



RCVD OCT 16 2019

LS

Department of Interior
U.S. Fish and Wildlife Service
Federal Fish and Wildlife Permit Application Form

Type of Activity

U.S. Fish and Wildlife Service
Division of Management Authority
Branch of Permits, MS: IA
5275 Leesburg Pike
Falls Church, VA 22041-3803
1-800-358-2104 or 703-358-2104

**EXPORT/RE-EXPORT/IMPORT/INTERSTATE AND FOREIGN
COMMERCE/TAKE OF ANIMALS (LIVE/ SAMPLES/PARTS/PRODUCTS)
under the Convention on International Trade in Endangered Species
(CITES) and/or the U.S. Endangered Species Act (ESA)**

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details. **Instructions on how to make your application complete and help avoid unnecessary delays are attached.**

Section A: Complete if applying as an individual

1.a. Last Name	1.b. First Name	1.c. Middle Name/Initial	1.d. Suffix
2. Date of Birth (mm/dd/yyyy)	3. Telephone Number	3.a. Alternate Telephone Number	4. E-mail address

Section B: Complete if applying on behalf of a business, corporation, public agency, Tribe, or institution

1.a. Name of business, agency, Tribe, or institution Purdue University Fort Wayne		1.b. Doing business as (DBA) Purdue University Fort Wayne	
2. Tax identification no. 0003123723		3. Description of business, agency, Tribe, or institution University	
4.a. Principal officer Last name Paladino	4.b. Principal officer First Name Frank	4.c. Principal officer Middle name/Initial V.	4.d. Suffix
5. Principal officer title Dr.		6. Primary contact name Laura St. Andrews	
7.a. Business telephone number	7.b. Alternate telephone number 1-518-796-8913	7.c. Business fax number 260-481-6087	7.d. Business e-mail address stanl02@pfw.edu

Section C: All applicants complete address information

1.a. Physical address (Street address; Apartment #, Suite #, or Room #; no P.O. Boxes) 2101 E. Coliseum Blvd., Science Building, Department of Biology				
1.b. City Fort Wayne	1.c. State IN	1.d. Zip code/Postal code 46805-1499	1.e. County/Province Allen	1.f. Country USA
2.a. Mailing address (include if different than physical address; include name of contact person if applicable)				
2.b. City	2.c. State	2.d. Zip code/Postal code	2.e. County/Province	2.f. Country

Section D: All applicants MUST complete

1. Attach the nonrefundable application processing fee in the form of a check or money order payable to the U.S. FISH AND WILDLIFE SERVICE in the amount of \$100 . Federal, Tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – attach documentation of fee exempt status as outlined in instructions [50 CFR 13.11(d)] .
2. Certification: I hereby certify that I have read and am familiar with the regulations contained in Title 50 Part 13 of the Code of Federal Regulations and the other applicable parts in subchapter B of Chapter I of Title 50 , and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001.
Signature of applicant/Principal Officer for permit (No photocopied or stamped signatures) Date of signature (mm/dd/yyyy) Frank V. Paladino <i>Frank V. Paladino</i> 10/08/2019
Please continue to next page

E. EXPORT/RE-EXPORT/IMPORT/INTERSTATE AND FOREIGN COMMERCE/TAKE OF ANIMALS (Live/samples/parts/products) (CITES and/or ESA)

Allow at least 90 days for the application to be processed. Applications for endangered species permits must be published in the Federal Register for a 30-day public comment period.

Complete all questions on the application. Mark questions that are not applicable with "N/A". If needed, use separate sheets of paper. On all attachments or separate sheets you submit, indicate the application question number you are addressing. If you are applying for multiple specimens, be sure to indicate which specimen you are addressing in each response.

NOTE: The import of live southern white rhinoceros from South Africa and Swaziland must meet specific CITES criteria for an import permit to be issued. If you are requesting authorization for the import of these species, please ensure that you respond to question 14 below.

Electronic submission of inventories, photographs, and receipts: Some applications contain extensive inventories and/or a large number of photographs or receipts. You may provide electronic versions of the documents. Such a submission will assist the processing of your application since it may reduce data entry by the U.S. Fish and Wildlife Service. If you wish to provide information electronically, once you have received an application number via the e-mailed acknowledgment letter, e-mail your information to Permits@fws.gov. Be sure to include the application number provided in the acknowledgment e-mail that will be sent to you when we receive your application.



I will be submitting documents electronically.

1. Name and address where you wish the permit to be mailed, **if different from page 1**. If you would like expedited shipping, please enclose a self-addressed, pre-paid, computer-generated, courier service airway bill. If unspecified, all documents will be mailed via regular mail through the U.S. Postal Service.

Frank V. Paladino Ph. D.

2101 E. Coliseum Blvd, Dept. of Biology, Purdue University Fort Wayne, Fort Wayne, IN 46805-1499

2. Who should we contact if we have questions about the application (name, phone number, and e-mail)?

Laura St. Andrews, +1-518-796-8913, stanl02@pfw.edu

Frank V. Paladino +1 260-481-6305, paladino@pfw.edu

3. Have you or any of the owners of the business (if applying as a business, corporation, or institution), been assessed a civil penalty or convicted of any criminal provision of any statute or regulation relating to the activity for which the application is filed; been convicted, or entered a plea of guilty or nolo contendere, for a felony violation of the Lacey Act, the Migratory Bird Treaty Act, or the Bald and Golden Eagle Protection Act; forfeited collateral; OR are currently under charges for any violation of the laws mentioned above?



No



Yes

If you answered "Yes" to Question 3, provide: a) the individual's name; b) date of charge; c) charge(s); d) location of incident; e) court, and f) action taken for each violation. Please be aware that a "Yes" response does not automatically disqualify you from getting a permit.

4. What activity are you requesting authorization to carry out (Indicate appropriate activities):

☐ EXPORT ☐ RE-EXPORT ☒ IMPORT ☐ TAKE (e.g., cull, lethal harvest)
☐ INTERSTATE COMMERCE ☐ FOREIGN COMMERCE

Note: Interstate Commerce permits authorize the sale of endangered and threatened species across State lines, but only for activities that will contribute to enhancing the propagation or survival of that species. Interstate commerce activities with wildlife require the buyer to obtain a permit prior to the sale or offer for sale.

5. For **EACH** animal/specimen involved in the proposed activity provide:

a. Scientific name (genus, species, and, if applicable, subspecies)	b. Common name	c. Birth/ Hatch Date (mm/dd/yyyy) (approximate of actual unknown)	d. Wild or captive-born	e. Quantity	f. Gender (male or female, if known), if	g. Permanent markings, if alive (e.g., tattoo, ID #, microchip #, scars)	h. Type of sample or product (e.g., blood, tissue, DNA)
EXAMPLE: <i>Pan troglodytes</i>	Chimpanzee						
See attached table							
See attached table							
See attached table							
See attached table							

6. The current location of the specimen(s) (address and country):

Name: Cape Eleuthera Institute
 Address: Cape Eleuthera Island School
 City: Eleuthera, The Bahamas
 State/Province:
 County, Postal Code:

7. Recipient/Sender:

- If **export**, provide name and address of the recipient in the foreign country.
- If **re-export**, provide the name and address of the recipient in the foreign country.
- If **import**, provide name and address of the exporter in the foreign country.
- If **interstate or foreign commerce**, provide name and address of the proposed seller/supplier.

Name: Laura St. Andrews or Frank V. Paladino
 Address: 2101 East Coliseum Blvd, Science building,
 City: Department of Biology PFW
 State/Province: Fort Wayne, IN, Allen County
 County, Postal Code: 46805-1499 USA

SOURCE OF SPECIMEN (answer question 8 or 9 for **EACH** animal/specimen involved, as appropriate).

8. For captive-bred animals or animal(s) from which the specimen(s) are/were obtained, provide a signed and dated statement from the breeder that includes the following:
- Scientific name (genus, species, and, if applicable, subspecies) and common name;
 - Name and address of the facility where the animal was bred and born;
 - Birth/hatch date (mm/dd/yyyy), and, if applicable, identification information;
 - Location (name of facility, address, city, State, postal code) of parental stock;
 - A statement that the animal was bred at the above facility;
 - Documentation demonstrating the history of transactions (e.g., chain of custody or ownership of the animal).

9. For **EACH** animal/specimen **taken from the wild**, provide the following:

- Scientific name (genus, species, and, if applicable, subspecies) and common name;

Chelonia mydas, green sea turtle

Caretta caretta, loggerhead sea turtle

Eretmochelys imbricata, hawksbill sea turtle

- Specific location of where, when, and by whom (name and address) the specimen was removed from the wild;

Please see response attached below to question 9b.

- Purpose of removal and length or approximate length of time held in captivity. Discuss issues such as the method of collection, was the collection done as part of a larger study, were animals returned to the wild after sampling, and did any mortalities or injuries occur due to collection or holding;

Please see attached response to question 9c.

- If and how any remuneration, either financial or in-kind, was provided for taking or capturing animals or for the collection of samples.

N/A

- Your efforts to use captive specimens (e.g., captive-born, captive-held), or parts thereof, in lieu of taking animals from the wild.

Please see attached response to question 9e.

- Copies of your foreign or domestic collecting permit, license, contract or agreement;
- Documentation showing that the specimen(s) was/were legally obtained by the applicant; and
- Copies of any applicable State, Tribal, Federal, or Foreign government permits or licenses that authorized the removal of this animal from the wild.

JUSTIFICATION FOR REQUESTED ACTIVITY.

10. Provide a detailed statement justifying the proposed activity, particularly the following:

- a. Describe the purpose of your proposed activity. For example, if the purpose is scientific research, attach a copy of your research proposal outlining the purpose, objectives, methods (e.g., specific information on survey/collection methods, sampling regime, equipment to be used), and whether similar work has already been done or is currently being done. If the purpose includes conservation education, provide copies of educational materials (e.g., handouts, text of signage or public presentations), and include the purpose and objectives of the proposed activity. If the purpose is for propagation for conservation purposes (including culling as part of herd management), provide a description of how the species will be propagated and the disposition of progeny, as well as long-term goals of the breeding program, how the breeding program is managed to maintain genetic vitality, and information on any cooperative breeding programs or agreements that are/will be established, including any future plans for re-introduction.

Please see attached "Research Proposal."

- b. Description of the technical expertise of each person (please also include CV or resume), as it relates to the proposed activities. If the proposed activity involves live animals, include the experience of each animal caretaker working with the species.

Please see attached response and CVs for technical expertise of each person in relation to the proposed activities for question 10b.

- c. Copies of contracts, agreements or other documents that identify persons involved and dates of activities for which authorization is being requested.

11. A statement on how the activities will **enhance or benefit the wild population** (e.g., in-situ and ex-situ projects).

At present, heavy metal loads have been assessed in multiple urbanized locations and sea turtle species. Such research has elucidated that excessive contamination of heavy metals in key tissues is linked to declines in physical and reproductive fitness. However, in order to maximize conservation benefit for sea turtles, we must understand the baseline of naturally occurring heavy metal loads. Our study seeks to analyze the concentration of heavy metals loads of wild, foraging sea turtles in a non-urbanized area (Eleuthera, The Bahamas) and compare such samples to samples of tissue taken in turtles foraging in urbanized environments (Massachusetts and Texas). We aim to provide baseline data to better understand the effects of excessive and naturally occurring heavy metal loads on the wild populations of these endangered animals. Such critical knowledge of heavy metal contamination in sea turtles can also serve as a key to understanding the broader impact of these contaminants on the world's oceans.

12. If live specimens are to be held in captivity as part of the proposed activity:

- a. Provide a detailed description (e.g., size, construction materials, protection from the elements) and photographs or diagrams (no blueprints, please) clearly depicting the existing facilities **where the wildlife will be maintained**. If the specimens will be housed at multiple facilities, either immediately or within the next year, provide a full description of each facility. If you are unsure of which facilities may be receiving specimens (e.g., final decisions on placement have not been made), please indicate likely candidates and the mechanism that will be used to determine recipient facilities;

Animals sampled will not be held in captivity.

- b. A statement of the specific technical experience of CV or resume available to the recipient(s) for maintaining and propagating live specimens of the same or similar species;

N/A

- c. The number of years each species has been maintained at the facility;

N/A

- d. The number of births by year for each species for the last 5 years; and

N/A

- e. Mortalities at the facility with these or similar species in the last 5 years, causes of such mortalities, and steps taken to avoid or decrease such mortalities.

N/A

IMPORTS, EXPORTS, OR RE-EXPORTS.

13. For shipment of LIVE specimens, the transport conditions for animals must comply with the CITES Guidelines for Transport of Live Animals or, in the case of air transport, with the International Air Transport Association (IATA) live animal regulations (contact airline for information). As such, describe:

- a. The type, size, and construction of any shipping container; and

We will not import live animals for our study. We seek to import tissue samples only.

- b. The arrangements for watering or otherwise caring for the wildlife during transport.

N/A

14. For import of live southern white rhinoceroses from South Africa and Swaziland, a determination that the importing facility meets the CITES "appropriate and acceptable destination" annotation must be made. Therefore, provide written documentation demonstrating that the proposed activity would promote *in situ* conservation of the species. **Note: For any permit authorizing trade of live rhinoceroses under an "appropriate and acceptable destination" annotation, the rhinoceros horn from these animals may not enter commercial trade and the animal may not be sport hunted.**
15. **For import of LIVE CITES Appendix-I listed marine mammal species**, provide a copy of your FWS or NOAA Fisheries permit or authorization.
16. For import of CITES **Appendix-I listed species**, provide information to show the import is not for primarily commercial purposes as outlined in [Resolution Conf. 5.10](#).
17. For export of CITES **Appendix-I listed species**, provide a copy of the CITES import permit, or evidence one will be issued by the Management Authority of the country to which you plan to export the specimen(s). In accordance with Article III of the CITES treaty, it is required that import permits are issued before the corresponding export permit.
18. If the specimen is being **re-exported** (e.g., exporting a specimen that was previously imported into the United States), provide:
 - a. A copy of the canceled CITES export or re-export document issued by the appropriate CITES office in the country from which the wildlife was imported (if applicable); and
 - b. A cleared copy of Form 3-177, wildlife Declaration for Import (hard copy or electronic release); **OR**
 - c. If you did not make the original import, provide a copy of the importer's documents outlined above and the invoice or other documentation that shows you acquired the wildlife from the original importer or history of transactions which demonstrate chain of ownership.

All international shipment(s) must be through a designated port. A [list of designated ports](#) (where an inspector is posted) is available. If you wish to use a port not listed, please contact the Office of Law Enforcement for a Designated Port Exemption Permit (form 3-200-2).

Section E Responses

1. Name and address where you wish the permit to be mailed:

Frank V. Paladino Ph. D.
2101 E. Coliseum Blvd
Department of Biology
Purdue University Fort Wayne
Fort Wayne, IN 46805-1499

2. Who should we contact if we have questions about the application (name, phone number, and e-mail)?

Laura St. Andrews, +1-518-796-8913, stanl02@pfw.edu
Frank V. Paladino +1 260-481-6305, paladino@pfw.edu

3. Have you or any of the owners of the business (if applying as a business, corporation, or institution), been assessed a civil penalty or convicted of any criminal provision of any statute or regulation relating to the activity for which the application is filed; been convicted, or entered a plea of guilty or nolo contendere, for a felony violation of the Lacey Act, the Migratory Bird Treaty Act, or the Bald and Golden Eagle Protection Act; forfeited collateral; OR are currently under charges for any violation of the laws mentioned above?

No

4. What activity are you requesting authorization to carry out (Indicate appropriate activities):

This permit is for import.

5. For EACH animal/specimen involved in the proposed activity provide:

a. Scientific name	b. Common name	c. Birth/Hatch Date	d. Wild or captive born	e. Quantity	f. Gender	g. Permanent markings	h. Type of sample or product
Chelonia mydas	Green sea turtle	N/A	Wild	70	N/A	N/A	Skin
Chelonia mydas	Green sea turtle	N/A	Wild	70	N/A	N/A	Blood
Chelonia mydas	Green sea turtle	N/A	Wild	70	N/A	N/A	Scute
Caretta caretta	Loggerhead sea turtle	N/A	Wild	10	N/A	N/A	Skin

Caretta caretta	Loggerhead sea turtle	N/A	Wild	10	N/A	N/A	Blood
Caretta caretta	Loggerhead sea turtle	N/A	Wild	10	N/A	N/A	Scute
Eretmochelys imbricata	Hawksbill sea turtle	N/A	Wild	10	N/A	N/A	Skin
Eretmochelys imbricata	Hawksbill sea turtle	N/A	Wild	10	N/A	N/A	Blood
Eretmochelys imbricata	Hawksbill sea turtle	N/A	Wild	10	N/A	N/A	Scute

***70 green sea turtles, 10 loggerheads and 10 hawksbills will be sampled for this project. We will collect 3 samples from each turtle for a total of 270 sample vials for import.**

6. The current location of the specimen(s) (address and country):

**Cape Eleuthera Institute
Cape Eleuthera Island School
Eleuthera, The Bahamas**

7. The name and address of the exporter are as follows:

Name:

Laura St. Andrews or Frank V. Paladino

Address:

2101 East Coliseum Blvd, Science building, Department of Biology PFW
Fort Wayne, IN, Allen County, 46805-1499 USA

8. For captive-bred animals or animal(s) from which the specimen(s) are/were obtained, provide a signed and dated statement from the breeder that includes the following:

No captive bred specimens will be sampled.

9. For EACH animal/specimen taken from the wild, provide the following:

All animals will be sampled from the wild.

- a. Scientific name (genus, species, and, if applicable, subspecies) and common name:

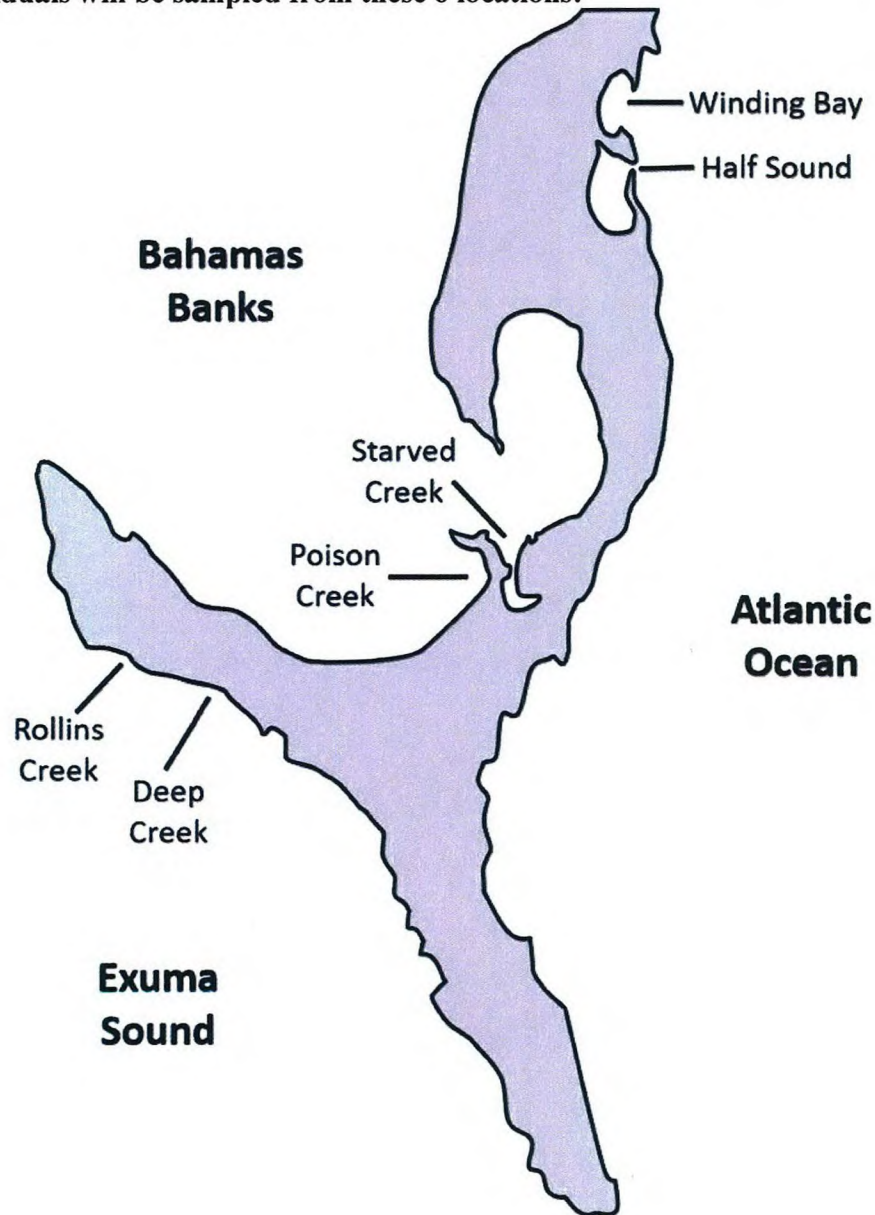
***Chelonia mydas*, green sea turtle**

***Caretta caretta*, loggerhead sea turtle**

***Eretmochelys imbricata*, hawksbill sea turtle**

- b. Specific location of where, when, and by whom (name and address) the specimen was removed from the wild:

We will collect 3 samples from 70 green, 10 loggerhead and 10 hawksbill sea turtles in the waters of southern Eleuthera, The Bahamas for a total of 270 vials of samples for import. Samples will be collected between August and December of 2019 by Laura St. Andrews of Purdue University Fort Wayne and Dr. Nathan Robinson of the Cape Eleuthera Institute. All samples will be stored in freezers prior to being sent to the USA for analysis at Purdue University. The 90 individuals will be sampled from these 6 locations:



- c. Purpose of removal and length or approximate length of time held in captivity. Discuss issues such as the method of collection, was the collection done as part of a larger study, were animals returned to the wild after sampling, and did any mortalities or injuries occur due to collection or holding:

The purpose of this study will be to assess heavy metal accumulation in green, loggerhead and hawksbill sea turtles of Eleuthera, The Bahamas. To assess heavy metal concentrations, we will collect various tissues for analysis; 3 mL blood, 0.5 g skin and 0.5 g scute, from 90 turtles that we will encounter in the waters of Eleuthera using a combination of seine netting and in water, 'rodeo' capture methods typical of existing sea turtle research methods. After turtles are caught using either technique, Dr. Robinson and Laura St. Andrews will collect three tissue samples per individual and immediately release the turtles at the same location they were found.

This tissue sampling is part of a larger study to identify baseline heavy metal loads in sea turtles between urbanized and non-urbanized locations. Although multiple, highly informative heavy metal load studies have been conducted in sea turtles in various locations, there is a strong bias for these studies to focus primarily on urbanized environments. Because of this, there is a dearth of data regarding baseline heavy metals that occur naturally in these animals. Thus, a primary focus of this study is to analyze a non-urbanized population of sea turtles in The Bahamas in order to provide baseline levels of heavy metal loads in sea turtles. Turtle samples taken from Eleuthera, The Bahamas will serve as the non-urbanized location. Additionally, for the duration of her master thesis, Laura St. Andrews will work with collaborators that will sample tissues of sea turtles in South Texas at the Padre Island National Seashore as well as collaborators at the Wellfleet Bay Wildlife Sanctuary with the Massachusetts Audubon Society. Turtles sampled in Texas and in Massachusetts will serve as the urbanized sample sets.

- d. If and how any remuneration, either financial or in-kind, was provided for taking or capturing animals or for the collection of samples.

N/A

- e. Your efforts to use captive specimens (e.g., captive-born, captive-held), or parts thereof, in lieu of taking animals from the wild.

The purpose of this study is to examine the heavy metal loads of wild turtles to assess the threats posed by heavy metal pollution to these species. As heavy metals accumulate and are generally obtained in sea turtles either by direct contact or by feeding on contaminated food sources, it is not possible to use captive animals to assess heavy metal accumulation in the wild. For this reason, it is necessary to sample animals in the wild.

- f. Copies of your foreign or domestic collecting permit, license, contract or agreement

Please see attached permits.

- g. Documentation showing that the specimen(s) was/were legally obtained by the applicant:

Please see attached documentation.

- h. Copies of any applicable State, Tribal, Federal, or Foreign government permits or licenses that authorized the removal of this animal from the wild.

N/A

10. Provide a detailed statement justifying the proposed activity, particularly the following:

- a. Describe the purpose of your proposed activity.

Please see attached "Research Proposal".

- b. Description of the technical expertise of each person (please also include CV or resume), as it relates to the proposed activities:

Dr. Frank Paladino- Dr. Paladino is a professor at Purdue University Fort Wayne, USA. Dr. Paladino is the primary supervisor of this research project. Dr. Paladino has over 30 years of field experience working with sea turtles and has published over 80 peer-reviewed articles on sea turtle biology and conservation.

Dr. Nathan Robinson- Dr. Robinson is Assistant Director of the Cape Eleuthera Institute, Eleuthera Island, The Bahamas. Dr. Robinson is the field supervisor for this project. He will be present for sampling on Eleuthera Island and to provide training and assistance. Dr. Robinson has over 10 years of experience in sea turtle research and conservation and has successfully managed sea turtle projects for multiple species of sea turtles all over the world.

Dr. Nick Higgs- Dr. Higgs is Director of the Cape Eleuthera Institute, Eleuthera Island, The Bahamas. Dr. Higgs will supervise permitted research activities and the permit procedure for exporting samples from The Bahamas. Dr. Higgs has 15 years of experience conducting marine research.

Laura St. Andrews, Msc- Laura is a master's candidate at Purdue University Fort Wayne. Laura will be the main collector and transporter of samples for the duration of this project and has three years of experience with sea turtle tissue collection and data management. Laura has worked in sea turtle rehabilitation centers and on nesting beaches and is trained in proper sea turtle handling techniques.

- c. Copies of contracts, agreements or other documents that identify persons involved and dates of activities for which authorization is being requested.
11. A statement on how the activities will enhance or benefit the wild population (e.g., in-situ and ex-situ projects).

At present, heavy metal loads have been assessed in multiple urbanized locations and sea turtle species. Such research has elucidated that excessive contamination of heavy metals in key tissues is linked to declines in physical and reproductive fitness. However, in order to maximize conservation benefit for sea turtles, we must understand the baseline of naturally occurring heavy metal loads. Our study seeks to analyze the concentration of heavy metals loads of wild, foraging sea turtles in a non-urbanized area (Eleuthera, The Bahamas) and compare such samples to samples of tissue taken in turtles foraging in urbanized environments (Massachusetts and Texas). We aim to provide baseline data to better understand the effects of excessive and naturally occurring heavy metal loads on the wild populations of these endangered animals. Such critical knowledge of heavy metal contamination in sea turtles can also serve as a key to understanding the broader impact of these contaminants on the world's oceans.

12. If live specimens are to be held in captivity as part of the proposed activity:

Animals sampled will not be held in captivity.

13. For shipment of LIVE specimens, the transport conditions for animals must comply with the CITES Guidelines for Transport of Live Animals or, in the case of air transport, with the International Air Transport Association (IATA) live animal regulations (contact airline for information). As such, describe:

We will not import live animals for our study. We seek to import tissue samples only.

14. For import of live southern white rhinoceroses from South Africa and Swaziland, a determination that the importing facility meets the CITES "appropriate and acceptable destination" annotation must be made. Therefore, provide written documentation demonstrating that the proposed activity would promote in situ conservation of the species. *Note: For any permit authorizing trade of live rhinoceroses under an "appropriate and acceptable destination" annotation, the rhinoceros horn from these animals may not enter commercial trade and the animal may not be sport hunted.*

N/A

15. For import of LIVE CITES Appendix-I listed marine mammal species; provide a copy of your FWS or NOAA Fisheries permit or authorization.

N/A

16. For import of CITES Appendix-I listed species, provide information to show the import is not for primarily commercial purposes as outlined in Resolution Conf. 5.10.

These samples will be used for scientific purposes and have no commercial value.

17. For export of CITES Appendix-I listed species, provide a copy of the CITES import permit, or evidence one will be issued by the Management Authority of the country to which you plan to export the specimen(s). In accordance with Article III of the CITES treaty, it is required that import permits are issued before the corresponding export permit.

N/A

18. If the specimen is being re-exported (e.g., exporting a specimen that was previously imported into the United States), provide: a. A copy of the canceled CITES export or re-export document issued by the appropriate CITES office in the country from which the wildlife was imported (if applicable); and b. A cleared copy of Form 3-177, wildlife Declaration for Import (hard copy or electronic release); OR c. If you did not make the original import, provide a copy of the importer's documents outlined above and the invoice or other documentation that shows you acquired the wildlife from the original importer or history of transactions which demonstrate chain of ownership.

N/A

All samples will be shipped through a designated port.

Research Proposal

Heavy Metal Contamination of Sea Turtle Tissues in Urbanized and Non-Urbanized Environments

Principal Investigators: Dr. Frank Paladino, Professor of Biology, Purdue University Fort Wayne and Dr. Nathan Robinson, Director of the Cape Eleuthera Institute

Study conducted by: Laura St. Andrews, MSc candidate, Purdue University Fort Wayne

Samples transferred by: Laura St. Andrews, MSc candidate, Purdue University Fort Wayne

Samples shall be transferred to:

C/o Laura St. Andrews and Frank Paladino
2101 E. Coliseum Blvd. Purdue University Fort Wayne
Science Building, Biology Department
Fort Wayne, IN 46805

Introduction:

Anthropogenic pollution in our oceans is rapidly increasing (Cortez-Gomez et al. 2017). Much scientific, media and political attention has been directed to the impact of readily visible pollutants, such as plastics and fishing gear, on marine life (Hamann 2008). Yet less visible sources of marine pollution, such as heavy metals, can be equally deleterious (Magnuson et al. 1990, Herbst and Klein 1995, Carneiro da Silva et al. 2014). Research on several marine taxa, including fish, seabirds, sea turtles and marine mammals has shown that excessive contamination of heavy metals in key tissues is linked to declines in physical and reproductive fitness (Murad and Houston 1988, Henny et al. 2002, Hoffman 2002, Pellisso et al. 2008, Perrault et al. 2017). Knowledge of heavy metal contamination is therefore of value when assessing the potential threats faced by endangered species and can serve as a key to understanding the broader impact of these contaminants on the world's oceans.

Heavy metal loads have already been assessed for several sea turtle species at multiple locations (Cortez-Gomez et al. 2017). While highly informative, there is a strong bias for these studies to focus primarily on urbanized environments (Godley et al. 1999, Storelli et al. 2005, Barraza et al. 2019). Indeed, heavy metals occur in low concentrations and would still be found in sea turtles that have minimal contact with anthropogenic pollution (Keller et al. 2006). Yet, the urbanized sampling bias denotes a lack of 'baseline' information on the amount of naturally occurring heavy metal loads that should be in non-polluted environments (Bolten and Bjorndal 1992, Camacho et al. 2014).

In this study, we aim to categorize heavy metal loads in green *Chelonia myda*, loggerhead *Caretta caretta* and hawksbill *Eretmochelys imbricata* sea turtles in both urbanized and non-urbanized environments. Specifically, we will collect blood, skin, and scute samples from turtles collected off of the urbanized Texas and Massachusetts, USA coasts and compare their heavy metal loads to samples from turtles caught in the non-urbanized habitats of Eleuthera, The Bahamas. We will collect several different samples, as each sample will reflect the exposure on a different temporal scale. For example, blood samples will indicate short term exposure to heavy metal contamination, skin samples will reflect intermediate scales, and scute samples are

valuable indicators of longer-term exposure (Day et al. 2005, Perrault et al. 2017, Yang et al. 2019).

Project Goals:

- Collect blood, skin and scute samples from up to 70 green, 10 loggerhead and 10 hawksbill turtles caught from foraging habitats around Eleuthera Island, The Bahamas.
- Compare tissue samples from sea turtles foraging around Eleuthera to blood, skin and scute samples from turtles that are found as a result of cold stunning events in Texas and Massachusetts.
- Assess the concentration of an array of heavy metals (Al, Cr, Mn, Fe, Co, Ni, Zn, As, Ag, Cd, Pb, Se and Hg) in all the samples using an Inductively Coupled Mass Spectrometer capable of analyzing this suite of heavy metals.
- Establish baseline levels of naturally occurring heavy metal loads using a comparison of urban versus non-urban environments.

Methodology:

We will collect three samples: skin, scute, and blood from all turtles at 6 specified sampling locations in Eleuthera. Turtles found foraging around Eleuthera will be obtained using a combination of seine netting and 'rodeo' capture methods typical for existing turtle research. The researchers will then manually restrain the animals to collect three tissue samples from an array of 70 juvenile green, 10 adult loggerhead and 10 adult hawksbill sea turtles. Each animal will be held up to twenty minutes on a stationary research vessel to attain the necessary samples before being released into the wild in the same areas in which they were found.

To sterilize tissue collection sites when taking skin and blood samples, researchers in The Bahamas will use betadine wipes prior to sampling. Once these two samples are attained, researchers will apply pressure with gauze or sterile wipes to the sites to prevent further blood loss. Skin samples will be collected from the right shoulder, between the neck and front flipper using a 6 mm biopsy punch for up to .5 grams of tissue (Owens and Ruiz 1980, Dutton 1996, Eckert et al. 1999). Scute samples will be collected from the rear of the first lateral scute of each turtle, particularly on scutes without abnormalities for a .5 gram sample from each individual (Barraza et al. 2019, Bean and Logan 2019, Day et al 2005). For blood samples, researchers will extract between 3 – 5 ml of blood from the dorsal cervical sinus using 21-gauge and 3.8 cm syringes and store it in sodium-heparinized 3 mL glass vacutainers (Owens and Ruiz 1980, Eckert 1999, Wyneken 2001, Barraza et al. 2019). All tissue samples will be immediately placed on ice and stored in -20° C freezers at the Cape Eleuthera Institute (Komoroske et al. 2011, Barraza et al. 2019).

Samples will be analyzed for heavy metal concentrations at either Stony Brook University or Purdue University, USA. From these tissues, we will compare temporal exposure of Al, Cr, Mn, Fe, Co, Ni, Zn, As, Ag, Cd, Pb, Se and Hg loads in each individual. This metal suite was selected in an effort to categorize the widest range of possible elements given our sample species and size, as well as our lab equipment available for analyses. From this range of samples, we will compare heavy metal loads between populations. Tissue samples will be stored by Laura St. Andrews at Purdue University Fort Wayne until lab analysis is possible.

Literature Cited

- Barraza, A.D., Komoroske, L.M., Allen, C., Eguchi, T., Gossett, R., Holland, E., Lawson, D.D., LeRoux, R.A., Long, A., Seminoff, J.A., Lowe, C.J. 2019. Trace metals in green sea turtles (*Chelonia mydas*) inhabiting two southern California coastal estuaries. *Chemosphere* 223, 342-350.
- Bean, S. and J.M. Logan. 2019. Stable isotope analysis of cold-stunned Kemp's ridley (*Lepidochelys kempii*) sea turtles at the northern extent of their coastal range. *Marine Biology* 166 (5): 64.
- Bjorndal, K/A. 1997. Foraging ecology and nutrition of sea turtles. In: Lutz P, Musick J (eds) *The biology of sea turtles*. CRC Press, Boca Raton FL, 199-231.
- Bolten, A.B. and Bjorndal, K.A., Blood profiles for a wild population of green turtles in the southern Bahamas: site-specific and sex-specific relationships. 1992. *Journal of Wildlife Diseases* 28 (3), 407-413.
- Camacho, M., L.D. Boada, J. Oros, P. Lopez, M. Zumbado, M. Almeida-Gonzalez, O.P. Luzardo. 2014. Monitoring organic and inorganic pollutants in juvenile live sea turtles: Results from a study of *Chelonia mydas* and *Eretmochelys imbricata* in Cape Verde. *Science of the Total Environment* 481, 303-310.
- Carneiro da Silva, C., Varela Jr, S.A., Barcarolli, I.F., Bianchini, A. 2014. Concentrations and distributions of metals in tissues of stranded green sea turtles (*Chelonia mydas*) from the southern Atlantic coast of Brazil. *Science of the Total Environment* 466-467, 109-118.
- Cortes-Gomez, A.A., Romero, D., Girondot, M. 2017. The current situation of inorganic elements in marine turtles: A general review and meta-analysis. *Environmental Pollution* 229, 567-85.
- Day, R.D., Christopher, S.J., Becker, P.R., Whitaker, D.W., 2005. Monitoring mercury in the loggerhead sea turtle, *Carretta carretta*,. *Environ. Sci. Technol.* 39, 437-446.
- Dutton, P. 1996. Methods for collection and preservation of samples for sea turtle genetic studies, p.17- 24. In: B.W. Bowen and W. N. Witzell (Eds.), *Proceedings of the International Symposium on Sea Turtle Conservation Genetics*. NOAA Technical Memorandum NMFS-SEFSC-396. U.S. Dept. Commerce.
- Eckert, K. L., Bjorndal, K. A., Abreu-Grobois, F. A. and M. Donnelly (Editors). 1999. *Research and Management Techniques for the Conservation of Sea Turtles*. IUCN/SSC Marine Turtle Specialist Group Publication No. 4.
- Godley, B.J., Thompson, D.R., Furness, R.W. (1999). Do Heavy Metal Concentrations Pose A Threat to Marine Turtles From The Mediterranean Sea? *Marine Pollution Bulletin* 38, 497-502.

Hamann, M., Godfrey, M.H., Seminoff, J.A., Arthur, K., Barata, P.C.R., Bjorndal, K.A., Bolten, A.B., Broderick, A.C., Campbell, L.M., Carreras, C., Casale, P., Chaloupka, M., Chan, S.K.F., Coyne, M.S., Crowder, L.B., Diez, C.E., Dutton, P.H., Epperly, S.P., FitzSimmons, N.N., Formia, A., Girondot, M., Hays, G.C., Cheng, I.S., Kaska, Y., Lewison, R., Mortimer, J.A., Nichols, W.J., Reina, R.D., Shanker, K., Spotila, J.R., Tomas, J., Wallace, B.P., Work, T.M., Zbinden, J., Godley, B.J., 2010. Global research priorities for sea turtles: informing management and conservation in the 21st century. *Endanger. Species Res.* 11, 245-269.

Henny, C., Hill, E., Hoffman, D., Spalding, M., Grove, R. 2002. Nineteenth century mercury: hazard to wading birds and cormorants of the Carson River, Nevada. *Ecotoxicology* 11, 213-231.

Herbst, L.H., Klein, P.A. 1995. Green turtle fibropapillomatosis: challenges to assessing the role of environmental cofactors. *Environmental Health Perspectives* 103:4, 27-30.

Hoffman, D.J. 2002. Role of selenium toxicity and oxidative stress in aquatic birds. *Aquat. Toxicol.* 57, 11-26.

Jones, T.T., Seminoff, J.A., 2013. Feeding biology in: Wyneken, J., Lohmann, K.J., Musick, J.A. (Eds.), *The Biology of Sea Turtles Volume III*. CRC Press, Boca Raton, pp. 211-248.

Keller, J.M., Peden-Adams, M.M., Aguirre, A.A., 2006. Immunotoxicology and implications for reptilian health. In: Gardner, S.C., Oberborster, E. (Eds.), *Toxicology of Reptiles*. CRC Press, Boca Raton, pp. 199-240.

Komorske, L.M., Lewison, R.L., Seminoff, J.A., Deheyn, D.D., Dutton, P.H. 2011. Pollutants and the health of green sea turtle resident to an urbanized estuary in San Diego, CA. *Chemosphere* 84, 544-552.

Magnuson, J.J., Bjorndal, K.A., Dupaul, W.D., Graham, G.L., Owens, D.W., Peterson, C.H., Pritchard, P.C.H., Richardson, J.I., Saul, G.E. and West, C.W. (1990). *Decline of the sea turtles: causes and prevention*. National Research Council, National Academy Press, Washington, 76 pp.

Murad, A., Houston, A.H., 1988. Leucocytes and leucopoietic capacity in goldfish, *Carassius auratus*, exposed to sublethal levels of cadmium. *Aquat. Toxicol.* 13, 141-154.

Owens, D.W., Ruiz, G.J., 1980. New methods of obtaining blood and cerebrospinal fluid from marine turtles. *Herpetologica* 17-20.

Pellisso, S.C., Munoz, M.J., Carballo, M., Sanchez-Vizcaino, J.M., 2008. Determination of the immunotoxic potential of heavy metals on the functional activity of bottlenose dolphin leukocytes in vitro. *Veterinary Immunol. Immunopathology* 121, 189-198.

Perrault, J.R., Stacy, N.I., Lehner, A.F., Poor, S.K., Buchweitz, J.P., Walsh, C.J. (2017). Toxic elements and associations with hematology, plasma biochemistry, and protein electrophoresis in nesting loggerhead sea turtles (*Caretta caretta*) from Casey Key, FL.

Storelli, M.M., Storelli, A., D'Addabbo, R., Marano, C., Bruno, R., Marcotrigiano, G.O., 2005. Trace elements in loggerhead turtles (*Caretta caretta*) from the eastern Mediterranean Sea: overview and evaluation. *Environmental Pollution* 135, 163-170.

Wyneken, J. 2001. The Anatomy of Sea Turtles. U.S. Department of Commerce NOAA Technical Memorandum NMFS-SEFSC-470, 1-172 pp.

Yang, T., Haas, H.L., Patel S., Smolowitz R., James, M.C., Williard, A.S. 2019. Blood biochemistry and haematology of migrating loggerhead turtles (*Caretta caretta*) in the Northwest Atlantic: reference intervals and intra-population comparisons. *Conservation physiology*. 7(1): coy079.



September 13, 2019
Laura St. Andrews, Msc.
Purdue University Fort Wayne
2101 E. Coliseum Blvd., Fort Wayne IN, 46805 USA

Dear Laura St. Andrews,

It is our pleasure to support your proposed Master of Science thesis research entitled "*Heavy Metal Contamination of Sea Turtle Tissues in Urbanized and Non-Urbanized Environments*". We consider your proposed study to be of vital importance in understanding pollution and heavy metal contamination in the region. The project also will strengthen the relationship between our organizations, increasing Purdue University Fort Wayne's research presence at the Cape Eleuthera Institute (CEI).

CEI is a private research and education facility that works to enhance conservation initiatives and economic prosperity at local, regional, and global scales through research, education, and outreach. CEI will provide logistical support for all sample collection, including vehicles and laboratory space. CEI will also include the proposed research in its annual research permit applications to the Government of the Commonwealth of The Bahamas. As the project evolves, there may be opportunities for the graduate student leading the project to become involved in instruction and research mentoring of high school participants in the study abroad program at The Island School. We look forward to building our collaboration together.

Sincerely,

Nathan Robinson
Director of the Cape Eleuthera Institute

Nathan Robinson

*The Cape Eleuthera Institute
PO Box EL-26029
Rock Sound, Eleuthera
The Bahamas
Phone: (242) 334-8552
www.ceibahamas.org*



Department of Marine Resources
Ministry of Agriculture and Marine Resources
P. O. Box N 3028
Nassau, Bahamas
Fax: (242)393-0238
fisheries@bahamas.gov.bs

MA&MR/FIS/9
January 31, 2019

PERMIT TO CONDUCT SCIENTIFIC RESEARCH DURING CY 2019

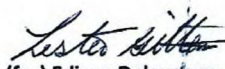
This serves to certify that **Dr. Nathan Robinson of Cape Eleuthera Institute, Eleuthera** has been granted permission to conduct research on **permaculture, terrestrial ecology, coastal restoration, aquaculture, flats ecology, deep sea ecology, geology, ciguatera poisoning, recreational fishing, pelagic fishes, fish aggregation devices, spiny lobster, Nassau grouper, queen conch, stone crab, sea cucumber, octopus, seabirds, bonefish, lionfish, sharks, stingrays, turtles, corals and sea urchins in Bahamian waters during calendar year 2019** and in conjunction with scientists too numerous to list here but listed in documentation submitted to the Department of Marine Resources by the applicant.

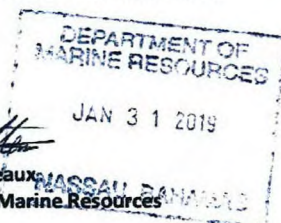
Permission to conduct this marine scientific research is given subject to the following conditions:

1. All participants in the research cruise(s) to The Bahamas abide by the laws of the Bahama Islands;
2. There be no commercialization of the equipment or supplies used during the research cruise(s);
3. The right be reserved by The Bahamas Government to appoint an observer/participant to any planned marine research cruise;
4. All equipment, etc., which may have been imported duty-free be exported at the end of the research cruise(s);
5. The research vessel used clear into The Bahamas at an official port-of-entry prior to commencing and research activities, and clear out at a port-of-exit upon completion of the cruise;
6. A cruise prospectus and list of those persons (names, nationalities and passport numbers) participating in the cruise be submitted to the Department of Marine Resources (Fisheries);
7. A detailed report on the cruise and research activities in The Bahamas, including specimens collected to the Department of Marine Resources no later than three (3) months after leaving The Bahamas;
8. Three (3) copies of all published papers, reports and/or books that may arise as a result of the research conducted in The Bahamas be submitted to the Department of Marine Resources when they become available.

This permit expires on 31st December 2019.

Yours sincerely,


(for) Edison Deleveaux
Acting Director of Marine Resources



cc Commodore , Royal Bahamas Defence Force



Mr. Edison Deleveaux
Director
Department of Marine Resources
Ministry of Agriculture and Fisheries
PO Box N-3028
Nassau, NP
The Bahamas

7th January 2019

Dear Mr. Deleveaux,

RE: 2019 Renewal of Scientific Research Permit for the Cape Eleuthera Island School

The Cape Eleuthera Island School and Cape Eleuthera Institute respectfully requests the renewal of our scientific research permit for the 2019 calendar year. We request permission to continue and expand our work on:

Resilient Landscapes

- 1) Permaculture and Sustainable Design
- 2) Terrestrial Ecology
- 3) Coastal Restoration and Rehabilitation

Sustainable Fisheries

- 4) Aquaculture and Alternative Fisheries Industries
- 5) Commercial Fisheries Ecology
- 6) Recreational Fisheries Ecology
- 7) Invasive Lionfish Ecology

Protected Species Conservation

- 8) Shark and Stingray Ecology
- 9) Sea Turtle Ecology
- 10) Marine Mammal Research
- 11) Seabird Ecology

Marine Ecosystems

- 12) Coral Reef Ecology
- 13) Flats Ecology
- 14) Deep Sea Ecology
- 15) Marine Geology and Sedimentology

1) Permaculture and Sustainable Design

The Bahamian government is encouraging the redevelopment of the agricultural industry on its “Family Islands”, including Eleuthera, to help revitalize the local economy and reduce dependence on imported produce. To be successful, agriculture must work within the confines of the local landscape, require low inputs of nutrients and chemicals, and be economically feasible. The goal of Permaculture Research conducted at Cape Eleuthera Island School is to examine ecologically sound and practical methods of agriculture that may lead to sustainable commercial food production on Eleuthera. In 2019, we will continue research into the ARES (Agricultural Research & Experiment Station), with a primary objective to improve food security not only at for our immediate community but on Eleuthera as a whole. This will be conducted through two main processes. Firstly, by continuing our research in permaculture design on campus. We will continue to test various methods of growing produce using local resources, and incorporating traditional ecological knowledge and modern ideas of sustainable systems, including the integration of renewable energy and natural nutrient sources. We will also be carrying out studies on how to increase the nutrient content and structure of poor soil using native tree species, seaweed and compost. Our overall goal is to have a fully edible campus. Secondly, we will be working closely with local farmers to increase the amount of fresh produce produced on the Eleuthera. To encourage this, The Island School will form relationships with local farmers to purchase their produce to be used in the dining hall. This will help establish a less volatile market through creating consistent demand. In addition to this we hope to eventually use our heavy machinery to open up more farmland. We will continue our research into suitable uses for the invasive Casuarina tree, whether this is for the creation of energy, biochar as a soil amendment, or as a building material. Lastly, we plan to expand our Aquaponics system, creating a working model for sustainable food production that is capable of producing enough fish, lettuce, and local herbs to meet the needs of our immediate community.

2) Terrestrial Ecology

(a) Sustainable controls on mosquitoes to prevent disease

As the geographic range of Zika virus continues to expand and human vaccines remain under development, vector abatement is the only viable option for the prevention and management of this infectious illness. The primary mosquito vector for Zika virus in the Western hemisphere is the container breeding species *Aedes aegypti*. Because this mosquito is obligately confined to closed aquatic habitats during the early life cycle, control efforts are typically more successful when targeted to the larval stage. But while a variety of granular and sustained-release larvicide formulations have become established as the “state of the art” in mosquito control over the past 30 years, a variety of obstacles may limit their widespread use, including

concerns regarding the environmental and public health safety of insecticides, availability of insecticides in remote locales, and the substantial economic burden that mosquito control imposes upon public health agencies. Our proposed research at the Cape Eleuthera Institute and in the surrounding community will take on two components of this intractable problem: 1) we will characterize at the household level source habitats of peridomestic mosquitoes potentially including *Ae. aegypti* and conduct a survey to understand residents' household water management practices, and 2) we will conduct experiments investigating use of vegetable oil as a cheap, effective means of controlling mosquito larvae. To address the first objective, we will conduct larval surveys of aquatic habitats in residential neighbourhoods with particular attention to water cisterns of private households. We will ask homeowners if they will allow access to sampling the cisterns and other artificial containers with a mesh aquarium net attached to a pole and store and identify collected mosquitoes at CEI. We also will conduct a survey of residents to understand their household water management practices and mosquito-borne disease risk perceptions (University of Maine Institutional Review Board approval #2017-06-09). To address the second objective, we will establish small experimental container habitats on CEI's campus. We will add a thin layer of vegetable oil to the surface of half these containers and monitor the containers daily for mosquito eggs to assess whether the presence of vegetable oil alters oviposition behaviour of *Ae. aegypti* and other mosquitoes. The other half of the containers we will deliberately allow to be colonized by mosquito larvae, and after several days we will add vegetable oil to assess its effect on rates of mosquito pupation. Collectively, these aims will contribute to characterizing the mosquito community and mosquito source habitat on Eleuthera and take initial steps exploring an inexpensive, safe and sustainable method for residents to control mosquitoes around the home. These efforts are intended to become the foundation of a long-term research program based at CEI to better characterize the ecology of mosquito-borne diseases in the region.

Investigator: Allie Gardner, School of Biology and Ecology, University of Maine

b) *Parasitology of white-crowned pigeons in developed and undeveloped habitats*

White crowned pigeons (*Patagioenas leucocephala*) are a near-threatened species with declining populations in The Bahamas and Florida. Because this species inhabits both heavily developed areas (such as south Florida) and relatively undeveloped areas (such as south Eleuthera), there is interest in understanding how this varying level of ecosystem disturbance effects the health of these birds. To investigate this question, we plan to obtain the carcasses of these pigeons from hunters on Eleuthera to analyze gut-borne parasites. Characterizing this internal faunal community will act as a healthy baseline for comparison to birds living in heavily developed areas. Carcasses will be collected, frozen and analyzed on-site. Additionally, live individuals will be captured with mist nets for satellite tracking and feather collection for further insights into trophic position and migration.

Collaborator: Dr. David Kerstetter, Nova Southeastern University

3) Coastal Restoration and Rehabilitation

The Cape Eleuthera Island School wishes to conduct a series of scientific monitoring projects focusing on understanding several questions critical to the conservation and management of mangrove ecosystems, including: What factors influence the growth of the mangroves? How much carbon is currently stored in the mangrove flats? At what rates are the mangrove flats sequestering carbon? What are the site to site differences in carbon storage and how are these explained? Are the mangrove flats that are most successful at sequestering carbon also the best fisheries? At several survey sites around Cape Eleuthera above and below ground plant biomass, mangrove age and growth rates, and carbon uptake will be monitored and measured. Woody stem, root, and leaf biomass will be harvested from select specimens to be tested for nutrient content. These samples will be analyzed for carbon content as well as other nutrients. Soil cores will be analyzed to determine bulk density, soil texture, percent organic carbon, and nutrient levels. The soil cores will also be examined to determine depth of sediment and depth of organic layers. This study will also begin to quantify the distribution and relative abundance of benthic macroinvertebrates in mangroves and adjacent flats ecosystems around Cape Eleuthera. This will be accomplished by collecting and sieving sediment cores and enumerating organisms to the lowest taxonomic level practicable.

Further, we aim to understand how hydrological connectivity through the use of restoration tools (e.g. bridges / culverts) can improve ecosystem functioning in areas previously cut off to regular tidal flow. The focus of this research will be to understand how economically and ecologically important fishes such as lemon sharks and bonefish use these formerly inaccessible habitats and how mangrove communities respond and potentially recover once tidal flow is restored. This will be accomplished through drone and unbaited video surveys to assess fish passage across these barriers compared to un-altered sites as well as through mangrove health assessments on either side of these barriers.

Related research will investigate how mangroves are able to disperse from habitats with limited access to the open ocean, and, consequently, how mangrove genetic diversity is affected within creek systems based on their connectivity to strong tidal flow and creek mouths. Mangrove propagule dispersal will also be investigated to understand how far, where, and when mangrove propagules move across space and time prior to settlement.

Occasionally, samples will be transported to universities in the United States or Canada for further analysis. Over time, these data will allow us to develop a comprehensive inventory of important macrobenthos associated with mangroves and flats in Eleuthera, develop estimates of species diversity at the selected survey sites, and begin to understand inter- and intra- site variability within the benthic community. In

addition, we will be doing work on genetic diversity of microbial communities in the sediments as well as genetic diversity of red mangroves.

a) Anthropogenic Effects on Mangrove Habitats

Deforestation and destruction of mangrove habitats is a critical stressor on nearshore habitats. To quantify the direct impact of mangrove deforestation and the construction of access roads through mangrove habitat, CEI will perform standardized Rapid Ecological Assessments (REA) throughout Eleuthera and The Bahamas. While REAs will be observational and non-invasive, some algal, sponge, coral, or invertebrate specimens may be vouchered if researchers are unable to identify the specimen in the field. In addition, passive tags will be applied to bonefish, snappers, checkered puffer, yellowfin mojarra, barracuda, and needlefish, among other species, to allow for determination of habitat preferences and movements via mark-recapture sampling.

Based on REA findings, particularly disturbed areas will be identified as candidates for rehabilitation efforts. Free-floating mangrove propagules will be collected and planted in transportable cultivator pots at CEI, and maintained in CEI's wetland until the propagule is established. With the assistance of community members, cultivator pots containing mangrove seedlings will be transplanted to reestablish mangrove forest in degraded habitats.

b) Restoring Mangroves for Coastal Protection

We will also be examining ways to restore or rehabilitate Cow Point; an artificial peninsula created for a former resort development where coastal erosion is currently occurring, threatening The Island School and potentially impacting adjacent habitat. At Cow Point, we will be determining the utility of propagating mangroves, and deploying artificial reefs to protect the coastline. We will continue to focus on the rehabilitation of the mangrove wetland situated between the campuses of The Island School and the Cape Eleuthera Institute, which was cut off from water flow nearly 50 years ago.

Collaborators: Fisheries Conservation Foundation, John Tiedeman and Dr. Pedram Daneshgar (Monmouth University, New Jersey)

4) Aquaculture and Alternative Fisheries Industries

The goal of the Aquaculture Research at the Cape Eleuthera Island School is to determine the feasibility of aquaculture in The Bahamas, which includes offshore cage aquaculture as well as smaller scale near-shore culture systems, from an environmental and socioeconomic standpoint. As such, our work involves environmental monitoring and assessment, the development of a hatchery, education and public awareness, and socio-economic and policy analysis for the sustainable development of an aquaculture industry.

a) Aquaponics and Small-scale Aquaculture

Cape Eleuthera Island School (CEIS) will continue to produce Red Tilapia, lettuce, basil and other leafy greens in our small scale aquaponics system. We will continue to breed tilapia in order to provide a sustainable source of protein for our campus kitchen. The nursery expansion and detachment from the main system will allow better management for fry production to better optimisation our current aquaponics system. CEIS now seeks to increase lettuce and other leafy green production through optimisation and development of new growing techniques. We will look to expand the grow bed space using a nutrient film technique (NFT) system to grow leafy greens above the grow beds in order to double the available space to grow plants. Alongside producing leafy greens for the kitchen, the aquaponics system will produce microgreens for the kitchen and livestock, to better utilise the excess nutrients within the system. Following the introduction of the NFT system the existing deep water grow beds will be converted to produce Giant Malaysian Shrimp. This system will increase our food conversion ratio (FCR) and provide a model for more efficient food production for Small Island Developing States (SIDS). CEIS will also expand our current food production rates with a design and build of a new Integrated Aquaponics and Hydroponics system (IAH). This system will provide up to two tilapia meals a week and all of the leafy greens and vegetables for the dinning hall and thus reduce CEIS food insecurity by up to 25%.

Collaborators: John Reid (Freshwater Farms Ltd)

b) Spiny Lobster Culture

Spiny lobster ranching operations are now well established in Southeast Asia and new facilities are developing in the Caribbean region. Ranching involves collecting newly settled post-larvae and growing them up to adult size in tanks, pens or sea-cages. The aim of these operations is to increase productivity by reducing mortality during early life phases, without impacting on recruitment to wild stock populations. As the Bahamas seeks to increase aquaculture production, the Caribbean spiny lobster (*Panulirus argus*) is a highly attractive candidate species, owing to its high market value. We are seeking permission to undertake preliminary studies to investigate:

- (i) efficient strategies for collecting post-larvae - This study would involve trialing different designs of post-larvae collectors in different environments to evaluate their efficacy. All larvae would be returned to the environment once counted.
- (ii) optimizing feeding strategies for juvenile lobsters - The feeding trials would require the collection of juvenile lobsters from the wild and subjecting them to different feeding regimes in land-based aquaria to

establish growth rates and survivability. All lobsters would be returned to the marine environment after the trials.

Collaborators: Michael Bowleg Jr.

5) Commercial Fisheries Ecology

a) Spiny Lobster Ecology

A primary goal of spiny lobster (*Panulirus argus*) research at the Cape Eleuthera Institute is to assess the current population of lobsters in the coral reef ecosystems around Eleuthera. This will be done with visual surveys on both snorkel and SCUBA, and night time surveys (when lobsters are most active). Research will also be conducted to monitor larval recruitment of spiny lobster in South Eleutheran creeks, utilizing traps to collect lobster larvae. Non-lethal tissue samples will also be collected for genetic analysis. Lastly Spiny lobster may be collected, to use in laboratory experiments. Lab experiments will investigate feeding behaviour and anti-predatory behaviour.

In tandem with research on the lobsters, we will be undertaking research on the use of artificial shelters (known as condos or casitas) that are widely used in the local fishery. This research aims to address gaps in our knowledge on the environmental impacts of these devices. We seek permission to deploy and maintain artificial lobster shelters to quantify their impact on the seabed environment and the species that interact with them.

b) Nassau Grouper Physiology

The Nassau Grouper (*Epinephelus striatus*) is the most important finfish fishery in The Bahamas, but stocks of this endangered species have been declining for the past several decades. Recent studies have shown that in The Bahamas, adult Nassau Grouper make round trip spawning migrations up to 200 km to aggregation sites during winter full moons. Some individuals have even been known to make more than one migration during one spawning season. These long distance movements incur energetic costs for individuals that normally live sedentary lives with small home ranges. Using its in-house respirometry laboratory, CEI will investigate the energetic costs of Nassau Grouper spawning migrations. Blood parameters including lactate, glucose, hematocrit, blood gases and cortisol will also be measured to understand the physiological consequences of prolonged migratory periods. All animals will be released upon conclusion of the study.

c) Queen Conch Populations of Eleuthera

In recent years, there have been concerns of over-exploitation of queen conch. Research conducted in The Bahamas shows marked declines in queen conch nursery and breeding grounds though more areas need to

be evaluated. The goal of queen conch research at the Cape Eleuthera Institute is to conduct additional surveys to determine the status of conch populations as well as nursery, juvenile, and adult habitats. Research methods would follow basic survey protocols using transects to assess population numbers and size distribution, including the use of SCUBA and underwater video units to survey deep-water populations. Non-lethal tissue samples will also be collected for genetic analysis.

d) Stone Crab Ecology

Stone crab is an emerging fishery in The Bahamas; they are now the fourth largest fishery. Fishing pressure is increasing rapidly in the family islands though baseline data is lacking for the current health of stone crab stocks. The goal of stone crab research at the Cape Eleuthera Institute is to quantify the population numbers of stone crabs around Eleuthera. This is done by utilizing commercial traps, and upon capture taking morphometric measurements as well as environmental data (e.g. temperature, depth) to determine if there is a preferred habitat for stone crabs in The Bahamas. Stone crabs may be collected, to use in laboratory experiments. Legal harvest dictates that one or both claws may be removed from a stone crab, though research is lacking on the long-term consequences of claw removal. Lab experiments will parse out claw removal effects on feeding behavior and anti-predatory behavior. Safe handling practices will also be evaluated in the laboratory with stone crabs, to potentially increase the survival rates of harvested crabs.

e) Sea Cucumber Ecology

Our goal is to examine the ecological roles of sea cucumbers and the potential impacts of sea cucumber fisheries. First, we will measure nitrogen excretion rates of sea cucumbers, collected from the wild, kept briefly in water-filled containers, and returned to reefs. Second, we will examine the effect of sea cucumber excretion on growth of primary producers (algae, phytoplankton, seagrass) with small cage and bottle experiments in the field. Third, we will compare the relative magnitude of nitrogen input by sea cucumbers and by coral reef fishes, which will require monitoring surveys of both taxa. Finally, we will conduct a translocation experiment in which we either increase or reduce the density of sea cucumbers in seagrass patches, and measure the effects of seagrass health and sediment characteristics.

f) Caribbean Reef Octopus Ecology

Caribbean reef octopus remain relatively understudied despite their abundance along coastlines in tropical and sub-tropical reef ecosystems. In order to assess the potential for a sustainable octopus fishery in The Bahamas, we aim to understand the drivers of octopus habitat use while conducting a mark-recapture study to estimate abundance across various habitat types. Capture procedures will involve daily night wades for two weeks during each season to identify trends in octopus abundance over time as well as minimally invasive PIT tagging and the collection of biometrics. Given the short lifespan and high reproductive rates

of this species, there is the potential for the development of small-scale sustainable fisheries for this species as an alternative to conch fishing after we sufficiently understand octopus ecology and population dynamics.

g) Social Science and Sustainable Fisheries

This work would attempt to assess perceptions and understandings surrounding sustainable fisheries and marine management in The Bahamas. The goal of this research is to monitor how the community's needs and demands change over time with the changing supply of local seafood. It will include interviews with community members, and will have several objectives: 1) To determine the demographics of the Eleutheran fishing community; 2) To determine perceived changes in the fishery over time; 3) To determine current seafood preferences; 4) to assess perceptions of marine management and sustainable fishing practices; and 5) to estimate fisheries pressure in the pelagic zone across The Bahamas.

h) Ciguatera toxin and human health

Ciguatera fish poisoning (CFP) is a pan-tropical disease caused by ciguatoxins produced by benthic dinoflagellates in the genus *Gambierdiscus*. Ciguatoxins are lipophilic and bioaccumulate in herbivorous reef fishes that inadvertently ingest toxic *Gambierdiscus* spp. attached to reef seaweeds. Ciguatoxins then become biomagnified in upper trophic level fishes that consume the herbivores. People become sick with CFP when they consume reef fish that have bioaccumulated sufficient ciguatoxin to affect human health. This syndrome impacts tens to hundreds of thousands of people annually, with the majority of illnesses affecting island communities who rely on subsistence fishing, including the Bahamas. Bahamian reports of CFP averaged 153 cases per year (range 24 – 263) between 1995 and 2011 yet little work is currently being done to document *Gambierdiscus* spp. abundance and ciguatoxin distributions in reef fishes in much of the Bahamian archipelago (Parsons and Richelin 2016). Research is required to understand the spatial and temporal variability of *Gambierdiscus* spp. throughout the Bahamas, including toxic and non-toxic species. Research is also required to better understand the distribution of ciguatoxins among Bahamian reef fishes, including upper trophic level fishes as well as the lower trophic level fishes that are important vectors for toxin biomagnification. This work will inform public outreach on the causes of CFP, local hotspots and fish to avoid, and will aid research on long term effects of climate change on *Gambierdiscus* and CFP in tropical environments.

6) Recreational Fisheries Ecology

Both the shallow-flats and deep-pelagic habitats of The Bahamas support a number of sports fisheries that are important to recreational, charter, and artisanal fishery sectors of the local economy. Additionally, the species of interest to sport and artisanal fishers (e.g., dolphinfish, wahoo, tunas and sailfishes incl. marlin)

are highly migratory and support economically important commercial and recreational fisheries outside of Bahamian waters.

a) Physiology and ecology of pelagic fishes

To better understand how these highly migratory species (described above) are affected by angling and shifting oceanic conditions, the Cape Eleuthera Institute proposes to perform laboratory-based studies to quantify energetics, physiological condition, and swimming capacity of various pelagic species. Dolphinfinch, tunas, mackerels, and common prey items (e.g., flyingfish and squid) will be collected via angling, seine net, light traps, or gill nets and transported by boat to CEI's wetlab. To quantify aerobic scope and swimming performance, fish will be exercised either in a swim tunnel or via standardized chase protocols. Fish may be dispatched, and blood plasma, tissue samples, and fish bicarbonate may be transported to the United States, Canada, or the United Kingdom for physiological analysis. Water conditions will also be manipulated prior to swim tunnel trials to simulate forecasted changes in ocean pH and temperature. Findings from these studies will provide insight into how shifting climate may affect the fitness and health of highly migratory species. Results will have implications for global management of economically important fishes, thus benefiting the health of the Bahamian pelagic fishery.

To supplement data collection on economically important pelagic species, fish will be fitted with individually numbered conventional (i.e., spaghetti tags) and pop-off satellite archival tags to elucidate migratory patterns through Bahamian waters. Tagging will be performed by CEI researchers with the assistance of local and international volunteer anglers.

b) Marine debris in the pelagic food web

The presence of plastic debris in the oceans has been identified as a major threat to the health of marine ecosystems. Ingestion of plastic has been documented to cause death and impair the health of birds, mammals, and fish, and is also a vector for the introduction of persistent organic pollutants (POPs; e.g., DDTs, PCBs) into the marine food web. To document the consumption of plastics by economically important pelagic fishes, dolphinfinch, tuna, and other scombrid (e.g., wahoo and mackerels) carcasses will be collected by angling or from recreational anglers for subsequent gut content analysis. Tissue (e.g., muscle, liver, and blood) sampled carcasses or non-lethally from live fish via biopsy and syringe may be transported for laboratory quantification of POPs. To investigate how plastic and POPs may accumulate up the food chain, key prey species (e.g., flyingfish, cephalopods, scombrids, etc.) will be collected by gillnet (5 cm mesh size), seine net, or light traps for subsequent gut content analyses.

To quantify the presence of free-floating plastics in the marine environment, CEI will deploy a high-speed trawl (i.e., neuston/plankton net) from a boat to collect and enumerate plastics at surface and subsurface

depths, particularly in Sargassum weedlines. Tissue samples from prey species (flying fish, cephalopods, and invertebrates) and larval fish captured in the trawl may also be transported for POP and stable isotope analysis.

c) Retention of plastic in the stomachs of pelagic fish

Preliminary results from 2015 (see: Marine debris in the pelagic food web, above) indicate that up to 30% of dolphinfish, wahoo, and yellowfin contain plastic in their stomachs, with microplastics (i.e., plastic fragments < 5 mm in diameter or length) being the most frequent size class of plastics identified through gut content analysis. Considering that microplastics are small enough to be passed through the digestive tract of fishes, it is likely that these results are under-representative of the actual occurrence of plastic ingestion by pelagic sportfish. CEI requests permission to test the retention time of plastic in pelagic sportfish such as dolphinfish and scombrids. To accomplish this, fish will be collected using hook and line angling, then transported to CEI's wetlab. Fish will be held in a flow-through tank, and all outflow will be filtered through a mesh filter bag. Fish will then be fed UV-reactive plastic pellets (i.e., plastic beads that glow when seen under a black light), which upon passing through the fish, will be captured in the mesh filter bag and easily identifiable when seen under a black light. In addition, the mesh filter bag will minimize the incidental loss of plastic pellets into the environment. In the case that plastics do not pass through the fish, fish will be humanely incapacitated via cerebral percussion and pithing, and the stomach dissected to confirm the retention of plastic. Results from this study would improve our understanding of how frequently fishes commonly captured for human consumption ingest plastics, highlighting the need for further investigation of the impact of plastic ingestion on fish and human health.

d) Fish Aggregation Device (FAD) ecology

We will investigate the effect of floating structures, referred to hereafter as Fish Aggregation Devices (FADs) on fish behavior. To accomplish this, anchored FADs will be constructed and deployed in depths ranging from 30 to 1400 m. To avoid navigational hazards, submerged FADs (i.e., those that do not have a surface buoy) will be deployed on anchor lines that reach no less than 6 m (20 ft) in depth from the sea surface. Floating FADs will be clearly marked with a high visibility buoy and radar reflector. All FADs will be clearly marked with CEI's contact information, constructed to International Seafood Sustainability Foundation's standards for best FAD practices (e.g., the use of non-entangling materials and non-synthetic materials such as palm fronds), and will be removed following completion of each study.

After deployment, FADs will be monitored to document colonization rates for pelagic prey and predator species using conventional methods as well as fisheries sonar. Fish will be captured using several methods including light traps, nets, and angling, and then fitted with conventional or PSAT tags to monitor

movement, residency time, and utilization of FADs by a variety of pelagic species including tunas, dolphinfish, billfish, triggerfish, and flying fish. Results will be used to provide baseline data on FAD ecology in a region (i.e., within the Bahamas EEZ) where FADs are not disturbed by commercial purse seiners, thus aiding in the establishment of best FAD management practices for the wider Caribbean.

e) Bonefish Populations of The Bahamas

Bonefish (*Albula* spp) epitomize the interconnectedness of flats habitats and have been selected as target species for this research. Understanding the role of bonefish in flats will also increase the capacity to manage and sustain tourist-based recreational fisheries important to The Bahamas. This program addresses 1) how catch-and-release angling affects the behavior and survival of bonefish and 2) what indirect impacts anglers can have, i.e. through wading or boat traffic, on flats environments. In addition, given that there is still so very little known about bonefish, much of our research is addressing 3) the basic ecology of bonefish throughout the Bahamian Archipelago.

To address many of our research questions, we are using a block or beach seine net to capture bonefish and other nearshore fish throughout the Bahamian archipelago. The use of a block net is an efficient, minimally stressful mode of capture that allows bonefish to be sampled and released unharmed, with minimal risk of bycatch. For our studies, bonefish are captured for conventional external tagging, ultrasonic telemetry, behavioral observations, genetic analysis, blood, cardiac, and respiratory physiology, bioenergetics, age and growth, diet analysis, and manipulative experiments in multiple creek systems and in the laboratory to examine multiple stressors (e.g. water temperature, exertion, hypoxia, predators). This research may involve the transport of blood and tissue (e.g., white muscle, liver, brain and kidney) samples to laboratory facilities in Canada, the United States, and the United Kingdom. In some cases, voucher specimens will be retained for morphology and to examine age, growth, reproduction, genetics, and bioenergetics.

To address some of these questions, bonefish will be transported back to the Cape Eleuthera Institute and held in a large enclosed wetland for behavioral observations, and to monitor their fine-scale movements using surgically-implanted telemetry tags, such as accelerometers, biologgers, and tip tags. In addition, bonefish and other flats species will be transported to CEI's Wege Center for Sustainable Fisheries for holding prior to the collection of behavioral, physiological, and energetics data via shuttle box and swim tunnel experiments. In 2016, we will conduct similar catch-and-release studies on great barracuda and sharks inhabiting inshore waters – two groups of fishes that are important apex predators on the flats and becoming a popular target of anglers. In 2016, we will continue our research on the acute and chronic impacts of catch-and-release angling on great barracuda, as well as examine the incidence of ciguatera poisoning, site fidelity, energetics including swimming performance, thermal ecology, and life history characteristics. The movement patterns of great barracuda and sharks will also be compared to those of

bonefish to examine predator-prey interactions. Great barracuda movement patterns will be quantified using pop-up satellite transmitters.

Understanding the ecology and population dynamics of bonefish will play a critical role in the development of effective management plans for this group of fishes throughout the Bahamian Archipelago. As such, we plan to coordinate the collection and conventional tagging of bonefish from sites throughout The Bahamas using hook and line or a block or seine net to assess spatial variation in life history traits and conduct population estimates. Other sampling methods may include the use of monofilament gill nets, hoop nets, and cast nets. In some cases, voucher specimens will be retained for morphology and to examine age, growth, reproduction, genetics, and bioenergetics. Coupled with this project will be a study that examines the schooling behavior and social dynamics of adult and juvenile bonefish using sophisticated 3-D telemetry. This project may also provide clues as to the reproductive ecology of bonefish – an important piece of this species life history that is still a mystery. Examining the reproductive ecology of bonefish is currently a major focus of our field research at the Cape Eleuthera Institute, and we hope to continue this research for the next 2-4 years.

Collaborators: Dr. Steven Brian Quinn (University of Western Scotland), Dr. Jeremy Kiszka (Florida International University), Dr. Michael Heithaus (Florida International University), Dr. David Kerstetter (Nova Southeastern University), Dr. Jason Adolf (Monmouth University).

7) Invasive Lionfish Ecology

CEI has an extensive track record of lionfish research that we wish to build upon over the coming year. We request permission to continue long-term monitoring of patch reefs to assess the effects of lionfish on reef fish assemblages and the benthic environment, which requires removal of lionfish. Fish assemblages are assessed through transects and benthic coverage monitored by photoquadrats. We also intend to undertake lab based studies of lionfish in captivity to study their behavior, feeding patterns and physiology.

Collaborators: Dr Isabelle Cote, Dr Stephanie Green, (University of Alberta), Dr. Steven J. Cooke, Chris Elvidge, Robert DeBruijn, Mike Lawrence, Erika Eliason, Tanya Prystay (Carleton University)

8) Shark and Stingray Ecology

The Shark Research and Conservation Program (SRCP) is comprised of several research projects investigating the biology, ecology and conservation of Bahamian sharks. The project has grown and diversified since its inception in 2006 and now has one or more projects focusing on every marine habitat that is essential habitat for Bahamian sharks, including shallow mangrove flats, coral reefs and the deep ocean. The SRCP understands the ecological and economic significance of the diverse and abundant apex

predator assemblages found in Bahamian waters and is committed to their preservation through primary research, community outreach and education.

In 2019, the SRCP plans on expanding its research programs in the following areas:

a) *Caribbean Reef Shark Ecology*

The Caribbean reef shark is one of the most economically and environmentally vital species of shark in the Bahamas. It is the predominant species encountered in the shark diving industry, and as such is directly responsible for the majority of the \$78 million of revenue generated annually by this activity. Furthermore, as one of the most abundant apex predators on Bahamian reefs, it has a crucial role to play in maintaining the health of coral reefs and the tourism and fisheries sectors which rely on them. The SRCP has been conducting research into the ecology of Bahamian Caribbean reef sharks for the last three years and the proposed research for 2019 will continue to investigate the movements, habitat use, growth rates, genetics, and ecology of this valuable species.

b) *Pelagic Shark Ecology*

The oceanic whitetip shark (*Carcharhinus longimanus*), silky shark (*Carcharhinus falciformis*), and dusky shark (*Carcharhinus obscurus / galapagensis*) were once among the most abundant pelagic apex predators on the planet. However, due to excessive fishing pressure, their populations are now considered threatened to critically endangered in the north Atlantic. The Bahamas is one of the last remaining places in the world that the oceanic whitetips can be found in relatively large numbers at an annual aggregation in the south of the Exuma Sound. Further, juvenile silky sharks and dusky sharks are known to frequent Exuma Sound, particularly during the winter months. Continuing studies into 2019 will further elucidate the underlying demographic characteristics of these groups, in addition to monitoring the movements and vertical habitat use of individuals through the deployment of pop-off satellite tags and role in the food web through muscle and blood sample collection as well as stomach lavage. Research will be further expanded to understand the acute impacts of fisheries capture on this species, by assessing the stress response of these sharks after capture on midwater pelagic longlines. In this way, novel assessments of fishing impacts on this species will be defined.

c) *Haematological Responses to Acute Fishing-Induced Stress*

As conservation physiology is being increasingly recognized as an important piece of the fisheries management puzzle, it becomes imperative to define species- and gear-specific stress responses within elasmobranchs to fisheries capture. Understanding the physiological response to capture, as well as information pertaining to temperature, pH, and CO₂ impacts, as well as recovery rates and population impacts, is pertinent in this age of multidisciplinary fisheries research. By understanding how the body

reacts to capture, we can back-track and find better ways to mitigate the fishing, handling, and release practices by fishermen. Such questions will be investigated in sharks caught on longline, polyball, and drumline. Outcomes will be shared with the local community, as well as the international research community.

d) Bull Shark Ecology

The Bull Shark (*Carcharhinus leucas*) is one of the most infamous sharks in the world's oceans. It is one of the only species that has the physiological capacity to spend time in fresh water which it utilises during its reproductive cycle, whereby females pup in river mouths, estuaries and lagoons where young are protected from predation by other large sharks. Pupping in Florida nurseries takes place from late April through to July, and there is some evidence to suggest that females return to the same nursery areas to pup year after year. Despite its infamy, the bull shark remains one of the least studied species in the greater Caribbean region and basic information relating to its biology and ecology is lacking making any form of management or conservation initiative virtually impossible. Bull sharks are regular visitors to Cape Eleuthera, and The Bahamas as a whole, typically arriving in the late autumn, and departing again in the spring. It appears that many of these sharks are transitory, but it is a mystery where they come from and where they depart to during the warmer months.

This study will begin to address many of the mysteries surrounding the Cape Eleuthera bull sharks and provide a platform for future research initiatives. Specific objectives for the preliminary project will be to:

- 1) Develop robust capture techniques for bull sharks in the confined area of the Cape Eleuthera marina.
- 2) Initiate a passive (numbered) tagging program which will facilitate the identification of individuals in future years.
- 3) Test the feasibility of deploying long term (~ 10 month) satellite tags on this species which will document the scale and timing of their seasonal migrations

e) Understanding Bycatch Interactions

Bycatch is the number one threat to the majority of marine megafauna species globally, including sharks. In order to reduce bycatch interactions and bycatch mortality in fisheries, and this support the mission of the Bahamian Shark Sanctuary, we aim to better understand the drivers of mortality for captured sharks, how to mitigate bycatch interactions and mortality, and increase post-release survivorship. These projects may range from testing the effects of low-cost bycatch reduction devices on shark catch rates on various fisheries gears to longline gangion modifications that reduce shark stress and mortality during and after capture.

f) *The response of nearshore sharks to electrical fields*

Offshore wind (i.e., ocean-based wind turbines) is gaining popularity as a potential alternative energy source for supplying electricity to coastal nations and islands. However, the construction of turbines and laying of electrical lines on the sea floor may have an impact on the ecology and biology of electro-receptive species such as rays and sharks. CEI proposes to determine how juvenile lemon sharks respond to an anthropogenic electric field of a strength similar to that generated by subsea power cables. Ten juvenile lemon sharks from mangrove creeks adjacent to CEI will be captured using conventional angling equipment, then implanted with ultrasonic transmitters and tracked in the creeks over three consecutive two-week segments using 15-20 hydrophone receivers. During the second two-week segment, a power cable emitting weak electric fields will be activated in Page Creek, thus allowing us to determine if shark behavior and spatial use changes when encountering anthropogenic electric fields in their environment. Results from this study will influence policy regarding the placement of subsea cables through sensitive habitats.

g) *Stingray ecology*

The Shark Research and Conservation Program has expanded its portfolio to include assessing demographics, abundance, site fidelity, genetic connectivity, trophic ecology, resource partitioning and behavior in southern stingrays (*Dasyatis americana*) the whiptail stingray (*Styracura schmardae*) and the yellow ray (*Urobatis jamaicensis*). This research will involve non-lethal collection of tissue samples for genetic analysis, stable isotope analysis and biochemical assays, as well as keeping specimens in aquaria for time-limited experiments. All animals will be released back into the environment after the experiments have finished. Samples will be exported to collaborator facilities for analysis.

h) *Shark Research Methodologies*

To complete the proposed research the SRCP will employ the following survey techniques:

Stratified Scientific Longline Surveys – Following the review of the scientific longline surveys conducted by the SRCP by the Bahamian cabinet, and the resulting permission granted by the Governor General of the Bahamas, longline surveys will once again be utilized to sample sharks in a stratified manner. Surveys will be designed to target only sharks and for longer duration sets, lines will be checked at a minimum of 90 minutes and all captured animals, worked up and released. All viable animals (shark and bycatch) captured will be released as soon as feasibly possible, moribund animals will be transported to the laboratory for educational dissection by Island School students.

Polyball Fishing – In situations where stratified sampling of the population is not required, directed fishing will take place using polyballs. This method employs a single baited circle hook attached to a series of

floats, and uses chum to attract candidate animals. This method allows the capture of specific individuals quickly and with minimal stress and will ordinarily be used to facilitate the deployment of electronic tracking devices.

Drumline Surveys – Drumlines are commonly used to capture more sensitive species of shark, or to conduct surveys in areas where the bathymetry does not allow longlines to be set, e.g. creek mouths. They consist of a single anchor point with a line and float attached. A long 10-30 m line attaches to swivel set just below the float, buoyed at the surface by a series of small floats, the other end of which terminates in a single circle hook. Any animals captured have a circle, twice the length of the line in diameter, in which they can swim. This facilitates water movement over the gills, reduces physiological stress, reducing impact on the individual and promoting post-release viability.

Baited Remote Underwater Video Surveys (BRUVS) – BRUVS are a novel, non-invasive method of generating relative abundance indices for a number of marine species, including sharks. The process requires the deployment of video units on the seabed for a period of 1-8 hours with bait attached. The resulting data can be used to monitor the diversity and relative abundance of sharks. This technique has seen extensive use in shallow water, and in 2019 the SRCP plans on developing a deep water version of this study.

Passive Tagging – One or two (dependent on the size of the shark) uniquely numbered tag types will be deployed on each shark captured. The first type which will only be deployed on sharks >120cm in length is a "rototag" style livestock tag attached to the upper third of the first dorsal fin (DuFlex, Destron Fearing, South St. Paul, Minnesota). Secondly a stainless steel or nylon headed dart tag will be inserted into the basolateral dorsal musculature (Hallprint, Victoria Harbour, Australia). The latter has the local contact information for the Cape Eleuthera Institute to facilitate tag returns. Ongoing tagging programs can yield data on growth rates, movement patterns and population size.

Animal-Borne Devices – Animal-borne devices, such as satellite transmitters or depth-temperature loggers, are widely used to monitor the movements, behavior, and habitat use of large mobile species such as sharks, tuna and marlin. These tags are attached to the candidate animal for a pre-set duration ranging from 30 days to over a year, after which it detaches from the animal, floats to the surface for recovery or remote data transmission. Tags can be attached alongside a boat via standard tagging devices or in-situ using modified spearguns.

Non-Lethal Blood Sampling – A small (<3cc) blood sample will be taken by caudal venipuncture to monitor various blood chemistry parameters (pH, Lactate, pCO₂) which in turn can provide an indication of an animal's physiological stress. Blood chemistry is a vital part of understanding the sub-lethal effects of

capture and the resulting viability of animals, which are released. Samples of whole blood and blood plasma need to be transported outside of The Bahamas for analysis.

Non-Lethal Tissue Sampling – Small tissue samples (<1g) will be used to analyze the ratios of stable carbon and nitrogen isotopes assimilated by a particular individual. Variation in these ratios between and within species provides important indications of the food web dynamics of and the role a particular species plays in the food chain. Furthermore, by analyzing the stable isotope signatures of the various food webs in the local area (e.g. seagrass, coral, pelagic), inferences can be made of broad movements and habitat preferences. Furthermore, tissue samples can be used for genetic analysis, which can be used for species identification and the analysis population structure. Tissue samples need to be transported outside of The Bahamas for analysis.

Maintaining Sharks in Captivity – In order to approach a number of experimental questions outlined the projects above it is necessary to capture and maintain small sharks in the experimental wet lab, and the mangrove mesocosm facilities at Cape Eleuthera. All sharks will be maintained in accordance with accepted elasmobranch husbandry protocols and be returned to their place of capture.

Seine Nets – In order to quantify the variation in the abundance and diversity of fish between mangrove creeks standardized seine net sampling will be used. All items captured will be weighed, measured and released unharmed.

Whole Shark Transport - Given the minimally studied nature of the majority of the deep water sharks encountered over the course of our research, many of the species encountered have rarely been studied by scientists. In the rare event of moribund animals being captured which are either new species, or very rare, we request that they be transported abroad for a full taxonomic and biological (reproduction, morphology etc) work up, and preservation in scientific collections.

Collaborators: Dr. Demian Chapman (Stonybrook University), Dr. Dean Grubbs (Florida State University), Cheston Peterson (Florida State University), Debra Abercrombie (Abercrombie and Fish Inc.), Lucy Howey-Jordan, Dr. Lance Jordan (Microwave Telemetry Inc.), Dr. Robert Hueter (Mote Marine Laboratory), Dr. Cory Suski, Dr. Jeff Stein (University of Illinois), Dr. John Mandelman, Dr. Nick Whitney, Dr. Jeff Kneebone, Tim Werner (New England Aquarium), Dr. David Sims (Marine Biological Association of the United Kingdom), Dr. Katherine Sloman (University of Plymouth), David Jacoby (Marine Biological Association of the United Kingdom), Dr. Edith Widder (Ocean Research and Conservation Association), Diego Bernal (University of Massachusetts Dartmouth), Richard Brill (National Oceanic and Atmospheric Administration), Dr. Jeremy Kiszka (Florida International University), Dr. Michael Heithaus (Florida International University), Ian Bouyoucos (James Cook University), Dr. Jodie Rummer (James Cook University), Dr. Robert Nowicki (Mote Marine Laboratory), Dr. Lucy Hawkes (Exeter University, UK), Dr.

David Kerstetter (Nova Southeastern University), Oliver Shipley (Stony Brook University), Guuske Tiktak (Manchester Metropolitan University), Dr. Baudouine Postaire (Florida International University), Dr. Judith Baker (Florida International University), Maurits Bergmann (Florida International University), Dr. Kristene Parsons (Bimini Biological Field Station), Joshua Moyer (University of Massachusetts)

9) Sea Turtle Ecology

We aim to investigate the ecology of green turtles (*Chelonia mydas*), loggerhead turtles (*Caretta caretta*) and hawksbill turtles (*Eretmochelys imbricata*) in the waters of Eleuthera, Abaco, and Great Exuma. This will be achieved partly by passive surveys of turtles conducted by stationary cameras, snorkelers, and Unmanned Aerial Vehicles (UAVs) or drones. In other instances, it will require direct capture of individuals. Capture of turtles will be achieved by either by using a seine net or by hand. For hand capture, turtles will be approached by boat until we are close enough to deploy a snorkeler into the water. Once in the water, the snorkeler will swim behind the turtle until they are able to safely grab the turtle by the base of the fore-flippers and lift it out of the water.

All turtles that are caught by hand will be measured, weighed, and tagged in the hind-flippers using Inconel metal tags or in the triceps complex using Passive Integrated Transponder (PIT) tags. Tissue samples will be collected from certain individuals using biopsy punches. Blood may also be sampled using a needle inserted into the dorso-cervical sinus. Some individuals will also be held for a short period for photogrammetry. We will also be deploying a variety of animal-borne devices, ranging from cameras to data-loggers to satellite transmitters. These animal-borne cameras will be fastened to the turtles' carapace using a quick setting epoxy that will degrade and detach over time.

Seagrass is a major component of green sea turtle diet and samples will be collected, processed and analysed for epiphytes.

Collaborators: Dr. Lucy Hawkes, Dr. Matthew Witt (University of Exeter), Dr. Elizabeth Whitman (Florida International University), Dr. William Louda (Florida Atlantic University), Dr. Duncan Irschick (University of Massachusetts), Sara-Xaali O'Reilly Berkeley (Manchester Metropolitan University).

10) Marine Mammal Research

a) Marine Mammal Ecology

Marine mammals are some of the most charismatic animals on Earth, drawing countless tourists to The Bahamas every year for in-water interactions across the islands and at aquarium facilities in Nassau and

elsewhere. Unfortunately, little is known about the occurrence, health, population structure, and population connectivity of marine mammals in Exuma Sound relative to other Bahamian ecosystems. While some deep-diving species like beaked whales and sperm whales and coastal species like bottlenose and spotted dolphins have been observed across this region, no research on these populations has occurred. As such, We aim to develop a marine mammal research program in Eleuthera, support regional health and stranding networks, and complement the work of the Bahamian Marine Mammal Organization located in Abaco through initial diversity and abundance surveys followed by more detailed investigations in subsequent field seasons. As part of this effort, we plan on conducting boat-based surveys and long-range unmanned aerial vehicle surveys to locate and identify animals at the species and individual levels. Further, through the collection of muscle tissue, blow spray, and fecal material, we will investigate the trophic ecology, population connectivity, and health of these animals across space and time. We also aim to investigate their foraging behavior in a pristine environment free of most sound pollution and sonar activity to inform management of human activities elsewhere. This will be accomplished through the use of animal-borne video cameras and data loggers that have been field-tested and approved in the U.S. and elsewhere. The entirety of this research will be in accordance with the highest levels of animal care and welfare standards developed by the United States' National Oceanic and Atmospheric Administration and Marine Mammal Commission.

b) Understanding and mitigating the effects of anthropogenic noise

Ocean noise is widely recognized as a primary threat to marine mammal health through impacts on foraging behavior, communication, and dive profiles. In some cases, severe underwater noise can lead to injury or even death of some individuals. In order to reduce this threat, there is a need to modify the existing outboard and inboard engine designs in wide use across the recreational boating community. Little attention has been paid to quieting these engines due to the disproportionate noise produced by large tankers, however in some locations (e.g. the Pacific Northwestern US) the cumulative impacts of ocean noise produced by countless small vessels can be severe and negatively affect critically endangered species like Southern Resident Killer Whales. Further, ocean noise has been shown to alter fish behavior and negatively impact a variety of marine organisms inhabiting coral reefs and otherwise. As such, we aim to develop low-cost engine modification kits to reduce our own 'noise-print' in the water around South Eleuthera while outsourcing that knowledge to boat captains elsewhere. Baseline noise levels in Exuma Sound will be assessed using a stationary hydrophone attached to a

Collaborators: Dr. Jeremy Kiszka & Dr. Michael Heithaus (Florida International University), Dr. Diane Claridge, Dr. Charlotte Dunn (Bahamas Marine Mammal Organization)

11) Seabird Ecology

Seabirds can travel long distances and aggregate in large numbers during foraging activities and at rookeries during breeding season. In addition, they can serve as valuable indicators of ecosystem health due to their high trophic position. Preliminary data suggest that the northeastern Exuma Sound may act as a valuable foraging habitat for several seabird colonies in The Bahamas. Here, we propose to integrate shipboard surveys, satellite tracking technologies, and prey identification techniques to shed light on which seabird species are using the Exuma Sound as a foraging site during the breeding season, their prey items in this region, and the movements of seabirds to other areas following the breeding season. By better understanding seabird abundances, movements, and prey selection, we also aim to identify potential sources of toxins that can bioaccumulate in seabird tissues and negatively affect chick survival.

This work will focus on brown noddys *Anous stolidus*, magnificent frigatebirds *Fregata magnificens*, least terns *Sternula antillarum*, bridled terns *Onychoprion anaethetus*, sooty terns *Onychoprion fuscatus*, as well as species of conservation concern such as white-tailed tropicbirds *Phaethon lepturus* and Audubon's shearwaters *Puffinus lherminieri*. We will capture birds using mist nets and use a combination of techniques such as satellite tagging and feather collection to answer these questions about trophic position and migration

12) Coral Reef Ecosystem Ecology

13) Coral Reef Ecosystem Ecology

a) Coral Propagation and Restoration

The Caribbean-wide decline of coral reefs necessitates effective management solutions that reverse the decline of critically endangered corals (i.e., *Acropora cervicornis* and *Acropora palmata*), as well as key reef-builders (i.e., *Orbicella* sp., *Diploria* sp., *Pseudodiploria* sp., *Porites* sp., etc.) Throughout the Caribbean, numerous governmental and non-governmental organizations have engaged in coral gardening, which currently aims to create a sustainable source of acroporid corals for outplanting onto degraded reefs. The ability of acroporids, as well as other key reef-building species, to reproduce through fragmentation and spawning makes them ideal candidates for such restoration efforts.

Since 2014, the Cape Eleuthera Institute (CEI) has maintained an offshore *A. cervicornis* nursery at Cape Eleuthera. CEI will expand its gardening efforts to include several other key species (*Orbicella faveolata*, *Orbicella annularis*, *Diploria labyrinthiformis*, *Pseudodiploria strigosa*, *Porites astreoides*, *Siderastrea siderea*, *Montastrea cavernosa*, *Colpophyllia natans*), an in-situ coral aquaculture facility, as well as address the following research topics:

- Effects of location, depth and nursery design on growth rates of coral fragments
- Effects of fragmentation on growth and survival of wild donor colonies
- Pre-and post-propagation growth and survival of nursery fragments
- Most effective methods and sites for outplanting viable fragments onto reefs
- Monitoring survival and growth of outplanted fragments

Reproduction through fragmentation (cloning) and therefore nursery efforts do not address the decrease in genetic diversity corals have suffered as a result of severe population declines. CEI will work with partners in The Bahamas to collect and exchange new genotypes in order to increase genetic diversity of key corals in south Eleuthera.

In addition, CEI will work with international and national partners to collect gametes (i.e., sperm and eggs) of acroporids, as well as key reef-building coral species around Eleuthera. This non-invasive approach to coral restoration will allow CEI to rear and culture coral in-situ, and ultimately outplant thousands of newly settled coral (via cement or ceramic “seeding units”) onto local coral reefs annually.

b) Elkhorn coral (*Acropora palmata*) - Baseline Assessment

Efforts have been in place throughout the Caribbean and The Bahamas to assess the status of critically endangered *A. palmata*. To date, however, no data exist regarding *A. palmata* populations in Eleuthera. Following the methods developed by Atlantic and Gulf Rapid Reef Assessment (AGRRA, www.agrra.org), CEI will systematically identify and survey *A. palmata* populations in Eleuthera, as well as other key reef-building species (i.e., other *Acropora sp.*, *Orbicella sp.*, *Diploria sp.*, *Pseudodiploria sp.*, *Porites sp.*). In doing so, a baseline will be created which will help follow, over time, the recovery or decline of these corals in Eleuthera. Data compiled will also be directly comparable to other locations in The Bahamas and the wider Caribbean.

c) Linking species traits to ecosystem functions and services

This new program, funded by the Natural Science and Engineering Council of Canada, proposes to use field observations and experiments to test the extent to which species with similar traits are ecologically equivalent and serve similar ecosystem functions. Field observations will focus on detailing the assemblages of fish and invertebrate species associated with coral species with similar and different morphologies. The main experiment will involve building small artificial reefs and seed them with small fragments of different coral species to examine the effect of species identity on ecosystem functions such as primary production and fish biomass accumulation. We will also examine fish and invertebrate assemblages on wrecks to determine whether framework structure influences species trait distribution.

d) *Transitional Nursery Habitat*

The shallow waters near Cape Eleuthera contain numerous patch reefs, many of which are located in and around a proposed marine no-take reserve. Our research this year will continue to map and measure patch reefs in South Eleuthera in collaboration with the Earthwatch Institute. We will continue to examine the abundance and size of ecologically and economically important reef fish inhabiting these patch reefs, through visual and video surveys and acoustic telemetry, to examine seasonal difference in habitat use and connectivity to other habitats including mangrove creeks and deeper reefs. We would like to expand the studies through collection of parrotfish (*Scarus* and *Sparisoma* spp) and groupers (*Epinephelus* and *Cephalopholis* spp) for behavioural studies within aquaria. This study aims to establish the effects of habitat complexity and the presence of predators on the bite rates of parrotfishes. All fishes will be returned to the wild after completion of the laboratory trials.

e) *Diadema*

The loss of coral over the last three decades has been significant; in some areas, declines are as high as 80%. Many species of coral are unable to recover for two reasons. First, the abundance of many coral species has been reduced so much that there are reproductive and recruitment failure. Examples of this are staghorn and elkhorn corals that are now critically endangered by the IUCN. The second reason is that a key grazer on Caribbean reefs, the long-spined sea urchin (*Diadema antillarum*) suffered a die-off in the 1980s, and they have yet to recover, making it difficult for corals to compete with fast-growing algae. *Diadema* populations are still at a small fraction of their pre-pathogen levels; urchin aquaculture could assist with their recovery. Research is required to develop methods to rear urchins in captivity and assess their survival post-release. Additionally, studies are needed to assess the effectiveness of reintroducing reef structure engineers, *Diadema*, as a reef restoration technique. If successful, the urchins' grazing will improve habitat for fish and invertebrates and increase suitable areas for coral growth and recruitment, in sum increasing the resilience of reefs for the future. The study will be involved the transplant of *Diadema* from recovering shallow populations, the assessment of reef benthos, in particular, algae coverage and the monitoring for *Diadema* survivorship over time.

Collaborators: Dr. Craig Dahlgren (Perry Institute of Marine Science), Dr. Alastair Harborne (Florida International University), Dr. Ian Enochs (NOAA), Dr. Derek Manzello, Dr. Francesca Forrestal (University of Miami), Dr. Diego Lirman (University of Miami), Dr. Allan Stoner (National Marine Fisheries Services, Oregon), Catherine Booker (Exuma Foundation, Bahamas), Martha (Davis Community Conch, Bahamas). Dr. Kenny Broad (University of Miami), Dr. Isabelle Cote (Simon Fraser University), Lad Akins (REEF), Dr. Mark Hixon and Dr. Stephanie Green (University of Alberta), Bob Wicklund Jr. (Deep Sea Ops), Bob Wicklund, Sr. (UNC Wilmington), Dr. Sylvia Earle (DOER), Dr. Edith Widder (ORCA), Dr.

Rod Wilson (University of Exeter), Katheryn Sloman (University of the West of Scotland), Dr. Chris Perry (Manchester Metropolitan University), Nancy Sheridan (Florida Fish and Wildlife Conservation Commission) and Benjamin Titus (Ohio State University), Dr. Lucy Hawkes (University of Exeter), Dr. Matthew Witt (University of Exeter), Stacy Williams (Institute for Socio-Ecological Research), Braulio Quintero (Institute for Socio-Ecological Research), Bahamas National Trust, The Nature Conservancy, Bahamas Reef Environmental Education Foundation, Dr. John Tiedemann, Dr. Pedram Daneshgar, Dr. Jason Adolph (Monmouth University).

14) Flats Ecology

Flats are comprised of a mosaic of distinct habitat types, such as seagrass beds, macro algal and sand plains, and mangrove creeks. Although traditionally studied as independent entities, flats are in fact integral parts of a connected ecosystem. For example, they provide nursery habitat for deeper water fish species. In addition, nutrient exchange occurs between habitats on the flats and other coastal ecosystems, such as coral reefs.

a) Environmental drivers of flats autecology

To address broader ecological questions about climate change, we will collect and examine the physiology and life history of several other fish, invertebrates, and corals associated with flats and reefs. Different pH, temperature, oxygen and salinity tolerances will be examined using behavioral cues, to determine if altered sea water conditions due to climate change will have impacts on species abilities to forage and detect/escape predators. Respirometry will be employed to quantify the energetic and metabolic cost of climate change on fishes and invertebrates. We will also experimentally manipulate fish status to understand how stressors influence wild marine fish. These species will include: bonefish, checkered puffers, mojarra, barracuda, adult and juvenile schoolmaster snapper, damsel fish, wrasse, parrotfish juv. spiny lobster, and crabs.

b) Ecology of Stress in Fish

Understanding how stress experienced by individual organisms influences organismal behaviour and population-level processes (e.g., demography) represent fundamental concepts in ecology. Much effort has been devoted to the effects of stress in a laboratory setting, but there is much less known about how organisms respond to stress in more natural systems. Using a variety of models including bonefish, checkered puffer, schoolmaster snapper, yellow stingrays and mojarra we will explore these concepts by experimentally manipulating cortisol levels and evaluating consequences on behaviour, energy use (e.g., through attachment of external accelerometers and internal heart rate loggers) and survival (e.g., through tethering experiments). Given the predator-rich nature of nearshore marine systems much of the work will focus on predator-prey interactions. Included will be evaluations of the effects of coastal development

pressures (e.g., silt mobilization, fisheries) to understand how different natural and anthropogenic stressors interact.

c) Chemical Ecology of Flats and Reef Organisms

Many marine invertebrates and fish have impressive sensory physiology capabilities that enable them to collect information from their environment and use that information (which is taken in through neural pathways) to alter their physiology and behaviour. Of particular importance is chemical ecology – the ability of organisms to “smell”. Some organisms can smell food, conspecifics and predators or even make assessments of habitat quality. Chemical ecology can be used (say the “smell of a predator”) to examine how and why organisms distribute themselves in space and time. We will use a variety of invertebrate and small reef and flats fish to study how chemical ecology influences the behaviour, physiology and inter/intra specific interactions in nearshore marine waters. Much of this work would occur in CEI’s laboratory and on-site mesocosm.

d) Invertebrate diversity in coastal ecosystems

Coastal development is one of the top threats to marine ecosystems. The Bahamas has over 700 Islands and an extensive coastline. This coastline is constantly under threat from development; however, the coastal invertebrate fauna of Eleuthera is still poorly described. The aim of this project is to take a census of invertebrate biodiversity in the coastal waters around Eleuthera. To achieve this, we will use a variety of baited traps to collect invertebrate samples to obtain voucher species for species descriptions.

Collaborators: Dr. Karen Murchie (College of the Bahamas); Dr. David Philipp, Julie Claussen, Dr. Jeffrey Stein (University of Illinois/Fisheries Conservation Foundation); Dr. Tony Goldberg (University of Wisconsin-Madison); Dr. Cory Suski (University of Illinois); Dr. Andy Danylchuk, Chris Haak, and Kate McClellan Press (University of Massachusetts); Dr. Steven Cooke, Chris Elvidge, Robert Debruijn, Dr. Mike Lawrence, Dr. Erica Eliason, Tanya Prystay, Clay Steell, Jake Brownscombe, Dr. Lee Gutowsky (Carleton University); Jeff Koppelman (Missouri Department of Conservation); Dr. Ken Heck (Dauphin Island Sea Lab); Dr. Lance Jordan (Microwave Telemetry); Eric Carey (Bahamas National Trust); Dr. Aaron Adams (Bonefish and Tarpon Trust); Dr. Elizabeth Wallace (Florida Fish and Wildlife Commission); Dr. Chris Perry and Dr. Mike Salter (University of Exeter); Dr. Eric A. Lazo-Wasem (Yale University).

15) Deep Sea Ecosystems

The exclusive economic zone of The Bahamas contains several areas of deep water habitat (< 200 m depth), including one of the longest and deepest underwater canyons in the world. These areas are important for key ecosystem processes and contain high levels of biodiversity. Our deep-water work seeks

to document the species that occupy deep-sea habitats and assess their vulnerability to potential deep-water fishing, oil and mineral extraction activities.

a) Deep Water Bathymetric Mapping and Exploration

Past and future deep water survey data would benefit greatly from high resolution bathymetric and chemical oceanographic data to both supplement biological conclusions, and guide future research hypotheses; however, at present CEI does not have the capacity to acquire this type of data. In collaboration with OceanX Media we propose to generate high-resolution bathymetric maps of the northern Exuma Sound and the Eleuthera Escarpment through the use of multibeam sonar units fitted to The Alucia. This mapping will be followed up with several dives using Remote Operated Vehicles (ROVs) and Human Occupied Vehicles (HOVs) to ground truth substrate type. Additionally, Baited Remote Underwater Video (BRUV) surveys will be deployed to assess species assemblages of deep-sea animals. By combining the on-going biological surveying currently underway, with the advanced data acquisition and exploration, a holistic profile of deep ocean communities and be generated at a spatial and temporal resolution that has never before been undertaken anywhere else in the world.

b) Deep Water Shark Research

The deep ocean (>200m) is the largest ecosystem on the planet, home to over 50% of all known species of shark, and is increasingly subjected to fishing pressure. The proposed research for 2019 will expand the depth range of the deep water longline surveys conducted to date to encompass the entire depth range of the Exuma Sound. These surveys will continue to investigate spatial variation in the diversity and abundance of deep water sharks in addition to using satellite telemetry to track their movements. In addition, we plan on developing deep water baited video surveys as a faster and cheaper alternative to longline surveys for assessing spatial and temporal variation in abundance and diversity. We further aim to use environmental-DNA (eDNA) as a non-invasive method to assess deepwater shark presence / absence and potentially abundance, which may be a valuable tool at-depth given the slow rates of decomposition of free-floating tissue in the water column and even the sediment. Lastly, past research in this location has revealed cryptic differences between some species of gulper sharks and catsharks in Exuma Sound and elsewhere; we believe that undescribed species endemic only to this region are found here. As such, we hope to describe these species through extensive genetic and morphological analysis.

c) Deep-Sea Biodiversity

The aim of this project is to take a census of biodiversity in deep water habitats of The Bahamas. The first step will be to compile a database of all species sampled during historic deep water research in The Bahamas. We will also use ROVs, submersibles and free-vehicle landers to sample and document the

diversity of deep sea communities in The Bahamas. In addition to these non-lethal sampling methods, specimens may be collected using lethal sampling methods (e.g. traps, submersible) to obtain voucher specimens for invertebrates and a limited number of vertebrates that will facilitate new species descriptions and biogeographic analyses.

Collaborators: Dr. Gustav Pauly, Jessica Whelpley (University of Florida, Florida Natural History Museum), Dr. Vincent Pierbone (OceanX), Dr Adrian Glover (Natural History Museum, London)

16) Marine Geology & Sedimentology

The specific goals of the marine geological research we wish to undertake is to examine the origin and evolution of submarine hardgrounds which are areas of sand that had become rock on the sea floor. Preliminary visual surveys indicate that the specimens in the area of South Eleuthera are quite different from other areas in The Bahamas. We wish to undertake a comprehensive study to examine the marine geology and sedimentology of the northern Exuma Sound, including the Schooner Cays since the formation and position of such structures on the sea floor likely play a significant role shaping the assemblage of marine fishes and invertebrates. This research would include visual surveys, photography, sample collection and processing.

a) Coral borers

We also request permission to recover 25-30 samples of dead coral framework (discrete dead coral heads) from the top of the reef wall along the western side of Eleuthera (vicinity of Hole-in-the-Wall site and similar localities - sampling will be spread between sites to limit any impact of removal at any one locality). The aim of this data collection will be to provide quantitative data on the relationships that exist between boring sponge cover/abundance on the surfaces of dead corals and the % internal coral framework removed by borers. This data will be used to underpin reef health assessment methods being developed through a Leverhulme Trust funded research project. We emphasize that no living corals just dead in-situ colonies with sponge borers in them will be collected. Samples would be returned to CEI for analysis of colony volume, and percentage sponge infestation.

b) Organic biogeochemistry

We would like to begin a study aimed at understanding the role of various sunscreen pigments in the cyanobacteria of these settings. This would involve collecting initial short core (appx. 45 mm x 0.5 m) sampling of carbonate sediments. This study will examine photosynthetic pigments / microphytobenthos and the cohesiveness of carbonates due to exopolymeric substance / organic matter contents. Additionally,

small surface samples and small cores (~ 45 mm x 10 cm) of microbial (cyanobacteria, diatoms, sulfur-bacteria) mats from the various hypersaline ponds on Eleuthera will be collected. Sample processing and initial analyses would be performed at CEI.

Collaborators: Dr. Chris Perry, Michael Salter (Manchester Metropolitan University), Dr. Rod Wilson (University of Exeter), Dr. William Louda (Florida Atlantic University), Dr. Greg Henkes (Stonybrook University).

Thank you for considering this request to renew our scientific research permit. A list of publications produced through the Cape Eleuthera Institute is available on our website (<http://www.ceibahamas.org/publications>) . Copies of research posters generated by our Island School students can be accessed here: http://www.fishconserve.org/arcel/admin/Island_School_Posters.php. Feel free to contact us if you have any questions regarding our request, or if you have any interest in formally collaborating in any of our research projects. Your support is vital to the success of the Cape Eleuthera Island School and Cape Eleuthera Institute. I look forward to hearing from you in the New Year.

Sincerely,

Nathan Robinson

Dr Nathan J. Robinson,

Director, Cape Eleuthera Institute

CURRICULUM VITAE



NAME: Frank Vincent Paladino
TITLE: Jack Schrey Distinguished Professor of Biological Sciences
ADDRESS: Department of Biological Sciences
Director of PFW Center for Marine Conservation & Biology
Purdue University
Fort Wayne, IN 46805-1499 USA
PHONE:Office: (260) 481-6305 **FAX** (260) 481-6087 or 481-6880 **Home:** [REDACTED]
INTERNET e-mail: Paladino@pfw.edu **Web Pages:** www.leatherback.org

EDUCATION:

- Ph.D. Washington State University, Pullman, WA 99164. MAJOR: ZooPhysiology, SPECIALIZATION: Environmental Physiology, Bioenergetics, Vertebrate Locomotion
MAJOR ADVISOR: Dr. James R. King
M.A. State University College at Buffalo, N.Y. 14222 MAJOR:Ecology; SPECIALIZATION: Ecology, Environmental Aquatic Toxicology. MAJOR ADVISOR: Dr. James R. Spotila
B.A. State University College at Plattsburgh, N.Y. 12901, MAJOR: Biology

BRIEF BIOGRAPHY:

Frank Paladino has had over 124 reviewed scientific research publications in top international journals with 8 publications in *NATURE* as well as numerous publications in journals such as *Proceedings of the Royal Society*, *PLOS 1*, *Journal of Experimental Biology*, *Physiological Zoology*, *American Zoologist*, *Physiological and Biochemical Zoology*, *Revue Canadienne de Biologie*, *Biological Conservation*, and *Chelonian Biology and Conservation*. He has received over \$5,500,000 in external grants from funding agencies such as the National Science Foundation, National Geographic Society, The Pew Foundation, Goldring Family Foundation, The Moore Foundation, The Gund Family Foundation and The Center for Field Research. Frank was elected as President of the ISTS, elected as a Fellow of the AAAS, elected as a Fellow of the American Physiological Society, a IISTS Lifetime Achievement Award Recipient, and has been the topic of two TV specials by National Geographic, also TV shows on the Discovery Channel and Scholastic Press Internet Network. He served as Biology Department Head for 11 years and guided the expansion of the department from 12 to 16 faculty and helped design a new 21 million dollar science building. In 2003 he organized and incorporated the Leatherback Trust a 501 3C international non-profit together with colleague James R. Spotila of Drexel University. In 2010 Frank was called to again serve as Department Chair of Biology. He now also serves as President of the Leatherback Trust that has raised millions of dollars for the conservation of leatherback turtles and is now the owner and operator of the Goldring-Gund Marine Biology Laboratory, in Playa Grande, Costa Rica, affiliated with IPFW, Purdue, Drexel, Kalamazoo, National University of Costa Rica, St. Thomas & Stanford Universities, University of Western Connecticut, University of Western KY and Monash University in Australia. He was appointed by the Purdue University Trustees to the Jack W. Schrey Distinguished Chair Professorship and serves as the Director of the Goldring-Gund Marine Biology Laboratory in Costa Rica. He has been awarded the highest honors from the government of Costa Rica for his work in the creation of Parque Marino Las Las Baulas and is a member of the IUCN Marine Turtle Specialists Group. For his work with marine turtles the International Sea Turtle Society awarded him their Lifetime Achievement Award in 2014.

Selected COMPETITIVE GRANTS APPROVED: [REDACTED] as PI from 41 grants since 1978

1. Paladino, F.V. [REDACTED] Sonoma County Community Foundation Grant. Sea turtle community conservation program in El Jobo, Costa Rica [REDACTED]
2. Paladino, F. V. [REDACTED] Population ecology of Leatherbacks and other sea turtles in Costa Rica. [REDACTED]
3. Paladino, F.V. [REDACTED] Pippert Research Scholar Award. [REDACTED]
4. Paladino, F.V. [REDACTED] US Embassy in Equatorial Guinea USAID Conservation Education Grant [REDACTED]
5. Paladino, F.V. [REDACTED] Mary Margaret Stucky Foundation Grant. Sea Turtle Conservation. [REDACTED]
6. Paladino, F.V. [REDACTED] Fort Wayne Children's Zoo Conservation Grant. A conservation monitoring program in El Jobo Bay Costa Rica [REDACTED]
7. Paladino, F. V. [REDACTED] Disney Conservation Foundation Grant: A Conservation and education program to conserve sea turtles in Pacific Costa Rica. [REDACTED]
8. Paladino F. V. [REDACTED] Kosmos-Trident Petroleum Co. Conservation of Sea turtles in Bioko with Co-PI Shaya Hanavar. [REDACTED]
9. Paladino F. V. [REDACTED] HESS petroleum Co. Conservation of Sea turtles in Bioko with Co-PI Shaya Hanavar. [REDACTED]
10. Paladino, F.V. Fort Wayne Childrens Zoo Grant 2016 [REDACTED]
11. Mary Margaret Stucky Foundation Grant [REDACTED]
12. World Turtle Trust Grant [REDACTED]
13. Sonoma County Community Foundation [REDACTED] The Ecology of Hawksbill turtles in El Jobo Bay Costa Rica. [REDACTED]
14. Earthwatch Costa Rican Sea Turtles [REDACTED]
15. Fort Wyne Children's Zoo grant. [REDACTED]
16. Mary Margret Stucky Foundation + World turtle Trust [REDACTED]
17. Sonoma County Foundation. The ecology and migrations of Pacific Green Turtles nesting on Playa Cabuyal, Costa Rica. [REDACTED]
18. The leatherback Trust Grants [REDACTED]
19. Goldring Family Foundation [REDACTED] Marine Education and Research [REDACTED]
20. Pew Foundation Leinfest Oceans Program Grant [REDACTED] Fisheries and turtles [REDACTED] (PI/J. Spotila, Drexel Univ)
21. Earthwatch, Cost Rican Sea Turtles [REDACTED]
22. Leatherback Trust Grant [REDACTED] (matching Foundation Grant) [REDACTED]
23. Earthwatch, Cost Rican Sea Turtles [REDACTED]
24. Goldring Family Foundation Marine Lab Logistics and support [REDACTED]
25. Earthwatch: Costa Rican Sea Turtles [REDACTED]
26. Goldring Family Foundation [REDACTED] Marine Education and Training program [REDACTED]
27. World Turtle Trust: [REDACTED] Conservation of Leatherback Turtles [REDACTED]
28. Earthwatch: [REDACTED] Costa Rican Sea Turtles [REDACTED]
29. Goldring Family Foundation: [REDACTED] Marine Lab Support
30. Earthwatch: Costa Rican Sea Turtles [REDACTED]
31. Ft Wayne Childrens Zoo "Conservation Education Program for Las Baulas [REDACTED]

32. Conservation International. "Pacific Seascape Corridor"
33. Anonymous Donor Sea Turtle Conservation
34. Earthwatch: Costa Rican Sea Turtles renewal renewal
35. Goldring Family Foundation, Sea Turtle conservation/Marine Station
36. Earthwatch: Costa Rican Sea Turtles renewal:
37. Earthwatch: Costa Rican Sea Turtles renewal:
38. National Geographic Society: Tracking hatchling leatherbacks
39. Earthwatch: Costa Rican Sea Turtles, renewal:
40. Earthwatch: The sea turtles of Costa Rica:
41. US National Marine Fisheries Grant (with PI Pamela Plotkin) Assessment of leatherback Populations in Costa Rica and Central America.
42. "Waters of Life" Guinness Grant Award, Las Baulas Park:
43. Earthwatch: The Sea Turtles of Costa Rica:
44. Earthwatch: The Sea Turtles of Costa Rica:
45. Satellite tracking leatherbacks. The Journey North Program.
46. A Pledge and a Promise. Anhueser Bush Environmental Award.
47. The Sea Turtles of Costa Rica. The Center for Field Studies.
48. Satellite telemetry of leatherback turtles in Costa Rica. National Geographic To F. Paladino
49. Satellite telemetry of leatherback turtles in the Pacific. National Geographic Society Grant to F. Paladino
50. NSF with Co-PI JR Spotila Physiology and thermoregulation of leatherbacks

Selected PROFESSIONAL ACTIVITIES:

1. 2018-19 PFW Pippert Scholar
2. 2016-17 President International Sea Turtle Society
3. 2014 International Sea Turtle Society, Lifetime Achievement Award
4. 2010-11 IPFW Featured Faculty
5. 2009 IPFW Pippert Scholar
6. 2007 Elected as a Fellow of the Chinese Academy of Sciences
7. Indiana Academy of Science 2002 Researcher of the year
8. Elected and Fellow of the AAAS 2003.
9. National Geographic Explorer TV special "Paladino and Leatherbacks" 1995, 2001 & 04
10. Discovery Channel Special "Love and Death on Turtle Beach, January 1998
11. Scholastic Network "Internet Discovery Program" Nov. 1998 - Feb 1999. "Saving Sea Turtles" Internet science teaching program used by grades 4 - 12 in the USA and Canada
12. Directed: Master's Thesis students: J. Fink, B. Strouse, S. Myers, T. Roeder, K. Williams, P. Klock, C. Barlow, J. Bilinski, M. Hamilton, S. Clusella, W. Rice N. Sill, C. Williams, P. Clune, K. Fulton, K. Wietgrief, K. Garrett, E. Keene, T. Backof, S. Friederichs, J. Koval, T. Backof, J. Bryan, J. Hill, C. Clyde-Brockway, A. Rhodes, L. Cruz, J. Price, L. Sinclair, C. Veelenterf, Emily Mettler, Ian Silver-Georges, Quintin Bergman, A. Silowsky, L. McKenna, K. Tolliver, AQdam Yaney-Keller: Ph.D. students through Drexel University: D. Penick, T. Steyermark, B. Wallace, V. Saba, B. Santidrian, A. Leslie, S. Patel, G. Blanco, A. Panagopoulou; Ph. D. Students Through Purdue University: N. Robinson, C. Clyde-Brockway & Maike Heidemeyer through University of Costa Rica.
11. Associate Editor: Chelonian Conservation and Biology 2004 - 2006

Selected PUBLICATIONS, Chapters, & Government Reports (total = 114 publications):

- Adam Yaney-Keller & **F. V. Paladino** 2019. Using Unmanned Aerial Systems (UAS) to assay mangrove estuaries on the Pacific coast of Costa Rica. PlosOne 2019 In Press
- Emily Mettler, C. Clyde-Brockway, S. Honarvar & **F. V. Paladino**. 2019. Newly Discovered migratory corridor and foraging ground for Atlantic green turtles, *Chelonia mydas*, nesting on Bioko Island, Equatorial Guinea. PlosOne In Press
- Price, J., B. Drye, R. Domangue, & F. V. Paladino. 2018. Exploring the role of artificial lighting on Loggerhead turtle (*Caretta Caretta*) nest-site selection & hatchling disorientation. Herptol. Conser. & Biol. 13(2)415-422.
- Swiggs, J., **F.V. Paladino**, J.R. Spotila, P. Santidrian-Tomillo. 2018. Depth of the drying front and temperature affect emergence of leatherback turtle hatchlings from the nest. Marine Biology (2018)165:91 <https://doi.org/10.1007/s00227-018-3350-y>
- Cruz, L. M., G. Shillinger, N. Robinson, P. Santidrian-Tomillo, & **F.V. Paladino**. 2018. Effect of light intensity and wavelength on the in-water orientation of Olive ridley turtle hatchlings. J. Exp. Mar. Biol. Ecol. 505:(2018)52-56
- Rees, A.F., L. Avens, K. Balloran, E. Bevan, A.C. Broderick, R. Carthy, M. Christianen, M. Heithaus, D. Johnson, J. Mangel, **F. Paladino**, K. Pendoley, R. Reina, N. Robinson, R. Ryan, S. Sykora-Bodie, D. Tilley, M. Varela, E. Whitman, P. Whittlock, T. Wibbels, B. Godley. 2018. The potential of unmanned aerial systems for sea turtle research and conservation: a review and future directions. Endangered Species Research 35:81-100(2018) DOI: <https://doi.org/10.3354/esr0087>
- Farlow, J.O., N. J. Robinson, C. J. Kumigai, **F. V. Paladino**, P. Falkingham, R. Elsey, & A. Martin. 2018: Trackways of the American Crocodile (*Crocodylus acutus*) in Northwestern Costa Rica: Implications for Crocodylian Ichnology. Ichnos: DOI: 1080/10420940.2017.1350856
- Price JT, **Paladino FV**, Lamont MM, Witherington BE, Bates ST, Soule T (2017) Characterization of the juvenile green turtle (*Chelonia mydas*) microbiome throughout an ontogenetic shift from pelagic to neritic habitats. PLoS ONE 12(5): e0177642. <https://doi.org/10.1371/journal.pone.0177642>
- Santidrian-Tomillo, P, L Fonseca, **F V. Paladino**, J R. Spotila, D Oro 2017 Are thermal barriers "higher" in deep sea turtle nests? PLoS ONE 12(5):e0177256. <https://doi.org/10.1371/journal.pone.0177256>
- Hill, J., N Robinson, C. King, **F.V. Paladino** 2017. Diving behavior and thermal habitats of gravid hawksbill turtles at St. Croix, USA. Mar Biol (2017)164(1):1-9 DOI 10.1007/s00227-016-3050-4
- Robinson, N. S. Morreale, R. Nel, & **F.V. Paladino** (2016) Coastal leatherback turtles reveal conservation hotspot. Nature Sci Rep 6, 37851; doi: 10.101038/srep37851(2016)
- Fei, Y. Rong Hou, J. R. Spotila, **F. V. Paladino**, Dunwu Qi & Zhihe Zhang. 2016 Metabolic rates of giant pandas inform conservation strategies. NATURE Sci. Rep. 6, 27248; doi: 10.1038/srep27248 (2016)
- Robinson, N.J., K. R Stewart, P. Dutton, R. Nel, **F. V. Paladino**, P. Santidrian-Tomillo. 2017. Standardising curved carapace length measurements for leatherback turtles, *Dermochelys coriacea*, to investigate global patterns in body size. Herp. J. 26 (April 2017), 133-136.

- Robinson, N., R. Majewska, E. Lazo-Wasem, R. Nel, **F. V. Paladino**, L. Rojas, T. Pinou 2016. Epibiotic Diatoms Are Universally Present On All Sea Turtle Species. PlosOne 2016 June 3. DOI:10.1371/journal.pone.0157011
- Robinson, N., E. Lazo-Wasem, **F.V. Paladino**, J. Zardus & T. Pinou 2016. Assortive epibiosis of leatherback, olive ridley and green turtles in the Eastern Tropical Pacific. J. Marine Biol. Assoc. U.K. doi:10.1017/S0025315416000734 2016
- Santidrián Tomillo, P., V. S. Saba, C Lombard, J Valiulis, N J. Robinson, **F V. Paladino**, J R. Spotila, C Fernández,, M L. Rivas, J Tucek, Ronel Nel & D Oro 2015. Global analysis of the effect of local climate on the hatchling output of leatherback turtles. NATURE SCIENTIFIC REPORTS | 5:16789 | DOI: 10.1038/srep16789
- Patel, S. H., S. J. Morreale, A. Panagopoulou, H. Bailey, N. J. Robinson, **F. V. Paladino**, D. Margaritoulis, and J. R. Spotila. 2015. Change-point analysis: a new approach for revealing animal movements and behaviors from satellite telemetry data. Ecosphere 6(12):291. <http://dx.doi.org/10.1890/ES15-00358.1>
- Santidrian Tomillio, P. , M. Genovart, **F.V. Paladino**, James R. Spotila, and Daniel Oro 2015 Climate Change Overruns Resilience Conferred by Temperature-dependent Sex Determination in Sea Turtles and Threatens Their Survival. Global Change Biology (2015),doi: 10.1111/gcb.12918
- Hill, J.E., **F.V. Paladino**, J. R. Spotila, P. Santidrian Tomillo. 2015. Shading and Watering as a Tool to Mitigate the Impacts of Climate Change in Sea Turtle Nests. PLOS ONE DOI:10.1371/journal.pone.0129528 June 1, 2015
- Cyrus, A Z., J. Swiggs, P. Santidrian Tomillo, **F.V. Paladino**, & Winfried Peters. 2015. Cannibalism Causes Size-dependent Intraspecific Predation Pressure but does not Trigger Autotomy in the Intertidal Gastropod *Aragona propatula*. Journal of Molluscan Studies (2015)1-9, doi:10.1093/mollus/eyv007
- Neeman, N., N. Robinson, **F.V. Paladino**, J. Spotila, M. O'Connor. 2015. Phenology shifts in leatherback turtles (*Dermochelys coriacea*) due to changes in sea surface temperatures. J Exper. Mar. Bio. Ecol. 462(2015)113-20.
- Santidrian-Tomillo, P., S. A. Roberts, R. Hernandez, J.R. Spotila, & **F.V. Paladino** 2014. Nesting ecology of East Pacific green turtles at Playa Cabuyal, Gulf of Papagayo, Costa Rica. Marine Ecology (2014)1-11, doi: 10.1111/maec.12159
- Santidrian-Tomillo, P., D. Oro, **F.V. Paladino**, R. Piedra, A. Sieg, J. R. Spotila. 2014. High beach temperatures increased female-biased primary sex ratios but reduced output of female hatchlings in the leatherback turtle. Biological Conservation 176(2014)71-79.
- Dornfeld, Tera C., Nathan J. Robinson, Pilar Santidrián Tomillo, **Frank V. Paladino** 2014 Ecology of solitary nesting olive ridley sea turtles at PlayaGrande, Costa Rica. Marine Biology 162(1): 123-139
- Roe, J., Stephen J. Morreale, **Frank V. Paladino**, George L. Shillinger, Scott R. Benson, Scott A. Eckert, Helen Bailey, Pilar Santidrián Tomillo, Steven J. Bograd, Tomoharu Eguchi, Peter H. Dutton, Jeffrey A. Seminoff, Barbara A. Block and James R. Spotila 2014, Predicting bycatch hotspots for endangered leatherback turtles on longlines in the Pacific Ocean *Proc. R. Soc. B* 2014 281
- Robinson N.J, S Valentine, P. Santidrian-Tomillo, V. Saba, J. Spotila & **Frank V. Paladino** 2014. Multidecadal trends in the nesting phenology of Pacific and Atlantic leatherback turtles are associated with population demography. *Endang Species Res* Vol. 24: 197–206, 2014

- Keene, E., T. SOULE, **FRANK PALADINO**, 2014, Microbial Isolations from Olive Ridley (*Lepidochelys olivacea*) and East Pacific Green (*Chelonia mydas agassizii*) Sea Turtle Nests in Pacific Costa Rica, and Testing of Cloacal Fluid Antimicrobial Properties. *Chelonian Conservation and Biology*, 2014, 13(1):
- Roe, J., P. Clune & **F. V. Paladino**. 2013. Characteristics of a leatherback nesting beach and implications for coastal development. *Chelonian Conservation & Biology* 12(1):34-43
- Bieser KL, Wibbels T, Mourad G, **Paladino F**. 2013. The cloning and expression analysis of Lhx9 during gonadal sex differentiation in the red-eared slider turtle, *Trachemys scripta*, a species with temperature-dependent sex determination. *J. Exp. Zool. (Mol. Dev. Evol.)* 9999B:1-9
- Vincent S. Saba¹, Charles A. Stock, James R. Spotila, **Frank V. Paladino** and Pilar Santidrián-Tomillo. 2012. Projected response of an endangered marine turtle population to climate change. *Nature: Climate Change*: DOI: 10.1038/NCCLIMATE15852
- Bieser KL, Wibbels T, Mourad G, **Paladino F**. 2013. The cloning and expression analysis of Lhx9 during gonadal sex differentiation in the red-eared slider turtle, *Trachemys scripta*, a species with temperature-dependent sex determination. *J. Exp. Zool. (Mol. Dev. Evol.)* 9999B:1-9
- Robinson N.J., and Paladino F.V 2013, Sea Turtles, Reference Module in Earth Systems and Environmental Sciences, Elsevier, 2013. 11-Sep-13 doi: 10.1016/B978-0-12-409548-9.04352-9
- Blanco, G., Stephen J. Morreale, Helen Bailey, Jeffrey A. Seminoff, **Frank V. Paladino**, James R. Spotila. 2012. Post-nesting movements and feeding grounds of a resident East Pacific green turtle *Chelonia mydas* population from Costa Rica *Endangered Species Research* 76(4):841-846 doi: 10.3354/esr00451
- BLANCO, Gabriela S. Stephen J. MORREALE, Jeffrey A. SEMINOFF, **Frank V. PALADINO**, Rotney Piedra and James R. SPOTILA (2012) Movements and diving behavior of internesting green turtles along Pacific Costa Rica. *Integrative Zoology* 2012; doi: 10.1111/j.1749-4877.2012.00298.x
- Troost, A., Samantha D. Rupert, Ariel Z. Cyrus, **Frank V. Paladino**, Benjamin F. Dattilo & Winfried S. Peters. 2012. What can we learn from confusing *Olivella columellaris* and *O. semistriata* (Olivellidae, Gastropoda), two key species in panamic sandy beach ecosystems? *Biota Neotrop.* 12(2): <http://www.biotaneotropica.org.br/v12n2/en/abstract?article+bn02112022012>
- Santidrián Tomillo, P., V. Saba, G. Blanco, C. Stock, **F. Paladino** and J. Spotila 2012. Climate driven egg and hatchling mortality threatens survival of Eastern Pacific leatherback turtles. *PLoS 1 Vol 7 (5) e37602*
- Bailey, H. S. Bensen, G. Shillinger, S. Bograd, P. Dutton, S. Eckert, S. Morreale, **F. Paladino**, T. Eguchi, D. Foley, B. Block, R. Piedra, C. Hippeuw, R. Tapilatu, & J. Spotila. 2012. Identification of distinct movement patterns in Pacific leatherback turtle populations influenced by ocean conditions. *Ecological Applications* 22(3): 735-747
- Bailey, H., S. Fossette, S. Bograd, G. Shillinger, A. Swithenbank, J-Y. Georges, P. Gaspar, K.H. P. Stromberg, F.V. Paladino, J. R. Spotila, B. A Block, & G. C. Hays. 2012. Movement Patterns for a Critically Endangered Species, the Leatherback Turtle (*Dermochelys coriacea*), linked to Foraging Success & Population Status. *Plos ONE* 7(5):e36401. Doi.10.1371/journal.pone.0036401
- Cyrus, A., S. Rupert, A. Silva, M. Graf, J. Rappaport, **F. Paladino**, W. Peters. 2012. The Behavioral and sensory ecology of *Agaronia propatula* (Olivadae, Caenogastropoda), a swash-surfing predator on sandy beaches of the panamic faunal province *Journal of Molluscan studies*. 0:1-11
- Sieg, A., C. Binkley, B. Wallace, P. Sandidrian Tomillo, R. Reina, **F. Paladino**, J. Spotila. 2011. Sex ratios of leatherback turtles: hatchery translocation decreases metabolic heating and female bias *Endangered Species Research* 15:195-204.
- Blanco, G, S J. Morreale, H. Bailey, J. Seminoff, **F.V. Paladino**, J. Spotila. 2012. Post-nesting

- movements and feeding grounds of a resident East Pacific green turtle *Chelonia mydas* population from Costa Rica. *Endang Species Res* doi: 10.3354/esr00451
- Bailey, H. S. Benson, G. Shillinger, S. Bograd, P. Dutton, S. Eckert, S. Morreale, **F. Paladino**, T. Eguchi, D. Foley, B. Block, R. Piedra, C. Hittipew, & J. Spotila. 2011. Identification of distinct movement patterns In Pacific leatherback turtle populations influenced by ocean conditions. *Eccological Applications* December :pp 189-201
- Blanco, G.; , S. Morreale, E. Velez, R. Piedra, W. Montes, **F. Paladino**, J. Spotila. 2011 Reproductive output & ultrasonography of endangered population of East Pacific Green Turtles. *The Journal of Wildlife Management* 9999:1-6 2011
- Rafferty, A.R., P. Santidrian-Tomillo, J. Spotila **F.V. Paladino**, R. Reina. 2011 Embryonic death is linked to maternal identity in the leatherback turtle (*Dermochelys coriacea*). *PLOsone* 6(6):e21038 doi:10.1371/journal.pone.0021038
- Roe, J., N. Sill, M. Columbia, **F.V. Paladino**. 2011. Trace Metals in Eggs and Hatchlings of Pacific Leatherback Turtles (*Dermochelys coriacea*) Nesting at Playa Grande, Costa Rica *Chelonian Conservation and Biology*, 2011, 10(1): 000–000
- Shillinger, G., A. Swithenbank, H. Bailey, S. Bograd, M. Castelton, B Wallace, J. Spotila, **F. Paladino**, R. Peidra, B. Block. 2011. Verticle and horizontal habitat preferences of post-nesting leatherback turtles in the South Pacific Ocean. *Mar. Ecol. Prog. Ser.* 422:275-289, 2011
- Santidrian-Tomillo, P. **Frank V. Paladino**, Jack S. Suss, & James R. Spotila. 2010 Predation of Leatherback Turtle Hatchlings During the Crawl to the Water. *Chelonian Conservation and Biology*, 2010, 9(1): 000–000
- Santidrián Tomillo, P., Jack S. Suss · Bryan P. Wallace · Kimberly D. Magrini · Gabriela Blanco **Frank V. Paladino** · James R. Spotila. 2009. Influence of emergence success on the annual reproductive output of leatherback turtles. *Mar. Biol.* DOI 10.1007/s00227-009-1234-x
- Sieg, A. E. Zandonà, V. M. Izzob, **Frank V. Paladino**, J.R. Spotila. 2010. Population level “flipperedness” in the eastern Pacific leatherback turtle. *Behavioural Brain Research* 206 (2010) 135–138
- H. Bailey, G. Shillinger, D. Palacios, S. Bograd, J. Spotila, **F. Paladino**, B. Block. 2009. Identifying and comparing phases of movement by leatherback turtles using state-space models. *Journal of Experimental Marine Biology and Ecology* doi:10.1016/j.jembe.2009.12.020
- Shillinger, G. D. Palacios, H. Bailey, S. Bograd, A. Swithenbank, P. Gaspar, B. Wallace, J. Spotila, **F. Paladino**. 2008. Persistent leatherback turtle migrations present opportunities for conservation. *PLOS Biology* 6(7):e171.doi:10.1371/journal.pbio.0060171
- Reina, R., J. Spotila, **F.V. Paladino**, & A. E. Dunham 2008. Changed reproductive schedule of Eastern Pacific leatherback turtles *Dermochelys coriacea* following El Nino and La Nina Transition. *Endangered Species Research* June 24, 2008
- Saba, V. G.S. Shillinger, A. Swithenbank, B.B. Block, J.R. Spotila & **F.V. Paladino**. 2008. An Oceanographic context for the foraging ecology of eastern Pacific leatherback turtles: Consequences of ENSO. *Deep-Sea Research I* 55(2008)646-660.
- Santidrian, P., V. Saba, R. Piedra, **F. Paladino**, J. Spotila. 2008. Effects of illegal egg harvest of eggs on the population decline of leatherback turtles in Las Baulas Marine National Park, Costa Rica. *Conservation Biol.* 22(5):1216-1224.
- Santidrian Tomillo, P., E. Velez, R. Reina, R. Piedra, **F. Paladino** & J. Spotila 2007. Reassessment of the leatherback turtle nesting population at Parque Marino Las Baulas Costa Rica: Effects of conservation efforts. *Chelon. Conser. Biol.* 6(1):54-62.
- Clusella Trullas, S. & **F. V. Paladino**. 2007. Micro-environment of olive Ridley turtle nests deposited Turing an aggregated nesting event. *J. Zoology (London)* 272(2007):367-376.

- Seminoff, J., **F. V. Paladino**, A. Rhodin. 2007. Refocusing on Leatherbacks: Conservation challenges and signs of success. *Chelon. Conser. Biol* 6(1):1-6.
- Saba, V., P. Santidrian-Tomillo, R. Reina, J. Spotila, J. Musick, D. Evans, & F. Paladino 2007. The effect of the El Nino Southern Oscillation on the reproductive frequency of eastern Pacific leatherback turtles. *J. of Appl. Ecol.* 44:395-404
- Price, E., **F. Paladino**, K. Strohl, P. Santidrian-Tomillo, K. Klann, J. Spotila. 2007. Respiration in neonate sea turtles. *Comp. Biochem. Physiol.* 146A:422-428.
- Wallace, B.P, P. Sotherland, P. Santidrian Tomillo, S. Bouchard, R. Reina, J. Spotila & **F. V. Paladino**. 2006. Egg components, egg size, and hatchling size in leatherback turtles. *Comp. Biochem & Physiol.* 145A:524-532
- Wallace, B. P. P. Sotherland, P. Santidrian Tomillo, R. Reina, J. Spotila & **F.V. Paladino**. 2007. Maternal investment in reproduction and its consequences in leatherback turtles. *Oecologia* 11 pages in press.
- Wallace, B.P., S. Kilham, **F.V. Paladino**, & J.R. Spotila. 2006. Energy Budget calculations indicate resource limitation in Eastern Pacific leatherback turtles. *Mar. Ecol. Prog. Ser.* 318:263-270
- Ralph, C. R., R. Reina, B. Wallace, P. Sotherland, J. Spotila, & **F. V. Paladino** 2005. Effect of egg location and respiratory gas concentrations on developmental success in nests of the leatherback turtle *Dermochelys coriacea*. *Australian J. Zool.* 53:289-294.
- Soslau, G., P. Prest, R. Class, R. George, **F. Paladino**, & G. Violetta. 2005. Comparison of sea turtle thrombocyte aggregation to human platelet aggregation in whole blood. *Comp. Biochem. Physiol.* 142B(2005):353-360.
- Clusella-Trullas, S., J. R. Spotila & **F.V. Paladino**. 2006 Energetics during hatchling dispersal of the olive ridley turtle *Lepidochelys olivacea* using doubly labeled water. *Physiol. & Biochem. Zool.* 79:(2)389-399, 2006
- Wallace, B., C. Williams, **F. Paladino**, S. Morreale, T. Lindstrom, J. Spotila. 2006. Bioenergetics and diving activity of internesting leatherback turtles (*Dermochelys coriacea*) at Parque Nacional Marino Las Baulas, Costa Rica. *Journal of Experimental Biology* 208:3873-3884
- Southwood, A., R. Andrews, **F. Paladino**, & D. Jones. 2005. Effects of diving and swimming behaviour on body temperatures of Pacific leatherback turtles in tropical seas. *Physiological & Biochemical Zoology* 78(2):2005
- Price, E., B. Wallace, R. Reina, J. Spotila, **F. Paladino**, R. Piedra, & E. Velez. 2004. Size, growth, and reproductive output of adult female leatherback turtles *Dermochelys coriacea*. *Endangered Species Research* 5:1-8 2004
- Nordmoe, E. A. Sieg, P. Sotherland, J. Spotila, **F. Paladino**, R.Reina. 2004. Nest site fidelity of leatherback turtles at Playa Grande, Costa Rica. *Animal Behavior* 68:387-394.
- Soslau, G. B. Wallace, C. Vicente, S. Goldenberg, T. Tupis, J. Spotila, R. George, **F. Paladino**, B. Whitaker, G. Violetta, R. Pietra. 2004. Comparison of functional aspects of the coagulation cascade in human and sea turtle plasmas. *Comp. Biochem. & Physiol.* 138B:399-406 (2004)
- Wallace, B., P. Sotherland, J. Spotila, R. Reina, B. Franks, **F. Paladino**. 2004. Biotic and abiotic factors affect nest environment of embryonic leatherback turtles, *Dermochelys coriacea*. *Physiological and Biochemical Zoology* 77(3)423-432 2004
- Spotila, J.R. & **F.V. Paladino**. 2004. Parque Marino Las Baulas: Conservation lessons from a new national park and from 45 years of conservation of sea turtles in Costa Rica. Chapter 15: In: Conservation Biology. G. Franke Ed. Academic Press N.Y. NY.
- Bell, B., J. Spotila, **F. Paladino**, R. Reina 2003. Low Reproductive success of leatherback turtles is due to high embryonic mortality. *Biological Conserv.* 15 (2003)131-138

- Crim, J. J. Spotila, M. O'Connor, R. Reina, C. Williams & **F. Paladino** 2002 The Leatherback turtle exhibits both polyandry and polygyny. *Molecular Evolution* 11:2097-2106
- Rostal, D.C., J.S. Griumbles, K. Palmer, V. Lance, J. Spotila & **F.V. Paladino** 2001. Changes in Gonadal and Adrenal Steroid levels in the leatherback Sea Turtle *Dermochelys coriacea* during the nesting cycle. *General & Comparative Endocrinology* 122:139-147
- Paladino, F.V.** & S.J. Morreale 2001. Marine Turtles. IN: *Encyclopedia of Marine Science*. Academic Press MS 403:12p
- Bilinski, J.J. **F. V. Paladino**, R. Reina, & J.R. Spotila. 2001 The Effects of nest environment on Calcium mobilization by leatherback turtle embryos (*Dermochelys coriacea*) during development. *Comp. Biochem & Physiol.* 130A(2001)151-162
- Spotila, J.R., R. Reina, A. Steyermark, P. Plotkin, and **F.V. Paladino**. 2000. Pacific leatherback turtles face extinction. *NATURE* 405:529-30
- Penick, D.N., J.R. Spotila, M.P. O'Connor, & A.C. Steyermark, R.H. George, C.J. Salice & **F.V. Paladino**. 1998. Thermal independence of muscle tissue metabolism of leatherback turtle. *Comp Biochem & Physiol.* 120A:399-403
- Southwood, A.L., R.D. Andrews, M.E. Lutcavage, **F.V. Paladino**, N.H. West, R. George, & D.R. Jones. 1999. Heart rates and dive behavior of leatherback sea turtles in the Eastern Pacific Ocean. *J. Of Experimental Biol.* 202:1115-1125
- Binkley, C, J.R. Spotila, K. Wilson, & **F.V. Paladino**. 1998. Sex determination and sex ratios of Pacific leatherback turtles *Dermochelys coriacea*. *Copeia*:1998:291-300.
- Paladino, F.V.**, J.R. Spotila. & P. Dodson. 1997. A blueprint for giants: Modeling the physioplogy of large dinosaurs In: J. Farlow & M. K. Brett-Surman (eds) The Complete Dinosaur I. U. Press (pp 491-505)
- Morreale, S., E. Standora, J. Spotila, & **F. Paladino** 1996. Migration corridor for leatherback turtles. *Nature* 384:319-320
- Spotila, J.R. & **F.V. Paladino**. 1996. Thermal Biology of Sea Turtles. In: The Biology of Sea Turtles. P. Lutz & J. Musick Eds. pp 297-314 CRC Press, Boca Raton, FL
- Spotila, J.R., A. E. Dunham, A.J. Leslie, A.C. Steyermark, P.T. Plotkin, **F.V. Paladino**. 1996. Worldwide population decline of *Dermochelys coriacea*: Are leatherback turtles going extinct? *Chelonian Conserv. & Biol.* 2(2):209-222
- Paladino, F.V.**, J.R. Spotila, M.P. O'Connor, & R.E. Gatten. 1996. Respiratory physiology of adult leatherback turtles (*Dermochelys coriacea*) while nesting on land. *Chelonian Conserv. & Biol.* 2(2):223-229
- Penick, D., **F. Paladino**, A. Steyermark, & J. Spotila. 1996. Temperature dependence of tissue metabolism of Green turtle swimming muscle. *Comp. Biochem. Physiol.* 113A:293-296
- Leslie, A.J., D.N. Penick, J.R. Spotila, & **F.V. Paladino**. 1996. Leatherback turtle, *Dermochelys coriacea*, nesting and nest success, at Tortuguero, Costa Rica in 1990 - 1991. *Chelonian Conserv. & Biol.* 2(2):159-168
- Rostal, D.C., **F.V. Paladino**, R. Patterson, & J.R. Spotila. 1996. Reproductive Physiology of nesting leatherback turtles (*Dermochelys coriacea*) at Las Baulas National Park, Costa Rica. *Chelonian Conserv. & Biol.* 2(2):230-236.
- Steyermark, A.S., K. Williams, J.R. Spotila, **F.V. Paladino**, D.C. Rostal, S. Morreale, M.T. Koberg, & R. Arauz. 1996. Nesting leatherback Turtles at Las Baulas National Park, Costa Rica. *Chelonian Conserv. & Biol.* 2(2): 173-182
- Paladino, F.V.**, S.A. Myers, J. R. Spotila & G. Somero. 1995. The effects of temperature and pressure on the aerobic and anaerobic enzymes of Leatherback turtle (*Dermochelys coriacea*) and Red-eared

- Slider pectoralis muscle. In: Proceedings of the fourteenth annual symposium on sea turtle biology and conservation. NOAA Tech. Memo. NMFS-SEFSC 387:230-235.
- Williams, K., A. Steyermark, C. Hurd, A. Schwandt, **F.V. Paladino**, & J.R. Spotila. 1995. Population ecology, nesting and success of leatherback turtles, Dermochelys coriacea, at Las Baúlas de Guanacaste National Park, Costa Rica. In: Proceedings of the 14 symposium on sea turtle biology and conservation. NOAA Tech. Memo. NMFS-SEFSC 387:340-341.
- Morreale, S.J., E.A. Standora, **F.V. Paladino**, and J.R. Spotila. 1994. Leatherback migrations along deepwater bathymetric contours. In Proceedings of the 13th Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum, NMFS-SEFC-341 pp. 109-110.
- Paladino, F.V.** & J.R. Spotila. 1994. Does the physiology of large living reptiles provide insights into the evolution of endothermy and paleophysiology of extinct dinosaurs. In: Rosengerg, G.D. & Wolberg, D.L. (Eds.), Dinofest Proceedings. Paleontological Society Special Pub. #7, University of Tenn. Press, Knoxville, p 261-274.
- Fink, J.P., J. Castrale & **F.V. Paladino**. 1994. Distribution and Bald Eagle habitat characterization in Indiana 1991-1992. Report to the Indiana Dept. Nat. Res. 54 pp
- Paladino, F.V.**, E.A. Standora, & S.J. Morealle. 1992. Tracking endangered species. Scientists use sonic, satellite and radio telemetry to save sea turtle. Environmental Science and Technology 26(3):424-428 March 1992
- Paladino, F.V.** and J.R. Spotila. 1992. Gigantothermy: Dinosaurs and leatherbacks standing up to the cold. Aust. J. Natural Hist. 23(12)Autumn:937-944.
- Spotila, J.R., M.P. O'Connor, P. Dodson, & **F.V. Paladino**. 1991. Hot and cold running dinosaurs: Body size, metabolism and migration. MODERN GEOLOGY 16:203-227
- Paladino, F.V.**, M.P. O'Connor, & J.R. Spotila. 1990. Metabolism of leatherback turtles. Gigantothermy and thermoregulation of dinosaurs. NATURE 344:858 - 860 April 26
- Paladino, F.V.**, P. Dodson, J. Hammond, & J. Spotila. 1989. Temperature dependent sex determination in dinosaurs? Implications for population dynamics and extinction. Publ. Geol. Soc. Am. Special paper #238 Chapter 4, J. Farlow (Ed.) pp63.
- Paladino, F. V.** 1989. Constraints of Bioenergetics on avian population dynamics. Physiol. Zool. 62:410-428.
- Paladino, F. V.** 1986. Transient nocturnal hypothermia in White-crowned sparrows. Ornis Scandinavica 17(1):78-81.
- Paladino, F. V.** 1985. Temperature effects on locomotion and activity bioenergetics of amphibians, reptiles and birds. Amer. Zool. 25(4):965-972.
- Paladino, F. V.** 1985. Animal energetics: Amphibians, Reptiles and birds. Amer. Zool. 25(4):931-932.
- Paladino, F.V.** & J. R. King. 1984. Thermoregulation and oxygen consumption during terrestrial locomotion by white-crowned sparrows Zonotrichia leucophrys gambelii. Phys. Zoo. 57(2):226-236.
- Paladino, F.V.**, J.R. Spotila, J.P. Schubauer, & K.T. Kowalski. 1980. The critical thermal maximum: a technique used to elucidate physiological stress and adaptation in fishes. Rev. Can. Biol. 39(2):115-122
- Paladino, F.V.** & J.R. King. 1979. Energetic cost of terrestrial locomotion: biped and quadruped runners compared. Rev. Can. Biol. 38(4):321-323
- Spotila, J.R. & **F.V. Paladino**. 1979. Toxicity of arsenic to developing muskellunge fry (Esox masquinongy). Comp. Biochem. Physiol. 62C:67-69
- Paladino, F. V.** & J.R. Spotila. 1978. The effect of arsenic on the thermal tolerance of newly hatched muskellunge fry (Esox masquinongy). J. Thermal Biol. 3:223-227

PROFESSIONAL EXPERIENCE: (in reverse order)

- 12/10 - now **Jack W. Schrey Distinguished Professor, Director of the Purdue Fort Wayne Center of Excellence for Marine Biology and Conservation, Director of the Goldring-Gund Marine Biology Laboratory, GGMBL.** The Purdue University Board of Trustees awarded the honor of a distinguished/chaired professor status which is the highest academic rank awarded by the University. In 2018 appointed as director of a Purdue Fort Wayne Academic Center of Excellence. This appointment was for many successful years of professional activities in the area of marine biology and conservation. Also my non-profit the Leatherback trust operates GMBL through an agreement with Purdue University and a consortium of other schools.
- 1/92 - 12/03 **Professor AND Chairman OF Biology** IPFW, for 21 years as chair and 1 as Acting Chair 1990-91, Director Life Sciences Resource Center & Crooked Lake Biological Station. I supervised 17 full time faculty, 6 full time staff, 12 adjunct and associate faculty, as well as direct the departmental operating budget, grants (over \$1,400,000/yr) promotion, tenure, hiring and salary decisions. I was appointed by the government of Costa Rica to set up "Las Baulas Marine National Park" to conserve the leatherback nesting beach we have working on. I also supervise the budgets personnel & operation of a new \$1,000,000 animal care facility and our lake research station with over 200 acres, 6 boats and motors, laboratory research and housing facilities for up to 12 scientists. Directed the design, planning and construction of a new \$24,500,000 science building that houses the Departments of Biology, Chemistry, and Geoscience and was dedicated 9/98.
- 6/87 - 12/91 **Associate Professor IPFW (Acting Chairman 1990-91),** Department of Biology IPFW. 1990 IPFW Sigma Xi Researcher of the year. (see below)
- 8/82 - 6/87 **Asistant Professor,** Department of Biology, Indiana-Purdue University, Fort Wayne, IN 46805. Taught undergraduate courses in: Human Anatomy and Physiology, Human Cadaver Dissection, Advanced Physiology. Graduate courses in: Comparative Physiology, Endocrinology, Environmental Biology, Medical Physiology. Developed a research program in Environmental/exercise Physiology and Aquatic Toxicology. Directed the research of 4 masters level students in our graduate programs and have an adjunct appointment at the Indiana University Medical School Physiology Department. On average my teaching load was two different courses per semester with 9 contact hours. Charter member of the Sigma Xi Research Club here at IPFW, served as secretary and President. Started the Sigma Xi Student research Report Competition that has become an annual event. Keith Zora a student in my lab received the Frank Brooks Award for best research presentation at the Beta Beta Beta (Biological Honorary Society).
- 8/79 - 8/82 **Visiting Assistant Professor,** Department of Zoology, Miami University, Oxford, OH 45056. Duties included teaching Human Anatomy and Physiology to nursing and allied health students, Ecology, Animal Diversity Genetics, and Intro to Biology. Taught three different classes per semester with 15 contact hours per week.
- 8/76 - 8/79 **NSF Predoctoral Fellow/Research Assistant,** Department of Zoophysiology, Washington State University, Pullman, WA 99164. Worked with Dr. James R. King conducting and directing research projects included in his/mine NSF grants. Lectured in

courses (Animal and Human Physiology, Ornithology) and supervised sections of the undergraduate senior seminar. Served as graduate student faculty representative, member of the Zoology Department 6-year planning committee.

- 9/75 - 5/76 **Teaching Assistant**, Department of Biology, Buffalo State University College, Buffalo, N.Y. 14222. Developed the lectures and laboratories for "Quantitative Ecology" course. Class was funded by an NSF Instructional Grant to PI Dr. James Spotila and was developed to acquaint upper level biology students to the rigors of scientific research. Assisted in the lab and lectured in the "Herpetology", "Fisheries Biology", and "Genetics" courses.
- 9/74 - 1/75 **Teaching Assistant**, Department of Psychology, Buffalo State University College, Buffalo, N.Y. Directed the experimental use and care of over 400 animals involved physiological psychology research by the faculty and students.
- 1/75 - 8/76 **Residence Hall Director**, Student Affairs, State University College, Buffalo, N.Y. 14222 Coordinated the educational, cultural and recreational environment; the supervision and development training of 10 undergraduate staff; counselor; advisor to student governing body; managed administrative, physical, and judicial areas in a high rise residence hall of 160 coeds.

RESEARCH INTERESTS AND EXPERIENCE:

Marine Environmental Biology and Conservation genetics, Satellite Imagery and telemetry, Comparative Marine Vertebrate Physiology, Sea Turtle Physiology, Biotelemetry and diving physiology of vertebrates, Ecology and Energetics, locomotion bioenergetics avian physiological ecology, aquatic toxicology, respiratory physiology. Endangered species conservation and international preservation of wildlife habitat. I have conducted research funded by National Institute of Health, National Science Foundation, Energy Research and Development Administration, State University College at Buffalo, Miami University, Purdue University Research Foundation, National Geographic Society, Caribbean Conservation Corporation, The World Wildlife Fund International, The Center for Field Research, Indiana Department of Natural Resources, Sigma Xi, The American Heart Association, and National Audubon Society projects involving thermoregulatory responses of the American Alligator, heat energy budget analysis and thermal modeling of the largemouth bass, respiration and metabolic capacity of African and Asian Elephants, assessing the effects of heavy metals, toxins, and acid rain on the thermal tolerance of fish, investigating the factors affecting hatchability and nest metabolism of sea turtles, determination of the effects of microclimate on thermoregulation, power consumption and locomotion energetics of sparrows, assessment of the effects of vasodilator drugs on the cardiac output of congestive heart failure patients, respiratory physiology of sea turtles and satellite telemetry of their movements, physiology while swimming, satellite tracking of sea turtles in the Atlantic and Pacific in leatherbacks and Kemp's ridleys. Costa Rica has appointed me to establish the "Las Baulas National Park" in Guanacaste Province. Investigated the population biology and ecology of the American Bald Eagle in the State of Indiana.

LICENSES, REGISTRATIONS, PERMITS, and/or CERTIFICATIONS:

Scuba Diver (PADI, Professional Association of Diving Instructors) 6/83-6/08 renewable
Master Bird Banding & Collecting Permit, U.S. Fish & Wild. Ser., Dept. Int. (till 2007).

CITES, USDA, U.S. Fish & Wildlife, State of IN Permits to work with all species of endangered sea turtles, permits from Costa Rica & U. S. to import & study the eggs, juveniles, tissues & adults of these animals.

CITATIONS IN BIOGRAPHICAL WORKS AND SCIENTIFIC LITERATURE:

1. Who's Who in Frontier Science and Technology, Who's Who in America. Marquis Who's Who, Chicago, Illinois 60611, 1983 - 2019. Listed in "American Men and Women in Science" "Dictionary of International Biography" 21-38 editions.
2. My research was profiled in NATIONAL GEOGRAPHIC MAGAZINE 1993, 1994 (1994, 2001 T.V. Specials), a Discovery Channel Special "Last Journey for the Leatherback" 2004, a 5 part PBS TV Special "Dinosaur" (1993), DISCOVER MAGAZINE, SCIENCE NEWS, a Larry Gonick 2 page color cartoon, and The Encyclopedia Britannica 1991 - 1995. Elected as a Fellow of the American Association for the Advancement of Science, Member of Phi Kappa Phi, Beta Beta Beta, Phi Beta Epsilon and Sigma Xi academic honor societies.
3. My research papers are cited in over 350 other research articles in a variety of journals including: Science, Nature, Proceedings of the National Academy of Science, Chelonia, Journal of Thermal Biology, Physiological Ecology, Ecology, The Auk, Journal of Experimental, Physiological and Biochemical Zoology, Journal of Wildlife Management, The Condor, Journal of Applied Physiology, Ornis Scandinavica, Bulletin of Environmental Contamination, Transactions of The American Fisheries Society, Journal of Experimental Zoology, Journal of Fish Biology, Review Canadienne de Biologie, Journal Of Water Pollution Control, Comparative Biochemistry and Physiology, The American Zoologist.

INSTITUTES AND WORKSHOPS ATTENDED:

Marine Turtle Specialists Group: Vision Meeting August 20-22 2005. Washington DC
International Sea Turtle Society Directors Retreat: August 2005 & 2005. NCTC West Va
The Pacific Leatherback turtle Survival Initiative April 24 - 26 2002 Monterey, CA)
NATO- Institute: Environmental Physiology of Fishes. Aug. 20-26, 1980 Montreal/Lennoxville, Quebec.
International Sea Turtle Biology and Conservation Workshops by
IUCN. 1988 - 2016 & Member of the IUCN Species Survival Commission.
IPFW Administrative Workshop 1992 - 2001-16
1995 Conference for Remote Sensing & Environmental Monitoring for Sustainable development of the Americas, San Juan, Puerto Rico

MEMBERSHIPS IN PROFESSIONAL SOCIETIES

American Ornithologists Union	American Society of Zoologists
Beta Beta Beta (Biological Honor Society)	Phi Kappa Phi (Honor Society)
Caribbean Conservation Corporation	Cooper Ornithological Society
Ecological Society of America	Herpetologists League
Sigma Xi (Honor Society:	
Past President) International Sea Turtle Society	
American Physiological Society (Honor Society)	

LETTERS OF REFERENCE MAY BE REQUESTED FROM:

Dr. Edward Standora, Department of Biology, Buffalo State College, 1300 Elmwood Ave, Buffalo, N.Y 14222, Phone: [REDACTED] E-mail: [REDACTED]

Dr. Pamela Plotkin, Director, Texas Sea Grant College Program, Department of Oceanography, Texas A&M University, MS 4115, College Station, TX 77845 Phone [REDACTED] Fax: [979-845-7525](tel:979-845-7525)
<http://texas-sea-grant.tamu.edu>

Dr. Rebecca Schnieder, Department of Natural Resources, Cornell University, Ithica, NY 14853
e-Mail: rls11@cornell.edu Phone : [REDACTED]

Dr. Stephen Morreale, NY Cooperative Fish and Wildlife Research Unit, Cornell University, Ithica, NY 14853 Phone [REDACTED] Fax (607)255-8088 email: sjm11@cornell.edu

PERSONAL DATA:

[REDACTED]



Curriculum Vitae
Nathan Jack Robinson

Email: [REDACTED]

EDUCATION

Ph.D in Biological Sciences **2010 – 2014**

Purdue University, USA.

- Dissertation: Migratory ecology of sea turtles.
- Co-advised by Frank V. Paladino, Ph.D. and Jeffrey R. Lucas, Ph.D.

Masters of Marine Biology **2005 – 2009**

University of Southampton. UK.

- Dissertation: The role of specific dynamic action in the hydrostatic pressure tolerance of the shallow water spider crab *Maja brachydactyla*.
 - Advised by Sven Thatje, Ph.D.
 - First-class honours.
 - Serves as a combined BSc and MSc degree.
-

PROFESSIONAL EXPERIENCE

Director **2017 - Present**

Cape Eleuthera Institute, The Bahamas

- Managing a team of post-graduate researchers.
- Developing and coordinating research projects in ecology and social science.
- Integrating high-school and university-level students into field research programs.

Research Associate **2017**

Cape Eleuthera Institute, The Bahamas

- Developing and coordinating research projects in ecology and social science.
- Integrating high-school and university-level students into field research programs.

Post-Doctoral Researcher **2015 – 2017**

Indiana University – Purdue University Fort Wayne, USA

- Expanding the research focus of the Goldring-Gund Marine Biology Station.
- Mentoring Masters and Ph.D. students.

Field Director **2013 – 2017**

The Leatherback Trust, Costa Rica.

- Managing a sea turtle research program at Las Baulas National Marine Park.
- Coordinating research projects for visiting scientists.

Project Coordinator **2011 – 2013**

Nelson Mandela Metropolitan University, South Africa.

- Managing a sea turtle research program in the iSimangaliso Wetland Park, South Africa.

Project Coordinator **2008 – 2010**

ARCHELON – The Sea Turtle Protection Society of Greece, Greece.

- Managing a sea turtle research program in Kyparissia and Rethymno, Greece.
-

MEDIA COVERAGE

During my career, I have been at the centre of several viral videos. The most impactful of these include:

Here Be Monsters: Giant Squid Filmed in America's Backyard

2019

>1,800,000 views at <https://youtu.be/Lqim34DvCrs>

- Myself, alongside Dr. Edith Widder, were the first people to ever record a live giant squid in US waters.

Sea Turtle with Straw up its Nostril - "NO" TO PLASTIC STRAWS

2015

> 38,000,000 million views at <https://youtu.be/4wH878t78bw>

- I was recorded removing a plastic straw from a sea turtle's nose. This incident sparked a global campaign to end the use single-use plastic straws.

Plastic Fork Removed From Sea Turtle's Nose

2015

>12,000,000 views at <https://youtu.be/VRiTABRQOjk>

- Shortly following the impact of the straw video, I was recorded removing a plastic fork from a sea turtle's nose.

RESEARCH INTERESTS / AREAS OF EXPERTISE

The role of technology in ecology and conservation, spatial ecology of marine megafauna, applied conservation biology, biological oceanography, trophic ecology, population dynamics of endangered species, remote sensing, telemetry, Unoccupied Aerial Vehicles.

PEER-REVIEWED PUBLICATIONS

1. Clyde-Brockway C, **Robinson NJ**, Blanco GS, Morreale SJ, Spotila JR, Santidrián Tomillo P, Paladino FV (In Press) Local variation in the inter-nesting behavior of green turtles in the Gulf of Papagayo, Costa Rica. *Chelonian Conservation and Biology*.
2. Majewska R, Bosak S, Frankovich TA, Ashworth MP, Sullivan MJ, **Robinson NJ**, Lazo-Wasem EA, Pinou T, Nel R, Manning SR, Van de Vijver B (2019) Six new epibiotic Proschkinia (Bacillariophyta) species and new insights into the genus phylogeny. *European Journal of Phycology* 25:1-23.
3. McKenna LN, Paladino FV, Santidrián Tomillo P, **Robinson NJ** (2019) Do sea turtles vocalize to synchronize hatching or nest emergence? *Copeia* 107:120-3.
4. Pinou T, Domenech F, Lazo-Wasem EA, Majewska R, Pfaller JB, Zardus JD, **Robinson NJ** (2019) Standardizing sea turtle epibiont sampling: outcomes of the Epibiont Workshop at the 37th International Sea Turtle Symposium. *Marine Turtle Newsletter* 157:22-32.
5. **Robinson NJ**, Lazo-Wasem EM, Butler BO, Lazo-Wasem EA, Zardus JD, Pinou T (2019) Spatial distribution of epibionts on olive ridley sea turtles at Playa Ostional, Costa Rica. *PLoS ONE* 14:e0218838.
6. Valverde-Cantillo V, **Robinson NJ**, Santidrián Tomillo P (2019) Influence of oceanographic conditions on nesting abundance, phenology and internesting periods of east Pacific green turtles. *Marine Biology* 166:93.
7. Williamson SA, Evans RG, **Robinson NJ**, Reina RD (2019) Synchronised nesting aggregations (arribadas) are associated with enhanced capacity for extended embryonic arrest in olive ridley sea turtles. *Scientific Reports* 9:9783.
8. Cruz LM, Shillinger GL, **Robinson NJ**, Santidrián Tomillo P, Paladino FV (2018) Effect of light intensity and wavelength on the in-water orientation of olive ridley turtle hatchlings. *Journal of Experimental Marine Biology and Ecology* 505:52-6.
9. Farlow JO, **Robinson NJ**, Kumagai CJ, Paladino FV, Falkingham PL, Elsey RM, Martin AJ (2018) Trackways of the American crocodile (*Crocodylus acutus*), Northwestern Costa Rica: implications for crocodylian ichnology. *Ichnos* 25:30-65.
10. Farlow JO, **Robinson NJ**, Turner ML, Black J, Gatesy SM (2018) Footfall pattern of a bottom-walking crocodile (*Crocodylus acutus*). *Palaios* 33:406-13.
11. Gatto CR, Rotger A, **Robinson NJ**, Santidrián Tomillo P (2018) A novel method for photo-identification of

sea turtles using scale patterns on the front flippers. *Journal of Experimental Marine Biology and Ecology* 506:18-24.

12. Majewska R, Ashworth MP, Lazo-Wasem E, **Robinson NJ**, Rojas L, Van de Vijver B, Pinou T (2018) *Craspedostauros alatus* sp. nov., a new diatom species found on museum sea turtle specimens. *Diatom Research* 33:229-40.
13. Pinou T, Prunier R, Bresson, Ildefonso EP, Francisco J, Perez J, Barrera C, Robles JAT, DiGiovanni Jr. RA, **Robinson NJ** (2018) Repeated sampling adds to the genetic diversity of *Lepidochelys olivacea* (Eschscholtz 1829) olive ridley sea turtle. *Journal of Natural History* 52:2899-917.
14. Rees AF, Avens L, Ballorain K, Bevan E, Broderick AC, Carthy RR, Christianen MJA, Duclos G, Heithaus M, Johnston DW, Mangel JC, Paladino F, Pendoley K, Reina R, **Robinson NJ**, Sykora-Bodie S, Tilley D, Varela MR, Whitman E, Whittock PA, Wibbels T, Godley BJ (2018) The potential of unmanned aerial systems for sea turtle research and conservation. *Endangered Species Research* 35:81-100.
15. **Robinson NJ**, Anders D, Bachoo S, Harris L, Kotze D, Maduray S, McCue S, Meyer M, Oosthuizen H, Paladino FV, Luschi P (2018) Review of satellite telemetry studies on sea turtles on the southeast African coastline. *Indian Ocean Turtle Newsletter* 28:3-7.
16. **Robinson NJ**, Peters WS (2018) Complexity of the prey spectrum of *Agaronia propatula* (Caenogastropoda: Olividae), a dominant predator in sandy beach ecosystems of Pacific Central America. *PeerJ* 6:e4714.
17. Hill JR, **Robinson NJ**, King CM, Paladino FV (2017) Diving behavior and thermal habitats of gravid hawksbill turtles at St. Croix, USA. *Marine Biology* 164:17.
18. **Robinson NJ**, Figgenger C, Gatto C, Lazo-Wasem EA, Paladino FV, Santidrián Tomillo P, Zardus JD, Pinou T (2017) Assessing potential limitations when characterising the epibiota of marine megafauna: effect of gender, sampling location, and inter-annual variation on the epibiont communities of olive ridley sea turtles. *Journal of Experimental Marine Biology and Ecology* 497:71-7.
19. **Robinson NJ**, Lazo-Wasem EA, Paladino FV, Zardus JD, Pinou T (2017) Assortative epibiosis of leatherback, olive ridley, and green sea turtles in the Eastern Tropical Pacific. *Journal of the Marine Biological Association of the United Kingdom* 97:1233-40.
20. **Robinson NJ**, Morreale SJ, Nel R, Paladino FV (2017) Movements and diving behaviour of inter-nesting leatherback turtles in an oceanographically dynamic habitat in South Africa. *Marine Ecology Progress Series* 571:221-32.
21. **Robinson NJ**, Paladino FV, Santidrián Tomillo P (2017) Evidence of a green turtle commencing a post-nesting migration without laying all its vitellogenic follicles. *Marine Turtle Newsletter* 152:8-10.
22. **Robinson NJ**, Stewart KR, Dutton PH, Nel R, Paladino FV, Santidrián Tomillo P (2017) Standardizing curved carapace length measurements for leatherback turtles, *Dermochelys coriacea*, to investigate global patterns in body size. *The Herpetological Journal* 27:231-4.
23. Santidrián Tomillo P, **Robinson NJ**, Fonseca L, Quirós W, Arauz R, Beange M, Piedra R, Vélez E, Paladino FV, Spotila JR, Wallace BP (2017) Secondary nesting beaches of leatherback turtles in Pacific Costa Rica. *Latin American Journal of Aquatic Research* 45:563-71.
24. Santidrián Tomillo P, **Robinson NJ**, Sanz-Aguilar A, Spotila JR, Paladino FV, Tavecchia G (2017) High and variable mortality of leatherback turtles reveal possible anthropogenic impacts. *Ecology* 98:2170-9.
25. Williamson SA, Evans RG, **Robinson NJ**, Reina RD (2017) Hypoxia as a novel method for preventing movement-induced mortality during translocation of turtle eggs. *Biological Conservation* 216:86-92.
26. **Robinson NJ**, Dornfeld TC, Butler BO, Domico LJ, Hertz CR, McKenna LN, Neilson CB, Williamson SA (2016) Plastic fork found inside the nostril of an olive ridley sea turtle. *Marine Turtle Newsletter* 150:1-3.
27. **Robinson NJ**, Majewska R, Lazo-Wasem EA, Nel R, Paladino FV, Rojas L, Zardus JD, Pinou T (2016) Epibiotic diatoms are universally present on all sea turtle species. *PLoS ONE* 11:e0157011.
28. **Robinson NJ**, Morreale SJ, Nel R, Paladino FV (2016) Coastal leatherback turtles reveal conservation hotspot. *Scientific Reports* 6:37851.
29. Dornfeld TC, **Robinson NJ**, Santidrián Tomillo P, Paladino FV (2015) Ecology of solitary nesting olive ridley sea turtles, *Lepidochelys olivacea*, at Playa Grande, Costa Rica. *Marine Biology* 162:123-39.
30. Neeman N, **Robinson NJ**, Paladino FV, Spotila JR, O'Connor MP (2015) Phenology shifts in leatherback turtles (*Dermochelys coriacea*) due to changes in sea surface temperature. *Journal of Experimental Marine Biology and Ecology* 462:113-20.
31. Patel SH, Morreale SJ, Panagopoulou A, Bailey H, **Robinson NJ**, Paladino FV, Margaritoulis D, Spotila JR (2015) Change point analysis: a new approach for revealing animal movements and behaviors from

- satellite telemetry data. *EcoSphere* 6:1-13.
32. **Robinson NJ**, Figgenger C (2015) Plastic straw found inside the nostril of an olive ridley sea turtle. *Marine Turtle Newsletter* 147:5-6.
 33. Santidrián Tomillo P, Saba VS, Lombard CD, Valiulis JM, **Robinson NJ**, Paladino FV, Spotila JR, Fernández C, Rivas ML, Tucek J, Nel R, Oro D. (2015) Global analysis of the effect of local climate on the hatchling output of leatherback turtles. *Scientific Reports* 5:16789.
 34. **Robinson NJ**, Valentine SE, Santidrián Tomillo P, Saba VS, Spotila JR, Paladino FV (2014) Multidecadal trends in the nesting phenology of Pacific and Atlantic leatherback turtles are associated with population demography. *Endangered Species Research* 24:197-206.
 35. Thatje S, **Robinson N** (2011) Specific dynamic action affects the hydrostatic pressure tolerance of the shallow-water spider crab *Maja brachydactyla*. *Naturwissenschaften* 98:299-313.
 36. **Robinson NJ**, Thatje S, Osseforth C (2009) Heartbeat sensors under pressure: a new method for hyperbaric physiology. *High Pressure Research* 29:422-30.
-

PUBLICATIONS IN PREPERATION

1. **Robinson NJ**, Johnsen S, Widder E (In Prep) Behavioural insights into the hunting behaviour of giant squid gained from the first-ever observation of a live individual in US waters. *Ecology*.
-

BOOK CHAPTERS

1. **Robinson NJ**, Paladino FV (2015) Diving behavior and physiology of the leatherback turtle. In: *The Leatherback Turtle: Biology and Conservation*. Spotila JR, Santidrián Tomillo P (eds). Johns Hopkins Press, Baltimore, MD, USA., pp 21-31.
 2. Kingsbury B, **Robinson NJ** (2016) Movement patterns and telemetry. In: *Reptile Ecology and Conservation*. Kenneth Dodd C (eds). Oxford University Press, Oxford, U.K., pp 110-121.
-

SELECTED SYMPOSIUM PRESENTATIONS

1. **Robinson NJ**, Deguzman K, DiGiovanni R, Pinou T (2019) Satellite tracking of juvenile green, loggerhead, and Kemp's ridley turtles released from rehabilitation centers in southern New England and Long Island. *39th Annual Symposium on Sea Turtle Biology and Conservation*. Charleston, USA. Poster presentation.
2. **Robinson NJ**, Blanco G, Clyde-Brockway C, Hill J, Patel SH, Panagapoulou A, Santidrián Tomillo P, Shillinger GS, Williams C, Spotila JR, Paladino FV (2017) Comparing the effect of temperature on the duration of the interesting interval across multiple sea turtle species. *37th Annual Symposium on Sea Turtle Biology and Conservation*. Las Vegas, USA. Oral presentation.
3. **Robinson NJ**, Morreale SJ, Nel R, Paladino FV (2016) Effect of Agulhas Current on the inter-nesting movements and diving behaviour of leatherback turtles in South Africa. *36th Annual Symposium on Sea Turtle Biology and Conservation*. Lima, Peru. Oral presentation.
4. **Robinson NJ**, Morreale SJ, Nel R, Paladino FV (2015) Unravelling the at-sea behavior of leatherback turtles around southern Africa by integrating horizontal and vertical movement patterns. *35th Annual Symposium on Sea Turtle Biology and Conservation*. Dalaman, Turkey. Oral presentation.
5. **Robinson NJ**, Morreale SJ, Batchoo S, Kotze D, McCue S, Meyer M, Oosthuizen H, Nel R, Paladino FV (2014) Revealing the migratory behaviour of nesting leatherback and loggerhead turtles from South Africa using satellite telemetry and stable isotope analysis. *34th Annual Symposium on Sea Turtle Biology and Conservation*. New Orleans, USA. Oral presentation.
6. **Robinson NJ**, Nel R, Morreale SJ, Paladino FV (2013) Coastal or pelagic: updating the leatherback paradigm. *33rd Annual Symposium on Sea Turtle Biology and Conservation*. Baltimore, USA. Oral presentation.
7. **Robinson, NJ**, Valentine S, Garner J, Santidrián Tomillo P, Saba VS, Spotila JR, Paladino FV (2012) Factors influencing the timing of the nesting season for Pacific and Atlantic leatherback turtles. *32st Annual Symposium on Sea Turtle Biology and Conservation*. Oaxaca, Mexico. Oral presentation.
8. **Robinson NJ**, Valentine S, Santidrián Tomillo P, Spotila JR, Paladino FV (2011) Effect of population demographics on the nesting phenology of the leatherback turtle (*Dermochelys coriacea*) at Playa Grande, Costa Rica. *Joint Meeting of Ichthyologists and Herpetologists*. Minneapolis, USA. Oral presentation.

GRADUATE STUDENTS

Laura St. Andrew - *Purdue University Fort Wayne, USA*. Co-Supervisor. **Active**
M.Sc Thesis: Trace metal loads in green sea turtles from urbanized and non-urbanized habitats.

Jenell Black - *Purdue University Fort Wayne, USA*. Co-Supervisor. **Graduated 2019**
M.Sc Thesis: Ecology of American alligators in the Tamarindo Estuary, Costa Rica

Quintin Bergman - *Purdue University Fort Wayne, USA*. Co-Supervisor. **Graduated 2019**
M.Sc Thesis: Spatial ecology of hawksbill turtles (*Eretmochelys imbricata*) nesting at Gandoca-Manzanillo National Wildlife Refuge.

Lindsay N. McKenna - *Indiana-Purdue University Fort Wayne, USA*. Primary Supervisor. **Graduated 2015**
M.Sc Thesis: Vocalizations in sea turtle hatchlings and embryos

Jacob Bryan - *Indiana-Purdue University Fort Wayne, USA*. Co-Supervisor. **Graduated 2014**
M.Sc Thesis: Trace metal concentrations in eastern Pacific sea turtles

GRANTS

██████████ – Underwater glider operations off Eleuthera Island, Bahamas ██████████. Lead Author / PI. *University of Miami, USA*.

██████████ – Growing the capacity of the coral rearing laboratory at The Bahamas Coral Innovation Hub ██████████
Lead Author / PI. *The Nature Conservancy, USA*.

██████████ – Using animal-borne camera to investigate the behaviour of juvenile green turtles ██████████. Lead Author / PI. *Finding Our Way – National Oceanographic and Atmospheric Administration, USA*

██████████ – Fostering stewardship for healthy coral reefs in The Bahamas: partnering ecological restoration efforts with educational outreach ██████████. Lead Author / Co-PI. *The Nature Conservancy, USA*.

██████████ – Out of the blue: Fish Aggregation Devices (FADs) in the Exuma Sound as an established research and education platform ██████████. Co-Author / Co-PI. *Moore Foundation, USA*

██████████ – Using drones to assess the abundance, distribution, and behaviour of green turtles in The Bahamas ██████████
Lead Author / PI. *British Chelonia Group, U.K.*

██████████ – Costa Rican Sea Turtles volunteer expedition ██████████. Lead Author / PI. *Earthwatch Institute, USA*.

██████████ – Using drones to monitor sea turtles and beach dynamics in northwest Costa Rica ██████████. Lead Author / PI. *Seeds of Change, USA*.

██████████ – Using drones to monitor biodiversity in northwest Costa Rica ██████████. Lead Author / PI. *Fort Wayne Children's Zoo, USA*.

██████████ – Costa Rican Sea Turtles volunteer expedition ██████████. Lead Author / PI. *Earthwatch Institute, USA*.

██████████ – Costa Rican Sea Turtles volunteer expedition ██████████. Lead Author / PI. *Earthwatch Institute, USA*.

██████████ – Expanding the research base of The Leatherback Trust ██████████. Lead Author / PI. *Goldring Family Foundation, USA*.

██████████ – Bilisland Dissertation Fellowship ██████████. *Purdue University, USA*.

██████████ – Leatherback turtles as ecological indicators: insights into the potential effects of climate change on an oceanic apex predator ██████████ Lead Author / PI. *The Leatherback Trust, Costa Rica.*

Travel Grants

International Sea Turtle Society, Herpetological Society of Western Connecticut State University, Peabody Museum at Yale University, Purdue Student Travel Award, Palomar State College Visiting Scientist Grant.

AWARDS

- Archie Carr Award (2014) Runner-Up Best Oral Presentation in Biology at the 34th Annual Symposium on Sea Turtle Biology and Conservation. New Orleans, USA.
- Highest Achieving Graduate Student in Oceanography (2009) *University of Southampton, U.K.*

ACADEMIC SERVICE

Invited Lectures

- | | |
|--|------|
| • Universidad De Costa Rica, Costa Rica | 2017 |
| • Universidad Latina, Costa Rica | 2016 |
| • Veritas University, Costa Rica | 2016 |
| • Western Connecticut State University, USA. | 2014 |

Symposia

- | | |
|--|------|
| • Program Chair - 37 th International Sea Turtle Symposium. Las Vegas, USA. | 2017 |
|--|------|

Invited Reviewer For Peer-Reviewed Journals

Animal Biotelemetry, Chelonian Conservation and Biology, Endangered Species Research, Herpetologica, Marine Biology, Marine Ecology Progress Series, Marine Turtle Newsletter, Journal of the Marine Biological Association of the United Kingdom, Journal of Zoology, PLoS One, Revista Ciencias Marinas y Costeras (REVMAR), Scientific Reports

Invited Reviewer For Funding Proposals

- Croatian Science Foundation (HRZZ)

TEACHING EXPERIENCE

Research Teacher

2017 - Present

Cape Eleuthera Institute, The Bahamas

- Incorporating high-school students into active research programs.

Course Director

2013 – 2017

Goldring-Gund Marine Biology Station, Costa Rica

- Intensive courses in Tropical Field Ecology for university-level and high-school students.

Guest Lecturer

2014

Western Connecticut State University, USA.

- Vertebrate Zoology, Introductory Biology for Non-Majors

Guest Lecturer

2013

Indiana University – Purdue University Fort Wayne, USA.

- Introductory Biology for Non-Majors

Graduate Teaching Assistant

2010 – 2012

Purdue University, USA.

-
- Human Anatomy and Physiology, Medical Terminology, Environmental and Conservation Biology
-

CAMPAIGNS, WORKSHOPS, AND RESEARCH EXPEDITIONS

Journey Into Midnight: Live and Light Below The Twilight Zone – Researcher 2019

NOAA - Office of Ocean Research and Exploration

- Responsible for deploying the deep-sea camera platform, the MEDUSA, which captured the first-ever footage of a live giant squid in US waters.

Uncovering Deep-Sea Life In The Exuma Sound – Principal Coordinator 2019

OceanX / Cape Eleuthera Institute

- Led a research expedition aboard the M/V Aluica to characterize the deep-sea life in the Exuma Sound, The Bahamas.

Sea Turtle Epibiont Working Group – Principal Coordinator 2015, 2016, 2017

Golding-Gund Marine Biology Station

- Hosted a workshop to develop novel methods for investigating sea turtle epibiosis.

Future Trends in Sea Turtle Epibiont Research – Co-Coordinator 2017

37th International Sea Turtle Symposium, USA.

- Hosted a workshop to outline the current knowledge concerning sea turtle epibiosis and outline potential directions for future research.

Monitoring The Behaviour of Captive-Bred Pandas In The Wild 2016

Global Cause Foundation, USA.

- Assisting with a program to reintroduce captive born giant pandas to the wild at the Dujiangyan Panda Base, China.
- Analysis of movement patterns of captive giant panda from satellite telemetry data.

UnPlastic – Co-Coordinator 2016

Veritas University, Costa Rica

- Hosted a public event on the university campus to raise awareness about the impacts of single-use plastics on marine life and present alternatives.

Microstructure of Sea Turtle Shells 2015 – 2016

Yale University, USA.

- Using scanning electron microscopy to uncover phylogenetic patterns in the micro-structure of Chelonid carapaces.

Diving Behaviour of Hawksbill Turtles 2012

Indiana University – Purdue University Fort Wayne, USA.

- Using radio telemetry and data loggers to reveal the movements and diving behaviour of hawksbill turtles around St. Croix, U.S. Virgin Islands.

Movement Patterns of Mediterranean Sea Turtles 2010

Drexel University, USA.

- Using satellite and radio telemetry to track the movements of loggerhead turtles around Crete, Greece using satellite transmitters.

Assessing Human Impacts in the Whittard Submarine Canyon 2009

University of Southampton, U.K.

- Using ROVs to survey to deep-sea fauna and geology of the Whittard Submarine Canyon aboard the RRS James Cook.

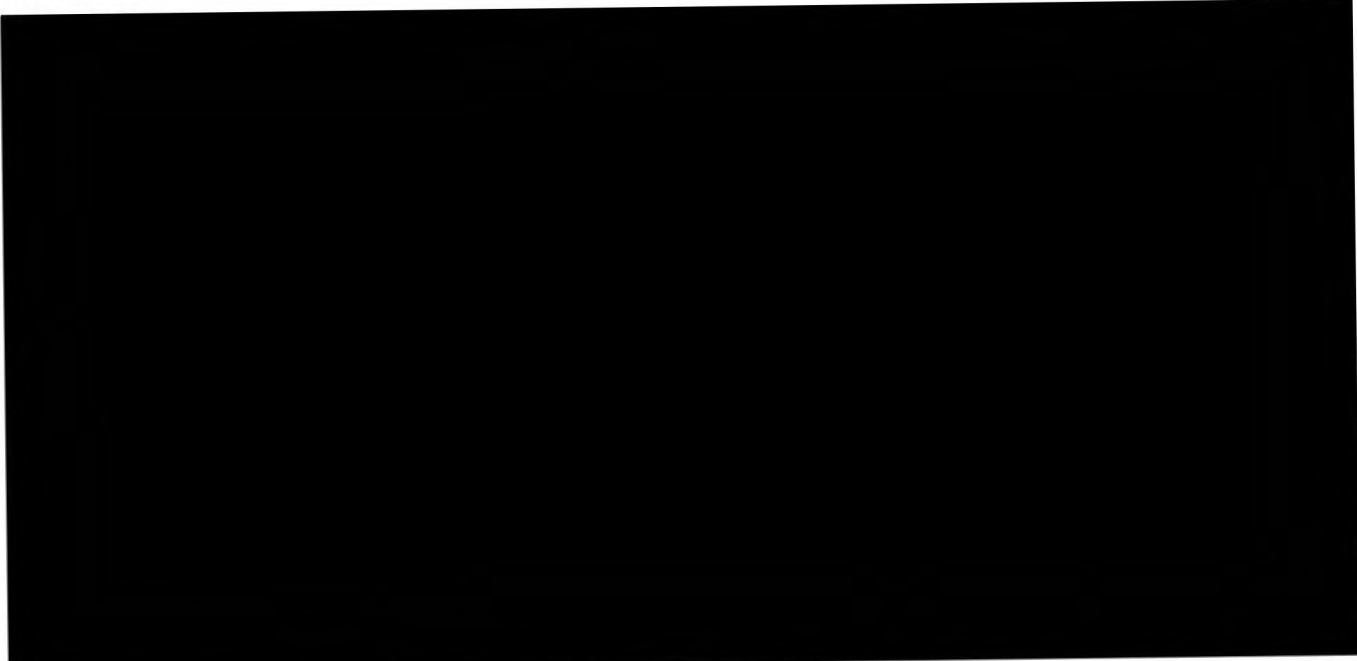
POPULAR SCIENCE ARTICLES

1. **Robinson NJ**, Santidrián Tomillo P, Paladino FV (2017) The benefits and costs of satellite telemetry. The State of the World's Sea Turtles. Report XII:6-7.
seaturtlestatus.org/sites/swot/files/report/0420517_SWOT12_p06-07_Satellite%20Tagging.pdf
2. Agyekumhene A, Aruna E, Airaud BF, Allman P, Ayissi I, Bourjea J, Dalleau M, Diagne T, Fallabrino A, Formia A, Freyey J, Girard A, Girondot M, Hancock J, Honarvar S, Marco A, Mast R, Missilou-Boukaka R, Morreale S, Mortimer JA, Olendo M, Nel R, Paladino FV, **Robinson NJ**, Kamla AT, Tiwari M, Van De Geer C, Vieira S, West L (2017) The sea turtles of Africa. The State of the World's Sea Turtles. Report XII:14-23.
seaturtlestatus.org/sites/swot/files/report/0420517_SWOT12_p14-29_Special%20Feature.pdf
3. **Robinson NJ** (2016) Sea turtle 'hitchhikers' could play an important role in conservation. *The Conversation*.
<https://theconversation.com/sea-turtle-hitchhikers-could-play-an-important-role-in-conservation-62081>
4. **Robinson NJ** (2016) Sea turtles can save themselves if we clean up our act. *National Geographic – Ocean Views*.
<http://voices.nationalgeographic.com/2016/09/29/sea-turtles-can-save-themselves-if-we-clean-up-our-act/>
5. **Robinson NJ** (2016) Leatherback turtles: giving thanks where it is due. *National Geographic – Ocean Views*
<http://voices.nationalgeographic.com/2016/11/23/leatherback-turtles-giving-thanks-where-it-is-due/>
6. **Robinson NJ**, Paladino FV (2013) Sea turtles. In: Reference Module in Earth Systems and Environmental Sciences. Elsevier, Amsterdam. doi:10.1016/B978-0-12-409548-9.04352-9

PROFESSIONAL SKILLS

- Website Design.
- Experience in email marketing systems (SalesForce).
- Proficiency with: ArcGIS, Dbase, ImageJ, Microsoft Office, Python, and R.
- Qualified PADI SCUBA diver (Advanced Open Water and Rescue Diver).
- Atlantic and Gulf Rapid Reed Assessment: Benthic Survey – Trainer Class (certification #20).
- European driving license.
- Wilderness First Responder (Certified by Solo).
- First Aid and CPR (Certified by Solo).
- Conversational Spanish and French.
- Experienced drone pilot.
- Boat Handling and Safety License - Boat U.S. Foundation (certification #0000000904991).

REFERENCES





Laura C. St. Andrews

Education

Purdue University, Indiana

2019-present

❖ **Masters of Science in Biology**

- Thesis: Heavy Metal Contamination of Sea Turtle Tissues In Urbanized and Non-Urbanized Environments
- Advised by Dr. Frank V. Paladino and Dr. Nathan J. Robinson

St. Lawrence University, NY

2010-2014

❖ **Bachelor of Arts in Environmental Studies and Government**

Minor: Asian Studies

- Cumulative GPA: 3.56/4.00

❖ **Chiang Mai University, Chiang Mai, Thailand**

- **Fall 2013**

- Taught English to Buddhist Monks in Chiang Mai.

❖ **Paññāsāstra University of Cambodia, Phnom Penh, Cambodia**

- **Fall 2013**

- Researched the politics and environmental concerns associated with the garment industry and labor organization through interviews conducted with the International Labor Organization in Phnom Penh

Professional Employment

❖ **Purdue University, Graduate Research Assistant, Fort Wayne, Indiana**

August 2019-Present

- Maintain standardized data collection procedures for sea turtle thesis
- Collect blood, scale and scute samples from turtles; Blood samples are collected from the dorsal cervical sinus, scale samples are collected from the shoulders and scute samples are collected from the 1st left costal.
- Organize logistics and write United States Fish and Wildlife Service proposals to work with collaborating researchers in Texas and Massachusetts who are collecting samples for my thesis analysis
- Apply and secure grants for further sea turtle research

❖ **Cape Eleuthera Institute, Sea Turtle Research Teacher, Eleuthera, The Bahamas**

August 2019- Present

- Introduce high school students to the scientific method through a group sea turtle research project with field and class components
- Lead high school students, gap year students, and interns in data collection and field work
- Drive powerboats and manual vehicles to remote field sites and seine net, or “rodeo” for sea turtles to sample
- Interpret and analyze behavior of sea turtles using drones and underwater camera devices

- Teach scientific writing and reading techniques as well as grade papers and prepare all necessary equipment for field work ~25 hours/week.
- ❖ **LaBella Associates, Environmental Scientist, Albany, NY**
October 2018- July 2019
 - Performed wetland delineations using the United States Army Corps of Engineers 1987 Wetland Delineation Manual
 - Identified trees, shrubs, plants and fauna of NYS, particularly avian, amphibian and reptilian species.
 - Identified hydric soils and hydrological determinates of wetlands
 - Collected data during meander surveys for endangered and threatened species (northern long eared bat, Indian bat, Karner blue butterfly and frosted elfin) and summarize findings in reports for clients and agencies
 - Collected data during meander surveys for invasive species and summarize findings in reports for clients and agencies
 - Coordinated with New York State Department of Environmental Conservation and US Army Corps of Engineers and advise wetland mitigation feasibility plans as well as design and conduct long term wetland monitoring
 - Wrote reports and permitting packages to local towns, New York State Department of Environmental Conservation and US Army Corps of Engineers
 - Created and manage GIS data to create maps and natural resource inventories
 - Submitted permit applications, State Historic and Preservation Society and New York Natural Heritage Program inquiries to New York State Department of Environmental Conservation and the US Army Corps of Engineers.
- ❖ **Sea Turtle Inc., Field Technician, South Padre Island, Texas**
March 2018- August 2018
 - Monitored all remote beach nesting activity using ATVs and trucks for Kemp's ridley sea turtles and served as the first responder to all nests and nesting females on the beach.
 - Maintained and conducted noise experiments in hatchery throughout nesting season, while also measuring hatchling output and analyzing data.
 - Collected data on sick, injured and deceased sea turtles that were found by patrollers or volunteers on South Padre Island
 - Organized and documented nesting information for the Island and send all data to National Park Service contacts for further analysis.
- ❖ **The Leatherback Trust, Field Team Leader, Playa Grande, Costa Rica**
September 2017 - March 2018
 - Maintained standardized data collection by leading nightly and morning sea turtle nesting walking patrols for green, leatherback and olive ridley. Data was collected from nesting turtles using PIT and metal tags as well as by measurement and nest location and size count.
 - Successfully monitored in-situ nests and relocated nests in tidal inundation or predator danger to hatchery and managed the release of hatchlings using thermocouples.
 - Coordinated logistics for citizen science volunteers coming to the field station from all over the world.

- Served as a liaison for The Leatherback Trust with the El Parque Nacional Marina Las Baulas park rangers.
- Managed a team of 5 Field Biologists and all safety of team and volunteers.
- ❖ **Sea Turtle Inc., Intern, South Padre Island, Texas**
March 2017- August 2017
 - Assisted in daily husbandry of sick and injured sea turtles; providing rudimentary medical care, testing water quality, tank maintenance.
 - Gave presentations daily to Sea Turtle Inc. visitors in order to provide understanding of the importance of sea turtle conservation
 - Monitored remote beach nesting activity for Kemp's ridley sea turtles through ATV beach patrols over 30+ miles.
 - Monitored relocated nests and released hatchlings that emerged from the hatchery.
- ❖ **The Leatherback Trust, Field Biologist September 2016- March 2017**
 - Collected and analyzed data on Eastern Pacific leatherback, olive ridley and Pacific green turtles through nightly and morning beach patrols.
 - Relocated nests in danger from predators and tidal inundation and monitored nests and hatchlings in our hatchery.
 - Monitored nests on Playa Grande using thermocouples and triangulations.
- ❖ **Earthwatch Institute, Program Coordinator, Boston, MA**
December 2014- August 2016
 - Liaised with Earthwatch Principal Investigators to coordinate research plans, logistics and volunteer itineraries for expeditions.
 - Managed and guided interns through the Education and Corporate Sustainability Internship Program

Research Experience

- ❖ **Hawkwatch International, Wasatch-Cache Mountains, Utah**
June 2016
 - Measured, observed and weighed and banded nesting Flammulated Owls, Western Screech Owls and Northern Saw-whet Owls while conducting habitat surveys for nest cavities. Used densiometers to determine successful nest locations.
- ❖ **Cape Eleuthera Institute, Eleuthera, Bahamas** **July 2015,**
February 2019
 - Facilitated team with ten high school students, monitoring safety and research while engaging the students.
 - Snorkeled to identify fish species and behavior to regulate health of reefs and mangroves and collected, dissected and measured lion fish to understand diet of this invasive species in the Bahamas.
- ❖ **St. Lawrence University, Independent Research, Canton, NY**
August 2013- January 2013
 - Researched the relocation efforts of indigenous communities and governments affected by severe climate change, with focus on Alaska and Small Island Developing States.
 - Analyzed United Nation policy for to climate refugees and indigenous rights.

- Secured funding, and coordinated and presented research at the United Nations Framework Convention on Climate Change, in Warsaw, Poland with Many Strong Voices, the Center for International Environmental Law and delegates from Small Island Developing States.
- ❖ **St. Lawrence University, Senior Year Research Experience, Canton, NY**
January 2013- May 2014
 - Produced a Community Assessment Report analyzing the relocation needs of Shaktoolik, Alaska using interviews and policy understanding.
 - Organized and administered the creation of a needs-based evaluation documentary published on www.aksik.org
- ❖ **Mount Kilimanjaro, Moshi and Arusha Tanzania, Nairobi, Kenya,**
January 2012
 - Selected and funded to study the effects of the glacier loss on cultures surrounding Mt. Kilimanjaro while climbing the mountain. Data and video footage were collected during the climb, which I later analyzed and produced a documentary from to showcase to campus.

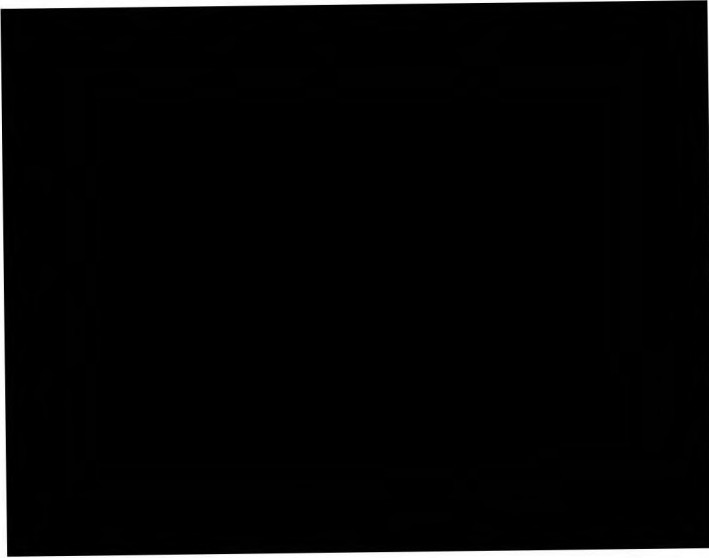
Skills

- ❖ Experienced in sea turtle population monitoring from managing night and morning walking and ATV beach patrols, analyzing and training on proper nest relocation techniques as well as monitoring nests and hatchlings for release, organizing data collection and input for *in situ* nests, relocated nests, nest temperatures, and turtle health monitoring. Skilled in applying metal and PIT tags to Kemp's ridley, olive ridley, leatherback, green and loggerhead turtles.
- ❖ Experienced Northeastern USA wetland delineator
- ❖ Proficient in data management through ArcGis Maps, Microsoft Office programs, Customer Resource Management systems, Trimble and Arrow GPS unit systems
- ❖ Highly skilled in managing international teams and volunteers: giving presentations, creating efficient, workable budgets, facilitating field team morale, training, scheduling, managing relationships and experience with safety and international incident management protocols.
- ❖ Conversational in Spanish
- ❖ Knowledgeable in operation of four-wheel drive vehicles, all-terrain vehicles, manual transmission vehicles, ATVs.

Volunteer

- ❖ New York State Department of Environmental Conservation: Amphibian migration surveys 2019
 - Identify roads likely to be crossed by amphibians during breeding migration
 - Identify and count salamander and frog species at road crossings and translocate live individuals across roads towards breeding pools
 - Collect spatial data on road-crossing transects
- ❖ New York State Department of Environmental Conservation: Raptor migration surveys 2019
 - Conduct point count surveys of New York's wintering northern harrier and short-eared owl populations for use in environmental mitigation planning

Professional References



Dr Nicholas D. Higgs Curriculum Vitae

T: +1 (242) 334-8551 ex. 6001
M: [REDACTED]
E: nickhiggs@ceibahamas.org
Tw: [REDACTED]

Cape Eleuthera Institute
PO Box EL-26029
Rock Sound, Eleuthera
The Bahamas

Citizenship:
[REDACTED]

I am a marine ecologist undertaking a range of research, from tropical fisheries in the Bahamas to biodiversity of the deep-sea. I help lead and manage the Cape Eleuthera Institute, the research division of the Cape Eleuthera Island School, delivering high quality research that supports a sustainable future for the Bahamas and conservation of global ocean ecosystems.

Academic Biography

2018–Pres: **Director** - Cape Eleuthera Institute

2018–2019: **Assistant Director** - Cape Eleuthera Institute

2016–2018: **Deputy Director of the Marine Institute** – University of Plymouth

2013–2016: **Postdoctoral Research Fellow & Research Officer** – University of Plymouth

2012–2012: **Postdoctoral Research Associate** – Natural History Museum, London

2008–2012: **PhD** (Deep-Sea Biology) – University of Leeds and Natural History Museum

2004–2008: **MSci Marine Biology** (First Class Honours) – University of Southampton

1997–2004: **Secondary Education** (10 GCSEs, 4 A-levels) – Culford School, Suffolk, UK

1991–1997: **Primary Education** – Spanish Wells All-Age School, Bahamas

Key professional development: *The Challenge of Science Leadership* – Barefoot Thinking

Teaching

I have completed the General Teaching Associates course and accredited as an Associate Fellow of the Higher Education Academy of the UK.

I currently teach on the Biological Oceanography (level 6) and Coastal Habitats (level 5) modules at Plymouth University and supervise students for their independent research projects.

I help lead the Marine Science and Conservation field course (level 5) to the Bahamas and have supported Marine Biology field course to Roscoff, France.

Key professional Development: HEA STEM Residential Workshop for New Lecturers (2014); HEA Transforming Environmental Science Fieldwork Practice Workshop (2012)

Science Communication and Outreach

Filmed ITV documentaries: *Britain's Whales* and *Britain's Sharks* with Big Wave Productions

Invited speaker at 2016 *Cheltenham Science Festival*, 2016 *New Scientist Live* and 2017 *British Science Association Festival*

Written articles for *New Scientist* and *Planet Earth* magazines

Interviews and research features for BBC, *Science*, *Telegraph*, *Planet Earth* (podcast)

Co-creator of the *Deep Sea ID* mobile app, displaying the diversity of marine life

Dr Nicholas D. Higgs

Curriculum Vitae

Public talks at the Natural History Museum, national Big Bang Science Fair and school groups
Interactive science sessions in schools for the *God & the Big Bang Programme*
Invited Lecture at Nottingham Contemporary Exhibition *Imagining the Deep*
Key professional development: NERC *Communicating Science to the Public* residential course

Awards

Fellowship from the Challenger Society for Marine Science (2016)
Deep-Sea Biology Society Landmark Paper of 2016

Field Expertise

I have participated in five oceanographic research cruises with collaborators from Japan and the USA, using ROVs, sediment multi-corers and otter trawls.

I have undertaken coastal research with fieldwork in temperate (Sweden, USA, UK) and tropical (Bahamas) marine environments. Competent in handling coastal powerboats.

Proficient in the maintenance and operation of shallow-class ROVs as well as other inshore sampling techniques for the benthic environment.

Analytical Expertise

Stable Isotope analysis – I have received training at the national Life Sciences Mass Spectrometry Facility, complimented by a weeklong residential course in Bayesian modelling of stable isotope data in *R* delivered by A Parnell and A Jackson (PR Statistics)

Multivariate statistics – Week long training course in theory and application of PRIMER software delivered by Robert Clarke and Raymond Gorely of PRIMER-E Ltd.

Consultancy

WWF-US – Review status of marine endangered, threatened and protected (ETP) species in The Bahamas and associated management strategies.

WWF-US – Identification of marine habitat and ecosystem research and monitoring in The Bahamas.

Pew Charitable Trusts – Lobbyist on FAO Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal Unreported and Unregulated Fishing.

Research Grants

NERC Engaging Environments [REDACTED] – “Blueprint: The Future of Our Seas” Lead Investigator: J. Parr, Co-investigator: N. Higgs

NERC LSMS facility: [REDACTED] – “Quantification of chemosynthesis-based food pathways in tropical seagrass habitats”. Lead Investigator: N. Higgs, Co-Investigator: M. Attrill

Higher Education Innovation Fund and National Marine Aquarium: [REDACTED] – “Plymouth Underwater Teaching Observatory and *Sea Life Live* project”. Lead Investigator: N. Higgs

Dr Nicholas D. Higgs Curriculum Vitae

Lerner-Gray Grant for Marine Research: [REDACTED] – Chemosynthesis-based food pathways in tropical seagrass habitats: Box crab (*Calappa* spp.) predation on tiger clams (Lucinidae). Lead Investigator: N. Higgs

NERC LSMS facility: [REDACTED] – “Predator-Prey Interactions Between Spiny Lobsters and Chemotrophic Clams” Lead Investigator: M. Attrill, Co-Investigator: N. Higgs

British Ecological Society: [REDACTED] – “Predator-Prey Interactions Between Spiny Lobsters and Chemotrophic Clams” Lead Investigator: N. Higgs

NERC NFSD Support: [REDACTED] – “Marine Environmental Taphonomy” project. Lead Investigator: A Glover, Co-Investigators: N. Higgs, K. Last, A. Davies

EU Assemble Grant: [REDACTED] – “STaCS” project. Lead Investigator: N. Higgs. Co-Investigators: A. Glover, T. Dahlgren

Peer-Reviewed Publications

Peake J, Bogdanoff AK, Layman CA, Castillo B, Reale-Munroe K, Chapman J, Dahl K, Patterson WF, Eddy C, Ellis R, Faletti M, **Higgs ND**, Johnston MA, Muñoz RC, Sandel V, Villasenor-Derbez JC & Morris JA (2018) Feeding ecology of invasive lionfish (*Pterois volitans* and *Pterois miles*) in the temperate and tropical western Atlantic. **Biological Invasions**, [in press]

Smale DA, Moore PJ, Querios AM, **Higgs ND**, Burrows MT (2018) Appreciating interconnectivity between habitats is key to Blue Carbon management. **Frontiers in Ecology and the Environment**, [in press].

Smith CR, Amon DJ, **Higgs ND**, Glover AG & Young EL (2017) Data are inadequate to test whale falls as chemosynthetic stepping-stones using network analysis: faunal overlaps do support a stepping-stone role. **Proceedings of the Royal Society B**, 248: 20171281.

Higgs ND, Newton J & Attrill MJ (2016) Caribbean Spiny Lobster Fishery Is Underpinned by Trophic Subsidies from Chemosynthetic Primary Production. **Current Biology** 26:3393-3398.

Higgs ND & Attrill MJ (2015) Biases in Biodiversity: Wide-Ranging Species Are Discovered First in the Deep Sea. **Frontiers in Marine Science**. 2:61.

Danise S & **Higgs ND** (2015) *Osedax* worms lived on Mesozoic marine reptile deadfalls. **Biology Letters**, 11:20150072. *Featured in Nature Research Highlights, Nature* 520:411

Smith CR, Glover AG, Treude T, **Higgs ND** & Amon DJ (2015) Whale-Fall Ecosystems: Recent Insights into Ecology, Paleoecology and Evolution. **Annual Review of Marine Science** 7:10.1-10.26.

Pokines JT & **Higgs ND** (2015) Macroscopic Taphonomic Alterations to Human Bone Recovered from Marine Environments. **Journal of Forensic Identification**, 65(6), 953–984.

Higgs ND, Glover AG, Dahlgren TG, Smith CR, Fujiwara Y, Pradillon F, Johnson SB, Vrijenhoek RC & Little CTS (2014) The morphological diversity of *Osedax* worm borings (Annelidia: Siboglinidae). **Journal of the Marine Biological Association of the UK** 94:1429-1439.

Higgs ND, Gates AR & Jones DOB (2014) Fish Food in the Deep Sea: Revisiting the Role of Large Food-Falls. **PLOS ONE** 9(5): e96016.

Anderung C, Danise S, Glover AG, **Higgs ND**, Jonsson L, Sabin R & Dahlgren TG (2014) A

Dr Nicholas D. Higgs Curriculum Vitae

Swedish subfossil find of a bowhead whale from the late Pleistocene: shore displacement, paleoecology in south-west Sweden and the identity of the Swedenborg whale (*Balaena swedenborgii* Liljeborg, 1867). **Historical Biology** 26:58-68.

Higgs N D, Little C T S, Glover A G, Dahlgren T G, Smith C R & Dominici S (2012) Evidence of *Osedax* worm borings in Pliocene (~3 Ma) whale bone from the Mediterranean. **Historical Biology** 24:269-277. *Featured in Nature Research Highlights, Nature* 479:153

Higgs N D, Little C T S & Glover A G (2011) Bones as biofuel: the composition of whale bones with implications for deep-sea biology and palaeoanthropology. **Proceedings of the Royal Society B** 278:9-17.

Higgs N D, Glover A G, Dahlgren T G & Little C T S (2011) Bone-Boring Worms: Characterizing the Morphology, Rate, and Method of Bioerosion by *Osedax mucofloris* (Annelida, Siboglinidae). **Biological Bulletin** 221:307-316.

Higgs N D, Glover A G, Dahlgren T G and Little C T S (2010) Using computed-tomography to document borings by *Osedax mucofloris* in whale bone. **Cahiers de Biologie Marine** 51:401-405.

Glover A G, **Higgs N D**, Bagley P M, Carlsson R, Davies A J, Kemp K M, Last K J, Norling K, Rosenberg R, Wallin K A, Källström B & Dahlgren T (2010) A live video observatory reveals temporal processes at a shelf-depth whale-fall. **Cahiers de Biologie Marine** 51:375-381.

Higgs N D, Reed A J, Hooke R A, Honey D J, Heilmayer O & Thatje S (2009) Growth and reproduction in the Antarctic brooding bivalve *Adacnarca nitens* (Philobryidae) from the Ross Sea. **Marine Biology** 156:1073-1081.

Scientific Reports

Higgs ND (2016) Report on the monitoring of lobster fishery impacts on endangered threatened and protected species in The Bahamas. *WWF-US*, 20 pp.

Higgs ND (2016) Report on monitoring of lobster fishery impacts on marine habitats and ecosystems in The Bahamas. *WWF-US*, 16 pp.

Book Chapters

Higgs ND & Pokines, JT (2014) Marine environmental alterations to bone. In: *Manual of Forensic Taphonomy*. CRC Press, Boca Raton, FL. pp.143-179.

Popular Science Publications

Higgs ND (2015). Dark Eaters: The Animals Living an Alternative Lifestyle. **New Scientist**, 3015:41-43.

Higgs ND (2016) Taxonomy in Trouble? An Ocean Science Perspective. **Ocean Challenge Magazine**, 21:110-11.

Pay To The Order Of U.S. Fish & Wildlife Service \$ 100.00

one hundred dollars Dollars

Date 10/08/2019 71-7274/2749 BRANCH 50

Security Features on Back

IV Credit Union
Indiana University
Employees Federal
Credit Union
Bloomington, Indiana 47401

Payees Add Fee

Frank V. Paladino

MP