Spring 2007 Internship with the South Florida Student Shark Project

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ECS 401
Introduction

During the course of the spring 2007 semester, I have interned with the South Florida Student Shark Project (SFSSP). The SFSSP is a new program under the principal direction of Neil Hammerschlag, a PhD candidate at the Rosenstial School of Marine and Atmospheric Science (RSMAS) in collaboration with a number of professionals from RSMAS, Mote Marine Laboratory and NOAA. The goal of the program is to study sharks and their roles in the ecosystems of South Florida, while simultaneously promoting awareness and conservation of these vital marine predators.

Through my involvement with the SFSSP, I have had the opportunity to gain extensive experience in scientific study. My work with the program has included running a number of field sampling techniques, performing taxonomical analysis of collected fish samples, aiding in the development of optimal research strategies, and working with and educating area high school volunteers.

Mission of the SFSSP

Despite being highly important apex predators, the current status of sharks in South Florida ecosystems is poorly understood. The goal of the SFSSP is to characterize the life history, key habitats, prey items, and threats of coastal shark species. This is to be accomplished by collecting and tagging sharks so as to assess population levels and migration patterns; performing genetic analysis to study population structures; performing mercury biopsies in order to determine levels toxic bioaccumulation; everting the stomachs of collected sharks so as to examine diet (see Gillneting); and collecting environmental conditions at sample sites so as to observe preferred environmental conditions. In addition to shark research, sampling trips are conducted to collect small
fish and crustaceans upon which sharks feed. These samples are coordinated with the location of shark collection so that data on prey abundance may be compared to prey selection data obtained from the stomachs of collected sharks.

In addition to the scientific benefit provided by this research, the SFSSP hopes to provide information to aid in management decisions. By better understanding the important habitats and prey items of coastal South Florida sharks, recommendations may be made for protection of habitats and regulation of fishing. As an added benefit, by examining mercury levels in sharks, hotspots of Hg accumulation may be identified. By observing the location of dangerous (both to human and environmental health) levels of mercury pollution efforts mitigate this threat may be increased and improved.

The SFSSP is a highly innovative project in a number of ways. As previously mentioned, data on shark ecology in South Florida is greatly lacking, due largely in part to the difficult nature of studying these organisms. The SFSSP is among the only research programs to attempt a study of this magnitude. The scale and labor-intensive nature of shark research makes it unfeasible for most organizations to attempt. The SFSSP has overcome this obstacle by mobilizing student interns and volunteers.

The SFSSP collaborates with a number of area high schools, namely Palmer Trinity and the MAST academy. Volunteers from these schools periodically aid in fieldwork and lab study, greatly speeding the process and at times providing the necessary workforce to perform the large scale netting procedures utilized by the SFSSP. In addition, this work provides high school students with invaluable hands on experience in science, and the opportunity to work with and learn from university interns.
Volunteers and interns such as myself from the University of Miami are a vital component of the SFSSP. On any given trip, the team generally consists of 2 to 3 professional staff and anywhere from 4 to 10 volunteers. In this way interns make this project viable, without student participation it would be simply impossible to collect data on the scale the SFSSP does. As a result, to date we have obtained totally unique data on the ecology of coastal South Florida sharks, including never before done night sampling within Biscayne Bay National Park. This fact makes interning for the SFSSP an amazing opportunity; one is not simply a side worker or aide but an integral part of the team.

An additional benefit of the role of students in this new program is being given to opportunity to aid in the development of a research project. Many times, volunteers are assimilated into a long established project and inserted into a set routine. While valuable skills may be acquired in this method, little to no insight into the development of these endeavors is obtained. By contrast, the SFSSP is still under development. As an intern then, I have had the opportunity to give feedback on the project and help make it more effective and scientifically rigorous. During the course of my work with the project, I have helped streamline the collection of fish samples, and suggested improved methods for returning tagged sharks to the wild during low visibility night trips.

Activities as an SFSSP Intern

My principal duties as an SFSSP intern are to perform field operations and collect samples. On average, I spend 10 to 20 hours per week working in our study sites in Biscayne Bay National Park. Two techniques are used to collect our samples: seine nets for capturing small fish and crustaceans, and gillnets for collecting sharks and other large marine organisms. The sample sites are established at points on the mainland and leeward
keys of Biscayne Bay National Park. Seine or gillnets are deployed in a transect perpendicular to the shore, beginning on the mangrove edge. The length of the transect is demarcated into numbered zones. A typical setup is illustrated in Fig.1

![Figure 1 General Scheme for Net Placement](image)

In this way, abundance of fish species caught in a particular zone may be compared to prey selection in sharks caught within the same region of the nets. In addition, by observing the favored location of certain species, the SFSSP hopes to determine the role of mangroves in predator and prey interactions. It is believed that mangroves play a pivotal role as nurseries for a variety of organisms. By observing the relative abundance of different species with respect to the mangrove edge, additional evidence may be gathered to support the important role of mangroves in marine ecosystems.
Seining

Seine nets are used to collect samples of small prey fish such as mojarra, juvenile snapper and barracuda, pufferfish, silversides and killifish. Sampling is done both day and night, preferably at low tide as the nets cannot be easily pulled in deep water. Upon arriving to the site, two team members enter the water to setup the zones. Each zone is marked by a weighted float, spaced 20m apart as shown in Fig. 1. The rest of the team then enters the water and begins to deploy the nets. Each net requires 3 to 4 people to pull, so the number of interns and volunteers available on any given trip dictates how many seines can be operated at once. Each net is set up facing the prevailing wind or current. The area sampled by the seine is standardized by use of tether poles and mainlines. A 15 m mainline is strung between the two poles of the net, setting the width. Two 9 m ropes are also attached to the poles of the net and grounded to tether poles, standardizing the length of the pole. In this way, the number of fish captured can be quantified as catch per unit effort. A team member stands at each pole, while at least one other follows the end of the net to remove snags and carry the bucket and pivot pole needed for sample collection. In unison, each net is pulled in the direction opposite the wind or current, with the people dragging the poles taking care that the net stays close to the bottom, preventing fish from escaping and ensuring bottom dwelling organisms are captured. The fish themselves are trapped in a bag in the middle of the net. This process is illustrated in Fig. 2.
Figure 2 Procedure for Seine Net Operation

In addition to collecting fish, environmental observations such as water depth, salinity, temperature and pH are recorded at each zone. Once collected, the fish are
placed in bags according to the zone they came from and placed on ice for later analysis. While it is unfortunate that the fish must be killed, the impact of this on their populations in the Park are negligible, especially when compared to the numbers routinely captured by commercial trawling operations. Once enough samples have been collected and information on the population structures of these ecosystems established, it will not be necessary to keep samples and instead the fish may be returned to the water.

Collected, fish are counted, measured and weighed. Also, when possible the stomach is dissected in order to better understand the food chain of the region. Seining provides then quantifiable data on population structures of these fish upon which coastal sharks prey.

**Gillnetting**

In order to capture sharks, a gillnet is used. A gillnet uses mesh large enough that small fish simply swim through it, but larger fish such as sharks become entangled and trapped. Unlike the seine nets, the gillnet utilized by the SFSSP is a continuous 600ft long. The advantage of utilizing a gillnet for capturing sharks is that it is passive, allowing for quantifiable data. While fishing or chumming may attract more sharks, these techniques are biased as it preferentially attract hungry sharks, and any sharks caught may not be representative of a particular area, as they may have smelled the food and come from a distance away. Using a gillnet, any shark that happens to run into the net is caught, ensuring random sampling of the local population.

The disadvantage of gillnetting is it is size specific: only organisms of a particular size will be trapped by the mesh, others will swim through or bounce off the net. This is an acceptable drawback for the SFSSP as the program at this point of the study is
interested in quantifiable data on small coastal species and juvenile sharks in the South Florida area, so only a certain size range is desired for capture. The gillnet has a float line on top and a lead line on the bottom, so it stays in place and floats in the water column. The end of the net is anchored to the mangroves, and the net is then deployed from the boat along the transect, perpendicular to the shore. After the net is set out, buoys are set out to mark the zones, just as in the seining procedure. This process is shown in Fig. 3.

**Figure 3** Deploying Gillnet

Once the net is deployed, two teams of two people enter the water, each team stationed at opposite ends of the net. At any time, if motion is seen in the net the nearest team immediately moves to respond. Being caught in the gillnet is extremely stressful for
sharks, so getting them out of the net as quickly as possible is vital to ensuring their survival. If no movement is seen in the net, each team remains at opposite ends of the net for 15 minutes, allowing the gillnet to sit undisturbed. This ensures that sharks are not frightened off by human presence. While sharks are always the priority for removal from the net, bycatch is also a factor when gillnetting. Often fish such as bar jacks, bonefish or snapper are caught by accident, along with sea turtles. Fish bycatch is returned to the boat for analysis; any turtles caught are immediately released.

Once a shark has been caught, it is taken as quickly as possible to the boat. As it is best to minimize the time spent by sharks in the net, if many are caught at once the first sharks to be removed from the net are kept in a holding pen until all are safely extricated from the gillnet and can be taken to the boat. Once on the boat, the sharks are kept in a saltwater tank with O₂ being bubbled into it, in order to allow the fish to breath while remaining relatively motionless. After the shark’s condition has been stabilized, it is removed from the tank and a stomach eversion is performed. Sharks are naturally able to vomit their stomachs out of their mouth in order to purge unwanted materials such as rocks or trash. The SFSSP utilizes this ability to remove the contents of the shark’s stomach without killing the animal. The shark is held upside down, and using forceps the stomach is everted through the mouth, where food items are rinsed out and stored on ice for later analysis.

As this is a highly stressful though non-harmful experience for the shark, it is returned to the ocean where it is held and swum through the water in order to rehabilitate the animal. Once returned to a healthy condition, the shark is placed back on board the boat where it undergoes further work. First, it is sexed, weighed and measured. A tiny
clip is then taken from the dorsal fin for DNA analysis. Next, a biopsy is taken for mercury analysis. Lastly, a numbered tag is inserted into the biopsy hole for future identification of the shark in the event of a recapture (which has already occurred). An example of this process is shown in Fig.4

![Data Collection and Tagging of Shark](image)

**Figure 4** Data Collection and Tagging of Shark

Once this process is completed, the shark is ready to be prepared for release. The shark is almost always extremely stressed by this process, and if simply tossed back into the water will most likely sink to the bottom and die, as sharks must swim in order to move water over their gills and breath. In order to release the shark, an SFSSP intern must take the animal into the water and by grabbing on to the head or body, depending on the species of shark, swim the animal in circles in its natural S shaped motion, forcing water over the gills. Once the handler deems the shark ready, it is released and pinched by the volunteer, hopefully inducing it to swim off on its own. Sometimes however this is
not the case and the shark sinks to the bottom, in which case it must be collected and revival continued. At night, it can often be difficult to see where the shark has fallen to if it has failed to swim on its own. As such, I found the best technique was to have one person watching the release underwater with a mask and light so as to monitor the position of the shark should it fall to the bottom. In this way nearly every shark captured has been returned safely and healthily to the wild, as illustrated in Fig.5

Figure 5 Recently Released Bonnethead Shark
High School Interaction

In addition to the scientific research aspects of interning with the SFSSP, my duties included working with high school volunteers. This was an extremely beneficial aspect of my internship. On occasion it would be my job to brief the visiting students and their teachers on the SFSSP and the work we would be doing that day. Having to explain the process to others in an engaging and informative manner encouraged me to learn as much as possible about the project so as to be better informed and able to present the material. It was also very rewarding to be able to talk with the kids about studying life sciences and to give them advice on the college process. This is an extremely important aspect of the SFSSP, by engaging local youth the program promotes conservation, both by increasing awareness of environmental and shark related issues and through encouraging the development of young scientists.

Opportunities Gained through SFSSP Internship

This internship has been a valuable to me not only in experience acquired but in future opportunities made available. As a result of my volunteering this semester, I was selected as one of two interns to be hired as a full time research assistant for the summer. In this capacity, I will be continuing my current work, along with taking on a number of new duties. Just now we have begun lab analysis of collected samples, namely counting, identifying and recoding data such as size weight and stomach contents of the fish collected through seining. During the summer, the second research assistant and I will be analyzing the contents of the everted shark stomachs, in order to study prey selection in these animals. This will not only provide valuable experience, but also potentially lead to
publishable findings. This would be both a fascinating endeavor and a great tool for applying to graduate programs in the future. In addition to this work, I will be performing visual surveys of fish species in the South Florida area, obtaining my boat crew chief certification, and aiding in genetic and mercury content analysis. All of these activities will not only be rewarding but add highly desirable qualifications to my resume. While only a summer position, my work as a research assistant for the SFSSP will greatly aid my search for future employment.

In addition, my internship with the SFSSP has opened the doors to a number of other exciting possibilities. Through a newspaper article on the program in the Miami Herald, a local philanthropist heard about our research and is offering the use of his 60ft yacht for exploratory research. Through this opportunity on May 19th the SFSSP will be going out into Florida Bay and baiting the water for large pelagic sharks and other fish.

The photographic opportunities afforded by this program have been an unexpected benefit. I have always loved photography and would be very interested in pursuing documentary filming or pictures. Through the SFSSP, I have come into contact with Jim Abernathy, a local shark dive operator and underwater photographer. He and his film crew have accompanied the SFSSP on a number of trips in order to document the project’s work. In the course of these encounters I have been able to learn new photographic techniques and discuss the documentary business. I hope to pursue this opportunity in order to gain further experience in this exciting field.

Lastly, the program is currently discussing organizing a trip to South Africa in the coming year in order to observe and interact with great white sharks. My director Neil spent several years studying these sharks in South Africa, so being able to go and work
with these amazing predators with an expert would be a tremendous opportunity few
would ever have the chance to experience.

**Policy Implications of the SFSSP**

The SFSSP is fascinating work as it aims to utilize hard science in order to
influence real ecosystem management policy. One of the principal goals of the project is
to study the importance of mangroves as protection for small prey fish and feeding
grounds for sharks. By gaining knowledge into this relationship, we may be better
informed as to the habitats most in need of protection. This is especially important in
Biscayne Bay National Park, as fishing is currently permitted there. By helping to
determine particularly valuable habitats for sharks, the SFSSP may help determine
regions of the Park which should be designated as no or restricted take zones.
Additionally, by studying the feeding patterns of these apex predators, it may be possible
to identify vital prey species, which then in turn may be targeted for conservation.

Secondly, the mercury analysis performed by the SFSSP has great potential for
ecosystem management. The impact of mercury on marine organisms is poorly
understood (Evers 2005). By studying the damage caused by Hg to sharks, it may be
possible to empirically show the detrimental impacts of this toxin to the marine
environment, encouraging regulation of this dangerous pollutant.

In addition, due to the biomagnifying abilities of Hg and the position of sharks at
the top of local food chains, sharks are an extremely useful indicator species of mercury
pollution (Evers unpublished report). High mercury levels in sharks likely reflect high
levels in the environment, an issue which greatly captures the attention of the public as
often these waters are used by people, and mercury represents a powerful threat to human health. Dangerously high levels of mercury have already been discovered in a number of South Florida sharks, as can be seen in data from a study done in collaboration with the SFSSP, shown in Fig. 6.

**Figure 6** Arithmetic mean (+/- sd) of mercury levels in six shark species. Yellow line represents EPA action level of 0.3μg/g. Orange line represents FDA action level of 1.0μg/g. Red line represents adverse effects level for freshwater fish (2.37μg/g) (Evers unpublished report)

Through the SFSSP’s work, further attention may be drawn to this important issue, furthering the cause of improved regulation mercury emissions, to the benefit of both marine ecosystems and humanity.

Lastly, by increasing public awareness of shark and ecosystem conservation through direct interactions with the community and media attention, support for these animals and their environment can be garnered. Disseminating information on sharks and the vital role they play in marine ecosystems will promote tolerance and appreciation
among the populace for these key predators, encouraging the development of beneficial management policies.

**Conclusions**

My internship with the SFSSP has provided me with invaluable work experience in scientific research and the development of knowledge on which ecosystem management should be based. The extensive field and lab work of the project has bolstered my skill sets and provided me with attributes highly desirable to future employers or graduate schools. Being able to collaborate with area high schools has improved my communication abilities and highlighted the techniques needed to accurately convey scientific information to the public. In addition, this program has greatly augmented my career possibilities, whether through future employment with the SFSSP itself or by aiding in the acquisition of other jobs or graduate school opportunities. I would highly recommend the program for future ECS majors in need of an internship, and the SFSSP has suggested that I take part in the selection of interested students. As such I would be glad to serve as a contact between the SFSSP and the Leonard and Jayne Abess Center for Ecosystem Science and Policy, so that other students may have access to the opportunities my internship has afforded me. For further information, contact myself or Neil Hammerschlag at nhammerschlag@rsmas.miami.edu.
Works Cited


Evers DC. Unpublished report: Mercury levels in Florida Sharks. BioDiversity Research Institute