VOLUNTEER PROGRAMS IN THE CONSERVATION OF SEA TURTLES IN COSTA RICA

A Professional Paper

by

STUART M. RECKSEIT

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ABSTRACT In Costa Rica, sea turtles are facing numerous threats from humans, diseases, and nature, resulting in a decrease in the abundances of the species that occur there. Natural threats include raccoons, ants, tides, and storms. Man-induced threats include poaching, pollution, and beach destruction. Diseases that threaten sea turtles include viruses and bacteria. It is an issue that must be addressed by all types of conservation organizations, whether or not they work for the government because every bit of help counts. Saving even one nest, which can contain over 100 eggs, can result in over 100 sea turtles hatching and returning to the sea, some of which would be females that survive to grow into adults and return to the beach to lay their own eggs. But in order to help ensure their survival, actions for conservation must be taken. For example, I was involved in a sea turtle conservation internship in Costa Rica for the summer of 2016, and during that time, I feel that we were making a real contribution to helping the sea turtles by protecting their eggs, releasing over 100 baby sea turtles, and collecting data on the biology of sea turtles that laid the eggs, the number of eggs laid, and the number of babies that hatched and were released into the sea. However, more is required, like other conservation organizations getting involved, trash clean-ups on the beaches, and environmental education programs, and conservation training programs. Such efforts will help secure the survival of the sea turtle species in Costa Rica.

KEY WORDS ASVO, conservation, Costa Rica, eggs, environment, programs, sea turtles, survival, threats, volunteer.

INTRODUCTION

Sea turtles are marine animals in Costa Rica that are suffering from a variety of threats from nature, humans, and diseases, causing their species to decline in density. It is an issue that requires the attention and support of self-managed, non-profit, non-governmental, and

governmental wildlife conservation organizations in order to achieve maximum conservation results. For example, from May 4, 2016, to July 31, 2016, I worked in Montezuma, Costa Rica, with the Asociación de Voluntarios para el Servicio en las Areas Protegidas (ASVO) as both an intern and a group leader. Our job was the conservation of the three sea turtle species that nested in that specific area of Costa Rica, which were the olive ridley sea turtle (*Lepidochelys olivacea*), the black sea turtle (*Chelonia mydas*), also known as the Pacific green sea turtle, and the leatherback sea turtle (*Dermochely coriacea*). However, during my time there, we encountered only one black sea turtle and more than 20 olive ridleys because it was their nesting season at the time. But even so, the internship provided me with a beneficial and enlightening experience in wildlife conservation. While organizations, like ASVO, face certain problems that require improvements, they are key contributors to the protection, preservation, and conservation of sea turtles in Costa Rica.

BIOLOGY OF THE SPECIES

There is a total of seven species of sea turtles, all of which are a monophyletic group of the suborder Cryptodira, which means that they are derived from a common ancestor that has not given rise to other living turtles (Meylan and Meylan 1999:1). They are considered highly derived morphologically and have many adaptations for life in the sea, like their paddle-shaped limbs and shells (Meylan and Meylan 1999:1). In addition, they are a species whose sex is determined by environmental temperature. Low temperatures give birth to male sea turtles, whereas high temperatures breed female sea turtles (Larios 1999:130). As a result of their temperature-dependent sex determination (TSD) and natal homing, sea turtles are likely to be adversely affected by global warming, which could have implications for conservation and management of their species (Larios 1999:130).

A common life cycle composed of a series of stages is shared by all sea turtle species (Heppell et al. 2003:277). Ontogenetic shifts, or shifts in location and habitat that occur during the life cycle in response to changes in vital rates regarding the development of organisms, have a major impact on where sea turtles of different sizes or stages occur and, subsequently, the human-caused hazards to which they are exposed. An example would be the shift from pelagic to benthic feeding areas (Heppell et al. 2003:277). The general life cycle of sea turtles can be briefly described as adult females reaching sexual maturity in 10-50 years, digging nest cavities on sandy, ocean-facing beaches and, depending on the species, deposit anywhere from 50 to 130 eggs per nest. Having completed a seasonal nesting cycle, a female may take from two to five years to accumulate enough energy at the feeding grounds to again support both her migration to the nesting beach, where there is typically no food, and the production of hundreds of eggs over a season lasting a few weeks. About 35 days after being laid, the eggs begin to hatch; and 10 days later, they start to emerge from the nests. Once the hatchlings emerge, they crawl down the beach to the water and swim out to the open ocean. Young juveniles remain pelagic for a length of time that varies depending on species and, potentially, geographic location within species (Heppell et al. 2003:277). Following the pelagic stage, juveniles of most species recruit to nearshore habitats and switch to feeding on benthic organisms, which are organisms that live in or near the seabed, also known as the benthic zone (Heppell et al. 2003:280). There are usually migrations between summer and winter habitats for juveniles found in temperate regions, whereas migrations are not as extensive for more tropical species.

Sea turtle species that can be found in Costa Rica include olive ridley sea turtles, black sea turtles, and leatherback sea turtles. According to Figure 1, both the olive ridley sea turtle and black sea turtle nest on the Pacific coast of Costa Rica, and while the peaks of their nesting

seasons occur at different times of the year, they lay eggs all year-round. Leatherback sea turtles, on the other hand, nest on both the Pacific and Caribbean coasts, which influences their nesting season. On the Pacific coast, they lay eggs from October to March; and on the Caribbean coast, from February to July.

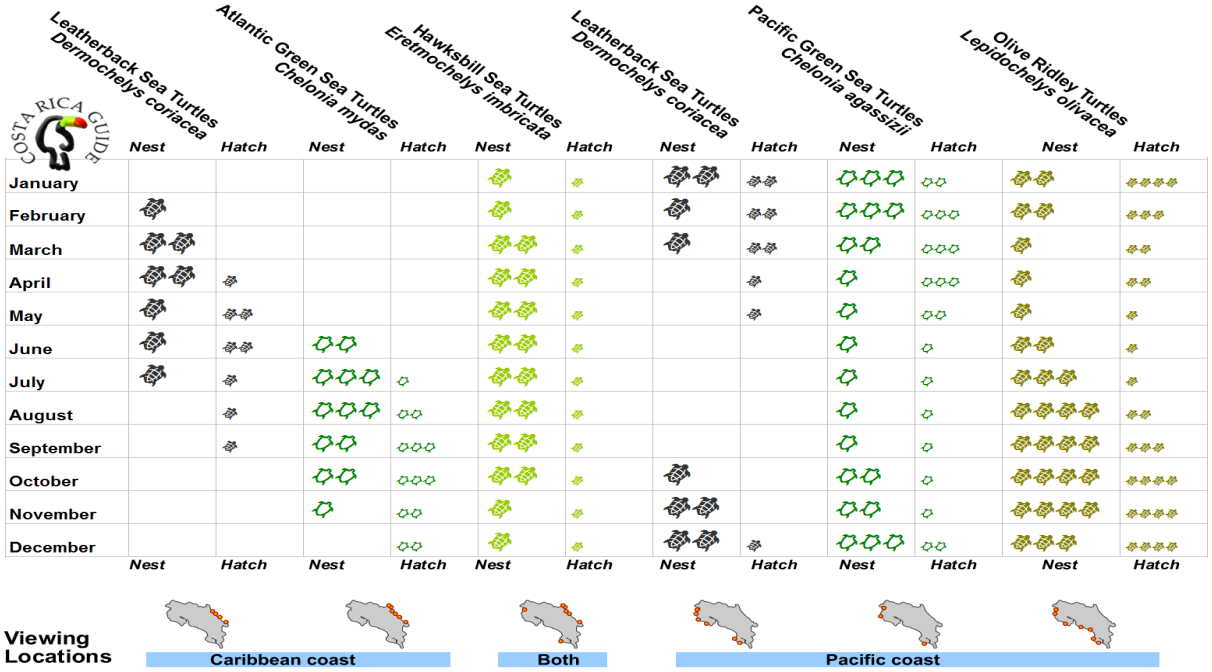

Figure 1. Sea turtle nesting and hatching calendar and locations in Costa Rica. Reprinted from Costa Rica Guide 2016.

Olive ridleys lay up to 110 eggs or more per nest and have 5-9 pairs of costal scutes on their shells (Meylan and Meylan 1999:1). They are omnivores that utilize a wide range of foraging habitats and have strong jaws for crustaceans, like crabs and shrimp (Bjorndal 1997:207). Black sea turtles, which are also known as the Pacific green turtle (Bjorndal 1997:200), lay up to 115 eggs or more per nest and have 4 pairs of costal scutes on their shells (Meylan and Meylan 1999:3). Newborns are carnivores, whereas juveniles and adults are herbivores (Bjorndal 1997:200-202). Leatherbacks are the largest and most pelagic of all the sea turtle species, spending much time in the open ocean (Bjorndal 1997:209). Even though they are

larger than olive ridleys and black sea turtles, they only lay 60-90 eggs or more per nest, and their shells are made of ridges instead of scutes (Meylan and Meylan 1999:3). They are carnivores whose distribution is largely dependent on that of the jellyfish, salps, and other gelatinous organisms upon which they feed due to their delicate, scissor-like jaws that would be damaged by anything other than a diet of soft-bodied animals (Bjorndal 1997:209). According to the IUCN Red List, both olive ridleys and leatherbacks are currently vulnerable, whereas black sea turtles are endangered, which makes it very important to protect them from all possible threats.

THREATS

Around the world, sea turtles face a variety of natural and anthropological threats that can occur directly or indirectly (Guagni dei Marcovaldi and Thomé 1999:165). There are also infectious diseases that present a serious threat to sea turtles (Herbst 1999:208). These threats affect the survival and growth rates of each sea turtle life stage, which, in turn, influences population growth rates and dynamics (Heppell et al. 2003:276). Natural threats include raccoons, crabs, ants, tides, storms, erosion, sedimentation, birds, fish and other marine animals, late sexual maturity, and low life expectancy for newborns. For example, fire ants present a serious threat because they have been known to burrow into nests and attack hatchlings as they emerge from their eggs (Boulon 1999:173). Also, eggs that are laid in nests close to the sea are at high risk of standing water in the nest cavity due to high tides, which can result in high embryo mortality (Boulon 1999:170). While nature can give life, it can also take life just as easily.

Anthropological threats can be very devastating and pervasive to declining populations (Guagni dei Marcovaldi and Thomé 1999:165). These types of threats include illegal commerce and consumption of meat and eggs, indiscriminate fishing, sea pollution, artificial lights and

coast development, invasive species, such as humans and pets, climate change, and beach destruction. For example, there are many coastal communities in Costa Rica where the locals do not have very good income, which can lead to a lack of food sources. As a result, they resort to poaching sea turtle eggs to either eat or sell in order to make some extra cash. While it is an understandable situation, it is still important to continue working towards protecting and conserving the eggs to ensure their safety. Even artificial sources of light can threaten sea turtles because they are sensitive to bright lights. That is why it is important to use red lights when patrolling beaches for sea turtles at night. For example, a sea turtle can be drawn to the light coming from a hotel on the beach and starts crawling across a road towards it, making it vulnerable to being run over by a car. There are also anthropological threats that affect sea turtle foraging habitats, which can indirectly impact the sea turtles themselves (Gibson and Smith 1999:184). Such threats include vessel groundings, near shore construction, certain fishing techniques, like dropping traps on living reefs, reef walking, shoreline armoring, such as seawalls, and careless snorkeling and diving (Gibson and Smith 1999:186). Around the world, a variety of man-induced factors threaten the survival of all sea turtle species (Guagni dei Marcovaldi and Thomé 1999:165).

While both natural and anthropological threats play key roles in the decline of sea turtle species, infectious diseases are also threats to be concerned about (Herbst 1999:208). When studying infectious diseases in populations, it is important to understand the difference between being infected with a disease causing agent and having a disease caused by that agent (Herbst 1999:208). According to Herbst (1999:208), for any disease agent in a population of turtles, there will be individuals that are infected but not sick, individuals that have never been infected, individuals that were infected but are now immune, and individuals that are both infected and

sick. But despite whether individuals are infected, sick, or both, the fact is that diseases can have negative impacts on the health of sea turtles, and possibly, their offspring.

The types of infectious diseases that sea turtles are exposed to include viruses, bacteria, and parasites (Herbst 1999:211). Despite their competent immune system and tough integument, sea turtles that experience aspiration of seawater and a traumatic injury to dermal tissues become susceptible to bacteria entering the body and bloodstream, resulting in aspiration pneumonias, multifocal abcesses, and lethal septicemia (George 1997:366). Viruses include the gray-patch disease, which is a stress-induced disease that is caused by a herpesvirus and results in two types of skin lesions (George 1997:371). Some exhibit a form of the disease in which numerous non-spreading papules or pustules develop on the head or front flippers, whereas others have rapidly spreading gray lesions with raised edges, which represent areas of superficial maceration (George 1997:371). Parasites that have been known to infect sea turtles include two significant species of leeches that suck the blood of their hosts (George 1997:375). *Ozobranchus branchiatus* can only be found on green turtles inhabiting tropical waters, and *Ozobranchus margoi* is found on most species of sea turtles that inhabit cooler waters and has a more worldwide distribution (George 1997:375). Such diseases present a major threat to the health and survival of sea turtles.

ACTION PLANS FOR CONSERVATION

Costa Rica is a country where the vast and beautiful diversity and abundance of wildlife creates an enthusiasm for nature that many people have not experienced since childhood (Henderson 2002:2). However, the conservation of sea turtle species in Costa Rica is a problem that is damaging that enthusiasm, and requires a reduction of threats and public support. Dozens of committed and passionate biologists, private citizens, and politicians have contributed to Costa

Rica's world leadership in wildlife protection, tropical forest conservation, and nature tourism through research, preservation, education, nature tourism, and conservation (Henderson 2002:3).

The conservation of sea turtles is a case of community-based conservation since a lot of coastal communities rely on sea turtles for money and food (Guagni dei Marcovaldi and Thomé 1999:165). This particular type of conservation involves changing the habits and outlooks of coastal communities in which the use of natural resources is a vital source of income and essential to survival, this is one of the biggest and most complex challenges to the long-term conservation of sea turtles (Guagni dei Marcovaldi and Thomé 1999:165). Locals who depend on these animals for their livelihood must be drawn into conservation and research programs that create direct and indirect benefits to their communities. This can be done by assessing and understanding primary community needs, as well as potential program benefits, and developing alternative programs and new sources of income (Guagni dei Marcovaldi and Thomé 1999:165-166).

There is substantial economic potential for exploiting wildlife resources for non-consumptive wildlife-oriented recreation (NCWOR) tourism and this type of tourism, if well managed, can result in the long-term conservation of wildlife resources (Wilson and Tisdell 2001). This is especially important in cases where wildlife resources are declining due to habitat destruction, poaching, and other human threats, as it is for sea turtles (Wilson and Tisdell 2001). In coastal communities where the locals do not have good income, they are more likely to kill sea turtles and steal eggs either to eat or sell for extra cash, resulting in high mortality rates and population declines. But in communities where the locals make decent money, like Montezuma, Costa Rica, which is a tourist town, they are less likely to participate in poaching activities towards sea turtles because they are already making money from the stores, restaurants, gift

shops, hotels, bars, and activity programs. Also, communities where sea turtles gather to nest can be a profitable tourist attraction. However, even with a good income, there is no guarantee that someone will not want to steal some turtle eggs for a little extra money. So, sea turtles have economic values for coastal communities in both positive and negative ways.

Community involvement in sea turtle conservation can be increased through program activities if local circumstance, such as available materials and training, are considered. An alternative for financing such activities through a direct relationship with the communities is the production and marketing of conservation oriented products based on species conservation programs, such as hats, shirts, and beach wear, resulting in reinvested profits in education, training, health, and jobs. Also, budgets that will support such activities until they become self-sufficient must be projected before initiating them, which can be done through non-government organizations, inter-governmental development banks, and government sources (Guagni dei Marcovaldi and Thomé 1999:166). Visitor's centers in areas of program activity, which may include retail stores, a small museum, signs explaining the biology and status of sea turtle species, display tanks containing local species in various life cycle stages, and program activities, are important tools for fund-raising campaigns and education, and can provide opportunities for direct contact between residents, visitors, and sea turtles. Also, hiring fishermen to carry out activities in sea turtle conservation and management provides both the possibility for future resource administration by the community and an alternative source of income (Guagni dei Marcovaldi and Thomé 1999:166). Such benefits can be essential towards changing people's outlook on sea turtle conservation because public support perpetuates the conservation programs, and enhances the survival of sea turtles (Guagni dei Marcovaldi and Thomé 1999:166).

Environmental education and communication are also important methods for raising public awareness (Guagni dei Marcovaldi and Thomé 1999:167). Using various tools of communication, such as mass media, marketing, flyers, posters, multi-media, oral presentations, exhibits, debates, and publications, can promote and develop educational campaigns. An example would be the provision of photographs, videos, and information about sea turtles in Costa Rica to media channels, especially with the rise in media interest in environmental issues. Also, applied methods of environmental education that involve youth groups and local inhabitants in specific courses and activities, such as paper recycling, junior ecological tour guiding, and the release of hatchlings, are useful methods for gaining the public's attention and making them aware of the issue (Guagni dei Marcovaldi and Thomé 1999:168).

A crucial part of sea turtle conservation is ensuring the survival of future generations, especially when mother sea turtles leave after laying their eggs, offering no protection from all possible threats. This requires the use of conservation strategies designed to reduce threats to turtle eggs and hatchlings. For example, *in situ* protection is the protection of sea turtle nests in their original places through a variety of methods (Boulon 1999:169). Disguising nests with masking odors, such as pepper sauce, and beach patrols on the nesting beaches can reduce a variety of threats, like predators, egg poaching, depredation, and, in the case of hatchlings, entrapment in beach debris or disorientation inland toward artificial light sources (Boulon 1999:169). Also, placing galvanized or plastic coated wire or rigid plastic mesh just below the sand surface or formed as a cage over the nest can deter nest excavation. Advantages of the *in situ* technique include lower costs for maintenance and personnel compared to hatcheries, natural emergence of hatchlings, and temperature and moisture profiles are likely to be closer to the norm (Boulon 1999:171). While protecting eggs *in situ* should always be the first and best

management choice, certain circumstances, such as erosion, inundation, and poaching, make the movement of eggs a viable conservation option (Boulon 1999:170).

It is recommended that relocating eggs to a protected hatchery site be undertaken only as a last resort due to certain limitations. In terms of human and financial resources required to collect and maintain each clutch of eggs, hatcheries can be very expensive (Mortimer 1999:175). Even when hatcheries are constructed and supervised by staff, the hatching success in hatcheries is usually lower than in natural nests (Mortimer 1999:175). The effective operation of a hatchery depends on well-trained, reliable staff, but constraints on budgets usually provide only minimum wage salaries or lead to relying on volunteers. Depending on the conditions in the hatchery, the sex ratios of the hatchlings are often skewed towards one sex or the other. Improper methods of hatchling release produce high rates of mortality, such as the creation of fish feeding stations when hatchlings are constantly released at the same time and place (Mortimer 1999:175). Human intervention becomes heavily depended on as a result of hatcheries being established as a compromise to mitigate the destruction of nesting habitats (Mortimer 1999:176). Due to how labor intensive they are, hatcheries have a harmful psychological effect on people because they promote a belief that participants and supporters are doing more good for turtles than they actually are, which can potentially result in more effective, but politically less attractive programs being ignored (Mortimer 1999:176). But despite these limitations, hatcheries can still be beneficial to the survival of sea turtle eggs, especially those that are laid in dangerous circumstances, like being too close to the sea, too close to artificial sources of light, in erosion-prone areas, or in the path of vehicle or foot traffic (Mortimer 1999:175). Even if it does not produce as many hatchlings as natural nests, it is still contributing to the conservation of the sea turtles.

Mitigating threats to nesting habitats is critical to the survival of sea turtle populations (Witherington 1999:179). These threats include erosion and accretion, beach armoring, artificial beach nourishment, which is the artificial replacement of sand that has been lost to erosion, sand mining, beach lighting, vehicles, foot traffic, livestock, certain obstacles, like debris, recreational and work equipment, and structures, and oil spills (Witherington 1999: 179-183). There are at least four types of responses for dealing with such threats. The first and best response is simply to eliminate the threat, like restricting sand mining to inland deposits or prohibiting beach driving. Risk reduction, or managed risk, is another response that aims to reduce the probability of a threat occurring and to reduce the negative effects of a threat when it does occur (Witherington 1999:179). Moving eggs from high-risk areas to safer natural beach areas or hatcheries is also a response option (Witherington 1999:179). The fourth response is to do nothing at all because some threats either cannot be eliminated or threaten too few nests to justify costly mitigation, such as chronic erosion (Witherington 1999:179). Keeping nesting habitats safe and secure can increase hatching success rates, thereby increasing the species density of sea turtles.

A widely recognized mortality factor for sea turtles is incidental catch in fisheries (Oravetz 1999:189). Major sources of sea turtle mortality by fishing gear are trawling, gill and entanglement nets or entrapment gear, pelagic and bottom longlines, entanglements in buoy or trap lines, and hooks and lines from commercial and recreational fishing (Oravetz 1999:189). But for each of these threats, there are methods for mitigation. For trawling, the use of the Turtle Excluder Device (TED), which is a barrier with an opening that is installed into the trawl through which sea turtles voluntarily or involuntarily escape, has become the standard for reduction of sea turtle mortality (Oravetz 1999:190). A reduction of fishing effort when sea turtles occur in

concentrations is a response for pelagic longlines. Mitigation measurements for bottom longlines and gill and entanglement nets include setting gear and nets in areas where turtles are not in abundance. Establishing restricted fishing zones and reducing fishing efforts are mitigation responses for buoy and trap lines. For hook and line gear, other than a general educational effort, there are no reasonable mitigation measures (Oravetz 1999:192). By reducing these threats, the chances for sea turtles surviving, reproducing, and increasing in density improve significantly.

While mitigating threats to sea turtles is an effective conservation strategy, not all threats can be eliminated. Therefore, other conservation strategies are needed to protect sea turtles, such as ranching and captive breeding, and rehabilitation. Captive breeding, or "farming," of sea turtles is done by maintaining captive adults who breed in captivity and whose offspring are raised for use, and collecting turtles from wild populations, usually as eggs, which are then raised in captivity for use, which is referred to as "ranching" (Ross 1999:197). The benefits of this conservation strategy include releasing large sized turtles back into the wild because of the presumed high mortality of sea turtles in the smaller size classes, and opportunities to study some aspects of sea turtle biology (Ross 1999:199-200). Rehabilitation of ill or injured sea turtles gives individuals a better chance at survival in the wild, whereas their injuries and illnesses would make them more vulnerable to causes of death, like predation (Walsh 1999:202). The process involves an initial evaluation of the individual's condition once rescued, taking a blood sample to diagnose the health of the turtle, various treatment techniques, such as food, whether it is regular feeding or tube feeding, shelter, and antibiotics, and release back into the wild once the turtle has fully recovered (Walsh 1999:202-204). In order for these or any other conservation strategies to produce any positive results, the assistance of committed wildlife organizations is a necessity.

During the past few decades, there has been a growth in the realization that all sea turtle species were facing extinction, and that a renewable natural resource with cultural, economic, and ecological value may be lost (Reichart 1999:221). As a result, international agreements and national legislative measures have gradually emerged in order to mitigate, or even put a halt to, human exploitation of sea turtles (Reichart 1999:221). For example, the first wildlife conservation law of Costa Rica was decreed on July 20, 1961, and was updated on June 7, 1965, with bylaws (Henderson 2002:5). These laws and regulations provided for the creation and enforcement of game laws, the establishment of fines for violations, the establishment of wildlife refuges, the issuance of fishing and hunting licenses, the prohibition of commercial sale of wildlife products, and the creation of restrictions on the import and export of wildlife (Henderson 2002:5). Other agreements include the protection of adult turtles, especially females, at all times and under all circumstances, and not harvesting eggs unless it can be convincingly demonstrated that they will not survive (Reichart 1999:222). At the present time, there are closely supervised and generally successful national egg collection initiatives in Suriname and Costa Rica (Reichart 1999:222). These national legislations should be harmonized with relevant international obligations, holistic in areas such as habitat protection, clear in their intents, equitable in their obligations, adequate in the areas of enforcement and penalty, and uncompromising with regard to the basic biology of sea turtles (Reichart 1999:223).

General marine conservation issues, especially those relating to far-ranging species like sea turtles, need to be addressed at a regional level. Truly successful conservation programs transcend political and geographical boundaries (Trono and Salm 1999:224). Some existing global conservation strategies and international conventions include provisions relevant to highly migratory and endangered species, such as sea turtles (Trono and Salm 1999:224). Examples of

these strategies and conventions are the Global Strategy for the Conservation of Marine Turtles developed by the IUCN/SSC Marine Turtle Specialist Group (MTSG) and the Global Biodiversity Strategy developed under the aegis of the World Conservation Union (IUCN), the U.N. Environment Programme (UNEP), and the World Resources Institute, both of which provide a framework for regional collaboration. In addition, the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), a partner organization to the Caribbean Environment Programme (CEP), is comprised of national coordinators in more than 30 nations and a well-developed grassroots network (Trono and Salm 1999:225). Its objectives are to promote a regional capability to implement scientifically sea turtle conservation programs, and to assist Wider Caribbean governments in fulfilling their obligations. Also, in response to the mass harvesting of sea turtle eggs in the Turtle Islands, the World Wildlife Fund Philippine Program (WWF-PP) developed a project proposal to establish the Turtle Islands as a transborder management area for marine turtles (Trono and Salm 1999:225).

PERSONAL EXPERIENCE

From May 4, 2016 – July 31, 2016, I did a sea turtle conservation internship with the Asociación de Voluntarios para el Servicio en las Areas Protegidas (ASVO) in Montezuma, Costa Rica. It's a self-managed, non-profit, and non-governmental organization that has been around for 27 years and primarily works towards the conservation of sea turtles with both national and foreign volunteers. For example, during my internship, I worked with people from all over the world, like Scotland, Finland, Spain, Denmark, the United Kingdom, the United States, and Tahiti. ASVO has 2 sea turtle conservation stations (Montezuma, Buena Vista) and works in 30 conservation areas. Its goal is to act as a bridge between civilians and natural areas in order to get more people responsibly involved in its natural and cultural heritage conservation.

When I first arrived, I was just a regular intern like all the others. Our responsibilities included hatchery maintenance work, community service efforts, environmental education sessions at the local school, beach clean-ups, including alternative uses of trash, and informational discussions with tourists. But, it was not even nesting season yet, so there were no night patrols or nests in the hatchery. The nesting season was expected to start in June. So, our plan was to start our night patrols on June 1. This gave me plenty of time to learn as much as possible about sea turtle conservation before nesting season began. I studied the data sheets that were used for both the night patrols and the hatchery, especially since they were in Spanish. I reviewed the biological information about the sea turtle species that we would encounter in order to improve my ability to identify them. I familiarized myself with the rules for the house I was living in, night patrols, and the hatchery, like only using red lights at both the hatchery and on night patrols, not putting on bug repellent two hours before patrols, wearing dark clothing, and staying quiet. Also, I practiced digging nests on the beach for when I would have to re-bury eggs at the hatchery. As time went by, even into the nesting season, I became more familiar with how everything works, and more volunteers and interns came. As a result, Roger Obregón, my supervisor, decided to make me one of the group leaders, which came with many more responsibilities.

As a group leader of the volunteers, my responsibilities included the coordination and leadership of beach night patrols on Montezuma Beach to collect data and recently laid eggs, and preparing the patrol kits with all of the necessary equipment. Since Montezuma Beach was only 800 meters long, we would walk back and forth along the beach for the entire patrol looking for turtles. It was a challenge at first, especially with waking up in the middle of the night to do the patrols. For example, during the week of July 4, half of our patrol leaders were on vacations, so I

ended up having to lead patrols every night of that week, which was not easy. But, with the support of my patrol groups, we were successful in our field work. Also, every patrol I was on gave me more knowledge and experience.

The data that we gathered on night patrols included specific species identification, flipper tagging, length and width of shells, location of nests, quantity of laid eggs, date and time of discovery, and length of time from egg laying phase to completion of nesting. Once the eggs were successfully collected, we would carefully transport them to our hatchery on the beach, where we would re-bury them in nests that we would dig that mimicked the depth and shape of a natural nest. In addition, we would record data upon receipt of the eggs, which included hatchery nest coding, recording of species that laid eggs, date and time the eggs were relocated to the hatchery, projected dates that the eggs would hatch and emerge from nests, and the actual number of eggs in the nests. In order to keep the eggs safe at all times, we were assigned 4-hour guard shifts of the nests during the day and night, where we had to protect the nests from any predators or poachers. However, once I became a group leader, I was no longer assigned to that task because I was leading night patrols instead. Unfortunately, there were a few instances were raccoons were able to sneak into the hatchery and steal some of our eggs, even though there were people on watch at the time. But overall, we were successful at keeping the eggs safe until they hatched and the babies emerged.

Being with ASVO for so long made me familiar with how the program works. Many of the new volunteers and interns would come to me for advice about the work, the schedule, and even the town. So, I was given the task of implementing an introductory presentation for incoming interns and volunteers to detail roles and responsibilities, expectations, key aspects of conservation work, and everything else that they would need to know during their time with

ASVO. In addition, I was in charge of the coordination and execution of training exercises, which included proper nest digging, release of newborns, procedures for nest guarding, and discovery of turtles while on night patrol. For example, we once got about more than 10 new volunteers at once. After showing them around the house, I had to give them the introduction presentation about the type of work that they would be involved in, the rules that they would need to follow, and what is expected of them. Afterwards, Ricardo Bonilla, my other supervisor, and I led the demonstration for digging nests together. Since my English was better than his, he dug the nest, while I explained the process. It felt good the knowledge that I had gained about sea turtle conservation with others.

On rare occasions, I had to take charge of the prioritization of daily workloads. For example, on July 6, neither of my supervisors nor the more experienced interns were present at the house. So, I was tasked with leading a group meeting to discuss some important topics that Ricardo wanted me to talk to them about. These topics included how they felt about the living conditions and the work, changing the work schedule for the weekend since some volunteers would be leaving, assigning volunteers to a field trip to Cobano on both the Thursday and Friday of that week, assigning people to certain jobs, and making changes to the guard shifts at the hatchery. It was not easy, but after a thorough discussion and critical thinking with everyone, we managed to sort everything out. It was activities like that where I felt like a real leader.

In addition to being promoted to a group leader, I was made the group photographer. The people at the ASVO office in San Jose, Costa Rica, wanted more recent pictures of the program to use in their marketing efforts. So, my job was to document the team's work throughout my internship, and use the photos to prepare a promotional Power Point presentation for ASVO to use. While I was successful with taking photos of activities taking place during the day, I had

less luck with night activities, like night patrols and releasing newborns at night because of how I was not allowed to use a flash due to sea turtles' sensitivity to bright lights. But, in the end, I was able to obtain many photos that I used to put together a well-organized presentation.

By the time I left Costa Rica, I felt that this had been a very beneficial experience for me. I saw, did, and learned a lot about sea turtle conservation. I gained experience with being a group leader. Most importantly, I felt that I, and presumably other interns before and after me, had made a real contribution to the preservation, protection, and conservation of endangered sea turtle species.

SUCCESSES AND PROBLEMS OF SEA TURTLE CONSERVATION PROGRAMS

Like all other wildlife conservation programs, there are a variety of successes and problems that occur, both of which result in progress. Successes reveal conservation plans that work and produce the best results. While problems show errors in conservation plans, they also help us discover where the errors were made, so that we can fix and improve them, leading to more successful ideas for conserving wildlife.

In the case of sea turtle conservation, a major success is the large number of protected nests, whether they are in hatcheries or *in situ*. By protecting so many nests from both natural and anthropological threats, a large number of eggs are kept safe, which can lead to hundreds of baby sea turtles successfully hatching and returning to the sea. As a result, the hatchlings have a chance to survive to adulthood, return to the beach, and lay eggs of their own. All of this can help contribute to an increase in the density of sea turtle species. For example, during my internship in Costa Rica, we had over 15 nests in our hatchery, and we released over 100 baby olive ridley sea turtles into the sea. In fact, according to Roger, from June – September 2016, ASVO released 1503 baby sea turtles at the Montezuma station and 4820 baby sea turtles at the

Buena Vista station. Successes such as these can have a major influence on sea turtle populations.

Unfortunately, certain problems also occur in sea turtle conservation, such as the loss of eggs due to predators, humans, and diseases that prevent them from hatching. For example, while I was in Costa Rica, we lost eggs in our hatchery to raccoons multiple times. Also, we once came across a nest that had been buried on the beach. When we dug it up to retrieve the eggs, we saw that the eggs had been burnt. Apparently, a group of tourists had a bonfire over the nest without realizing it and burnt the eggs, and bonfires were illegal on the beach. In our hatchery, three nests were expected to produce babies before my internship ended. Of those three nests, baby sea turtles emerged from only two of them. As for the third nest, Roger dug up the eggs, opened some of them, and saw that there was only yolk in them. According to Roger, the female sea turtle that laid those eggs must have been sick at the time and the eggs were not fertile, so the babies did not even develop. Problems like these prove the sad reality that despite our best efforts, you can't save them all.

WAYS TO IMPROVE CONSERVATION EFFORTS

Based on my own experience, the only thing that I can think of that could be improved is better support for enforcing laws against environmental degradation. For example, on a few night patrols that I led, my group and I came across some bonfires on the beach, which are illegal and potentially dangerous to sea turtles because of how sensitive they are to bright lights. These can either scare turtles off or lure them in. In the case of a bonfire, a sea turtle could be drawn to the light from the flames, crawl over to it, and get burnt. In fact, the burnt eggs that we found in the buried nest demonstrate the negative impact of bonfires and the need for better law enforcement prohibiting it, like more patrols on the beaches at night from local policemen. Other than that, the

conservation program did not show many flaws. There were always volunteers and interns involved, whether it was for a couple of weeks, a couple of months, or more. Everybody did their jobs correctly, whether it was night patrol, hatchery watch, or another task. Also, the program seemed well-funded since we were able to purchase all of the necessary material, like new fencing material for the hatchery. However, on a larger scale, there are areas that can be improved.

Marine and coastal habitats may be protected individually or through regional or national systems of marine protected areas (MPAs). The acceptance by coastal communities, the existence of appropriate legal frameworks, an effective and well-supported management system, and the delineation of areas so their boundaries are clear and they can be treated as self-contained units influences the success of either types of MPAs (Salm et al. 2000:13). An MPA is a multiple use strategy that may be designated for any one or a combination of reasons, like how it provides a critical habitat for particular species or group of species, it is the best example of an important ecosystem or habitat type, it has high species diversity, it is a location of intense biological activity, it is needed for sustainability of fisheries such as through "no-take" zones, it is a tourist attraction, it protects the coastline from storms, it has special cultural values, and it facilitates necessary research or determination of "natural" baseline conditions (Salm et al. 2000:13-14). Through the use of tracking technologies, which are often proposed as a method to explain the complex migratory life histories of migratory marine vertebrates, such as sea turtles, allowing spatially explicit threats to be identified and mitigated, Scott et al. (2012) have learned that turtles aggregate in designated MPAs far more than would be expected. On a global scale, 35% of all sea turtles have were located within MPAs (Scott et al. 2012). When considered separately by ocean basin, 16% were found in the Pacific, 67% in the Atlantic, 19% in the Mediterranean,

and 34% in the Indian. In addition, Scott et al. (2012) show that the level of protection, size, and time of establishment of MPAs affects the likelihood of foraging turtles being found within MPAs, highlighting the importance of large, well-established reserves.

According to Maxwell et al. (2011), using satellite tracking can optimize the protection of olive ridley sea turtles. Using knowledge gained about animal movements, how movement relates to political boundaries, and our confidence in spatial analyses of movement, this strategy can be used to protect breeding adults. While studies have shown the vulnerability of early life stages of some marine species, like sea turtles, protection of breeding adults of long-lived species sustains populations in two ways (Maxwell et al. 2011). First, breeding individuals contribute disproportionately to sustaining the population compared to non-breeding individuals (Maxwell et al. 2011). Second, for many species, reproductive activities span several months and take place in distinct geographic regions that are often highly vulnerable, but allow practical protection that is more feasible than in cases where individuals are dispersed throughout the range (Maxwell et al. 2011). Satellite telemetry has proven an effective tool for gaining knowledge of at-sea behavior because it enables managers to determine movements away from land and is especially useful on remote nesting beaches where turtles are not reencountered frequently (Maxwell et al. 2011). This knowledge dictates the scale at which protective measures are necessary, helping managers develop conservation plans in better context of human and ecological needs (Maxwell et al. 2011).

Training programs for tourists could be an effective improvement in sea turtle conservation in terms of raising awareness and teaching tourists about how they can contribute to such conservation programs. For example, a tour guide training program was developed for rural communities near Costa Rica's Tortuguero National Park to respond to the impacts of the

increase in park visitation, to involve local communities in resource management, and to provide regional environmental education (Jacobson and Robles 1992). This program helped mitigate negative tourism impacts on the natural resources of Tortuguero National Park, particularly by regulating tourists on the park's beach, which is used for nesting by endangered sea turtles. It provided environmental education to an important segment of the local community not traditionally reached through school or government development projects. Environmental information was provided to tourists, thus enhancing their visit, and possibly increasing the likelihood that they will contribute to sea turtle conservation efforts in the future (Jacobson and Robles 1992). Also, through profitable part-time employment, it provided local economic benefits, thereby allowing local people to participate more fully in the tourism system (Jacobson and Robles 1992). Based on the results of this training program, it is clear that by creating more, we can make the public more aware of the situation about sea turtle conservation and get them more involved, which can have beneficial outcomes.

CONCLUSION

Based on this information and my own experience, it is clear that sea turtle species in Costa Rica are suffering population declines, and are in desperate need of effective conservation action. They are facing threats caused by diseases, humans, and nature, all of which are resulting in mortality and a decrease in abundance of the three species. It is a situation that demands a response from conservation organizations towards developing plans for restoring, protecting, and conserving these species before they go extinct. In this paper, I reviewed the problems facing sea turtles and the effectiveness of local volunteer based conservation actions. Such efforts will help ensure a future for sea turtles in Costa Rica.

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