge about sea turtles. For example, many of the Costa Rican students had seen turtle eggs for sale on the street, other students had seen television programs about sea turtles, and a few students had seen sea turtles nesting. Working in groups, students pooled their knowledge to compile important information that would help to guide them in their turtle research. During this first discussion, students were provided basic information about the population of sea turtles that nest at the Pacuare Reserve, along with an introduction to the reserve and its mission. Concepts such as range, habitat, life cycle and nesting process were introduced.

After our introductory discussions, there was a formal introduction to the scientific method. STEP curriculum used the "circle of scientific logic" as shown in Figure 3.1 as

the baseline this lecture, and for the entire student-centered research projects that followed. These same steps are used to teach the scientific method at the Teton Science School in Grand Teton National Park, Wyoming, and were adapted slightly for STEP. During the formal lecture, an explanation was given for each step and we emphasized that students would complete the research process—from background knowledge to presentations—during their stay at the reserve. Interestingly, the students from the local school had never studied the scientific method, while the Lincoln students expressed some familiarity with the formal process. Whether or not the participants expressed knowledge of the method, the formal lecture reinforced its applicability to real life situations.

Figure 3.1 STEP Circle of Scientific Logic



To prepare for field work, the students were split into two groups, "Egg Experts" and "Turtle Experts." Groups had specialized duties related to the types of long-term data they would collect. Each expert group met separately with an instructor to guide them through the formulation of a research question, hypothesis, and development of methodology. The egg expert group's responsibilities included counting the number of

fertile and infertile eggs laid by each turtle, collecting the eggs in a plastic sack so they could be relocated to a safer area, and digging a replacement nest cavity. The duties of the turtle expert group included recording the time that the turtle was first discovered and describing turtle behavior at that time, checking for tags and recording tag numbers if present, and measuring the length and width of the turtle's carapace. Based on their initial data, expert groups formulated a research question that was answerable and comparable (Feinsinger et al. 1997). All student groups invariably came up with many questions, but the advice of the scientist mentor was necessary to frame the question in a way that it could be answered in just a few nights of data collection. Students were encouraged to collaborate with the other expert group, use their data as appropriate, and to collect additional data as necessary to answer their question. Once a question was agreed upon by the group, the students wrote it into their journal along with a corresponding hypothesis and rationale. Student hypotheses from the 2000 program are shown in Table 2.1.

With questions in hand and the help of scientists and teachers, student groups devised and practiced their methodology for data collection. Because sea turtle data are collected on long term monitoring programs around the world, specific measurement procedures are required for researchers across the globe.

Finally, it was time for data collection. Beach patrol groups set out at 8:00 p.m., 9:00 p.m., and 11:00 p.m. in search of nesting sea turtles. Each patrol group had the same number of turtle experts and egg experts. Before leaving, the experts taught each other their methodology, and practiced data collection techniques before they found a nesting turtle. This sharing of methodology was important in case they discovered a turtle who

was nearly finished with the nesting process—in this case, data needed to be collected rapidly and efficiently before the turtle returned to the ocean. The experts had to help each other to complete the required measurements in a short time period.

Each morning after patrolling, data were transcribed onto a large data table, and methodology and team work were discussed. Problems during patrols, such as forgetting to collect information, appeared as blank areas on the large data table. Students discussed what had happened and how to improve data collection in the second night. All students kept up-to-date data tables in their journals.

After two nights of data collection, the expert groups re-convened to review their data and original hypothesis. Using worksheets in the journal, they analyzed data, prepared visual aids with summary information, and developed a presentation for their peers. In the presentation, groups were asked to describe the research question and hypothesis, and equipment and methods used. Groups presented summary results, along with an interpretation and discussion of the results. They were asked to address potential errors, and to consider questions that they might want to pursue in the future. These presentations were attended by all students and their teachers, the biologists and the park guards.

An important part of the research experience was a presentation from the reserve biologist, Belinda Dick. She gave a lecture on sea turtle biology that focused on the reserve's goals and current work. After a night on the beach working with sea turtles, the students were eager to learn more about the turtles and their reproductive habits. This lecture provided an effective lead-in to the afternoon sea turtle migration activity.

To better connect the students' work at the reserve to the big picture of sea turtle tagging efforts, I designed a lesson on sea turtle migration using actual tag reports from leatherback sea turtles (Appendix II). The focus of this activity was to follow the journeys and tribulations of six different sea turtles that had been tagged originally at the Pacuare Nature Reserve. Turtle tag reports consisted two parts; first, was the letter from the individual who found the tagged sea turtle that had been. This letter was sent to Gainesville, Florida (as per the address on the back of the tags used at the reserve). These letters came from Costa Rica, Panama, the United States, and Spain; some were written in English, and some in Spanish.

Table 3.1 STEP Sea Turtle Migration Activity Questions

1. Where was the turtle first tagged?
2. What was the date the turtle was tagged?
3. Who found the turtle? What do you know about them? Names, where they live, what they do for a job, etc.
4. Did the person who found the turtle write in English or in Spanish?
5. Who did the people who found the turtle send the tag information to?
6. When was the turtle found?
7. How long had passed between when the turtle was first tagged and the time of its recapture?
8. Where was the turtle found?
9. How far away (in kilometers) was it from where it was tagged?
10. Leatherback sea turtles swim at a constant rate of about 3km an hour for approximately 10 hours every day. How many days would it take for the leatherback to swim from where it was tagged to where it was recaptured?
11. Was it alive when it was recaptured? If so, what was it doing?
12. Was it dead when it was recaptured? Does the report say how it might have died?
13. Was a reward sent to the person who recaptured the turtle? How much? If not, why not?

The second part of the tag report was the letter from the Gainesville office to the individual who found the sea turtle. Copies of the tag reports used for this exercise are found in Appendix II. Students split into pairs, read the report for their turtle, and then answered the questions in table 3.1.

Maps drawn at different scales were provided to the students so they could calculate distances and determine where the turtles traveled. After each pair finished answering the questions, they presented their turtle to the entire group.

Assessment

Several assessment indicators were used to evaluate the impact of this curriculum on student learning and attitudes. Assessment indicators included work produced and accomplished, results of pre- and post-program tests, student presentations, quality of data collected, the journals, and post-program closing remarks. Work produced by STEP participants included the number of turtles tagged, and the number of hours and kilometers of patrol coverage. Video taped interviews of students were conducted at different times during the program. All students completed a written test with questions related to knowledge and attitudes both before and after program participation. Questions addressed basic ecological knowledge and sea turtle ecology, interest in pursuing biology careers, interest in university study, local conservation issues and current conservation involvement. Students presentations represented the culmination of their research projects. Student closing remarks, a response to, "What did you learn while at the reserve?", were video taped for later review.

The questionnaires indicated significant increases in ecological knowledge and knowledge of sea turtle conservation for all student participants (Chapter 2). Moreover, all students learned and applied the scientific method, and presented the results of their research project to their peers and the reserve staff. Post-program student comments in assessment interviews and closing circles reflected not only increased knowledge of sea turtles and coastal ecosystems, but a reverence for the area and the animals that depend on it (Appendix III).

Several follow-up activities were designed to integrate the STEP experience into the regular school curriculum of participating groups. Students from the Lincoln School were credited with 20 hours of lab time for the work at the reserve. Two participants from the Lincoln School used the experience as the focus of an extended research paper required for partial fulfillment of the International Baccalaureate program. Other students were required to prepare a presentation for their peers who were not able to attend. At the end of the program the teachers agreed that many aspects of the turtle curriculum directly related to their regular classroom curriculum.

Final Impressions

The approach used by STEP to incorporate research into an educational setting was modified from current programming in place at the Teton Science School (TSS) in Grand Teton National Park, Wyoming. The expert group approach has been used successfully at TSS for stream research, biodiversity studies, and snow pit research. The approach is clearly adaptable, and its application to new ecosystems within the U.S.A. and abroad deserves further consideration.

The success of STEP was due, in part, to the formation of partnerships based on a common vision. This program can be applied to monitoring programs in different ecosystems with careful consideration and dialog between potential partners. Partners must view the educational impacts on the students, scientists, and teachers, as the priority, and set aside other goals as secondary benefits.

The educational program in STEP involves the integration of multiple subjects and skills; it is not simply a field biology program. Because the core focus is conservation education, a variety of issues in the social, political, and biological arenas are important. This collaboration by people representing diverse interests is fundamental to the successful implementation of this model.

Following the successful pilot implementation of STEP, a new non-profit educational organization has been started, Ecology Project International (EPI). The mission of EPI is to develop international ecological education partnerships between scientists and high school students to address critical conservation issues. EPI resulted directly from this thesis work, and will work to continue the efforts at the Pacuare Nature Reserve in Costa Rica. In 2001, we hope to have eight Costa Rican school groups visit the reserve (about 120 students) and five student groups from the United States (about 75 students).

By including students from the U.S.A., we hope to expand the research collaboration—international high school student peers will meet at the research site to work together, exchange perspectives, and share experiences. In addition to overlapping time at the research site, partnerships can be accomplished through school visits, home-stays in the community, and via the internet.

EPI staff hope to use communication technology to strengthen cultural awareness and environmental partnerships. Through the use of the internet, research sites and students will be connected both before and after their own visit. Students will follow the work of others throughout the field season, and communicate with participants and scientists.

In addition to the work in Costa Rica, additional host-countries and research sites will be added as the organization grows. For example, we currently are talking to scientists using satellite telemetry in their work with migratory red-tail hawks. Data are needed from Mexico detailing the raptor's winter habitat use. In addition to on-the-ground site work, students from around the world could follow migration routes of these raptors using satellite telemetry data and tools via the internet. EPI organizers believe strongly that site-based research programs are effective in conservation education, and are transferable to other countries and different ecosystems.

Chapter Four: Students as Researchers

Data Collection on a Sea Turtle Population Monitoring Program

Integrating students in site-based research has the potential for significant contributions to the scientist, the student, and the teacher. Several studies have suggested that creating successful student-scientist partnerships helps students enjoy and engage in science learning because the students recognize the impact and context of their learning (Alper, 1994; Hays 1994; National Research Council [NRC], 1996, 1997; Caton et. al., 2000). Engaging students is paramount to learning, but in terms of rewards, successful collaborations can have deeper impacts. Students learn first hand *what* scientists do, *how* they do it and *why* they do it. These partnerships increase the public's understanding of biologists work, help to create a scientifically literate population, and provide training and inspiration to future ecologists, researchers, and scientists. For the researcher, these partnerships can initiate or extend a dialog with local communities and residents. Actual implementation of student-scientist partnerships takes planning and patience; this chapter discusses the process and effectiveness of student-researcher partnerships at a sea turtle monitoring program in Costa Rica.

Through effective planning, high school students can develop a vested interest in a research project and related data collection. When research is well integrated with the school curriculum, and students are encouraged to create their own research questions, they can be motivated and actively engaged in science.

Successful integration of students as researchers involves four components: collaborating with teachers, training the biologists, training the students, and implementing the research project. Classroom teachers support their students throughout

the research program, providing invaluable assistance preparing students for the visit to the research site, working with students at the research site, and finally, transferring the experience beyond the site-visit back to the classroom. Students must be competent in the project's methodology to collect quality data. For example, in the field of conservation biology, careful attention to the methods of data collected are essential. Data must be accurate, or the study may not be useful in helping conservation biologists make decisions about important species and habitats. This competence level may be affected by motivation, knowledge, and skill; and all of these factors are influenced by program planning and implementation. Like any successful collaboration, partners need to understand each other's backgrounds and working styles. Professional biologists working with pre-college students for the first time can benefit by learning how students learn and by working with professional educators to integrate student research into their course work. Educators can also help train students in data collection methodologies. Successfully participating in the actual research program is the final test.

Collaborating with teachers

A key factor in the successful implementation of student-scientist partnerships is to work with teachers that are enthusiastic supporters of experiential education. These professional educators can help prepare the students with the skills and attitudes required for site-based research. For STEP research, I met with Lincoln and Matina school teachers at six months, and one week before program implementation; we discussed logistics, expectations, and curriculum goals. Teachers referred to the upcoming STEP

research trip as an incentive for students for several months prior to the program. The trip was viewed as a reward for exceptional performance in the classroom.

Upon arrival at the reserve, STEP staff met with the teachers to explain site logistics, and to discuss the role of teachers during the program. Because none of the teachers had been to the Pacuare Nature Reserve, we encouraged them to participate fully in all lessons and activities. As a team we discussed the schedule, revisited the goals of the three day research experience, and answered their questions.

Training students

Successful researchers have knowledge, skill, and motivation. With the right opportunity, high school students can develop in these same three areas. Creating successful student-scientist partnerships helps students enjoy and engage in science learning because students can recognize the impact and context of their learning (Alper, 1994; Hays 1994; National Research Council [NRC], 1996, 1997; Caton et. al., 2000). Similar to the process of training professionals, training students begins before the research project starts. Prior to the actual sea turtle monitoring study, I met with all student participants to brief them on the reserve, the importance of the work, and program expectations before the students actually visited the Pacuare Nature Reserve. I emphasized the relevance of the work, and the student's role in the process. The students were told they would be working alongside scientists who needed their help to collect information on an endangered species, and that the data they collected would be sent to an international database in Florida, U.S.A. During this preliminary meeting, students learned about sea turtle ecology and the goals of the research. This meeting

helped facilitate the teachers' ability to connect the research site-visit to classroom curriculum.

Student research training continued later during the site visit. Upon arrival, students learned more about the reserve's monitoring program and sea turtle ecology. They were introduced to the scientific method as it applied to the sea turtle research program so that they would appreciate the bigger picture of their work at the reserve, and *why* it was important. Students also developed their own parallel research question that they would attempt to answer during their stay. Their research questions gave them a personal investment in the collection of good data. Project staff helped students develop research methods and data collection techniques, important skills required to do quality work. Before students actually worked with sea turtles, they worked with biologists to practice techniques and perfect their data collection skills. They learned about relevant tools, sampling methodology, appropriate behavior, and specific issues to working with sea turtles.

Preparing biologists

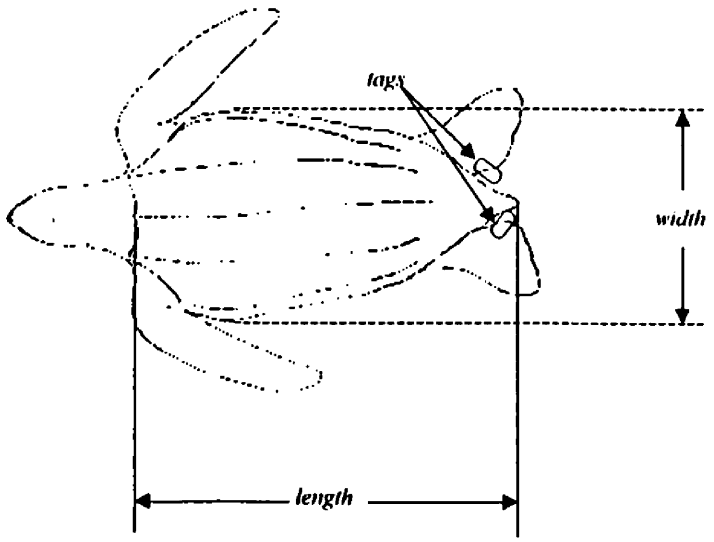
While one benefit to scientists was to have assistance with their work, the goal was to introduce students to scientific field work, the scientific process, and the conservation biology of sea turtles. Meetings between project staff and the biologists before students visited the reserve was important for determining scientists needs and expectations. It was important to make sure that the teachers, biologists, and STEP staff were all prepared for the arrival of the students and the turtles. During the initial meeting, specific methodology and data recording needs were discussed with the biologists. Once the

students arrived on-site, the biologists were given time to meet directly with the students, and reinforce the methodology and data collection.

Students as Researchers

Students began their research projects soon after arriving at the site. Each evening at the reserve, three patrol groups left at staggered intervals (8 p.m., 9 p.m. and 11 p.m.) and explored five kilometers of beach. Depending on the number of turtles encountered, each patrol spent from three to six hours on the beach. Data collection took place under the supervision of a reserve biologist or trained park guard. Student patrol groups were able to practice data collection protocol and techniques, and perfect teamwork and communication skills on the first turtle they encountered. As the students gained experience, they took on more responsibility for data collection and recording. All data necessary for the monitoring program at the Pacuare Nature Reserve were collected by students (with the exception of beach zone) including: date, tag numbers, time, length and

Figure 4.1 Length and Width Measurements of a Leatherback Sea Turtle



width of turtle carapace, number of fertile eggs, and the number of infertile eggs (*vanos*). Figure 4.1 shows the appropriate measurements taken of a nesting leatherback sea turtle. If a turtle did not already have tags, the biologist with each group was responsible for tagging the animal. The students were responsible for all taking all measurements and counting the number of eggs laid.

What the Student Researchers Learned

During eight nights of student patrolling at the Pacuare Nature Reserve (May 9 – May 16, 2000), 39 leatherback sea turtles were encountered by the student groups. Students accomplished approximately 120 patrol-hours of beach monitoring, approximately 210 km of total beach. Furthermore, they relocated 23 nests to safer beach areas. In addition to these long-term monitoring data, students collected additional data related to their group projects, including distance to sea, nest depth, weight of eggs, fin length of turtle, and beach slope.

Data Accuracy

The reproductive cycle of leatherback sea turtles lends itself to checking for accuracy of data collected by the students. The leatherback sea turtle enters a nesting cycle once every two to three years. And within the three month nesting season, the same turtle will come ashore to lay eggs every nine to ten days. By May 9 – May 16, 2000, a month into the leatherback nesting season, most turtles already had been captured once or twice by Pacuare Nature Reserve biologists. STEP students recaptured several turtles that had nested 10 or 20 days before the student visits. Typically, scientists assume the carapace

Table 4.1 Capture/Recapture Information for STEP turtles

This table shows the date that individual turtles were encountered, and the measurements taken on that date. The "difference" columns show the difference (in cm and %) between student measurements and scientist measurements (of length and width). Shaded rows indicate data recorded by STEP students.

Tag #		Date	Carapace (cm)		Difference Length		Width	
Left	Right		Length	Width	cm	%	cm	%
V2570	V2571	20-Apr	163	110	9	5.52	1	0.91
		30-Apr	154	107	0	0	2	1.87
		9-May	154	109				
V2497	V2498	7-Apr	163	122	2	1.23	3	2.46
		18-Apr	167	120	6	3.59	1	0.83
		9-May	164	120	3	1.83	1	0.83
		9-May	161	119				
V2360	V2361	27-Mar	148.1	109.7	1.1	0.74	2.3	2.1
		9-May	147	112				
V2469	V2470	13-Apr	152	107.2	1.4	0.92	2.3	2.15
		9-May	153.4	110.5				
D8663	D8654	17-Mar						
		13-Apr	163	107.5	0	0	0	0
		9-May	163	107.5				
V2615	V2618	4-May	148	108	2	1.35	5	4.63
		10-May	150	113				
V2845	V2646	2-May	148	109	0	0	4	3.67
		10-May	148	113				
V2397	V2398	2-Apr	149	108	0	0	7	6.48
		10-May	149	101				
V2644	79517	2-May	145	105.1	0	0	1.9	1.81
		12-May	145	107				
V2605	V2606	22-Apr	149	104	1	0.67	1	0.96
		12-May	148	103				
V2388	V2389	31-Mar	139	103	0	0	0	0
		18-Apr	139	104	1	0.72	1	0.96
		12-May	140	103				
V2507	V2508	15-Apr	153	115	2	1.31	3	2.61
		5-May	155	117	0	0	1	0.85
		13-May	155	118				
8759	V2407	16-Apr	149.7	107	2.7	1.8	1	0.93
		13-May	147	108				
V2343	V2342	24-Mar	154.5	111.5	1	0.65	0.5	0.45
		11-Apr	153.5	114.8	1.5	0.98	3.8	3.31
		13-May	152	111				
7588	V2822	18-Mar	166	122	1	0.6	3	2.46
		4-May	165	120	2	1.21	1	0.83
		13-May	167	119				
V2728	V2729	5-May	138.5	109.2	0.5	0.36	0.2	0.18
		13-May	138	109				

dimensions of an adult sea turtle will not change significantly within a short window of time (i.e. several weeks), it was possible to estimate the relative accuracy of the data collected by students by comparing student data to measurements made by previous researchers. Each morning, student data were compiled on large data tables. These data were reviewed by the reserve biologist for completeness and accuracy. The measurements taken by STEP students correlated well with previous measurements (Table 4.2).

The feedback from the reserve biologist, her assistant, and all of the park guards supported the fact that the student participants were not only enthusiastic, but accurate with their data collection. Table 4.2 (a summary of Table 4.1) shows that student measurements of carapace length differed an average of 1.6 cm (n=24, SD=2.12), or 1.0% (n=24, SD=1.3), from measurements of the same turtles that had been taken within two months of the students' recapture. Student measurements of carapace width varied an average of 2.0 cm (n=24, SD=1.7), or 1.8% (n=24, SD=1.6), from measurements of the same turtles that had been taken within two months of the students' recapture. This pilot program suggested that the data collected were consistent with previous measurements, but that research needs to continue to evaluate the ability of high school students to collect quality, consistent, and reliable data in field-based research projects.

Table 4.2 Student Measurement Accuracy Relative to Previously Measured Turtles

This table shows the average measurements in length and width as recorded by STEP participants. The table also shows the average difference between the student measurement and previous measurements (taken by scientists) for the same turtles. Mean difference is first shown in centimeters and percent. SD = standard deviation.

	Mean (cm) n = 39	SD	Mean Difference (cm) n = 24	SD	Mean Difference (%) n = 24	SD
Length	152.40	8.40	1.62	2.12	1.02	1.29
Width	110.87	5.84	2.00	1.73	1.80	1.58

In addition to fulfilling the reserve's data needs, student groups collected 50% more data during their stay at the reserve than the reserve collects under normal operation. The potential benefits of additional data collection should be considered in the design of any long-term monitoring research project.

Other Considerations and Limitations

Additional considerations must be addressed when considering the integration of school groups into monitoring or other research projects. Off-season logistics increase dramatically to facilitate collaborations between scientists, teachers, students, administrators, and parents. Arrangements must be made to determine timing of student group arrivals and associated preparation at the site; and the site must have residential facilities for the student visitors. In addition, there are costs associated with the room, board, and transportation of student groups. These logistical and financial issues must be balanced with both the short-term needs and educational potential of the project. STEP participants from the Lincoln school possessed the resources to pay for the expenses of transportation, room, and board during their visit. The funding for the Matina students came from diverse sources. They provided their own transportation to the reserve, the

reserve owner provided their room and board, and I provided the educational materials. Because the Pacuare Reserve already had a volunteer program in place, they were prepared to handle large residential groups.

Maturity levels and attention spans of high school students are also important considerations for selecting appropriate research projects. Students can get bored and, at times, behavior may be an issue. Teachers and biologists should expect this, and be prepared with appropriate mitigation strategies. Student groups were self-selecting, and so generally behavior was not an issue. Potential safety issues, such as running on the beach at night, not staying together as a patrol group at night, and swimming in the ocean, were dealt with immediately by teachers, STEP staff, or the reserve staff. It was important that teachers, STEP staff, reserve staff, and students all agreed (before programming) upon the rules that would be followed. In STEP we addressed behavior problems in several ways, including talking individually with the students and their teachers, and arranging evacuation from the reserve for continued inappropriate behavior. No students were forced to leave the research site during STEP.

Long-term monitoring projects might benefit from the institutional longevity of high schools as a consistent source of reliable data collectors. Although the logistics of student-scientist partnerships may be large in the first few field seasons, the benefit of a stable source of energetic research assistants can provide great rewards in the long run.

Conclusions

Well-trained high school students can help long-term monitoring projects have additional staff to increase the amount of relevant data that can be collected; in addition, if properly prepared and trained, student researchers can be reliable and effective. The cultural and education benefits to students, teachers, and scientists are critical to long term success of the efforts of conservation science. These impacts extend well beyond the site-visit because student-scientist partnerships foster scientific literacy, increases the public understanding of biologists' work, and provide training and inspiration to future ecologists, researchers, and scientists.

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APPENDIX I

Map of Costa Rica

Costa Rica's Caribbean Coast

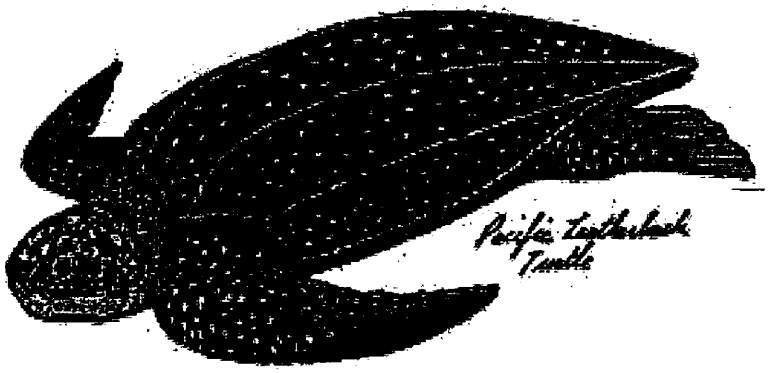
APPENDIX II

CURRICULAR MATERIALS

Ecology Project International

Sea Turtle Ecology Program

Pacuare Nature Reserve
Spring 2001



Name: _____

Patrol Group: _____

www.ecologyproject.org

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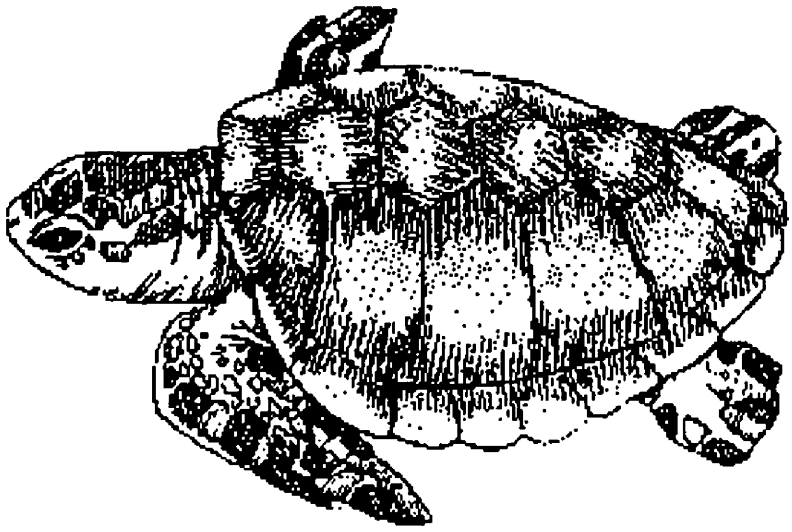
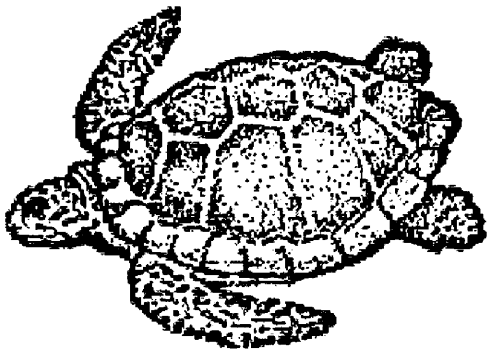


Pacuare Nature Reserve Rules

The Pacuare Nature Reserve is a special place with an important mission. We want to make sure we're invited back! To reduce our impact on the reserve and the turtles that nest here, please follow these simple rules...



In the cabins:

- Never leave a candle unattended at any time.
- Always take off your shoes and wash any sand from your feet in the bucket of water provided before entering.
- Keep the rooms and bathrooms clean -- brooms and other cleaning materials are provided.
- Use water sparingly.

No swimming! There are crocodiles and caiman in the lagoon and strong riptides in the sea.

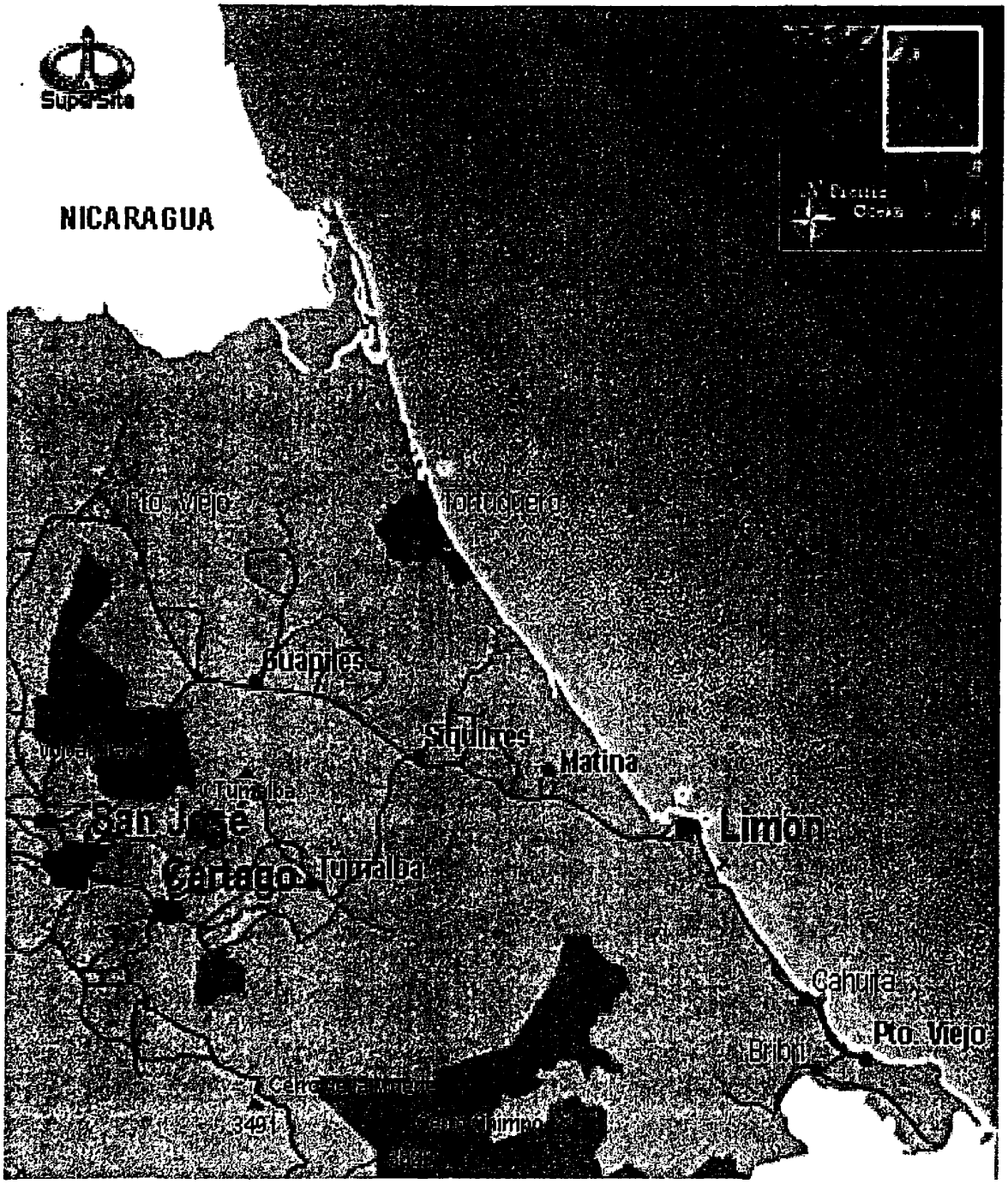
Shake out your shoes before you put them on to make sure no scorpion or other insect has climbed into them.

Watch out for snakes! Though they will also try and avoid you, some species are poisonous and should be treated with caution.

See the "turtle patrol briefing" page for instructions about patrolling.

Map of Costa Rica

Map of the Caribbean Coast

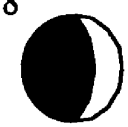
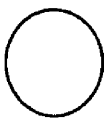


Weather data

		Day 1	Day 2	Day 3
temp				
	max			
	min			
	during patrol			
wind				
	speed			
	direction			
cloud				
	cover (%)			
	type			
hum				
	relative (%)			—

Lunar Cycle

May, 2001

Sunday	Monday	Tuesday	Wed	Thursday	Friday	Saturday
7  waxing cresent	8 	9 	10 	11  third quarter	12 	13 
14 	15 	16 	17 	18  full	19 	20  waning cresent

Tide Chart

May, 2001

Pacuare Reserve Species Lists - Animals

Mammals

pisote	*Nasua narica*	coati
tigre	*Felis onca*	jaguar
perezoso de tres dedos	*Bradypus variegatus*	three-toed sloth
saino	*Tayassu tajacu*	collared peccary
mapache	*Procyon lotor*	racoon
guatusa	*Dasyprocta punctata*	agouti
danto	*Tapirus bairdii*	tapir
<u>monkeys</u>		
mono colorado	*Ateles geoffroyi*	spider monkey
mono congo	*Alouatta palliata*	howler monkey
mono cara blanca	*Cebus capucinus*	white-faced capuchin
<u>bats</u>		
frutero jamaicano	*Artibeus jamaicensis*	Jamaican fruit bat
golengualarga	*Glossophaga soricina*	nectar bat
vampiro	*Desmodus rotundus*	vampire bat

Reptiles

<u>turtles</u>		
baula	*Dermochelys coriacea*	leatherback
verde	*Chelonia mydas*	green
carey	*Eretmochelys imbricata*	hawksbill
caguama	*Caretta caretta*	loggerhead
<u>snakes</u>		
terciopelo	*Bothrops asper*	fer de lance
boa	*Boa constrictor*	boa
zopilota	*Drymarchon corais*	indigo
bejuquillo	*Oxybelis aeneus*	vine snake
coral	*Micrurus nigrocinctus*	coral snake
<u>lizards</u>		
iguana	*Iguana iguana*	common iguana
garrobo/iguana negra	*Ctenosaura similis*	ctnenosaur
lagartija	*Norops polylepis*	anolis lizard
basilica		Jesus Christ lizard
<u>frogs and toads</u>		
rana calzonuda	*Agalychnis callidryas*	gaudy leaf frog
ranita roja	*Dendrobates granuliferus*	red poison arrow frog
ranita negro y verde	*Dendrobates auratus*	black and green dart frog
martillito	*Eleutherodactylus diastema*	tink frog
sapo	*Bufo haematiticus*	toad
sapo grande	*Bufo marinus*	
caimán	*Caiman crocodilus*	spectacled caiman

Birds

raptors		
zopilote negro	*Coragyps atratus*	black vulture
zopilote cabecirrojo	*Cathartes aura*	
gavilán cangrejero	*Buteogallus anthracinus*	common black hawk
shorebirds		
fregata	*Fregata magnificens*	magnificent frigatebird
pelicano	*Pelecanus occidentalis*	brown pelican
garza pechi-castaña	*Agamia agami*	chestnut-bellied heron
	Porphyrula martinica	purple gallinule
cirujano	*Jacana spinosa*	northern jacana
cristo fue		great kiskadee
forest birds		
lapa verde	*Ara ambigua*	great green macaw
tucanillo	*Pteroglossus*	colored aracari
	Ramphastos swainsonii	chestnut-mandibled toucan

Insects

chicharra	*Fidicina mannifera*	cicada
coloradillas	*Eutrombicula spp.*	chiggers
purrujas	*Culicoides spp.*	no see ums
zancudos	*Haemagogus spp.*	mosquitos
cucaracha	*Blaberus giganteus*	cockroach
avispita del higo	*Blastophaga spp.*	fig wasp
juan palo	*Calynda bicuspis*	walking stick
saltamonte oroverde	*Drymophilacris bimaculata*	green and gold grasshopper
esperanza	*Orophus conspersus*	bush katydid
gallito azul	*Megaloprepus coerulatus*	helicopter damselfly
mosca de café	*Simulium spp.*	black fly
reduvio	*Apiomerus pictipes*	assassin bug
libelula		dragonfly
coeloptera (bettles)		
rueda caca	*Dichotomius carolinus colonicus*	dung beetle
arlequín	*Acrocinus longimanus*	harlequin beetle
cornizuelo	*Megasoma elephas*	rhinoceros beetle
abejón tigre	*Pseudoxychila tarsalis*	tiger beetle
ants		
zompopas	*Atta cephalotes*	leaf-cutters
hormiga arriera	*Eciton burchelli*	army ants
bala	*Paraponera clavata*	bullet ant
hormiga del cornizuelo	*Pseudomyrmex ferruginea*	acacia ants
hormiga azteca	*Azteca spp.*	cecropia ants
comején	*Nasutitermes spp.*	termites
butterflies		
celeste común	*Morpho peleides*	morpho butterfly
lechera/papilio grande	*Papilio cresphontes*	giant swallowtail

Pacuare Reserve Species Lists - Plants

Beach

coco	*Cocos nucifera*	cononut palm
icaco		
uva de playa		beach grape
majagua		beach hibiscus
pudre oreja	*Ipomoea pes-caprae*	beach morning glory
	Canavalia maritima	

Mangrove

rojo	*Rhizophora mangle*	red mangrove
negro	*Avicennia germinans*	black mangrove
blanco	*Laguncularia racemosa*	white mangrove
mangle botón	*Conocarpus erecta*	buttonwood
helecho mangle	*Acrosticum aureum*	mangrove fern

Rainforest

<u>trees</u>

baco o mastate	*Brosimum utile*	milk tree
indio desnudo	*Bursera simaruba*	naked indian
arból de panama		
cerito	*Casearia corymbosa*	
ceiba	*Ceiba pentandra*	kapok tree
higo	*Ficus cotinifolia*	fig
guyaba de mono		monkey guava
yolillo	*Raffia*	
palma caminadora	*Socratea durisima*	walking palm

<u>understory</u>

lotería	*Dieffenbachia spp.*	dumb cane
helecho lengua	*Elaphoglossum spp.*	paddle fern
platanillo	*Heliconia latispatha*	wild plantain
licopodio	*Lycopodium spp.*	club moss
granadilla del monte	*Passiflora vitifolia*	passionflower
candela	*Piper spp.*	pepper
helechos	*Pteridophytes spp.*	ferns
guarumo	*Cecropia spp.*	cecropia
carludovica	Cyclantacea	panama hat palm
		spiral ginger
lianas		vines

<u>epiphytes</u>

piñuelas	*Bromeliads spp.*	bromeliads
filodendron		filodendron
orquídeas	Orchidaceae	orchids
semana santa	*Encyclia cordigera*	easter orchid
bandera española	*Epidendrum radicans*	

Vocabulary of an Ecologist

Habitat _____

_____

Community _____

_____

Ecosystem _____

_____

Biodiversity _____

_____

Biotic _____

_____

Abiotic _____

_____

Anthropogenic _____

_____

Food web _____

_____

Species _____

_____

Omnivore _____

_____

Hypothesis _____

_____

Ecological Communities

The interface of the marine and terrestrial ecosystems at the Pacuare Reserve result in a wide diversity of species and community types here. Use the space provided on the following pages, make notes and draw pictures of the biotic and abiotic features of these communities. How are they interrelated?

Intertidal

Beach

Rainforest

Lagoon

Species Account

Date/Time: _____ Location: _____

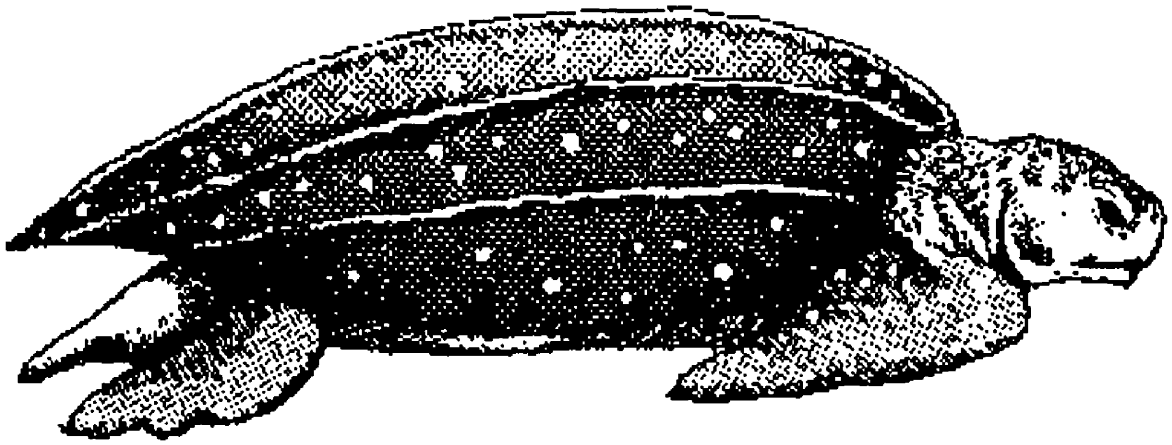
Species name: _____(common)

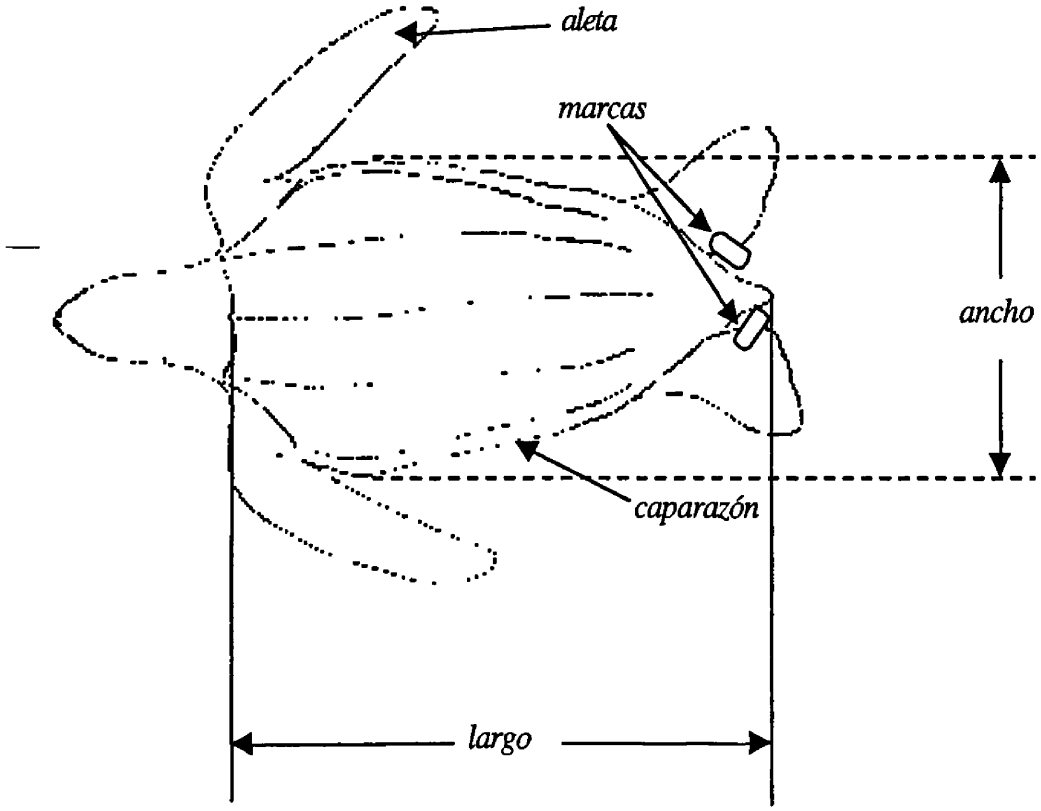
_____(scientific)

Habitat: _____

Description (include sketch and labels):

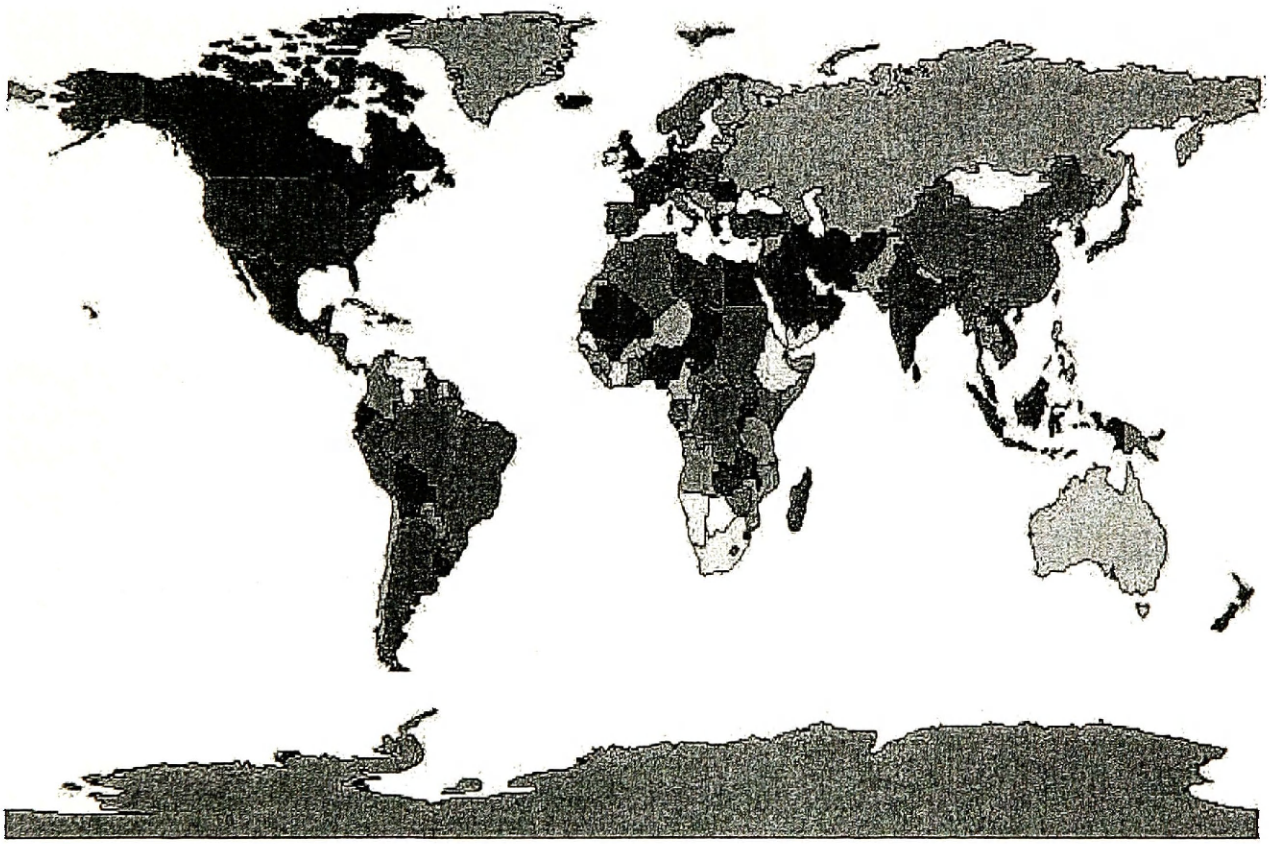
Notes




aleta
marcas
ancho
caparazón
largo

Turtles of the World - Range

Where are these sea turtle species found?
Use this map to illustrate the range of each of the species described on the previous pages.



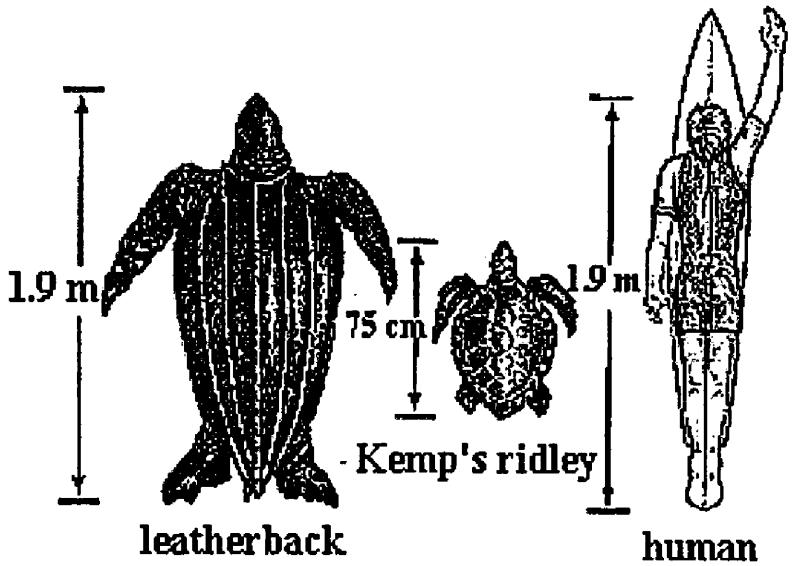
Which species are found in Costa Rica?

1. _____
2. _____
3. _____
4. _____
5. _____

At the Pacuare Reserve?

1. _____
2. _____
3. _____

Turtles of the World - Sizes



The leatherback is the largest of all sea turtle species -- the Kemp's ridley is the smallest. Leatherbacks can weigh up to 500 kg and the largest ever found was more than two meters long! This picture shows the variation in the size of the different turtle species and compares them to the size of a person.

Turtles of Costa Rica- Identification

Leatherback soft carapace with 5 ridges or crests; no scutes or plates

- carapace pointed on the posterior end
- carapace surface soft, like leather, flexible
- dark gray or black, with white or pale spots
- mandible with deep grooves
- up to 500 kg, carapace length up to 200 cm

All others hard carapace without continuous crests; with large scutes or plates

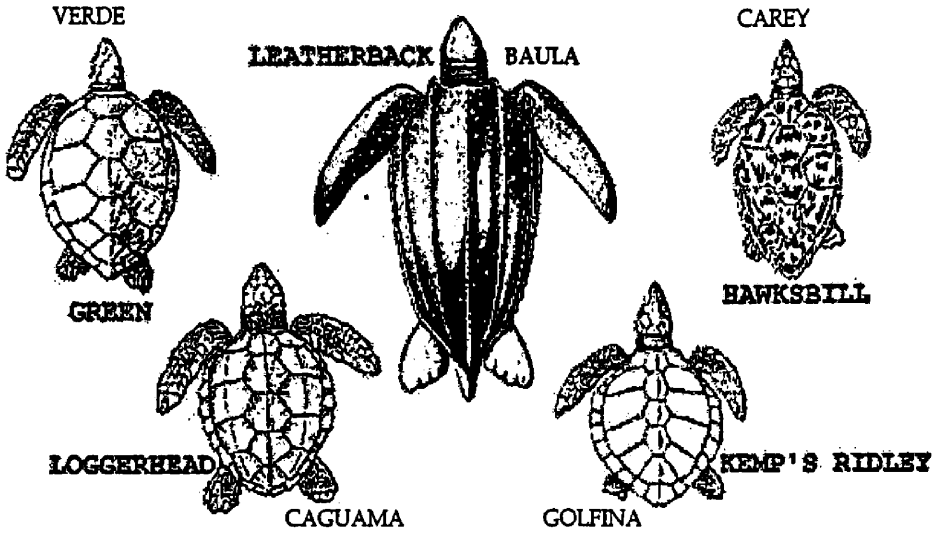
Green 4 pairs of lateral scutes
- scutes not overlapping
- round head, with a serrated mandible
- coloration: variable in juveniles, dark green fat in adults
- up to 230 kg, carapace length up to 125 cm
- 1 pair of prefrontal scales

Hawksbill 4 pairs of lateral scutes
- carapace scutes overlap
- pointed head, with a protruding upper mandible
- coloration: variable in juveniles, orange, chestnut brown, yellow or black in adults
- up to 85 kg, carapace length up to 95 cm
- 2 pairs of prefrontal scales

Loggerhead 5 pairs (occasionally 6 pairs) of lateral scutes
- carapace wider than long
- 3 scutes over the spine, without pores
- wide head (up to 25 cm)
- color chestnut - reddish to chestnut brown
- up to 200 kg, carapace length up to 120 cm

Olive ridley 6 or more pairs of lateral scutes (sometimes asymmetrical)
- carapace is almost circular
- 4 scutes over the spine, with pores
- very rare north of 13°N
- coloration: gray in juveniles, dark green fat in adults
- up to 45 kg, carapace length up to 70 cm

Turtles of the World - Species



Leatherback (*Dermochelys coriacea*)

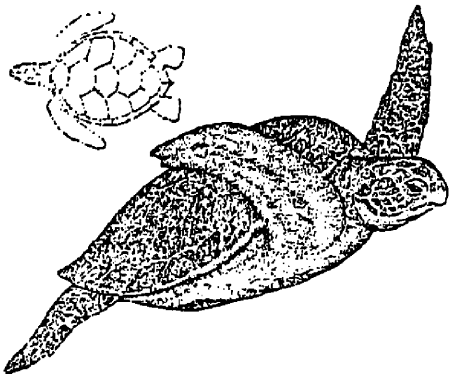
Etymology: the only sea turtle without a hard shell and with delicate jaws; its shell is made of a thin layer of tough, rubbery skin
Diet: soft-bodied animals, primarily jellyfish
Habitat: open ocean; the only reptile known to be active at temperatures below 40°F
Range: worldwide, from Alaska to southern Africa

Green turtle (*Chelonia mydas mydas*)

Etymology: named for the green color of fat under its shell; the shell can be black, gray or brown
Diet: adults are strictly herbivorous, they eat mostly sea grass and algae
Habitat: primarily near coastlines and around islands
Range: all temperate and tropical waters

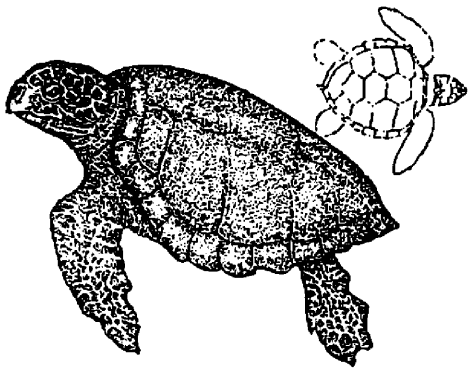
Black turtle (*Chelonia mydas agassizi*)

Etymology: named for color of the shell; the shell can be black, gray or brown
Diet: adults are strictly herbivorous, they eat mostly sea grass and algae
Habitat: bays and protected shores; rarely observed in the open ocean
Range: along the west coasts of the Americas, from Baja California to Peru



Hawksbill (*Eretmochelys imbricata*)
Etymology: has a narrow head and large beak
Diet: sponges, anemones, squid and shrimp; feed in crevices
Habitat: typically around coastal reefs, rocky areas, estuaries and lagoons
Range: tropical and subtropical Atlantic, Pacific and Indian Oceans

Loggerhead (*Caretta caretta*)
Etymology: named because of its exceptionally large head
Diet: carnivorous; feed mostly on shellfish (horseshoe crabs, clams, mussels, other invertebrates) at the bottom of the ocean
Habitat: prefer to feed close to mainland shores, especially coastal bays and estuaries and the shallow water along the continental shelves
Range: temperate and subtropical waters worldwide

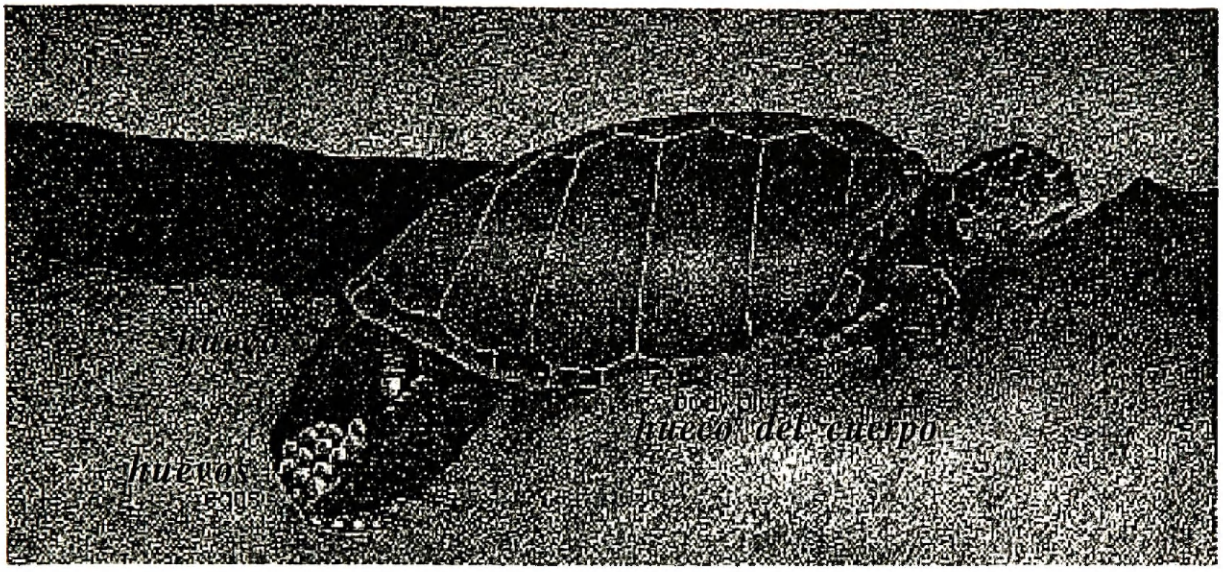


Olive ridley (*Lepidochelys olivacea*)
Etymology: olive green in color
Diet: carnivorous; shellfish, fish, sea urchins, squid and jellyfish
Habitat: typically forage off shore in surface waters or to depths of 150 m
Range: tropical Pacific, Indian and Atlantic Oceans

Kemp's ridley (*Lepidochelys kempii*)
Etymology: named after Richard Kemp, who helped discover and study this turtle
Diet: carnivorous; shellfish, fish, sea urchins, squid and jellyfish
Habitat: prefer shallow areas with sandy and muddy bottoms
Range: tropical and temperate costs of NW Atlantic, primarily Gulf of Mexico

Australian flatback (*Natator depressa*)
Etymology: very flat shell
Diet: sea cucumbers, jellyfish, mollusks, prawns, bryozoans, seaweed
Habitat: prefer turbid inshore waters and bays
Range: coastal waters of northwestern, northern and northeastern Australia; not beyond Australia's continental shelf

Sea Turtle Nesting Behavior

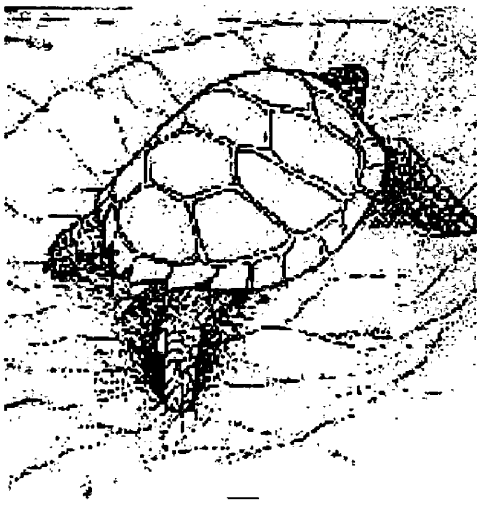


Arrival

- most females return to the same beach each time they are ready to nest, a few weeks to a few months after mating
- only females nest, and most often at night and during high tide
- when she arrives on shore, the female turtle pauses frequently while crawling to her nesting site
- a "false crawl" occurs occasionally, when the female turtle leaves the ocean but for some reason decides not to nest
- females of most species nest at least twice during the nesting season
- leatherbacks nest every 2 to 3 years, laying 6 to 9 egg clutches in a season

Nest Construction

- the female turtle crawls to a dry part of the beach and begins to fling away loose sand with her flippers
- she then constructs a "body pit" by digging with her front flippers and rotating her body
- the turtle then digs an egg cavity using her cupped rear flippers as shovels
- the egg cavity is shaped roughly like a tear drop and is usually tilted slightly



Laying and Burying the Eggs

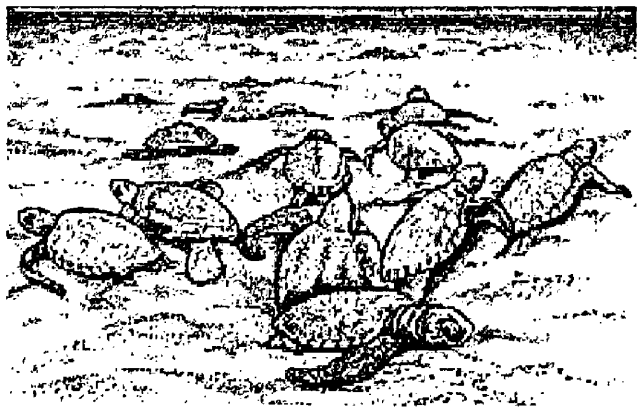
- once the egg chamber is complete, the turtle begins to lay eggs
- she lays two or three soft-shelled, flexible eggs at a time
- mucus is secreted throughout the process
- the average clutch size for leatherbacks is 80 fertile and 30 infertile eggs
- using her rear flippers, the turtle then covers the egg cavity with sand
- with her front flippers, the turtle refills the body pit and disguises the nest by throwing sand in all directions
- the turtle then crawls back to the sea, never returning to tend the nest

Incubation

- time varies by species, clutch size and the temperature and humidity in the nest
- hotter sand typically speeds up the development of the embryos
- cooler sand typically produces more male tortugitas
- leatherback eggs incubate for approximately 65 days

Emerging from the nest

- hatchlings first break through their shell with their "caruncle", a temporary egg-tooth
- digging out of the nest can take several days
- hatchlings usually emerge at night or during a rainstorm when temperatures are cooler
- all the turtles erupt from the cavity as a group and hurry towards the brightest horizon
- dehydration and predation are immediate threats to their survival
- in the water, they float and feed in surface seaweed, called "sargasso weed"
- only about 1 in 1,000 turtle eggs actually survive to adulthood



Notes

Threats to Sea Turtle Survival

Sea turtles face many threats to survival. These threats are both natural and human-caused.

Natural

predators
- eggs/hatchlings
  - coatis
  - shorebirds
  - racoons
  - crabs
- adults
  - large sharks
  - killer whales
  - crocodiles

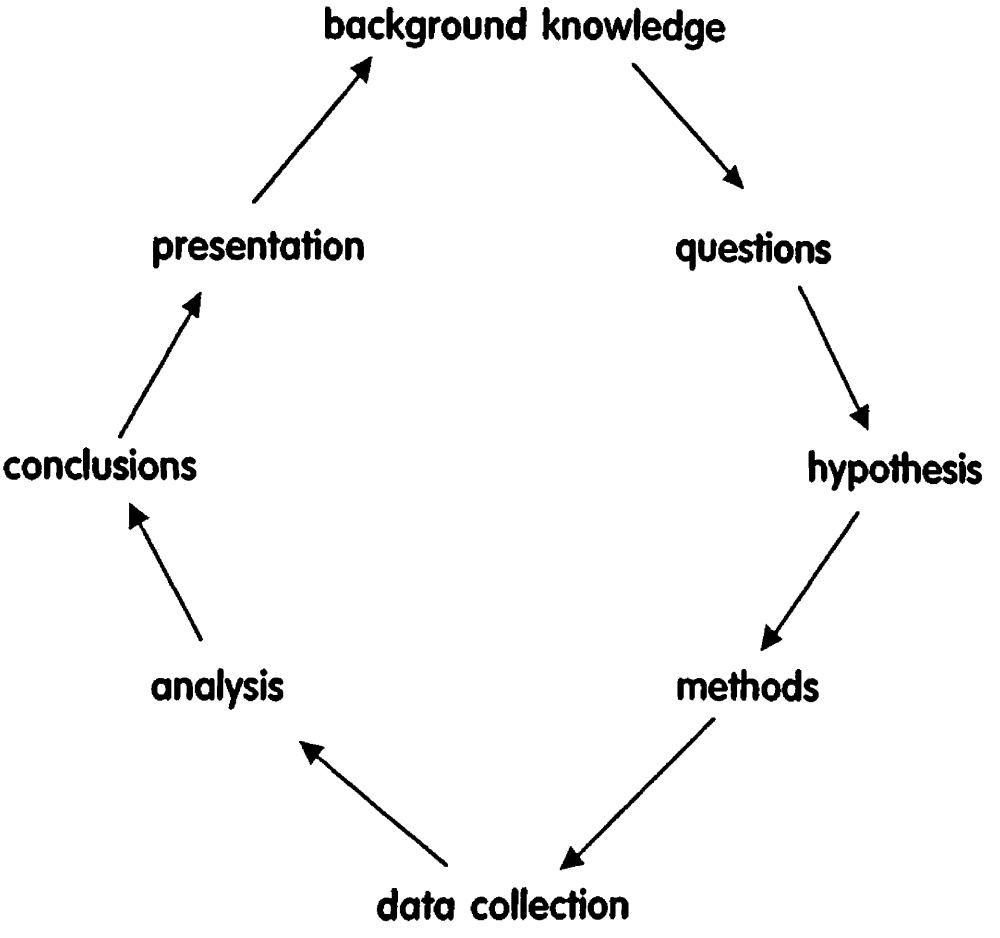
nesting success

Anthropogenic

indirect
- commercial fishing (by-catch)
- ingestion of debris and plastic
- pollution
- coastal armoring
- artificial lighting
- beach nourishment

direct
- consumption of turtle meat and eggs
- turtle products (jewelry, souvenirs)

Scientific Method



Expert Group: _____

Tasks:

Questions:

Hypotheses/Rationale:

Turtle Patrol Data Sheet

Día: _____ Hora: _____ Zona: _____

Notas:

salida falsa?

	izquierda	*derecha*	Tortuga	
marca #			tamaño	
Huevos/Nido	*fértiles*	*años*	*largo*	
número			*ancho*	
peso			zona	
peso promedio			*distancia del mar*	
profundidad del nido			*la inclinación de la playa*	

—

Día: _____ Hora: _____ Zona: _____

Notas:

salida falsa?

	izquierda	*derecha*	Tortuga	
marca #			tamaño	
Huevos/Nido	*fértiles*	*años*	*largo*	
número			*ancho*	
peso			zona	
peso promedio			*distancia del mar*	
profundidad del nido			*la inclinación de la playa*	

Turtle Patrol Data Sheet

Día: _____ Hora: _____ Zona:_____

Notas:

salida falsa?

izquierda	derecha	Tortuga	
marca #			tamaño
Huevos/Nido	*fértiles*	*vanos*	*largo*
número			*ancho*
peso			zona
peso promedio			*distancia del mar*
profundidad del nido			*la inclinación de la playa*

Día: _____ Hora: _____ Zona:_____

Notas:

salida falsa?

izquierda	derecha	Tortuga	
marca #			tamaño
Huevos/Nido	*fértiles*	*vanos*	*largo*
número			*ancho*
peso			zona
peso promedio			*distancia del mar*
profundidad del nido			*la inclinación de la playa*

Turtle Patrol Data Sheet

Día: _____ Hora: _____ Zona: _____

Notas:

salida falsa?

	izquierda	*derecha*	**Tortuga**	
marca #			tamaño	
Huevos/Nido	*fértiles*	*vanos*	*largo*	
número			*ancho*	
peso			zona	
peso promedio			*distancia del mar*	
profundidad del nido			*la inclinación de la playa*	

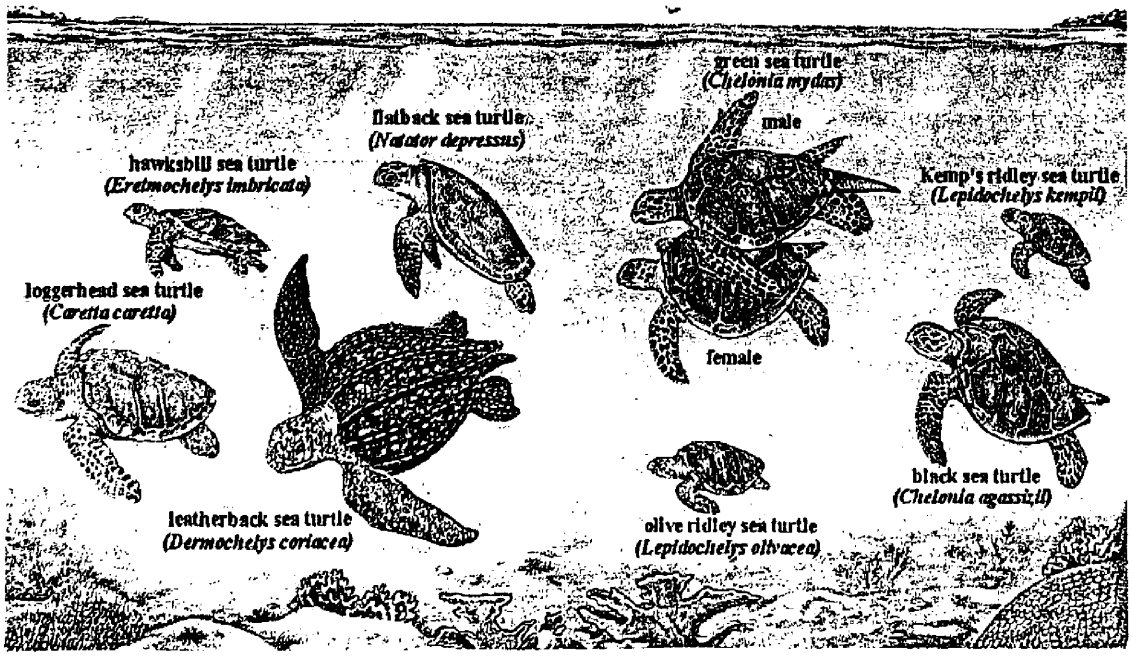
Día: _____ Hora: _____ Zona: _____

Notas:

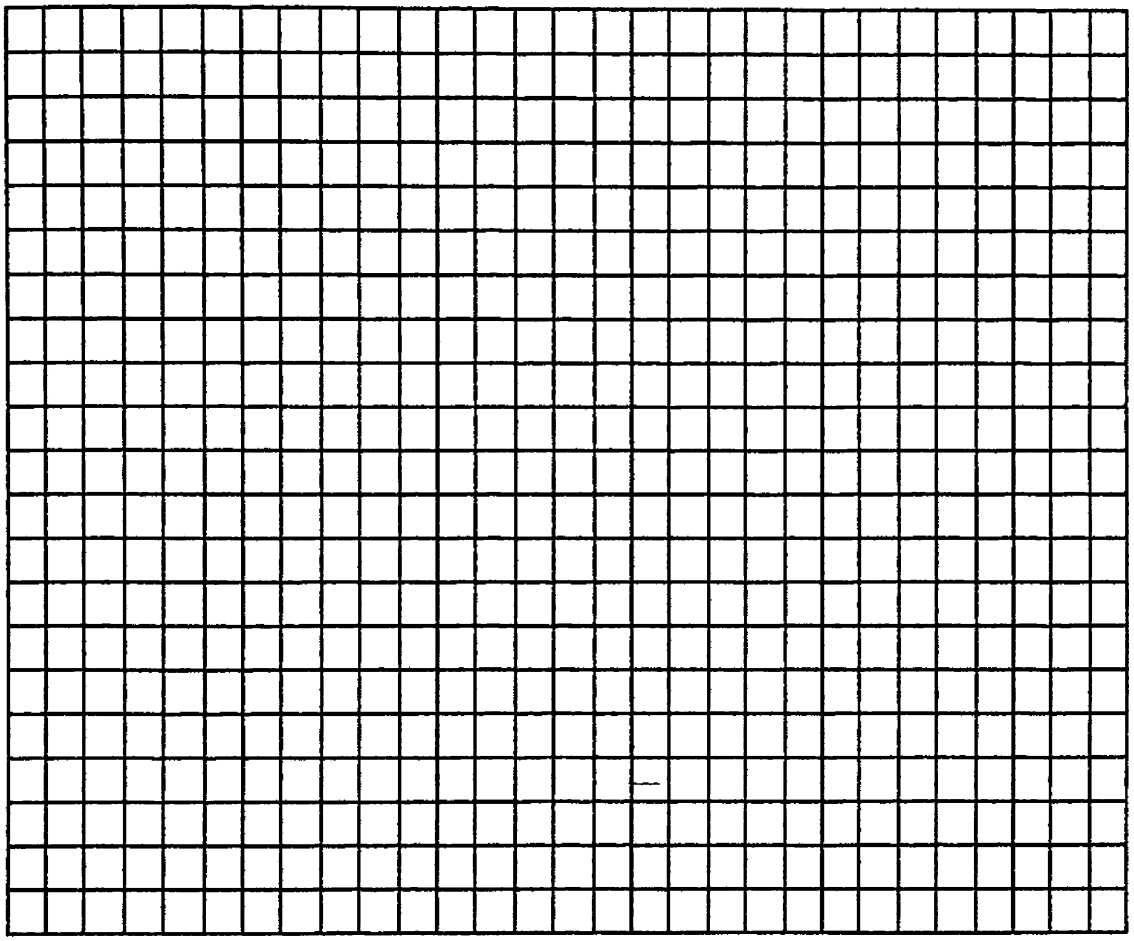
salida falsa?

	izquierda	*derecha*	**Tortuga**	
marca #			tamaño	
Huevos/Nido	*fértiles*	*vanos*	*largo*	
número			*ancho*	
peso			zona	
peso promedio			*distancia del mar*	
profundidad del nido			*la inclinación de la playa*	

Turtle Research Graph



Turtle Research Graph



Sea Turtle Research Presentation

I. Statement of research question

II. Statement of hypothesis and rationale

III. Summary of equipment and methods

IV. Presentation of results

Explain the chart of results, including its title and labels.

V. Interpretation and discussion of results

(a) Identify and explain any patterns observed.

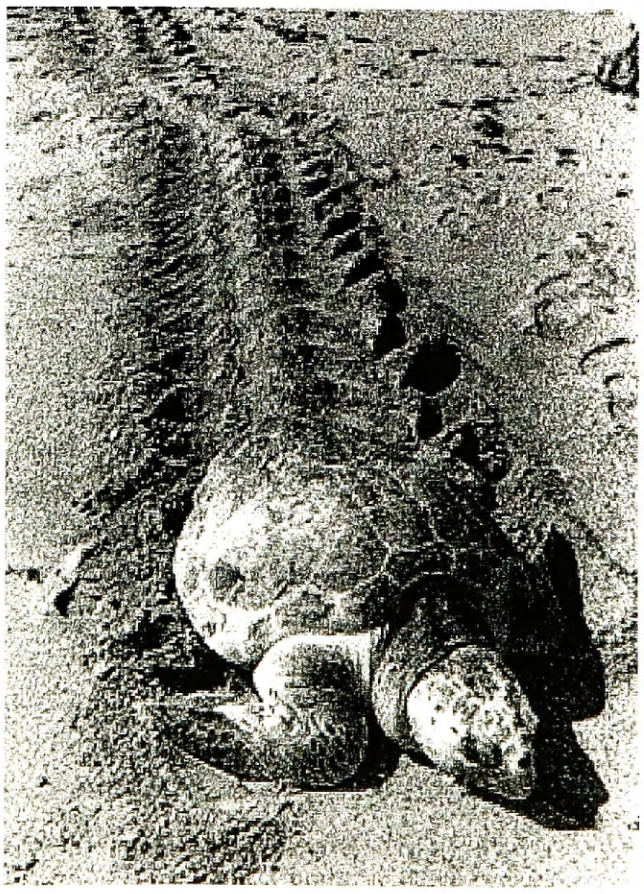
(b) Was the hypothesis supported or not? If not, why might you have gotten the results you did?

(c) Describe what you would do if you could study this research question more in the future.

(d) Describe any significant problems or major errors that might have influenced your results.

VI. Conclusions -- what have you learned?

VII. Questions for the future



Journal Entry

Day 1: Arrival at the Pacuare Nature Reserve

Date: _____

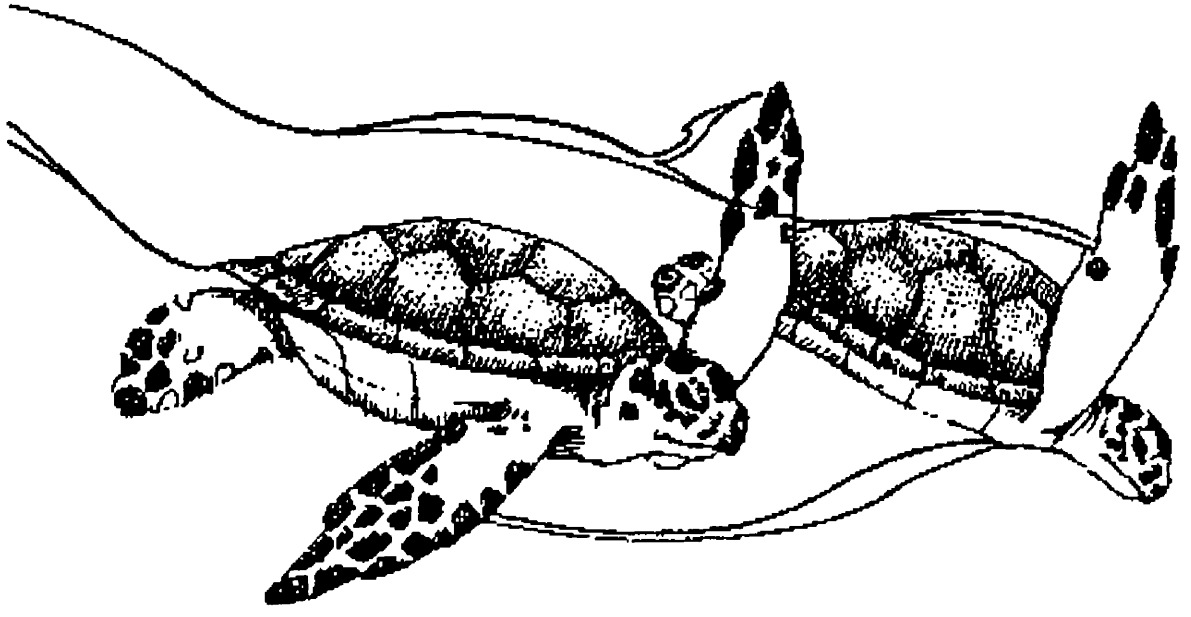
Pretend you're on the bus ride home from the reserve after three days here. Describe two things that you will have learned and/or experienced while at the reserve.

Journal Entry

Day 2: Research at the Pacuare Nature Reserve

Date: _____

What did you find most interesting about turtle patrolling? What did you like and not like about the research? What are you going to do differently on tonight's patrol?

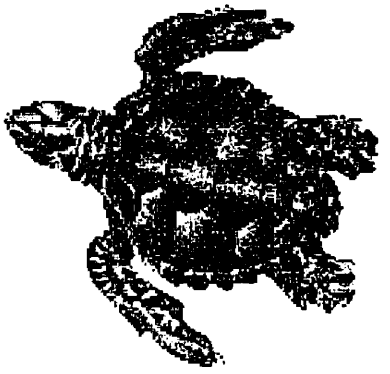


Journal Entry

Day 3: Last day at the Pacuare Nature Reserve

Date: _____

What do you think about sea turtle conservation? How has being at the reserve affected you?



Research Tools

Ruler

Sea turtle spanish/english vocabulary

beach	*playa*
carapace	*caparazón*
eggs	*huevos*
false crawl	*salida falsa*
flipper	*aleta*
hatchlings	*tortugitas*
lay eggs	*poner huevos*
leatherback	*baula*
nest	*nido*
ocean/sea	*mar*
patrol	*patrullaje*
poacher	*huevero*
sand	*arena*
sea turtle	*tortuga marina*
tag	*marca*
tracks	*huellas*

Horario

	Day 1	Day 2	Day 3
Morning		*Breakfast* Debrief first patrol Sea turtle ecology	*Breakfast* Compile and analyze data Presentations
Afternoon	*Arrival* Names and games Goals, Expectations Research Intro	*Lunch* Communities and coastal ecology excursion	*Departure*
Evening	*Dinner* Patrol groups Expert group mtgs	*Dinner* Art project Expert group mtgs	
Night	Turtle patrols	Turtle patrols	

Turtle Patrol Briefing

Preparation:

- Every group should have a flashlight with red plastic covering
- Wear dark clothing (no yellows or whites)
- Wear long pants and a long sleeved shirt
- Wear shoes, comfortable for walking
- Bring a rain jacket, water and insect repellent

Patrolling:

Safety first!

- stay together in your patrol group
- do not run
- always stay with your patrol "buddy"
- watch out for debris such as sticks and tree trunks on the beach

When you find a turtle...

- stay back initially and follow the directions of the Reserve Ranger
- always approach turtles from behind, never head on
- be patient! the nesting process can be lengthy
- do not take flash photos
- the best time to get a close look at a turtle is when it's returning to the surf

Turtle Patrol Checklist

dark clothes
rain jacket
day pack
flashlight
water bottle
insect repellent
watch/timer
journal
pencil

Tag 57710 returned June 13, 1994

Dear S.C. Montonquillo

This letter is in regard to my recent encountering of a sea turtle that your center had tagged.

I saw the turtle on the East (Atlantic) Coast of Panamá, in the province of Bocas del Toro, about two miles south of border between Costa Rica & Panama.

This took place on May 28th of this year. ~~They~~ The tag that I'm sending came from the left "aft fin". There is a tag still remaining on the right side.

My name & address follows:

Jeff Kennedy
1493-D Del Rio Cir.
Concord CA 94518
Phone (#510) 671-7462

Sincerely,
Jeff K

Viva Panama

RCD. 6/18/94 ACK.
TAGGED
BOOK ~~LOG~~ ~~LOG~~
MAP COMPUTER ✓
CHECK # 1630
~~COMP. ID #~~

UNIVERSITY OF FLORIDA
ARCHIE CARR CENTER FOR SEA TURTLE RESEARCH
223 BARTRAM HALL
GAINESVILLE, FL 32611

TELEPHONE 904 392-5194
FAX 904 392-9166

March 28, 1995

Mr. Jeff Kennedy
1493-D Del Rio Circle
Concord, CA 94518

Dear Mr. Kennedy,

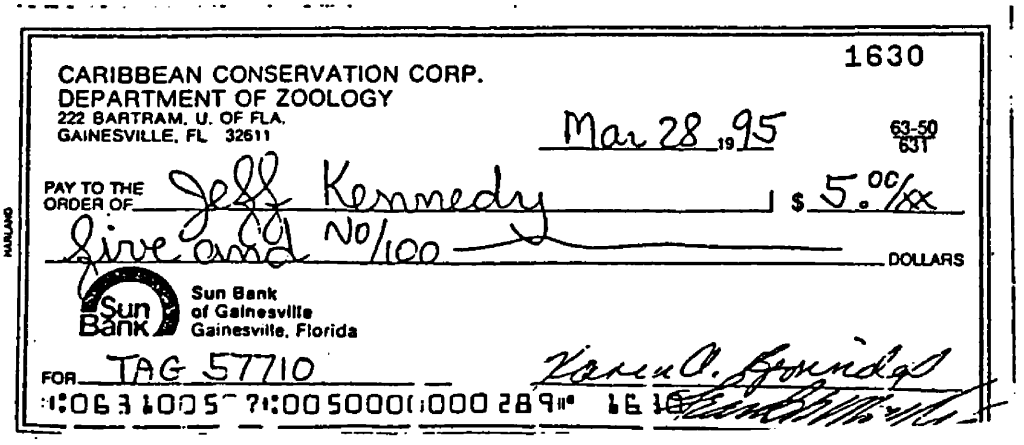
Thank you very much for sending us the tag #57710. Turtles are tagged in this manner in order to study their ecology and migrations, and it is with the cooperation of people such as yourself that knowledge of these turtles is growing. This turtle was tagged as she came up to lay eggs at Mondonguillo Beach on the Atlantic coast of Costa Rica, during the summer of 1994. However, we would like to know how this turtle was captured, what it was doing, and if the turtle was killed.

Please send this information to:
Center for Sea Turtle Research
309 Carr Hall
Dept. of Zoology
University of Florida
Gainesville, FL 32611 USA

I am enclosing our usual reward of $5.00 for sending in each tag with information.

Thank you again for the tag, and we hope to hear from you soon with the requested information.

Sincerely,
Peter Ehrazar
FCR Karen Bjorndal, Director


CARIBBEAN CONSERVATION CORP.
DEPARTMENT OF ZOOLOGY
222 BARTRAM, U. OF FLA.
GAINESVILLE, FL 32611

1630

Mar 28 1995

63-50
631

PAY TO THE ORDER OF Jeff Kennedy $ 5.00xx

Five and No/100 DOLLARS

Sun Bank of Gainesville Gainesville, Florida

FOR TAG 57710

Karen A. Bjorndal

:063100571:00500001000289" 16

PHOTOS IN ENVELOPE

May 15th 1995

Dear Sir/Mom,

In Regard to the turtle that had the #5771C tag which I had sent to you. This is the information which you requested.

This turtle was in the process of laying eggs. when we came upon it to take pictures. We had seen that there were tags on each side of the "back fins" and that they were the same #. We removed one before the turtle returned to the sea that morning.

As I stated in my first letter, this took place South of the Sixaola River on the Atlantic coast of Panama. on May 28th of 1994.

Sincerely, Jeff Kennedy

Jeffrey A. Kennedy

P.S

We did not know the gentleman in the photo, and as you probably ~~guessed~~ guessed; he was there to steal the eggs. He agreed to let us take pictures after the turtle had started laying the eggs. We were appalled by the "different" poachers down the beach who were slaughtering the turtles for the meat. We saw no means of stopping any of this!!

UNIVERSITY OF FLORIDA
ARCHIE CARR CENTER FOR SEA TURTLE RESEARCH
223 BARTRAM HALL
GAINESVILLE, FL 32611

TELEPHONE 904 392-5194
FAX 904 392-9166

June 5, 1995

Mr. Jeff Kennedy
1493-D Del Rio Circle
Concord, CA 94518

Dear Mr. Kennedy,

Thank you very much for sending us the requested information on tag #57710. It is nice to hear she was laying eggs and was able to return to the sea. However, as you mentioned, egg poaching is a terrible problem. We, meaning turtle researchers in general, are constantly pressing countries with this problem to not only declare egg harvesting illegal, but also to back it up with patrols on the heavily utilized nesting beaches. Obviously further pressure is needed here.

Thank you again for kindly answering my letter. Getting complete recapture data greatly helps us in our research. Please write us again if you chance upon any more of our tags.

Sincerely,

Karen Bjorndal, Director

Viva

Tags not returned

Mi Nombre: Aden MORALES Chinchilla

Reporto el Desobede tortuga

Lugar

Limon COSTARICA

25 Kilometros despues de limon centro carretera

A SIXAOLA sobre laplaya

Inicio del desobe 11:05 pm

FINAL del desobe 11:30 pm

Fecha: 13-3-97

CANTIDAD de Huevos 175 unidades

"REGRESO AL MAR- ilesa"

(4 falsos o pequeños)

NUMERACION de tortuga

EN AMBAS ALETAS

60460

60461

Montenegro 1994

Direccion:

Guapiles Costa Rica

Del Universidad CARIT

400 metros Norte calle a piso Auch

KATICOLOR

Translation of Letter #4

My name: Adam Morales Chinchilla
Reporting the nesting of a sea turtle.
Place: Limon, Costa Rica
25 kilometers past the center of Limon on the highway towards Sixaola [south of Puerto Limon] on the beach

Began laying eggs: 11:05pm
Finished laying eggs: 11:30pm
Date: 3/3/97
Number of eggs: 75; and 4 small eggs

It returned unharmed to the sea

Numbers on the turtle's flipper tags:
60460
60461

Address:
San Jose, Costa Rica
From the Matervida Highway
400 meters north Paso Ancho Street
KATICOLOR

ANTONIO PIÑEIRO SEAGE
ASESORIA ECONOMICO-FISCAL
Rosalía de Castro-9, 1º
Teléfono 86 02 87
15920 RIANXO (A Coruña)

9-5-95

ECONOMISTA
Col. n.º C-560

ECONOMISTA ASESOR FISCAL
N.º E. A. F. 758

AUDITOR DE CONTAS
N.º R. O. A. C. 08286

NOVO ENDEREZO
C Rosalía de Castro, 9 1º
(Frente Polideportivo Municipal)
Teléfono 86 02 87
Fax 86 62 79
RIANXO

DEPT. BIOLOGY
University of GAINISVILLE
FLORIDA (USA)

¡Estimados Srs.! Quiero comunicarles la aparición aquí, ayer día 8 de mayo, de un ejemplar grande y adulto de tortuga laúd (Dermochelys coriacea). Apareció flotando en el mar muerta, ya debía llevar varios días muerta ya que tenía desgastes en la piel y aletas, y en algún sitio le faltaba algo de piel; aparentemente ~~no tenía~~ ninguna extremidad rota y no puedo decir la causa de la muerte.

Medidas principales:
longitud total 211 cm.
longitud total caparazón 156 cm.
longitud aleta pectoral 86cm. (desde la punta hasta el codo).

Tenía dos anillas con los siguientes números 60597 y 60598

Esperando sus noticias y que nos comuniquen los datos del anillamiento, aprovechamos para saludarles atentamente.

Fdo.: Antonio Piñeiro Seage

SOCIEDADE GALEGA DE HISTORIA NATURAL
Apartado 330
SANTIAGO DE COMPOSTELA (España)

P.S. Lugar de aparición: Rianxo, Ría de Arousa, Galicia en el noroeste de España.

May 29, 1997

Adan Morales Chinchilla
Paso Ancho Norte
de la Maternidad
Carit 400 M Norte
Calle a Paso Aucho
Katicolor
San Jose, Costa Rica

Dear Sr. Chinchilla,

Thank you very much for sending us the information on the turtle bearing tags 60460 and 60461. Turtles are tagged in this manner in order to study their ecology and migrations, and it is with the cooperation of people such as yourself that knowledge of these turtles is growing. This turtle was tagged as she came up to lay eggs on the beach at Tortuguero, Costa Rica in 1994.

I regret to inform you that we are unable to provide a reward for tags returned from within Costa Rica, the site of the original tagging. To do so would encourage people to interfere with the turtles when they are laying eggs on the beach. I've enclosed a few postcards and a pamphlet as a token of our appreciation for your help with this project.

Thank you again for this information which greatly helps our research project.

Sincerely,

Karen Bjorndal, Director

Jiva
Parismina

Tag 60493 returned
Mondonguillo

May 26th

Dear sir:

I found this tag on a leatherback turtle who nested on the beach by Costa Parismina, Rica on May 17th 1994. Hope this helps w/ your research. If you could send me information on what research you are doing etc. I would be interested

I'm living on Costa Rica, but will be returning to the U.S. in July therefore my address to send info is:

Laura Stivers
9524 47th St W
Tacoma WA 98466

Thanks,
Laura

COMP. ID #_____
RCD._____ ACK._____
TAGGED_____
BOOK_____ LOG_____ LOG_✓_
MAP_____ COMPUTER_✓_
NO CHECK

UNIVERSITY OF FLORIDA
ARCHIE CARR CENTER FOR SEA TURTLE RESEARCH
223 BARTRAM HALL
GAINESVILLE, FL 32611

TELEPHONE 904 392-5194
FAX 904 392-9166

March 12, 1996

Antonio Pineiro Seage
Sociedade Galega de Historia Natural
Apartado 330
Santiago de Compostela, ESPANA

Dear Sr. Seage:

Thank you very much for sending us the information on the turtle bearing tags #60597 and 60598. I apologize for the long delay in writing. Turtles are tagged in this manner in order to study their ecology and migrations, and it is with the cooperation of people and organizations such as yours that knowledge of these turtles is growing. This leatherback turtle was tagged as she came up to lay eggs on a beach in Costa Rica during the 1994 nesting season.

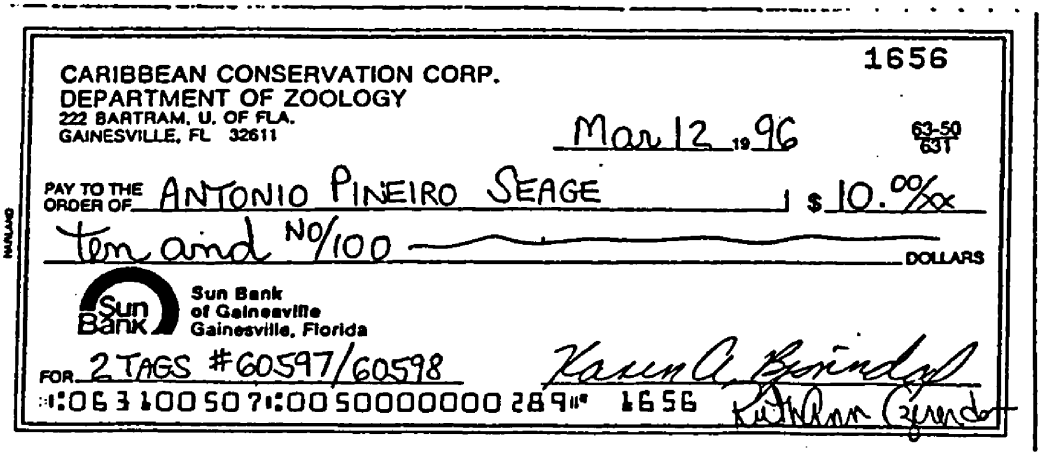
Enclosed is a check for $10.00, our usual reward for two tag returns with information. I am sending your letter on to our collaborators who actually tagged this turtle.

They and I thank you again for sending us the information.

Sincerely,

Karen Bjorndal

Karen Bjorndal, Director



UNIVERSITY OF FLORIDA
ARCHIE CARR CENTER FOR SEA TURTLE RESEARCH
223 BARTRAM HALL
GAINESVILLE, FL 32611

TELEPHONE 904 392-5194
FAX 904 392-9166

March 28, 1995

Ms. Laura Stivers
9524 47th St. W.
Tacoma, WA 98466

Dear Ms. Stivers:

Thank you very much for sending us the information on the turtle bearing tag # 60493, and I apologize for the long delay in writing. Turtles are tagged in this manner in order to study their ecology and migrations, and it is with the cooperation of people such as yourself that knowledge of these turtles is growing. This leatherback turtle was tagged as she came up to lay eggs at Mondonguillo Beach, on the Atlantic coast of Costa Rica, during the summer of 1994.

I regret to inform you that we are unable to provide a reward for tags returned from within Costa Rica, the site of their original tagging. To do so would encourage people to interfere with the turtles when they are laying eggs on the beach. I've enclosed a few postcards and a pamphlet as a token of our appreciation for your help with this project.

Thank you again for this information.

Sincerely,

Karen Bjorndal, Director

Anthony E. Smith, PhD
HC 61, Box 29A • Franklin, WV • 26807
TEL/FAX 304/358-3330 • E-MAIL 412-7116@MCIMAIL.COM

Tag 60574 returned

Mondonguillo 1994

October 27, 1997

Biology Department
University of Florida
Gainesville, FL

Re: Turtle tag #60574

Dear Sirs and Mmes:

While we were on holiday at Waves, NC (along the Outer Banks) in early June of this year, we came upon a large sea turtle that had apparently run foul of some large propellor. We discovered the turtle washed up on the shore on June 5th. We found a tag with your address, and took pictures. Both are enclosed. Please excuse the delay in forwarding these to you.

We would be most interested in learning about this turtle -- when and where it was tagged, and what the likely path it took in its travels. The tag mentions a reward, and we would be interested in that as well. Of course, we would also appreciate learning about your research and monitoring program.

Thank you in advance for keeping us informed. We hope the enclosed tag and pictures help with your research to understand and preserve this unique species.

Sincerely yours,

Celia Reid & Anthony Smith

Anthony E. Smith and Celia J. Reid

encl.

P.S. The turtle measured approximately 3' long from beak to tail.

RCD. 11/10/97 ACK. 11/18/97
TAGGED TORT 96
TEAM CCC
NOTIFIED 11/26/97
Q+A ✓
CK # 1716

CARIBBEAN CONSERVATION CORPORATION

January 5, 1998

Anthony E. Smith
Celia J. Reid
HC 61, Box 29A
Franklin, WV 26807

Dear Colleagues:

We recently received a copy of your correspondence dated 27 October 1997 to the University of Florida. Thank you very much for returning the tags from the stranded leatherback turtle and the information you provided about its (unfortunate) destination. Our organization funds the rewards paid for our own and various other turtle tagging projects. We have learned a great deal over the years about turtle migration destinations and the impacts hunting and other threats are having on sea turtle populations from these tagging programs. We have been conducting tagging programs ourselves on Caribbean green turtles for over 40 years, and in 1995, we instituted a new, ongoing leatherback program at our Costa Rican field station at Tortuguero.

The leatherback that you found had been tagged at Mondonguillo beach, Costa Rica in 1994, when she crawled up on the beach to dig a nest and lay her eggs. I will send on the information you provided to the leaders of the tagging project at Mondonguillo and see if they have additional information on the turtle's post-nesting movements. If they do, I will gladly provide it to you. Beach protection efforts at Mondonguillo are quite good so hopefully some of your poor turtle's progeny survived to replace her.

We are in communication with many leatherback tagging projects in Colombia, Panama, Costa Rica, and Honduras and one thing that our studies are confirming, collectively, is the highly migratory nature of leatherbacks. Unlike green turtles which apparently return only to their natal beach to nest and nest nowhere else, leatherbacks use various beaches for nesting, even within the course of a single nesting season. At our own project in Tortuguero, we commonly encounter leatherbacks that were tagged some two or more weeks earlier on another Costa Rican or Panamanian beach. After nesting season, leatherbacks generally head northward, and may get well up into the north Atlantic before dropping water temperatures in the fall force them southward. One of the leatherbacks we tagged in Costa Rica was caught in a fishing net off the coast of Spain two years ago.

4424 N.W. 13th St., Suite A-1, Gainesville, FL 32609 (352) 373-6441 Fax: (352) 375-2449 ccc@cccturtle.org
Apartado Postal 246-2050, San Pedro, Costa Rica (506) 224-92-15 Fax: (506) 225-75-16 baulas@sol.racsa.co.cr
http://www.cccturtle.org

Translation of Letter #5

Antonio Piñeiro Seage
Economic & Fiscal Consulting
Rosalia de Castro – 9, 1st
Telephone 86 02 87
15920 Rianxo (A Coruña) May 9, 1995\

Economist
Economic Consultant
Account Auditor

Dear Sirs:

I wish to inform you of the appearance here, yesterday May 8, of a large adult leatherback (*Dermochelys coriacea*) sea turtle. It was found floating, dead, in the sea. It seems to have been dead for a few days, because areas on its skin were rubbed off or missing; apparently it did not have any broken extremities, and I could not determine the cause of death.

Principal measurements:
Total length: 211cm
Length of carapace: 156 cm
Length of pectoral flipper: 86 cm (from the end to the joint)

It had two tags with the following numbers 60597 and 60598

I await news from you and hope you let us know when it was tagged.

Sincerely,

Antonio Piñeiro Seage
SOCIEDADE GALEGA DE HISTORIA NATURAL
Box 330
SANTIAGO DE COMPOSTELA (Spain)

P.S. Place where the turtle was found: Rianxo, Ría de Arousa, Galicia, in northeast Spain.

APPENDIX III

INTERVIEW TRANSCRIPTS

INTERVIEWS WITH GUARDS AT PACUARE RESERVE
Transcribed November 8 & 10, 2000

Miguel Madrigal

INTRO
(Well,) My name is Miguel Madrigal. I've worked at the Reserve, first I was here for two years at the Reserve, then, I transferred to National Parks, afterwards I was here another season with the Reserve, and this year -- 2000 -- I've returned again to the Reserve.

POACHERS
(1:49) Well, the poachers, that's a problem that has always existed here. From the beginning of the Reserve, from the time I've worked, we've had that problem with the "hueveros," that they've always tried to plunder the beach, the turtle's nests. And we'll always try, even though it's very difficult, I hope. All of us who are interested in conservation, we hope to someday control that. It's very hard.

BOATS
The boats, we've observed one boat that always passes, but that's s big problem because they're very fast and we don't have a vehicle that's fast and we have to walk, and by the time we get there, the hueveros have left.

EGGS
Human beings don't need turtle meat to survive, some people think that eating their eggs they can have children if they're sterile, they can have children, or they feel stronger, but I think that's a dumb theory. (3 8:08) but, in reality, no no, I've never read that the eggs have more, are more nutritious than the food we use every day. I think that's a way that harms the animals, the turtles

CONSCIOUSNESS
I consider that man is the most dangerous because in spite of having a consciousness, man doesn't use it, the animals acts unconsciously to survive, yet man...yes, it's a very big problem, (5:21) the hueveros, a very big problem.

DREAM
Well, I almost dream, desire that some day, we could have, we could definitely control this, because it's the most serious thing we have.

LOCAL STUDENTS
And I have like a lot the form in which they have brought students here, local students, they attain consciousness, so that each consciousness can transmit to others, the experiences they've had, because you were able to listen to the students who came from Matila. Matila is a place that has a lot of hueveros, and you could hear a person that has never known a turtle, with all the years with the turtle projects, well, they're unconscious as far as that's concerned. Now, I think, that with this experience they've had, I hope

that, they transmit to others, and perhaps it will come to the ear of those that are unconscious, and perhaps feel somewhat ashamed. (6:25). Perhaps a father, already grown, that hasn't taught his children, the manner to conserve, knowing that what's left on the planet is little; we've destroyed too much and now we should, on the one hand, cooperate, avoid harm. We should ... stop it... in time.

TOMORROWS BIOLOGISTS

This experience is very good. I consider that all these young people, who are going to be the conservationists of the future, the biologists of tomorrow, I think it's a good experience. And it's a good way, mainly for the locals, it's good that they come from all places, from all the countries, it's very pretty, that way there's interchange of cultures, but, well, it's a thing that we should feel embarrassment, to know that other people from other countries come to conserve what we have and don't want, we don't want to conserve.

NO RIGHT/NATURES

What's more, I don't think anyone has the right to give away a turtle egg because they don't belong to anyone. It's Nature. And if Nature or the turtle could talk, (3 17:30) she would say, "No." Definitely, I think that. Better yet, I think she would say, 'Hey, aren't you tired of harming me so much, it's better if you left me in peace. Look for another path and another way for you to eat eggs.'" Like that.

OBLIGATIONS

Yes, from one point of view I see it as very good and yes, I have faith that it will result in a good affect in some future because, well, it's only the obligation of the Reserve, and yet, it's the, it with conservation. I think that we all have the obligation, we should all feel obligated, because we all live under this planet, beneath this sky, and we all step on this earth that we need to love, our Mother, Nature; I think we all have the obligation to fight, to conserve, and yes, it's a very good program; that's how I see it, that it's very good and it's going to have very good effects in the future, yes. Of course. I think it's going to have a lot of results. A lot.

STORY/NOT MY EGGS

(3 15:07) Here, one time I had a discussion with a man. He asked me, "Do you take care of the Reserve?" I said, "Yes, sir."

He said, "Can you give me permission to go sack a nest to get some eggs?"

I told him, "I can't give you permission because they're not mine."

"But can they give me permission at the Reserve?"

"No, because it's not theirs either. They belong to the turtles. Ask the turtles and see if they'll give them to you. If they could talk, they'd say, No. And since I believe they'll say, No, then I can't give you permission because no one is owner of those eggs. They belong to them.

He tells me, "It's that, everything that is on the earth is for humans (hombres) to eat."

I told him, "That's your idea, to eat it."

FASHION

(3 21:22) Just like every year there's fashions, different fashions, well, very simple, that there be a fashion of Conservation and I think that it's very beneficial. Instead of modern music, or, a music is discovered or is in fashion, or such a way of dressing, I think the best fashion for the future is Conservation. That everyone be in fashion in Conservation. It'd be a benefit for everyone. And I think we'd have more years on this planet which we have almost destroyed. Yes, that's my way of thinking, naturally. Do you have a question?

José Gerardo Zúñiga

My name is José Gerardo Zúñiga. I live in San José. In Guadalupe, and I'm here at the Reserve working with turtles. I suppose you looked for me because of the experience I have. I have worked with turtles for eleven years. I'm an accountant by profession, but I don't work in accounting.

Question
For eleven years. Working with turtles? No. I've worked with turtles since 1989 in a very small project, about 12 miles, that'd be about...18 kilometers, towards the South in a very small port. There were about 4 or 5 turtles. We [usually means "I"] came back in 1990, here 12 miles from here, and in Dec. of 90 we went to Playa Grande. The season in Playa Grande is different from here. Over there it's in December. November, December, January, and February.

So then, in 91, I worked with the Ministry of Natural Resources, and then we began to work here in the Reserve and at Guanacasta (?). It's only been ... the last two years, I've gone to Guanacasta. I need to go because it's very pretty there, that area, but other than that, I've always worked at both places. Half a year here, then the end of the year at Guanacasta.

Question: What did you do before you worked here....
I have little experience with the poachers. I don't like that. I don't like to work pursuing people. They asked me if I'd come work as a guard, and I said, no. I was very sorry. To work with the turtles, yes. With poachers, no. I don't like to be a guard. With poachers, the only experience I have is to try to make them aware [bring consciousness to them!] of the importance of conserving the turtles, but that's all. I never, never, ... that is, I've never liked to work against people.

Comments, questions

Well, first, I try to make him give me the eggs by talking to him. And if he doesn't want to, no, I don't take them away. If I can take them by talking, I take them, if not, then I don't. Say, for instance, here, I call the guards. They can take charge of the poachers.

Question: Why do most of the poachers want to take eggs?
Most of the time it's people without work, and they're looking for an easy way, they take the eggs to go buy drugs. It's the easiest way they have; they don't look for work or anything; they think it's easy to come steal the turtles' eggs. And they don't think about the harm they're doing. They do it to maintain their addiction. Most of the time that's what it is. Or to be honest -- all the time. It's very hard for a poacher to earn a living by poaching eggs. That's a lie.

Question: Wondering if you could tell us about what you like about working with the turtles ...

Oh, that's hard! The answer is difficult, but I don't know, since the first day I met them, that is, I had never known such large animals. The land ones are very little. And they caught my interest, and each time, I went but the answer is, yes, very difficult. I love them! And the day I go to the beach and don't see a turtle, I come back somewhat disheartened, I feel tired. On the other hand, when I see a turtle, I'm so happy. I don't know.

Comment: He can't really say...
Question.

Oh, you want to know my age, don't you? Laughter.

No, no, no, no, no problem. It was in '89. I was 44 years old when I began to work with turtles. I didn't know they existed. That is, I didn't know them. Land turtles, yes, but not marine turtles.

Add eleven to 44, and you'll know how old I am. My birthday is soon, in a couple of weeks.

Question: The difference working with the Tico students...
Yes. That is, I don't know whose idea it was to bring this group of students from Matina; whoever it was, I congratulate him, because we had never done this before. Here at the Reserve. And I thought it was a wonderful [pretty] experience. Very good. They left very motivated. And if there's something we need to do, it's to raise consciousness here in the area [the zone] because they are the future poachers. Perhaps not them, because they're students, and they have a higher standard of living. I liked that experience a lot; I had never had one like that. In spite of the fact that I've worked with kids that age, since I worked for a long time with the Scouts, and I worked with boys from 15-18 years of age, but they were from San José, they weren't from the area. This experience was very wonderful. I like it a lot.

Comments.
Excuse me. There is somewhat of a difference between the kids that came last time, and this group, because they're from San José. Because the ones from San José leave, and perhaps one of them will remember the turtles, yet all the kids from the zone were very very interested. The turtles are more important to them. _____ To the house _____ and they haven't noticed.

Comments. What impact...
[he doesn't understand the question.]

I hope so. I hope it'll be positive. That it have a very good effect. Up until now, I've seen the kids very interested. And I would love it if people, especially from this zone, continue to come. Not necessarily from San José, but from here. There's a lot of places close by that we still need to bring, and I hope they can continue to do so. It's wonderful.

Is it programmed for the long run, the program with the students, or is it only for now? Is this the only time, or are they going to continue the program? Do you understand? [Entendés -- the Central American -- vos]

Comments. They want to and next year they hope they'll be more!

Yes, but from the zone: from Limón, Matina, Batan, _____ that is where the poachers live. It could be the uncles, or what do I know, of those boys, that are poachers. So then, we want for them to make those men aware so they don't come here anymore to steal eggs. It would be very good, because the people from San José buy them, but it's a lie they come to steal them, they only buy them. That would be to solve the problem at its root. Hopefully they could bring the little ones from school, hopefully they'd be young students, little ones, not grown already, not so old. It would be a lot better. Although it would be very hard to work with them at a beach.

Comments. Do you have any questions for him?
Do you have anything else to say about the Reserve....

But like what, more or less, ... as far as I'm concerned, what John is doing here, I congratulate him. That is, it's not any person who invests in land to conserve. In reality, in Costa Rica, there's very little of that, what they do is only, _____ as far as John, I congratulate him, for what he does, that's the only reason I like him. For what he does. But the, no, no, the question covers a great deal, I don't know how to explain...I love the Reserve here. If you ask me where I'd like to stay, here or San José, I'd stay here. Because in San José it's only cement and cars, up and down, and not here, here it's very tranquil, if not for the poachers who come to bother, but here, it's so tranquil, so pretty.

Comments.
Thank you.

Alfonso is the head of the guards.

Question.

I don't like it, they're very attached to their work. They love it. To pursue people, and I don't like it. First of all, I admire the poachers. I say it sincerely, I admire them. They're very courageous. Barefooted, without shoes. When they see us, they run into the jungle. Two years ago, a young man took off running when he saw us, someone with a "foco" [shot? light?] stopped and a hollow formed here in the sole of his foot and it almost came out at the top, it traversed like this, we helped him, a young man that was with me and I did help him [first aid, cured]. We pitied him. He was pitiful. But I admire them. They take off running and go in there, through the trail, and shots flying and they keep running. It's very dangerous in there at night. There's a lot of serpents. At night it's dangerous to go along those trails. During the day, it's not, no, not dangerous, but at night it is. And one knows that courage is necessary to do that. To run into the jungle, full of mosquitoes, I don't understand how they do it, and I don't

understand how they think, perhaps they like danger, to be pursued, sincerely, I don't understand why they do it. And they don't understand that if they continue they're going to extinguish the turtles. Before they know it, there won't be anymore turtles. And we're going to ruin, part of Nature, which is very wise. They don't understand that. Unfortunately, they're people without any education, without any preparation

comments:

Are you going to talk to her too?

INTERVIEWS WITH STUDENTS AT PACUARE RESERVE
Transcribed November 8 & 10, 2000

Lincoln Group One
CR 1 tape log

28:00 Closing circle group 1/Lincoln school

Girl (Janina?)
It was a wonderful experience, thinking I didn't know anything about turtles before, now I go away with a lot of knowledge and a lot of questions also because I started with some questions and ended up with some more questions. It was a wonderful experience, actually, I want to thank you guys, thank you very much for this, and I know it was tiring also. I mean you talk about these things and talk about scientific information in books and you see all these discoveries and you never think about the whole process behind all this. It's so much hard work and like, uh, consistency, because you have to do this every night—you have to go out, and you get tired, but you have to go again and so I know it was like a complete experience in all the sense of the word, not only because we gathered so much information, but because we learned stuff that's completely different from science because you learn things about life also these type of things. So I think it was a wonderful experience.

29;26

Girl 2 (dark green shirt): It's very different to experience it, rather than to read it.

Holly: The reality of getting all that information into books. Reading it is easy.

Havier: I agree with Janina because we came here and we got some of the practical side of all this—not only the being in classes and theoretical and studying, but you actually have hands on work, right, and you realize that how to collect the data, how to manage it, how to interpret it. It's nice to work with something which is real. It's not imaginary—you have the real thing. I learned a lot—a lot, but there still is a lot I don't know. It's nice to realize that there is a problem and to be part of the solution. I'm glad I came, I really am, it's nice to be here.

31:13
Girl 3 (dark blue tank top): It was a very different experience, I think it was eye-opening for most of us because most of us came here thinking it was such a romantic thing to do. 'Oh we're going to go save the little turtles, going to get the eggs. Once we were there to get the eggs, it wasn't as romantic as we thought.

Julie: being on the backside of a turtle

G3: ...having it throw sand at you...

Other: ..Hitting and knocking you over

G3:..It was really hard, but it was incredible to have that turtle right there and have it. I don't know...such a big animal. It's very hard to see animals like that. We go into the jungle and take a five hour walk and you wont see an animal, then there's a huge animal which is really rare and almost no one sees it and you are actually touching it and tagging it and measuring it and...

32:24
Janina: ..And actually seeing such an important part of human nature, because breeding is the most important thing we have in the world. Last night we were commenting that last night wow this would be so weird having so many people around you when you're giving birth.

Holly: wait a minute, you've never given birth, you do have a lot of people giving birth, let me tell you.

Janina...it must be uncomfortable, but it's actually one of the most beautiful parts of life so it was a beautiful experience.

33;02
Boy1 (glasses, white T-shirt, dark hair): The part that I loved the most was when we saw the turtles going back to the sea again because then we knew that we were 'saving' her eggs and maybe have the opportunity to see one of her eggs to come back again to the beach so it's very nice, very exciting.

33;27
Leo: I found that this is extremely direct, it was really hands on. I enjoyed working on the field very natural, lack of light, electrical lighting. It all contributes to the fact of nature.

33:58
Monica (green T-shirt): I think that the whole project is very interesting and very important. I hope that the project doesn't interfere with the natural cycle of the turtles and no one is watching us so they can go get the eggs, because that is what is quite a problem. I think it is quite nice.

34:30
G4 (blue tank top): First I was very excited you know coming here and looking at the turtle and when we were walking during the first night it was like 'oh my god, maybe they're not coming out tonight, maybe we're not going to be able to look at them', then all of a sudden it's so different to see them come out of the water and be able to work with them. I mean it's a total different experience then you see in class. So I like it very much, but then after the first turtle I was tired and I didn't want them to really come out again. And I just can't imagine what scientists like you, being here every day, going out each night, and doing this I mean it's like really important. I don't know who said that it

was different reading it in the book—it's really different. When you are walking out there at 1 in the morning you wish you were really with a book only. No, but I liked it very much. Congratulations.

35;46
B2 (white T-shirt, dark hair): When you're at night and you're alone, well not alone, and you see nothing—Michael and I had pretty much time to think about everything 'what are we doing here'. We are soaking wet and everything, but it's nice because you are at least trying to make something out of an opportunity, something that's going to help the ecosystem, the turtles and we can actually try to make a study, something that will actually help control and keep track of what's damaging turtles, what can help them make improve or whatever. I think it's sometimes controversial that if you put your, stick your hand in you are effecting the ecosystem but actually you do it with the best intentions. So, it's nice to take an important role in something that's for the benefit of nature and everything. But, although it's hard and it's wet and tiring, it's very satisfactory for us, when we end our job, it's very nice.

37;37
B3 (tall guy, no shirt): I really liked being with the turtles. They are really impressive, like all the time I saw one I was so impressed. They are so big and huge and strong and been here for millions of years. But I also thought about the same thing about getting in the way with things, like I don't know. The turtle's here and maybe seeing that everybody is surrounding her and taking her eggs and I don't know if we are effecting her are we really going to make a difference. But I really liked the fieldwork. It was nice.

38;18
B4 (no shirt, shaved head): I also liked it a lot, but I like the fact that if you're gonna come here, you're really gonna have to work . It's not good to come here and just start complaining about everything. So if you're gonna come here realize you are going to work, hard.

38;44
B5 (glasses, white T-shirt, blonde): I really didn't know the process like how much data or what like biologists did before I just thought they were tagging them and seeing tem when they came and when they left. I never knew there was so much data that could be collected and how it could be applied in so many ways. So I just find that interesting that this place can gather so much. I saw how many, like 12 turtles in these two days, I was just impressed at how it's like this every night, how much can be here in a week and how much can be around the world. So now I'm more aware of the process that biologists are taking and their efforts.

40;00
Pilar (teacher): Well I think it was a very great experience for all the students to work with all of you. That they have come out from a totally artificial environment that is the school where you are telling them about the possible things they can learn in this country and from this country. And they have had the opportunity to come here to see the possibilities that the country is offering them to care for it. And that it was a great experience for them as well to work with all of you that they have learned a lot.

40:58
B2...communicate to other people that we have a national and international duty to like you were saying, this is our country and we have to care for it while we have. But also we need people working here we need people working in Chile, wherever, and people working all over the world so we actually do something big for the entire population of turtles, not just okay, we have what a six km beach here that's taking care of but it's a very small part of the turtle's route, turtles life, so somehow need to get more people going, yeah more involved with the organization.

CR9 group 1 continued

00;00
Janina; I know if I was to mention with you like you only really know what you lose until you lose it, right? You only know what you have until you lose it. Maybe people that live in Spain or places like that where they see their ecosystems are disappearing or being destroyed, but we still have all these beautiful things all around us. Maybe we take them for granted. I know I think there should be more awareness in the Ticos in the Costa Ricans to see if we can actually make this even though it's a very small place, it's so rich in so many things. So I think it would be very important for Ticos to be around here.

00;42
Havier: One thing which Scott and I were talking about was how that the students which come here or the people which come here can learn from this place and ;learn to appreciate this and not only keep it for ourselves, but also try to spread this attitude among, try to let others know that this is something very valuable and something which we have to care for and appreciate, and value, right, because it is very valuable. So if we have an attitude of trying to spread this kind of, or try to let others know that we have this and it's important and valuable and beautiful, I mean, it would be a good attitude for us to take.

01;37
Julie: If I can share from my experience, you guys are all guinea pigs for us, so we didn't know...we planned a very busy schedule for you and we didn't know how it was going to be received, but it was great to see how much stamina you have, what hard workers you are, how mature you are. You really handled the situation very well. I know you were out here in a vacation area, basically, where most people would just want to be in the ocean but you had school the whole time. It was also really fun for me to see the difference between the two nights of patrolling, I know it's difficult to go two night without sleep, but the change between the first night and the second night was very impressive—everybody knew exactly what they were doing. You looked like scientists.

02;22
G3: Once you got to know the turtles it was different. For example with the first turtle Belinda told us to 'stand in front of her so you can stop her' No way! You think they'll bite me or something. But then, when you got to know them and you see that they are very gentle animals and they wouldn't harm you in any way it was really different because you could touch them and really take good care of them.

02;51
Scott: I'm psyched. You guys learned a lot these two days. You've only been here two nights and it's incredible to see this much information, how much better it got between the first and the second night and to hear you guys talk about how much you learned—I'm impressed. And we pushed you guys, for sure. We put a schedule together that we knew you guys could (couldn't?) keep up with and you did. To me it was incredible.

Havier: We're pretty impressed, at least I'm pretty impressed with you guys too, your work here, it's good.

Janina: I mean were here two days now were hoping to get to our houses and sleep some and you guys are here and you're going to stay here I don't know how much time. People have been here for months and they still go out at night, that's incredible and it's an attitude that I hope I can have in the future.

Girl (out of view G2 I think): It's just amazing how you get excited with every turtle. We saw the first one and we didn't even know what to do, we forgot that we needed to weigh the eggs we were so impressed with it. The second one was like 'oh how nice, but I want to sleep'. Day after day after day and you do something its just amazing.

Lincoln Group 2
CR27

04;46 Group 4 closing circle
Guillermo (green shirt, braces): I don't know, it was really nice and interesting, and I liked it. I had never seen a live turtle and now I saw it and it was really nice and the fact of seeing how they laid the eggs, and then seeing the little turtle that we found. I think that makes us see the importance of it not just in a textbook, so now I don't know it has like more meaning and so it was very nice.

05;20
Boy (no shirt, glasses on head): I learned a lot. I really wasn't very interested at first but then I liked it. I liked the turtles, I liked working with them on the beach. I want to thank you all for teaching us this and maybe we'll see you later.

05;43
Leslie/American teacher (white shirt, gray hair): I think the most rewarding was the care that people have for these turtles. All of us, but also the guides, the security people, the instructors. Everybody has a real love and the way they treat them is they're important, and they're cared for and I love to see that. I just think that's—it was an honor for us to be here and I appreciate it and thank you all, but for me that was tops.

06;17
G1 (white tank top, blonde): I had a great time here and I think it was a great opportunity for us. I want to thank you for inviting us and also for the really good job with the turtles.

06;31
G2 (glasses, blue tank,): This was an excellent experience for me and I really enjoyed meeting with the turtles and working in groups and with the staff. I really learned a lot. Thank you.

06;56
G3 (dark curly hair, glasses): I agree with Guillermo that the best thing about the trip was to see what we learned in textbooks out in real life. What I liked most was the patrols working with the turtles assisting the birth.

07;15
G4 (blue plaid shirt): I think I also learned a lot. This is a unique experience. I would love to do it again. I think it gives us a more overview because by helping each turtle laying the eggs and seeing them hatch we know that we are changing the world and we are helping save this species. So it is a very important job and its very fun and it's much better than being in school and reading from it and thank you for giving us the time and opportunity to be here.

07;59
Marco (green/white T-shirt) : I enjoyed living the experience instead of reading it as someone said before it's always nice, but seeing the eggs come out—you always see them in videos on the Discovery Channel—grabbing them. The little turtle just holding it, I saw that everybody was excited. Chino came running with the little turtle. I mean did you see how people appreciate it and the significance when we come that close to nature. Last night there was a, we stayed a while waiting for a turtle to come back into the sea and we came up to here with the turtle you could see it like that going into the water that was nice just seeing it go away. A nice experience. Something you will remember for quite a while.

8;43
G5 (orange tank top): I also loved the experience. I also think that it's a unique one. Yesterday I was very excited because I was able to touch the eggs, finally. Same as Marco, seeing the little turtle I've never seen one. I loved working with all of you as a group and I think I would like to come next year. Thanks a lot.

9;15
G6 (dark shirt, headphones around neck): What I really liked most of all was the fact that we were actually out there we actually got to like touch the turtles and the eggs and we didn't just have to see them from far away we were actually right next to them touching them and helping them and everything. And like Marco said we were able to go yesterday into the water with one of the turtles and I really liked that because it is where the turtle was most comfortable and where it really belongs and everything and I really liked that we were able to do that with it. And I am really grateful to have been given the opportunity to be able to come here and I want to thank everyone.

10;00
Chino (no shirt, Asian): I had a really good time, I felt like I was in a Discovery Channel program...

Scott: Maybe you will be

Chino: I've never walked so much but it was worth it. Thanks a lot.

10;15
Boy (orange shirt) As everyone, I liked it and I got to realize that it's a really tough job being a biologist. You have the books and take for granted that the information is there, but you never get to think about the hard work everyone's doing to gather the information.

10;40
Boy (blue/gray T-shirt): I liked it. It was hard work but it was worth it. I learned a lot especially because I didn't know anything about turtles before. It was a good experience.

10;52
Boy (white shirt, backward cap): It's an excellent opportunity to be here. I enjoyed a lot working with the turtles because they are amazing animals. They are so big. I really liked it a lot so I hope that I can come back sometime.

11;10
Boy (purple shirt): So many hot days, very long nights. I was slapped by a turtle, no electricity. It was definitely an experience you don't live every day. I really enjoyed it although it was very tiring, it was very fun.

11;25
Boy (dreadlocks): I really enjoyed being here. It was really nice working with such big animals, you never see them only on TV. And I'd like to think that we helped some and maybe in a few years they will come back and lay their eggs. It was nice and thank you all.

11;47
Girl (gray T-shirt): It was a great experience and when we are here we love nature even more and thank you for inviting us.

12;01
Boy (white T-shirt); good experience and it]'s repeated and everyone should do it at least once because it really raises your awareness about the plight of these animals and of animals in general. It gets you very optimistic because you realize that there is so much destruction there is much pollution that there is some people that care that take the time to actually try to correct things. I would like to thank you all for that.

12;32
Teacher (glasses, blue shirt): I felt that when the turtle was there it was like a religious experience—something more spiritual than actually a material thing. The moment I really enjoyed the most was when the little turtle hit the sea. I hope she makes it back.

13;13
Scott: Well thanks you guys. One of my thoughts before you came, one of my goals was not only to teach you guys some science and to get you interested and everything but also just to see if high school guys like you could come pout and collect the data. And all these groups—there have been four groups that have come –and you guys have done a fabulous job. I think even the reserve staff ahs been impressed. They've been asking questions about what you're doing about how you are taking measurements and every morning we've had the data on the board and then confirmed it with tag reports and it's like you guys are right on. To me it's like it's really impressive. Because a lot of people are thinking 'oh they're just high school students what can they do', you know? And it's

like no, you can do it. And now we've got these numbers that say yes, they can do it. And it's nice also just to see your guys enthusiasm about being with these creatures and the care that's really great, it's important. A lot of people think these days they kind of forget how to care and they forget what is going on around them. They kind of focus in on their lives, their cars, their electricity, and it's nice to take you away from that and really see you caring about what's happening and putting your heart into the work. So thank you. For me it's inspiring.

Julie: Yeah, I was very inspired by all of you. It was great to see so many people so enthusiastic. We did a lot of walking and so few turtles, but when those turtles came up everybody was really focused and worked together impressively well. And to be at a vacation spot like this and not get to go swimming in the ocean and have to go to class all day long and no sleep at night you guys did fantastic. I was so impressed. Thanks to you guys for getting me up after only two hours of sleep last night for another rainforest walk. It was great to see so much enthusiasm. I hope to see you next year back here.

15;30
Inez: Well I'll thank you everybody for coming and helping us with the turtles. And I hope you've learned that conservation is not easy work. You know people here are working very hard, not just two days, all season, every night on the beach and well you are the future of this country so I am very happy to have you here learning to respect nature and thank you for coming.

Matina Group One Closing Circle Comments

Group 2 begins at about 2hrs 15min on VHS 2
Translations are in chronological order, and descriptions are based on what they are wearing, if they were a teacher or student. In a couple cases, I could remember the name

Suhey Tucker Colphan - GIRL1, Jo? (white tube top)
I learned that now its very important to take care of the turtles. Because like the Baulas that are endangered of extinction. That the process the turtles has is very interesting, when it lays eggs, the trajectory that it has. What I don't like are the mosquitoes. The walks are beautiful. Everything is beautiful

Yahaira Expinoza Roblero - GIRL2 (sunglasses on head, profile shot, white shirt)
It's important to know how life is and how the turtles develop. I also didn't like the mosquitoes. It's too pretty. And I would like to come back.

Francisco Diaz - MATH TEACHER
What I liked the most is to be with people that knows how to guide us in a good way. The first experience, the first talk was very important, and that was the base for the whole investigation and collaboration. That is where it came from tat first talk. It was very important. What one shouldn't do. To find a leader in each group is very important also. And what I didn't like, I don't know, I think that I liked everything, the food was excellent, the attention was excellent. You all, 100points

Yendri Rojas Va'squez - GIRL3 (wind blowing hair from behind, white shirt, glasses on head)
Well, I liked because it's the first time I saw a turtle and the experience was beautiful and Id like to come back. I didn't like the mosquitoes and I'm pretty tired.

Demaris Leito'n Quesada - FEMALE TEACHER (the one who threw the party for us)
My friends. That we didn't have lights, telephone, noise, noise of cars and things and that's another important thing because we are always immersed and dependent on the refer, and things like the lights. We were with candles. In our room we didn't have mosquitoes be cause we had netting so we avoided the mosquitoes. That's another important thing of life, that we are always dependent on light and we had candles and we were fine. We had a super light which was the moon. We had a ver y good time

GIRL4 (white tank top over blue bikini strap, hair pulled back)
No translation, too soft spoken

MATH TEACHER
I don't know if you have done this on other occasions, but you presented a video where you showed a video of the damage that is being done to the planet and also to our own country. As far as the robbery of the eggs, and that you show a graph showing how the turtle has diminished and the ones that could exist and what could happen if something is

not done for them. Also to show in that same video where there are people that take the turtle and they die there and they take the meat and sell it and commercialize it and nothing is done. And there are countries where that is permitted like to take a cow and kill it. Just like that. Its very important. Its very important to form a consciousness in students in schools both public and private. Its very important work that you are doing.

Minor Lindo - MUSIC TEACHER
I would say that it is very important to teach people that its not just our country that is doing this it is a world problem. That what we are doing here what you are teaching us here, other countries are doing just the opposite. They are destroying even more than we do. And that they are not interested in conserving. It would be nice to not only influence our country but it influence other countries to conserve the turtles.

Marielos Madrigal Soto - FEMALE TEACHER2 (white shirt, Inez standing behind her)
What I loved is that one feels useful here. That one is doing something that is going to be helpful to others later. Perhaps one may not see the results right away, bit one knows on is doing something. Also the turtles are so impressive, so big, but very indefensive. So one feels that at least to count the eggs and put them in another place ...

MARIELOS (the cook): no translation

Natalie Go'mez Garcia - GIRL5 (brown tank top, gold necklace)
Well I wan to thank Scott for having promised us and following through this dream because I was so anxious to get here., My suitcase was packed since Monday. Everything was beautiful.

FEMALE TEACHER 1
If you need for us to give us a conference or a lecture, we will be there.

Ericka Lee Ubando - GIRL6 (front shot, wind in hair, water bottle over right shoulder)
Very seldom do we get a training like this. It would also be important to train the men who live close by, so that they would know because we at least I didn't know it was bad to eat the eggs. I never ate them because I don't know. And I didn't know they were bad because they have so much cholesterol. And since I didn't have any information, I didn't know they were so bad.

Sisley Rogers Carballo - GIRL7 (white shirt, Inez behind with pager on waist)
I loved it I loved it. Because we were abler to measure the turtles also when we went over there (lagoon) we saw so many trees I didn't know there names. It was beautiful. And the sea is beautiful. And I also like the attention you gave us and you had a lot of patience in spite of the fact that sometimes we didn't behave so well. And I would also love to return.

GIRL 8
NONE

Adreina Watson Ramirez - GIRL9 (black tank, sitting on ground)
Those birds we saw at the lake. They had a crest that was very pretty. All of the lake was gorgeous. All the trees that we had no knowledge about. But what I liked the most was the birds that was so pretty. And all of the lessons that you gave us. The attention that you gave us. It was special all of that. All about the turtles because really I didn't know anything about those things, For instance I had never put my hands in the nest. No, because I don't eat them never. I never eaten them because I get noxious. It was very important to learn to measure the length of the turtles. It was very special and very pretty.

Henry Rui'z Urbina - BOY1 (white tank, grass behind)
I would like to study this, to come here and help. I would like to be a biologist. Its a very helpful to know what one wants like me. It's a beautiful experience. We didn't just learn about the pillage? We also learned they travel all over the world. They come here, to Spain, the US, they travel a long way.

MUSIC TEACHER
I learned a lot about the sexuality of turtles. It wasn't so hard for me

FEMALE TEACHER 2
What I liked most was that last turtle we measured.

Miguel Gonza'lez Castro - BOY2 (blue shirt)
If the turtles were like this...this is a paradise, and its not so far, really. Who should come here at re the CR not the foreigners.. This is our country. I don't have words to say what I feel, its really nice, really pretty.

Matina Group 2
Begins at about 6mins on VHS 3

Juan Carlos Potoy Abarca - BOY1 (Billabong cap)
What I most liked of this trip was the travelling over by the sweet water, and when we arrived here, I felt very happy to meet new people and to learn about the turtle because I ahs never seen them, didn't know them.. A lot of things about the turtles, a lot of very strange birds that I didn't know, it fascinated me. And I had really good time and I'm very grate3ful to you.

Kenroy Jimenez Smith - BOY2 (Addidas cap)
It was a very good experience and very very/too emotional for me. I liked this place a lot. Its very pretty. I liked it even better when we went out and met the turtles and learned everything that I didn't know. I didn't know that its so close.

Luis Diego Garcia Mendosa - BOY3 (floral print shirt, close up of face)
I liked to have learned something about the turtles. I had seen them but didn't know anything. I like the kindness with which you gave us, thank you very much.

Gustavo Rodriguez Carrio'n - BOY4 (green/blue cap, profile)
What I liked too was to learn something about the turtles because I didn't know anything about them except that they lay eggs and also I liked the way you all are and that's why I thank you for showing me things that I didn't know. That's all.

JULIE
No translation

MIGUEL
Well for me even though I had little opportunity to work with you, only once. I went out with the girls. It was a very good opportunity I think and I would desire that all of this be contagious with the other colleges, that you explain the experience that you've had so hopefully this can continue. Because you know perfectly well that this for the future that every day things are learned more. That experience I hope that you pas it on to others, so that they can also have that experience. Always, we cant forget the struggle. This is an obligation of all humanity and that we learn that what we have here belongs to everybody. That we are concerned, that we struggle for it, because this is pour patrimony. That we give advice to people that have another kind of mentality. A very different mentality that they want to harm or do such things. Demonstrate that they are wrong. And I am very grateful to you . The day that I went with group, I felt it was very interesting. You are very educated, full of spirit, of conservation. And very pleasant and I hope that we will have you here again very soon. Thank you.

INEZ
Well, I want to thank you for the conduct in the reserve which is very good. Just as the previous group, you are very good kids. I am very happy that you are here, so that you

can see because I am realizing many people don't know what you have here. You will understand and realize that what you have here is worth a lot. I will do the best possible so that more people from the community will come. And I will do the best to get help from wherever we can get it, so you can come. So that more of you can come. And at the end of the season we can go by the school and tell you how all this ended, this little story of ours of the turtles that you have helped a lot, and you have a right to know how it ends. Thank you very much for helping us with the turtles.

RICARDO
I think how Inez and Miguel has said, it is very important that you are from this area. In spite of the fact that you didn't know us, being from around here its important that you get know it and value what you have here because it is something that a lot of people, a lot of countries would like to have and you have it right here close by. And I think it is very important work to come here and get to know it, and like Miguel said, that you pass it on to your friends that couldn't come here., and you have a very good reference to know what's here, and between all of us we try to conserve this. We are very grateful for your good conduct, how educated and correct you are, what good persons you are. I'm just delighted that you could come.

ENIA
I'm very happy to have had the opportunity to participate with you and to know a little bit about your curiosity, and I very astounded to se your enthusiasm with which you have entered the program with a lot of enthusiasm. A lot of energy to know all of the aspects of conservation and ecology. To me it is very important because I like conservation a lot, and like the rest of the colleagues, I am very happy that it's a group of the community that is getting involved in the problem and I just want to say if you have a question of natural history or whatever it is, contact me. I am here, and with pleasure

Gabriella Sa'nchez Bastos - (black tshirt)
Since originally I wasn't included, but the professor gave me his space, I could come and learn about the turtles. I would like to learn more. Thanks a lot to all of you.

SCOTT
No translation

Idalia Urbina Morales - GIRL1 (tall girl, white shirt w/flowers)
I thank you well I learned lot, and I will return as volunteer God willing.

Guiselle - FEMALE TEACHER (Jezel?, white shirt)
Like one of the teachers and in this case a student of yours, I want to thank you truthfully. Infinite thanks for having taken us into account. Because theres a lot of scientists in this country, but they think to work with young people it is hard. But you have demonstrated that it is possible. That if one wants to, its possible and in truth I thank you; Scott and Belinda, and to Julie, to Enya, Inez, Ricardo, Miguel, Kristin who I don't forget, and to the camera man I want to thank you and to the cooks, everybody to have welcomed us with open arms. To have offered us your patience, and to have offered us the opportunity

to know about the conservation of the turtle. The same as Jan Carlos, I had never seen them only on TV and yes only the little ones. And it seemed to me to be incredible to see their size, to see them laying eggs, to know about the temperature that influences, to find out about the quality of the eggs, to know in reality what the turtle is, to know about the trail its beautiful and to know all of you and to have had intercultural exchange has been very good. I thank you, We will wait for you at school. Any time you can come visit us and maybe you can explain to the other students and colleges the obligation that we have as CR to conserve what god has given us. I thank you

Ambi - FEMALE TEACHER (white shirt with Daffy Duck)
Well, as far as I'm concerned just like everyone else, my colleges and my students I am very grateful for the opportunity that you have offered us. Because really its incredible to see that its so close and yet ewe didn't know this beauty that others would desire to have in their country and that we have. Really, I feel committed to raise consciousness in all of those young people that are in our school, that they should help even though they are far over there. But they need to help raise consciousness in their families, in their neighborhoods, to explain to them how important conservation is, to conserve and protect everything that we have here in our country, everything we have so close. Really I am also so grateful to all the students that came with us, my students who have behaved incredibly, have behaved so well. I am very grateful to every one of them. They have completed some excellent work. Really, I didn't expect less of them because I know they are great kids. And also I would like to return if the opportunity would present itself again, come back and hep in anything that I can. Just like Jezel said, the doors of the school are open to every one of you if you want to return to give us a talk or ask for our help, whatever it is. And we are so grateful to everything and the personnel that has attended to us here from the cook to the guards because everybody has behaved well with us. Truthfully, the word is excellent. What else can I say.

Cathy - FEMALE TEACHER (Tazmanian Devil shirt)
Additionally I am very grateful to the friends and students. I am very grateful that we were invited. My passion has always been biology, I love it. I don't know if further on I will have the opportunity to study biology I'm going to do it because I love it. I am very grateful to all of you for the invitation you've given us, and how you've helped us and how you've treated us. Its been excellent, marvelous. And I hope that one day my colleges and students can come back again, if God permits.

APPENDIX IV

ASSESSMENT DATA

Pre – Program Short Answer Assessment

	Student	Gender	School	1	2	3	4	5	6	7	8	16	10	11	12	13	14	15
31	JC	M	M	5	2	4	2	3	2	1	1	1	1	1	1	2	1	1
32	MGC	M	M	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1
33	YE	F	M	3	1	1	1	1	1	1	1	1	2	1	2	1	2	2
34	NG	F	M	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1
35	GRC	M	M	5	1	1	1	1	1	1	1	1	3	1	2	2	2	1
36	EL	F	M	1	3	4	1	1	2	1	1	1	3	1	1	2	2	1
37	KR	F	M	1	1	1	1	1	1	1	1	1	2	1	2	1	1	1
38	KJS	M	M	1	1	1	1	1	1	1	1	1	2	1	1	1	2	2
39	SRC	F	M	2	1	1	4	1	1	1	1	1	3	1	2	1	2	1
40	AW	F	M	1	1	1	1	1	1	1	1	1	2	1	2	1	2	2
41	HRU	M	M	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1
42	IU	F	M	2	1	1	1	1	1	1	1	1	2	1	1	2	1	1
43	YRV	M	M	1	1	1	1	1	1	1	1	1	2	1	2	2	2	1
44	STC	F	M	5	1	1	1	1	1	1	1	1	1	1	2	1	1	1
1	EA	F	L	2	4	3	5	1	1	1	1	2	4	1	2	1	2	2
2	SMA	F	L	3	3	5	3	2	5	1	1	1	4	1	1	2	3	3
3	AB	M	L	3	5	3	5	2	2	1	1	2	3	1	1	1	2	2
4	MAC	M	L	3	2	4	5	2	1	1	1	2	3	1	2	1	4	2
5	ACJ	M	L	3	4	4	5	1	1	1	1	1	3	1	1	1	2	2
6	KF	M	L	2	4	5	5	2	3	1	1	1	3	1	1	1	2	3
7	RCubas	M	L	3	5	4	2	2	4	1	1	1	2	5	2	1	3	2
8	Rcubro	M	L	3	1	1	5	1	1	1	1	1	1	1	2	1	2	2
9	EE	M	L	3	4	5	3	2	3	1	1	1	2	1	1	2	2	2
10	ME	F	L	5	2	5	5	1	1	1	1	3	3	1	1	1	3	3
11	XF	M	L	3	1	1	1	1	1	1	1	1	4	1	1	1	3	4
12	GF	M	L	2	3	4	3	2	1	1	1	1	3	1	1	1	2	1
13	VG	M	L	2	4	1	1	1	1	1	1	1	3	1	1	1	2	2
14	GG	M	L	2	1	5	2	1	1	4	1	1	3	5	1	1	1	1
15	CMB	F	L	2	1	3	1	1	1	1	1	1	3	1	1	1	2	2
16	CJM	F	L	3	1	5	1	2	2	1	1	1	4	1	1	2	3	3
17	VH	F	L	2	4	4	5	1	4	1	1	1	4	1	1	1	4	4
18	MPM	F	L	2	4	5	4	2	2	1	1	1	1	1	1	4	3	4
19	LM	M	L	5	4	5	5	1	5	2	1	1	2	1	2	1	2	1
20	JMQ	M	L	2	3	3	1	1	3	1	1	1	3	4	5	1	2	3
21	MR	M	L	3	3	4	3	1	1	1	1	1	3	1	1	4	3	4
22	MJR	F	L	2	1	3	5	2	4	1	1	1	4	1	1	1	4	1
23	ARM	M	L	3	4	4	3	2	4	1	1	1	4	2	1	3	3	3
24	RR	M	L	2	3	4	5	1	2	1	1	5	2	1	1	2	3	4
25	ER	M	L	2	3	4	1	1	1	1	1	3	3	5	2	2	3	5
26	RS	F	L	2	3	1	1	1	1	1	1	3	5	1	1	1	5	4
27	YS	F	L	3	4	4	3	2	4	1	1	1	4	1	1	3	3	2
28	SU	M	L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
29	MW	F	L	2	3	4	5	1	3	1	1	1	3	1	2	1	2	1
30	DZ	F	L	2	4	4	5	1	1	1	1	1	4	1	1	1	3	5

Post – Program Short Answer Assessment

	Student	Gender	School	1	2	3	4	5	6	7	8	16	10	11	12	13	14	15
31	JC	M	M	5	3	4	5	5	3	5	5	5	2	1	1	4	1	3
32	MGC	M	M	5	5	1	5	1	5	5	5	5	3	1	2	1	4	2
33	YE	F	M	5	5	4	5	2	3	5	5	5	3	1	2	1	2	2
34	NG	F	M	5	5	2	5	2	1	1	5	5	1	1	2	1	1	1
35	GRC	M	M	5	3	1	5	4	4	2	5	5	3	1	2	2	2	2
36	EL	F	M	5	5	5	5	2	5	5	1	5	3	1	3	2	2	2
37	KR	F	M	5	3	1	5	1	1	5	5	5	3	1	2	1	2	3
38	KJS	M	M	5	5	5	4	2	3	5	5	5	3	5	2	2	2	2
39	SRC	F	M	5	3	4	1	1	1	1	1	5	1	1	2	2	2	2
40	AW	F	M	5	5	4	5	1	4	5	5	4	3	1	2	1	2	2
41	HRU	M	M	5	5	5	5	2	5	5	5	5	4	1	1	1	3	3
42	IU	F	M	5	3	5	5	3	5	5	5	5	3	1	2	2	4	4
43	YRV	M	M	5	3	1	3	1	1	2	1	5	3	1	2	2	2	3
44	STC	F	M	5	3	5	5	1	4	1	5	5	3	1	2	1	3	4
1	EA	F	L	3	3	4	5	1	5	5	5	5	4	1	2	1	2	3
2	SMA	F	L	5	4	5	5	5	5	5	3	1	5	5	5	3	4	4
3	AB	M	L	3	4	4	1	2	5	5	4	4	3	1	1	1	3	2
4	MAC	M	L	5	3	4	5	4	5	5	5	5	4	1	2	2	3	2
5	ACJ	M	L	4	4	4	5	1	5	5	5	1	1	1	1	1	2	2
6	KF	M	L	3	4	5	4	2	1	1	5	5	4	1	2	2	2	3
7	RCubas	M	L	5	4	4	5	1	5	1	3	5	3	5	4	4	4	3
8	Rcubro	M	L	5	3	3	5	1	5	1	1	5	3	1	2	1	2	2
9	EE	M	L	3	3	1	3	1	3	1	1	5	2	5	4	2	2	1
10	ME	F	L	5	4	5	2	5	5	2	3	5	3	5	2	2	4	2
11	XF	M	L	5	3	5	5	5	5	3	2	5	4	5	2	2	4	5
12	GF	M	L	5	3	5	5	2	5	5	5	3	3	1	1	1	2	1
13	VG	M	L	3	3	1	5	1	5	5	1	5	3	1	2	1	3	2
14	GG	M	L	2	1	3	1	3	4	1	1	5	3	1	1	1	3	4
15	CMB	F	L	3	3	4	5	5	5	5	5	5	4	5	3	2	3	3
16	CJM	F	L	3	3	5	5	2	5	4	1	5	4	1	3	2	2	4
17	VH	F	L	5	5	5	5	5	5	5	5	5	5	5	1	1	3	5
18	MPM	F	L	5	3	5	1	2	5	5	5	3	4	5	3	2	2	2
19	LM	M	L	5	4	5	5	5	5	5	3	5	4	4	3	5	3	3
20	JMQ	M	L	3	3	4	5	4	5	5	5	5	3	5	3	2	3	3
21	MR	M	L	5	4	4	5	5	5	1	1	5	4	5	5	5	4	5
22	MJR	F	L	3	3	5	5	2	5	5	5	3	3	3	3	2	4	3
23	ARM	M	L	5	3	4	3	2	5	1	5	5	3	1	1	2	3	3
24	RR	M	L	1	3	5	5	1	5	3	5	5	4	5	4	5	3	3
25	ER	M	L	3	3	5	5	2	2	1	2	5	2	5	2	2	3	3
26	RS	F	L	5	4	4	4	2	3	5	5	3	3	1	1	2	3	2
27	YS	F	L	5	3	5	3	5	5	1	3	5	3	5	2	3	5	4
28	SU	M	L	5	3	4	5	5	5	3	2	5	2	1	1	4	5	5
29	MW	F	L	4	3	5	5	5	5	5	5	5	3	1	2	1	3	3
30	DZ	F	L	5	3	5	5	5	5	5	5	5	5	5	5	3	4	5

Pre – Program Numerical Assessment Data

Answers are grouped according to learner outcome

				S	S	S	S	EB	EB	EB	EB	EB	EB	SR	SR	SR	SR	C	C	C	C	C	C					
	Student	Gender	School	2	3	4	5	6	9	14	15	16	22	7	8	10	17	18	19	20	21	23	24	1	11	12	13	25
31	JC	M	M	5	5	5	1	4	4	5	5	5	5	5	3	3	5	5	5	4	5	5	5	3	5	5	5	1
32	MGC	M	M	5	4	1	1	3	4	5	4	4	5	4	3	5	5	5	5	4	4	4	5	2	5	5	4	5
33	YE	F	M	5	5	5	1	4	4	5	4	4	4	3	3	5	5	5	5	4	3	5	4	2	5	5	5	5
34	NG	F	M	5	5	2	1	5	5	2	5	5	5	2	1	1	1	5	5	5	5		5	1	5	5	5	5
35	GRC	M	M	5	5	5	1	3	4	4	5	4	3	4	5	5	4	5	5	4	5	3	5	1	5	5	4	1
36	EL	F	M	5	4	5	3	2	4	4	5	5	4	4	5	5	5	4	5	4	4	5	4	1	4	5	5	5
37	KR	F	M	5	5	5	3	5	5	5	5	5	5	4	4	4	5	5	5	5	5	5	5	1	4	5	5	5
38	KJS	M	M	5	5	5	3	4	4	5	5	5	3	4	4	4	5	5	5	4	3	3	4	1	4	5	5	3
39	SRC	F	M	5	1	5	3	5		5	5	5	5	3	5	5	5	5	5	5	4	5	5	1	2	5	5	5
40	AW	F	M	1	1	3	3	1	1	5	5	5	5	5	4	3	2	5	5	5	5	5	5	1	1	5	5	1
41	HRU	M	M	5	1	5	3	5	5	5	5	5	4	5	4	5	5	5	5	5	5	4	5	1	5	5	5	3
42	IU	F	M	5	5	5	2	5	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5	1	5	5	5	5
43	YRV	M	M	5	5	5	1	3	3	4	5	3	5	1	4	3	4	5	5	4		5	4	1	5	5	5	3
44	STC	F	M	5	5	5	3	3	5	4	4	4	5	3	4	4	5	4	5	4	4	5	5	2	3	5	4	4
1	EA	F	L	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	5	5	5	5
2	SMA	F	L	5	5	5	3	4	2	5	2	4	4	1	3	3	3	5	5	3	4	5	5	3	2	5	5	4
3	AB	M	L	5	5	5	1	3	2	3	3	3	4	3	2	2	2	5	5	4	4	3	4	1	5	5	4	5
4	MAC	M	L	5	4	5	5	2	4	3	1	1	5	1	1	1	1	4	4	4	5	5	5	3	1	1	1	1
5	ACJ	M	L	1	1	1	1	2	2	3	4	3	2	4	4	4	5	3	3	3	5	4	3	2	2	5	3	5
6	KF	M	L	5	4	5	4	4	3	4	4	4	4	4	3	3	4	5	5	4	4	5	5	3	4	5	5	4
7	RCubas	M	L	5	5	5	5	4	3	5	5	4	5	4	5	5	5	5	5	4	5	5	5	3	4	5	5	5
8	Rcubro	M	L	5	5	5	4	1	1	5	1	1	5	1	1	1	2	5	4	3	2	5	5	3	5	5	5	1
9	EE	M	L	5	3	5	4	2	3	4	4	4	4	5	4	3	4	4	4	4	4	5	5	1	4	5	4	4
10	ME	F	L	5	5	5	5	3	3	4	5	4	3	3	3	5	5	5	5	5	3	5	5	1	5	5	4	5
11	XF	M	L	5	5	5	5	4	4	4	4	4	5	4	4	4	4	5	5	5	5	5	5	4	4	4	4	3
12	GF	M	L	5	5	5	5	3	3	3	2	2	3	3	3	3	3	4	4	3	4	3	4	1	4	5	3	3
13	VG	M	L	5	5	5	3	2	2	4	3	3	4	2	2	3	5	5	5	5	5	5	5	5	4	5	5	5

14	GG	M	L	4	4	5	5	2	1	3	2	2	3	1	2	2	2	3	2	3	3	3	4	3	3	5	2	4
15	CMB	F	L	5	5	5	5	4	3	4	2	2	4	3	5	5	5	4	4	3	4	3	4	3	3	5	4	2
16	CJM	F	L	5	5	5	5	3	4	4	4	5	5	4	4	5	4	5	5	5	5	5	5	1	5	5	5	5
17	VH	F	L	5	5	5	5	3	4	5	4	5	5	4	3	2	4	5	5	5	5	4	5	2	5	5	5	5
18	MPM	F	L	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5
19	LM	M	L	5	5	5	5	5	2	3	3	3	5	5	5	3	2	5	5	5	5	5	5	1	4	5	4	3
20	JMQ	M	L	5	5	1	2	2	3	4	3	4	4	3	4	5	5	5	4	4	4	5	5	2	3	5	4	2
21	MR	M	L	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	3
22	MJR	F	L	5	5	5	5	4	4	5	4	5	5	5	4	4	4	5	5	5	5	5	5	1	5	5	5	3
23	ARM	M	L	5	5	5	5			5	4	5	5	4	5	5	5	5	5	5	5	5	5	1	4	5	5	5
24	RR	M	L	5	5	5	5	4	4	5	4	5	5	4	5	5	5	5	5	5	5	5	5	1	4	5	5	5
25	ER	M	L	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	5	5	5	5
26	RS	F	L	5	5	5	5	1	1	4	1	1	5	1	1	1	1	5	5	5	5	5	5	1	5	5	4	5
27	YS	F	L	5	5	5	5	3	3	4	3	5	5	4	5	5	5	5	5	5	5	5	5	2	3	5	5	3
28	SU	M	L	5	5	4	3	3	2	3	2	2	3	3	4	4	5	3	3	3	3	3	3	3	2	5	3	3
29	MW	F	L	5	5	5	1	3	4	5	4	5	5	5	4	4	5	5	5	5	5	5	5	2	5	5	5	4
30	DZ	F	L	5	5	5	5	4	5	5	5	5	5	5	4	4	4	5	5	5	5	5	5	1	5	5	5	5

Post – Program Numerical Assessment Data

Answers are grouped according to learner outcome

				S	S	S	S	EB	EB	EB	EB	EB	EB	SR	SR	SR	SR	C	C	C	C	C	C					
	Student	Gender	School	2	3	4	5	6	9	14	15	16	22	7	8	10	17	18	19	20	21	23	24	1	11	12	13	25
31	JC	M	M	5	5	5	1	5	5	5	5	5	5	5	4	5	5		5	5	5	5	5	5	5	4	5	1
32	MGC	M	M	5	4	1	4	4	4	5	5	5	5	4	5	5	5	5	5	5	5	5	5	1	5	5	5	5
33	YE	F	M	5	5	5	4	3	3	4	4	5	4	3	3	3	5	5	5	4	3	3	5	1	5	5	5	3
34	NG	F	M	5	5	5	1	1		2	2	5	5	1	1		5	5	5	5	5	5	5	1	5	2	5	5
35	GRC	M	M	5	5	3	1	3	4	4	4	4	4	3	4	5	4	4	4	4	5	4	4	2	4	5	4	
36	EL	F	M	5	5	5	2	3	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5	1	4	5	5	5
37	KR	F	M	5	5	1	4	5	5	5	5	5	5	4	4	4	5	5	5	5	5	5	5	1	4	5	5	
38	KJS	M	M	5	5	5	4	5	5	5	5	5	5	5	5	4	5	5	5	4	5	5	5	1	5	5	5	3
39	SRC	F	M	5	5	2	3	5	4	4	5	5	5	5	5	4	5	5	5	5	5	5	5	1	4	5	5	4
40	AW	F	M	5	5	5	4	5	5	5	5	5	5	3	5	4	5	5	5	5	4	4	5	1	1	5	5	1
41	HRU	M	M	5	5	5	4	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	1	5	5	5	4
42	IU	F	M	5	5	5	1	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	1	5	5	5	5
43	YRV	M	M	5	5	5	3	2	4	4	3	4	4	4	1	3	4	5	5	3	4	4	5	1	4	5	4	3
44	STC	F	M	1	1	1	2	4	4	5	5	4	4	3	4	5	5	5	5	4	5	5	5	1	4	5	5	4
1	EA	F	L	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	5	5	5	5
2	SMA	F	L	5	5	5	3	3	3	4	5	5	4	4	3	3	4	5	5	4	4	5	5	2	4	5	5	3
3	AB	M	L	5	5	1	5	2	2	4	3	2	5	3	2	2	2	5	5	5	5	5	5	1	5	5	5	5
4	MAC	M	L	5	5	5	5	2	2	3	3	3	4	5	5	5	5	5	5	4	4	4	4	2	5	5	3	4
5	ACJ	M	L	1	1	1	3	2	3	3	4	3	3	3	4	4	4	3	3	3	4	3	3	2	2	5	3	4
6	KF	M	L	4	5	5	4	3	3	4	4	4	4	4	4	4	3	5	5	4	4	4	4	2	4	5	4	4
7	RCubas	M	L	5	5	5	4	4	5	4	4	4	4	5	5	5	5	5	5	5	5	4	5	3	4	5	5	5
8	Rcubro	M	L	5	5	5	5	1	1	3	3	3	5	1	1	1	2	5	5	3	3	5	5	3	5	5	5	3
9	EE	M	L	5	5	5	5	4	4	4	5	4	3	5	5	5	4	5	5	4	3	4	5	2	5	4	4	4
10	ME	F	L	5	5	5	5	1	1	1	1	1	1	1	1	1	1	5	5	5	5	4	5	1	5	5	5	5
11	XF	M	L	5	5	5	3	4	4	5	4	5	5	4	4	4	4	5	5	5	5	4	5	1	4	5	5	1
12	GF	M	L	5	5	4	4	2	2	2	2	2	2	2	2	2	2	3	3	4	2	3	3	2	2	5	2	3
13	VG	M	L	5	5	5	4	1	3	4	2	2	5	1	3	3	4	5	5	5	5	5	5	5	1	5	4	5

14	GG	M	L	4	4	5	3	2	1	2	1	1	5	1	2	1	1	3	2	2	5	3	3	3	5	5	2	5
15	CMB	F	L	5	5	5	5	5	3	3	3	2	3	3	4	5	5	3	4	3	3	3	4	4	3	5	3	3
16	CJM	F	L	5	5	5	4	3	3	4	4	3	5	4	4	4	5	5	5	5	5	5	5	2	5	5	5	5
17	VH	F	L	5	5	5	1	2	4	5	4	5	5	4	3	4	4	5	5	5	5	5	5	1	4	5	5	4
18	MPM	F	L	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	5	5	5	5
19	LM	M	L	5	5	5	5	1	3	4	3	4	4	5	5	5	1	5	5	5	5	5	5	1	5	5	4	5
20	JMQ	M	L	5	5	1	2	2	2	2	3	3	4	4	5	5	5	5	4	3	4	5	4	2	3	5	3	2
21	MR	M	L	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	4
22	MJR	F	L	5	5	5	5	3	3	4	3	5	5	5	4	3	3	5	5	5	5	4	5	1	5	5	5	5
23	ARM	M	L	5	5	5	3	3	3	4	3	3	4	3	5	5	5	5	5	5	4	4	5	1	3	5	5	4
24	RR	M	L	5	5	1	5	4	4	4	4	4	5	4	5	5	5	5	5	5	5	5	5	1	4	5	4	4
25	ER	M	L	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	2	5	5	5	4
26	RS	F	L	5	5	5	5	1	1	3	1	1	5	1	1	1	1	5	5	5	4	5	5	1	5	5	5	5
27	YS	F	L	5	5	5	5	1	1	5	3	3	5	2	3	5	1	5	5	5	5	5	5	1	3	5	5	5
28	SU	M	L	5	5	2	3	1	1	1	1	1	5	1	2	2	1	2	2	5	5	5	4	2	1	5	1	2
29	MW	F	L	5	5	5	3	3	4	5	4	4	5	4	4	3	5	5	5	5	5	5	5	2	4	5	5	5
30	DZ	F	L	5	5	1	5	4	5	5	5	5	5	5	4	4	4	5	5	5	5	5	5	1	5	5	5	5

STEP Quantitative Assessment

This questionnaire was completed by all participants before, and after, STEP programming.

Pre/Post Quantitative Assessment

For each question circle one of the following choices:

1 – Completely Agree, 3 – Undecided, 5 – Completely Disagree.

1. When I go to the beach with my family or friends, we always turn off unnecessary lights after dark.	1	2	3	4	5
2. If I was at the beach at night and saw a nesting sea turtle, I might take its eggs to eat or sell.	1	2	3	4	5
3. On a beach where there are several sea turtle nests, it would be okay to take the eggs from one nest to sell or eat.	1	2	3	4	5
4. Pollution is not really a big problem in the oceans because they are so big.	1	2	3	4	5
5. There are lots of sea turtles in the ocean	1	2	3	4	5

Rate your interest in the following:

	not interested				very interested
6. Becoming a biologist	1	2	3	4	5
7. Field studies outside the classroom	1	2	3	4	5
8. Applied science projects	1	2	3	4	5
9. Coastal ecosystem structure and function	1	2	3	4	5
10. Scientific research	1	2	3	4	5
11. Spending time outside	1	2	3	4	5
12. Attending a university after high school	1	2	3	4	5
13. Learning about nature	1	2	3	4	5
14. Understanding the science of ecology	1	2	3	4	5
15. Working with wildlife biologists	1	2	3	4	5
16. Designing a wildlife conservation project	1	2	3	4	5
17. Learning how to do scientific research	1	2	3	4	5

Rate your concern about the following:

	not concerned				very concerned
18. Protecting the Costa Rican rainforest	1	2	3	4	5
19. Protecting sea turtles	1	2	3	4	5
20. Conservation issues in your community	1	2	3	4	5
21. Pollution in the area where you live	1	2	3	4	5
22. Knowing the ecology of the area you live	1	2	3	4	5
23. Biodiversity in Costa Rica	1	2	3	4	5
24. Preserving Costa Rica's coastal communities	1	2	3	4	5
25. Foreigners who visit your country	1	2	3	4	5

STEP Short Answer Assessment

1. What species of sea turtles nest along the Caribbean shore of Costa Rica?

2. What time of year do they nest?

3. What is the current status of these turtle's populations?

4. How many weeks do the eggs of the leatherback sea turtle stay in the sand before hatching?

5. Where do hatchlings go after they first make it to the sea?

6. How far do adult leatherback sea turtles migrate?

7. How often does an adult female leatherback lay eggs?

8. How many times does a female leatherback lay eggs during a nesting season?

9. Are sea turtle eggs sold where you live?
Do you eat sea turtle eggs?
Do you think it is a problem to buy or eat sea turtle eggs?

10. What is an ecosystem?

11. Name four communities in the coastal ecosystem

12. Name four species of plant or animal in each of these coastal communities

13. Draw a food web with the coastal ecological communities and plants and animals that live there.

14. Will the coastal ecosystem be affected if one of these ecological communities is gone? Why?

15. Why is the coastal ecosystem important to the Ocean ecosystem?

16. On the sea turtle below, show the required measurements taken for sea turtle monitoring projects.

(See Figure 4.1 for turtle diagram)

Each response to short answer questions was given a number from 1 (no answer) to 5 (answer suggests subject mastery). See Appendix IV for the rubric used to distinguish criteria for grading of these short answer questions.

Rubric for Short Answer Assessment

Pre- and Post- Program Student Assessment

1. What species of sea turtles nest along the Caribbean shore of Costa Rica?

1 – No species named 3 – two species named 5 – all three species named

2. What time of year do they nest?

1 – No answer 3 – one species' season 5 – two species' seasons

3. What is the current status of these turtle's populations?

1– No answer 3 – "few", or "little", etc 5 – in danger of extinction

4. How many weeks do the eggs of the leatherback sea turtle stay in the sand before hatching?

1- No answer 3 – 4-6 or 8-10 5 – 7-8 weeks

5. Where do hatchlings go after they first make it to the sea?

1 – No answer 3 – "look for food", "swimming" 5 – unknown, "lost year"

6. How far do adult leatherback sea turtles migrate?

1 – No answer 3 – "far", or some vague answer 5 – "Spain", "3,000 – 5,000 miles", or some destination that we learned of during the migration activity.

7. How often does an adult female leatherback lay eggs?

1 – No answer 3 – not every year, almost every year 5- every 2-3 years

8. How many times does a female leatherback lay eggs during a nesting season?

1 – No answer 3 – often, more than once 5 – 7-10 times

9. Are sea turtle eggs sold where you live? NO RUBRIC FOR #9
Do you eat sea turtle eggs?
Do you think it is a problem to buy or eat sea turtle eggs?

10. What is an ecosystem?

1 – No answer	3 – a place where animals live, habitat, etc.	5 – Some description of the relation between abiotic and biotic, systems, cycles, variety of communities, self-sustaining, etc.

11. Name four communities in the coastal ecosystem

1 – No answer	3 – 2 communities	5 – four communities (tidal, ocean, lagoon, forest, mangrove, etc.)

12. Name four species of plant or animal in each of these coastal communities

1 – No answer	3 – at least six spp. In two distinguished communities	5 – at least 10 spp in four communities

13. Draw a food web with the coastal ecological communities and plants and animals that live there.

1 – No answer	2- simple food chain (common answer)	4 – at least 6 spp with interactions.

14. Will the coastal ecosystem be affected if one of these ecological communities is gone? Why?

1 – No answer	3 – Yes, example of one connection	5 – Yes, description of connection in terms of energy flow w/ examples

15. Why is the coastal ecosystem important to the Ocean ecosystem?

1 – No answer	3 – They border each other, and one example of connection	5 – Example of energy flow, and spp that use both.

16. On the sea turtle below, show the required measurements taken for sea turtle monitoring projects.

1 – no answer	3 – one correct measurement	5 – both correct measurements