

UNIVERSITY
OF MIAMI

R.J. DUNLAP MARINE
CONSERVATION PROGRAM



2012

ANNUAL REPORT

TABLE OF CONTENTS

This document is a report summarizing the achievements and progress of the University of Miami's R.J. Dunlap Marine Conservation Program (RJD) in 2012.



RJD is a joint initiative of the Rosenstiel School of Marine & Atmospheric Science (RSMAS) and the Leonard and Jayne Abess Center for Ecosystem Science and Policy at the University of Miami.



2	OVERVIEW
4	RESEARCH
12	EDUCATION
14	OUTREACH
16	SUPPORT
18	HIGHLIGHTS
22	CREDITS

OVERVIEW

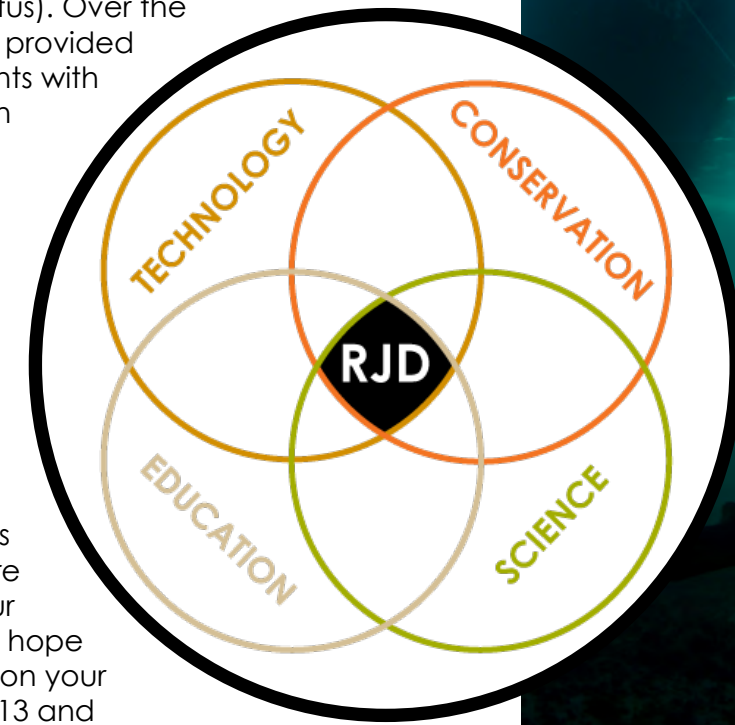


The mission of RJD is to advance ocean conservation and scientific literacy by conducting cutting edge scientific research and providing innovative and meaningful outreach opportunities for students through exhilarating hands-on research and virtual learning experiences in marine biology. Focusing primarily on the study and conservation of sharks, the Program's full-immersion approach allows students to actively grow as future scientists.

From a broad research perspective, the over-arching theme of our scientific work focuses on understanding and addressing issues relating to the negative anthropogenic impacts on marine ecosystems. This research includes (1) understanding the ecological impacts of predator declines, (2) determining habitat use and migratory patterns of large sharks using satellite tracking, (3) understanding how toxins biomagnify up marine food webs, (4) evaluating the susceptibility of different fishes to human threats (e.g. fishing and habitat destruction) and how best to mitigate these risks, and (5) investigating the economic benefits, ecological impacts and social implications of shark tourism (diving and fishing,) while promoting best practices.

From a broad educational perspective, the RJD Program addresses two major needs in the United States and abroad: (1) a lack of engaging science education opportunities that inspire youth to learn STEM (Science, Technology, Engineering and Math) skills and adopt conservation attitudes and behaviors, and (2) a lack of knowledge and awareness about marine ecology and conservation. To meet these educational challenges and bring about the desired change, RJD engages in numerous activities including community outreach, marine-based field, lab, and virtual research experiences and online educational activities. Educational opportunities are provided to high school students, undergraduate and graduate students, as well as members of the general public through the Citizen Science™ initiative. High school outreach opportunities are especially made available for those in land-locked communities as well as those in traditionally under-served populations (gender, disability, race, socioeconomic status). Over the past years, RJD has provided thousands of students with real in-field research experiences and continues to reach tens of thousands of people every month through our online interactive website.

Included in this report are the Program's objectives, activities and results that were generated with your support in 2012. We hope that we can count on your support again in 2013 and beyond.



RESEARCH

Through strong collaborative efforts, the RJD Team is investigating 11 primary research projects. The goal of this work is to generate data that can be used by managers to help implement effective conservation strategies. Below please find a brief overview of progress towards these projects in 2012.

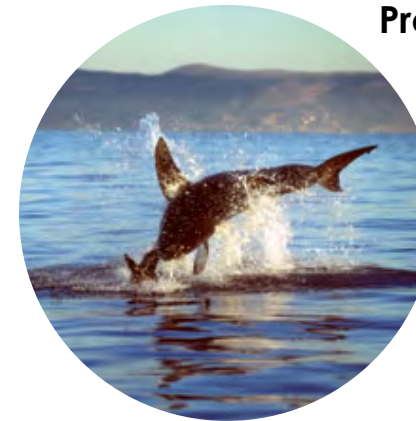


Biomagnification of Toxins in Marine & Coastal Food Webs

In the spring of 2012, RJD published an article in collaboration with Dr. Deborah Mash and the University of Miami's Medical School sharing alarming results pertinent to human health. The study, published in the journal *Marine Drugs*, discovered that a naturally occurring neurotoxin called BMAA was found in high concentrations in shark fins. BMAA has been linked to a higher risk of developing neurodegenerative diseases such as Alzheimer's. These results suggest that consuming products made from shark parts, such as shark fin soup, can increase one's risk of developing these detrimental diseases.

Satellite Tracking of Threatened Fishes

Working in collaboration with University of Miami tarpon researchers Dr. Jerry Ault and Dr. Jiangang Luo, RJD conducted a joint satellite tagging study on tarpon and bull sharks in South Florida. The results were published in the journal *PLOS ONE* and suggested that tarpon may avoid areas of high bull shark habitat use to avoid potential predation by sharks. The paper also showed relatively high site fidelity in shallow, nearshore waters by both animals, making them disproportionately vulnerable to coastal fishing, reduced water quality, pollution and habitat degradation. Taken together, the study provides insights into prioritizing areas for protection as well as understanding how loss of sharks or tarpon may impact ecosystems.



Predatory Behavior of Great White Sharks

Using basic principles of underwater optics and physics, Dr. Neil Hammerschlag and the late Dr. Aidan Martin investigated marine predator-prey interactions between great white sharks and Cape fur seals in South Africa. The research, published in the journal *Marine Biology Research*, revealed that attacks by sharks on seals appear to be impacted by the sharks' ability to encounter, ambush and subjugate Cape fur seals and the seal's ability to detect, avoid, out-manuever, and injure its predator.

Ecological Risk Assessment of Threatened Sharks

In an ecologically changing world and ocean, understanding the vulnerabilities of species to human-induced stressors is critical to determining how their survival will be challenged. In 2012, Ph.D. candidate Austin Gallagher and Dr. Neil Hammerschlag published an article in the *Journal of Fish Biology* that builds on a framework for Gallagher's thesis work in 'triaging' threatened shark species based on their capacity to withstand and adapt to changing oceans. They have shown that it is useful to incorporate sharks' physiological and behavioral traits into management strategies, especially for species that are already in serious decline.



Research also Continued for these Projects:

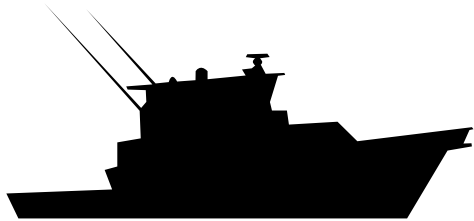
- Fish Stress Physiology & Post-Release Survival from Angling
- Food-Risk Trade-Offs in Mangrove & Coral Reef Fishes
- Using Steroid Hormone Analysis, Ultrasonography and Satellite Telemetry as Non-invasive Tools for Examining Reproduction in Tiger Sharks
- Atlantic Sailfish: Migration and Growth
- Cascading Ecosystem Impacts of Overfishing
- Bull Shark Distribution & Behavior in South Africa
- Tracking Bacterial Loads in Coastal Waters

Explore more RJD research information, photos, video, and infographics on our website: **SharkTagging.com**.

RESEARCH

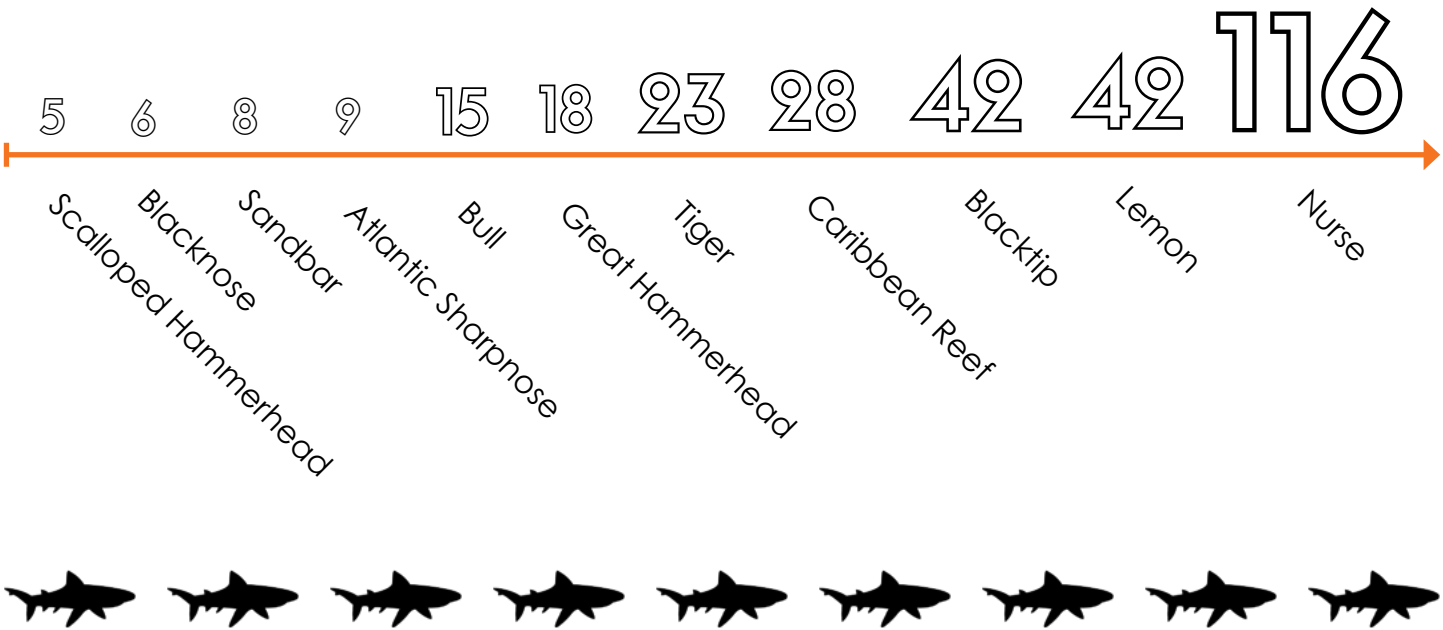
In 2012 the RJD research team embarked upon:

- 60 cruises throughout South Florida and the Keys.
- 3 week-long Bahamian cruises
- and 1 to Haiti.



WHAT'S THE CATCH?

328 TOTAL FISH were caught this year. 293 CARTILAGINOUS FISH were caught, sampled, tagged, and released. 35 bony fish were caught.



This year, we added a new type of satellite tag called a **“HAMMERTAG”** to our toolbox. The custom-made tag has the ability to recharge its battery via a small SOLAR PANEL, permitting multi-year deployments. The tag can record position, depth, acceleration, orientation, and temperature.



In 2012, we deployed 24 SATELLITE TAGS:

- 8 Bull Sharks
- 2 Great Hammerhead Sharks
- 14 Tiger Sharks

RESEARCH

2012 SCIENTIFIC PUBLICATIONS

Hammerschlag N, Luo J, Irschick DJ, Ault JS (2012) A Comparison of Spatial and Movement Patterns between Sympatric Predators: Bull Sharks (*Carcharhinus leucas*) and Atlantic Tarpon (*Megalops atlanticus*). PLoS ONE 7(9): e45958. doi:10.1371/journal.pone.0045958



Shifman DS. 2012. Twitter as a tool for conservation education and outreach: what scientific conferences can do to promote live-tweeting. Journal of Environmental Studies and Sciences DOI 10.1007/s13412-012-0080-1

Shiffman DS, Gallagher AJ, Boyle MD, Hammerschlag-Peyer CM, Hammerschlag N. 2012 (Cover). Stable Isotope Analysis as a Tool for Elasmobranch Conservation Research: A Primer for Non-Specialists. Marine and Freshwater Research, 63:635-643.

Gallagher AJ, Kyne PM, Hammerschlag N. 2012. Ecological risk assessment and its application to elasmobranch conservation and management. Journal of Fish Biology, 85(5): 1727-1748

Thaler AD, Zelnio KA, Freitag A, MacPherson R, Shiffman DS, Bik H, Goldstein MC, McClain C. 2012. Digital environmentalism: tools and strategies for the evolving online ecosystem. In SAGE Reference — Environmental Leadership: A Reference Handbook D. Gallagher (Ed.).

Mondo K, Hammerschlag N, Basile M, Pablo J, Banack SA, Mash DC. 2012. Cyanobacterial Neurotoxin β -N-Methylamino-L-alanine (BMAA) in Shark Fins, Marine Drugs, 10(2), 509-520; doi:10.3390/md10020509

Fallows C, Martin RA, Hammerschlag N. 2012. Comparisons between white shark-pinniped interactions at Seal Island (South Africa) with other sites in California (United States). In: Global Perspectives on the Biology and Life History of the Great White Shark, ed. Michael L. Domeier, CRC Press, Boca Raton, FL.



Hammerschlag N, Gallagher AJ, Wester J, Luo J, Ault JS. 2012 (Cover). Don't bite the hand that feeds: assessing ecological impacts of provisioning ecotourism on an apex marine predator. Functional Ecology, 26(3): 567-576

Martin RA, Hammerschlag N. (2012): Marine predator—prey contests: Ambush and speed versus vigilance and agility, Marine Biology Research, 8:1, 90-94

Hammerschlag N, Martin RA, Fallows C, Collier R, Lawrence R. 2012. Investigatory Behavior towards surface objects and Non-consumptive Strikes on Seabirds by White Sharks (*Carcharodon carcharias*) at Seal Island, South Africa (1997-2010 In: Global Perspectives on the Biology and Life History of the Great White Shark, ed. Michael L. Domeier, CRC Press, Boca Raton, FL.

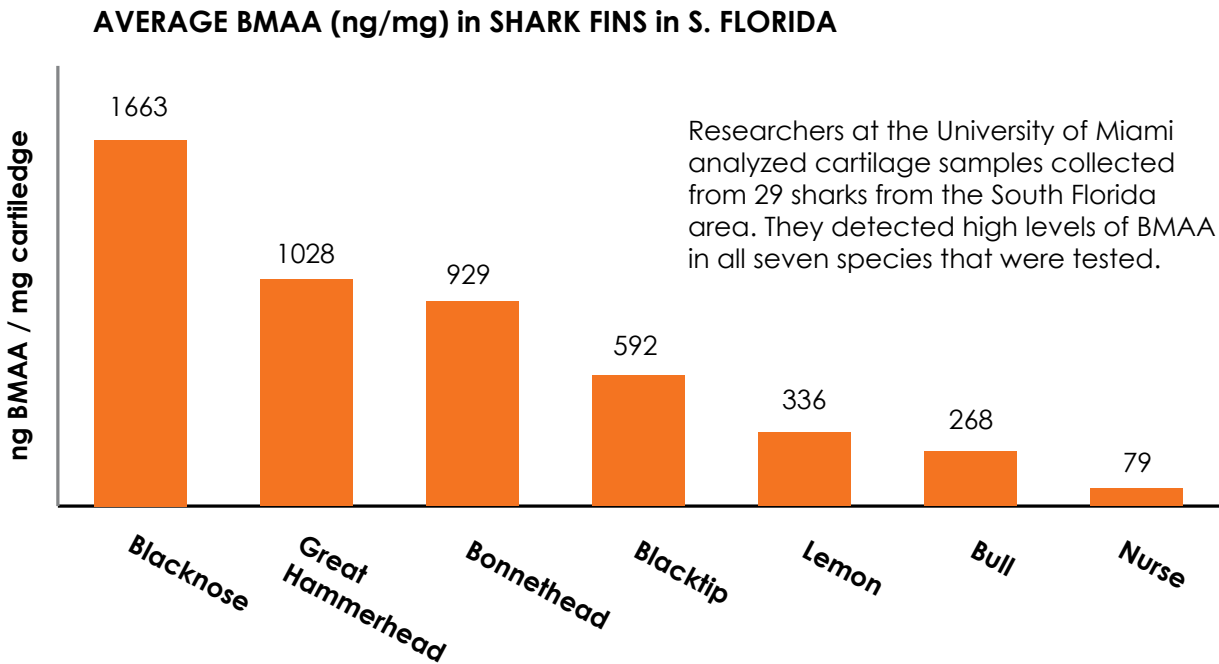
DOES ECOTOURISM IN THE BAHAMAS AFFECT TIGER SHARK MOVEMENT AND BEHAVIOR?



Last year, Dr. Neil Hammerschlag and Ph.D. Candidate Austin Gallagher published an article discussing the economic benefits of shark ecotourism. This year, they investigated another aspect of ecotourism - its **ecological impacts**. Published in *Functional Ecology*, the article showed that for tiger sharks in the sub-tropical Atlantic, **ecotourism did not impact** their long-term, large-scale **movements**. In fact one of the sharks in this study covered an area larger than **1 billion football fields!**

The Hidden Harm of Shark Finning - An Infographic

Shark finning is a profitable yet destructive industry, in which the fins of approximately 100 million sharks end up in the shark fin trade each year. Shark fins are a highly valued commodity for their use in health supplements and shark fin soup. However, researchers at the University of Miami have discovered that shark finning may have devastating impacts for both sharks and humans alike. A recent study by Dr. Neil Hammerschlag in collaboration with Dr. Deborah Mash at the University of Miami's Medical School has shown that shark cartilage contains a neurotoxin that has been linked with Alzheimer's Disease and Lou Gehrig's Disease (ALS), putting shark fin consumers at elevated risk for developing neurodegenerative diseases.

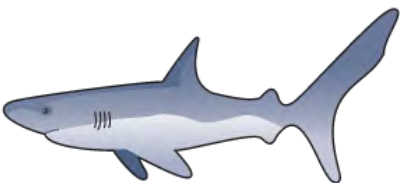


The Journey of a Neurotoxin

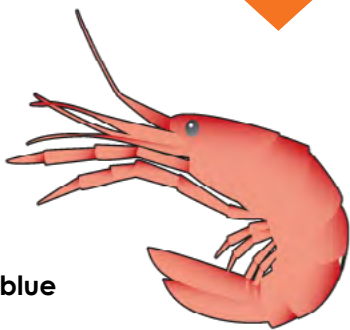
High concentrations of the neurotoxin **BMAA (beta-N-Methylamino-L-alanine)** have been detected in fin cartilage samples collected from seven species of sharks off the coast of Florida. Originally produced by bacteria, **BMAA bioaccumulates** through the food chain, and can be toxic to humans.



Cyanobacteria, an aquatic bacteria at the base of the marine food web, are found in most marine and freshwater habitats. When conditions are optimal, they reproduce rapidly, creating visible surface blooms. Most types of cyanobacteria **naturally produce BMAA** as a byproduct of metabolism.



Sharks are long-lived apex predators, accumulating **high concentrations of toxins**, such as mercury and BMAA. As highly migratory fish, sharks likely encounter active cyanobacterial blooms, feeding on BMAA-containing fish and crustaceans.



A diverse group of small marine animals **feed on cyanobacteria**. Many fish and crustaceans have been found to have high concentrations of BMAA, **especially pink shrimp and blue crabs** in South Florida.



Shark fin soup, an Asian delicacy, often sells for **\$100 per bowl**, making it one of the world's most expensive fishery products. Shark fin cartilage is also sold as supplements that claim to prevent cancer and joint problems, although there is no scientific evidence supporting this.



Neuroscientist Dr. D. Mash found that brain samples from people who died of **Alzheimer's or Lou Gehrig's disease (ALS)** had **elevated levels of BMAA**.

This infographic was originally created by RJD Graphic Design Intern Morgan Visalli.

RESEARCH



CAN SOCIAL MEDIA HELP SPREAD NEWS OF IMPORTANT SCIENTIFIC DISCOVERIES?

In 2011, Ph.D. student David Shiffman was invited to attend the Society for Conservation Biology's International Congress for Conservation Biology in New Zealand to share some of the scientific presentations given at the conference over Twitter. Last year, he published an article about these experiences in the *Journal of Environmental Studies and Sciences*. David was able to help create a truly global conversation about new discoveries in conservation biology, with Twitter followers from over 40 countries participating in the discussion. He estimates that as many as 150,000 people saw at least one conference-related Tweet, a figure many times larger than the size of the conference itself, showing that Twitter can be an incredibly useful tool for public outreach at scientific conferences.

ANIMAL WELFARE

The RJD Program is committed to protecting the health and safety of all individuals involved in its research and outreach, including the animals. All staff, students, interns, volunteers, and participants receive shark handling and safety training. In addition, we are always brainstorming new ways to improve our efficiency and decrease shark stress exposure.

The University of Miami ensures that all faculty and staff comply with federal and state guidelines concerning the use of animals in research and teaching through the Institutional Animal Care & Use Committee (IACUC). Working in conjunction with the Division of Veterinary Resources (DVR), the IACUC is accredited by the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) and meets monthly to review protocols. IACUC members include participants from all University campuses and the general community.

"SHARK - FRIENDLY" RESEARCH TECHNIQUES



Circle Hooks & Drumlines

Using custom-designed fishing units called drumlines, hooked sharks can swim in large circles, promoting ventilation of the gills and thus animal vitality. Circle hooks reduce the incidence of deep hooking.



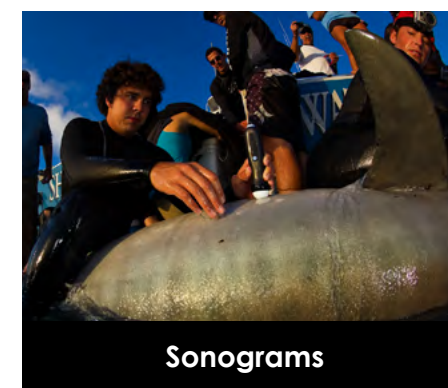
Ventilation Pump

If the shark is brought aboard for tagging and sampling, a water pump is placed in its mouth that pushes fresh ocean water over its gills; this allows for continued breathing, and reduced stress levels.



Non-Lethal Sampling

Just like at the doctor's office, a quick blood test can reveal a wealth of information without an invasive procedure; this is one of the methods used to conduct non-lethal sampling. Others include finclips and biopsies.



Sonograms

During special expeditions, sharks will be quickly and painlessly inspected via sonogram for pregnancy. This is a cutting edge, non-lethal method for studying shark reproduction.



Satellite Telemetry

Utilizing satellite tag technology, we can gather invaluable data without compromising the life of an endangered shark; the tag is attached with the utmost consideration to shark health and safety.



Quick, Efficient Work-up's

Our team works like a race car pit crew to quickly tag and sample the shark before releasing it back into the ocean. We monitor the shark's condition upon release to help gauge the efficacy of our stress-reducing efforts.

EDUCATION

RJD staff and interns work closely with local educators to give high school students a chance to experience scientific research in marine biology. These experiences both promote environmental stewardship and foster scientific career pathways. Additionally, face-to-face teaching builds relationships between high school and college students.



Student Field Trips

One of the core components of the RJD Program is providing experiential learning opportunities to young adults, whether it's tagging a shark or billfish, planting a coral, or measuring a mangrove. RJD offers amazing, educational experiences to groups of high school students all year long. Classes take an active role in real research projects, learn the scientific method, and assist in protecting some of the world's most threatened resources. Within the 2012 season, the team was able to embark on **over 60 research trips**.



Public Presentations

Many RJD Interns now choose to undergo intensive practical training to improve their teaching and student engagement skills. These individuals are then eligible to speak on behalf of RJD at a variety of settings, such as schools, universities, community centers, and conferences. In 2012, the team delivered **over 20 presentations**, both in person and via Skype.



Undergraduate and Graduate Internships



The RJD Internship Program has expanded to include both science and multimedia. Students gain valuable instruction in field research techniques, laboratory analysis, conservation writing, photography, Edu-Media, and public speaking. In addition, within each semester, approximately six training sessions are offered to interns in a variety of subjects, such as stable isotope analysis, policy tools for conservation, and social science survey design. In 2012, **27 undergraduate and graduate students participated** in the internship program.

Virtual Learning

To impact an even larger audience from across the globe, RJD continues to use a variety of online education tools, including **virtual expeditions**, satellite tracking of sharks, webinars, podcasts, blogs, online curricula and social media. 2012 highlights include an expansion of blog topics and content, Twitter Teach-In events, and both **infographics** and **video abstracts** to accompany scientific publication releases.

In 2012, RJD provided the first marine science "**Twitter Teach-In**", a 30 minute marine biology 101 style lectures taught entirely over twitter that includes links to videos, news articles, and scientific papers. We have since hosted four (overfishing, bycatch, marine protected areas, and sea turtle biology and conservation) and have involved thousands of people from all over the world. The Twitter Teach-Ins are created and hosted by Ph.D. student David Shiffman.



Citizen Science™



Citizen Science™ is an opportunity for nonprofessional scientists to be involved in scientific inquiry through proactive participation with scientists working on problems relating to their research goals. RJD offers a **customized shark tagging experience** both in Miami, the Florida Keys, and the Bahamas that allows individuals to participate in collection of scientific data from sharks with our research team. In 2012, RJD hosted trips for many **corporate groups** as well, including Oracle, Mazda, Toyota, and WPO.

OUTREACH

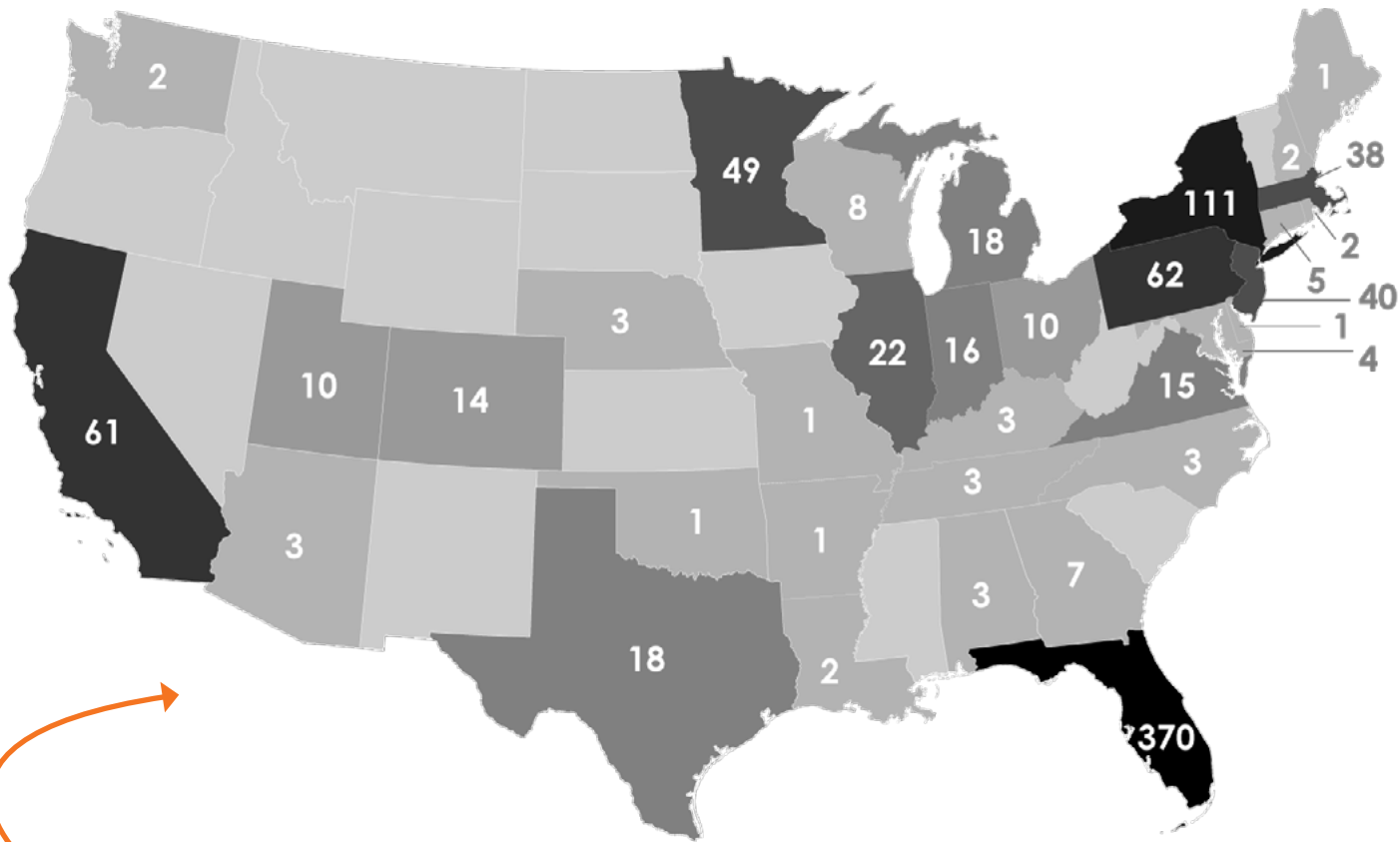
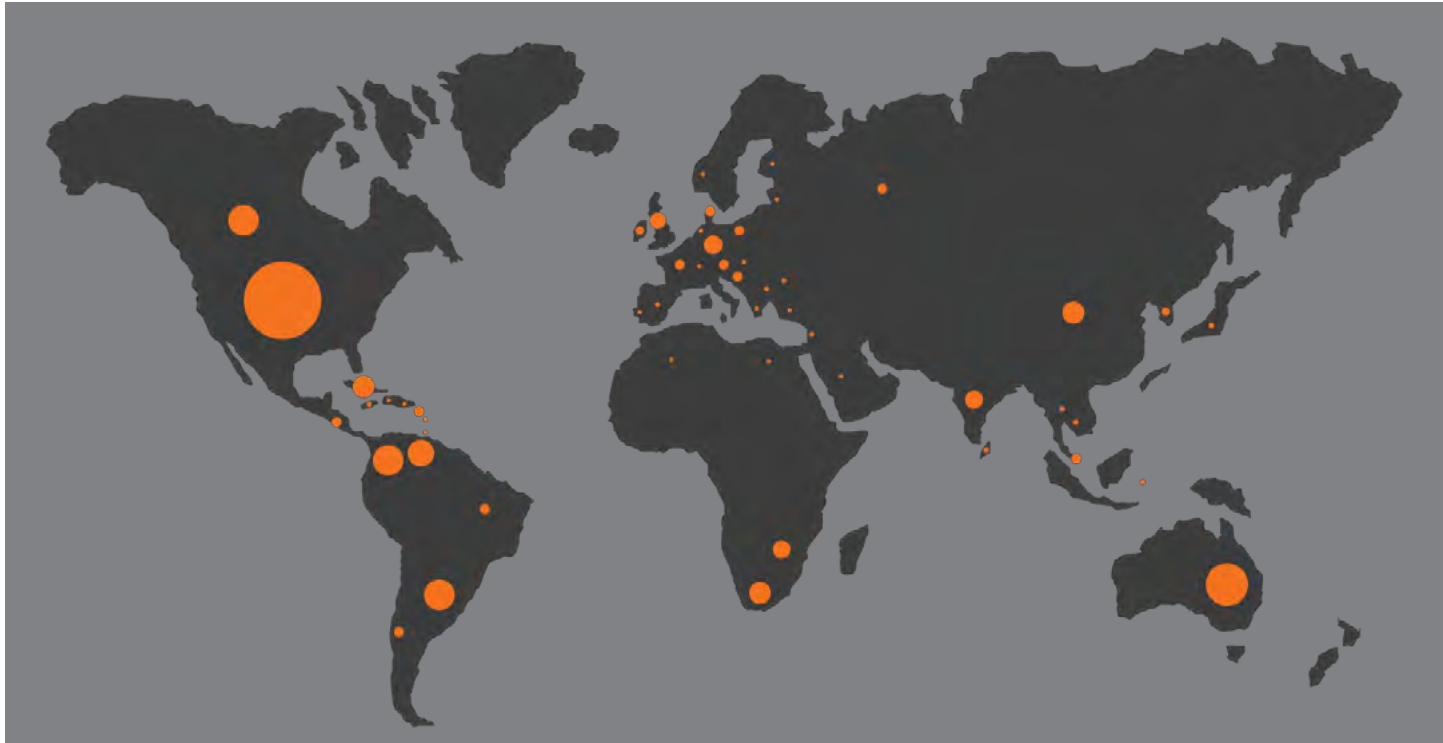
DETAILED SUMMARY OF PARTICIPANTS

1443

individuals participated in RJD Shark trips during the 2011 season.

57

countries of origin were represented.



33

states of origin were represented.

8

universities were represented among the RJD Internship Program at the University of Miami.

Over 1000 students from 15 high schools participated in RJD shark trips during 2012. Of the 1443 participants, 52 youth joined trips through non-profit, higher education programs (S.T.E.M. programs), such as Miami Museum of Science IMPACT, Breakthrough Miami, and Barrington Irving's Experience Aviation. These programs provide fundamental support to students in their preparation for college entrance and their development of professional skills. Additionally, the following agencies, corporations, and organizations joined RJD trips during 2012: Aimia, Avalon, Desert Star Systems, Encounters Experience, Good World Games, Unmatt Foundation, Key Largo Cultural Center, LMANA, LBC, Moore FDN, National Ocean and Atmospheric Association, One World One Ocean, Ocean Club Excellence, Plan B, Shark Savers, Sidewalk Salads, Summit Series, Scuttlefish, UM Global Academy, UM CSTARS, Waitt Institute, Waterlust, and the World President's Organization.

SUPPORT



DONATIONS

Established through a founding donation from Marian Dunlap in honor of her late husband Richard James Dunlap, the RJD Program is largely supported through the generosity of its donors. Thanks to these donations, we have been able to reach thousands of students and individuals to educate and inform them on the oceans and shark conservation. All support for this work is greatly appreciated.

Donations were made by individuals such as: Altman, R., Balonek, A., Batchelor, S., Buechele, L., Harris, M., Hartog, J., Katz, B., Dunlap, M., Nelson, L., Oh, J., Steinberg, R., and Weber, J.

Donations were made by organizations, institutions and corporations including: Aimia Proprietary Loyalty, Batchelor Foundation, Inc., Boca Raton Preparatory School, Carlson Marketing Worldwide, Inc, Citizen's Board, Disney Wildlife Conservation Fund, Dive Bar, Elite Minds, Inc., Kellogg School of Business Executive MBA Coral Gables Class of 2013, Florida Sea Grant, Goldman, Sachs & Co., Guy Harvey Ocean Foundation, Marine Exhibition Co., McDonalds, Michael Ford, Palmer Trinity School, Roddenberry Foundation, TOMS, and Wells Fargo Foundation.



SHOPFORSHARKS.COM

ShopForSharks.com is a collaboration between designers, researchers, and the B1self clothing company to create an **online store of RJD-branded gear**. Profit from sales come back to support RJD. Our team of scientists and interns proudly wear the RJD field shirts during each trip!

ADOPT A SHARK

Researching these apex predators is neither easy nor cheap. So to ensure RJD's satellite tracking study of sharks continues, the program accepts donations in the amount of \$2,500, which covers the cost to purchase one **new satellite tag**. In return, donors are given the opportunity to name the adopted shark and **follow the shark's movements on our website** using an interactive Google Earth map. Classes and entire schools are also welcome to collectively adopt sharks. The University of Miami is a Florida not-for-profit corporation and all donations are tax deductible as appropriate by law.

*To pledge your support for RJD, visit the "Donate" section of our website: **SharkTagging.com**.*

2012 HIGHLIGHTS

“ This year has been our most successful as of yet. I am proud of our team and partners, with their passion for educating the next generation of conservation-minded individuals and their dedication to scientifically sound, conservation research. I can't wait for 2013!

- Neil Hammerschlag
Director, RJD

New Website Launch

In October 2012, we launched a brand new, visually-driven website. With greatly enhanced content and streamlined navigation, it's easy to explore and learn about RJD's work and opportunities for participation. Check out the website at: SharkTagging.com.



After TOMS Founder Blake Mycoskie participated in an RJD shark tagging trip during Summit Series at Sea, he felt inspired to support our shark conservation work.

THE SHARK SHOE



HELP PRESERVE AN AWE-INSPIRING SPECIES

Proceeds from each pair go to the RJ Dunlap Marine Conservation Program at the University of Miami to protect sharks and their environment. And as always, with every pair you purchase, TOMS will give a pair of new shoes to a child in need. One for One.™

In August 2012, the TOMS Shark Shoe launched, donating proceeds from each pair to RJD. In less than a week, all of the shoes sold out. Thank you TOMS!

Mass Media Coverage

RJD research was frequently in the news during 2012. Highlights included a feature segment on Discovery's Daily Planet show and stories on CBS, NBC, BBC, and ABC's Good Morning America.



2012 HIGHLIGHTS

Citizen Science™ & Oracle Club Excellence

For the second year, RJD teamed up with Oracle to provide a Citizen Science™ experience to their top salespeople from around the world during their Club Excellence retreat. In September 2012, the RJD team traveled to Nassau, Bahamas. In just four days, we brought over 200 participants from 21 countries out on the water to learn more about shark research and conservation. Using a custom-made cage, dozens of participants were able to have an in-water view of the shark research. We greatly appreciate this innovative partnership, and the multiple shark adoptions from Oracle.



CITIZEN SCIENCE™



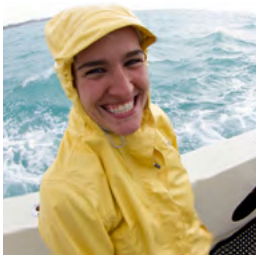
Conference Presentations

Dr. Neil Hammerschlag presented at the **TEDxMIA** conference on his new research on neurotoxins in shark fins. RJD students presented their research at three major conferences: ScienceOnline, Benthic Ecology, and the American Elasmobranch Society conference.

We appreciate your engagement in both our scientific and educational endeavors. A community of informed individuals fosters a healthy and lasting marine conservation ethic. Thank you for the time and dedication of the program faculty, staff and advisors: Dr. Neil Hammerschlag (Director), Christine Shepard (Multimedia Specialist), Dr. Evan D'Alessandro (Broad Key Manager), Virginia Ansaldi (Lab Manager), Rosemary Mann (Assistant Dean - RSMAS), Susan Gerrish (Assistant Director Advancement), Dr. Roni Avissar (Dean - RSMAS), and Dr. Kenneth Broad (Director - Abess Center). A special thanks to Marian Dunlap, Captain Curt (Curt-A-Sea Aquatic Adventures), Mrs. Kelli Slonim, their associates, and family. Thank you to Leann Winn, a local teacher and outdoor education coordinator, whose shark conservation volunteer work spans nearly ten years. For their leadership, thanks to Catherine Macdonald, Austin Gallagher, Julia Wester, and David Shiffman. Finally a big thank you to the Program's associates, interns, participants, and students over this past year. We look forward to many more seasons to come.

CREDITS

The 2012 RJD Annual Report has been a collaborative effort between these primary contributors:



TOGETHER, WE ARE

MAKING
WAVES.



www.SharkTagging.com