

Dutton, P.H. 1996. Use of molecular markers for stock identification, fingerprinting, and the study of mating behavior in leatherbacks U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-396:79-86.

## MIXED STOCK COMPOSITION OF THE MISKITU CAYS GREEN TURTLE FISHERY BASED ON mtDNA MARKERS

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Anna L. Bass<sup>1</sup>, Cynthia J. Lagueur<sup>2</sup>, and Brian W. Bowen<sup>1</sup>

<sup>1</sup>BEECS Genetic Analysis Core, University of Florida, 12085 Research Drive, Alachua, FL 32615, U.S.A.

<sup>2</sup>Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL 32611, U.S.A.

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The seagrass beds of the Caribbean coastal waters of Nicaragua support the largest foraging population of green sea turtles, (*Chelonia mydas*), in the Western Hemisphere. For over 400 years, Miskitu Indians have harvested green turtles from this foraging ground for subsistence. Where are these turtles coming from? Rookery specific mtDNA control region polymorphisms (and related haplotype frequency shifts) can be used to identify the origin of the turtles on the foraging ground. Information on the relative contribution of nesting colonies to this feeding ground is necessary for assessing the impact of the green turtle fishery on the greater Caribbean population.

## GTFP ON THE WORLD WIDE WEB

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Peter A. Bennett and Ursula Keuper-Bennett

24 Reid Drive #3, Mississauga ON, L5M 2A6, Canada

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George Balazs: "No fibropapilloma in Tahiti. But of course, they also have nearly no turtles. I'm trying to decide which is worse."

Good evening. My wife and I spend each July and August at Honokowai, West Maui, Hawaii. Two or three times a day, we dive with sea turtles. While this might sound like fun, it's not. Nearly all of these turtles have green turtle fibropapilloma tumours--GTFP for short. We're turtle-watchers, and we've put the story of the Honokowai turtles and their GTFP on the World Wide Web. Tonight I'll tell you a little about what we've done and why we've done it. We put GTFP on the Internet because we made a promise to Clothahump, the first sea turtle we ever met. She swam into our lives one day in 1988, and we saw her almost daily each summer until 1993. That year, we saw her just once. The sight of her eyes and neck burdened with tumours was profoundly painful. After that dive, we tried to come to grips with our emotions. We did what hurt people do when they're angry: we laid blame. We blamed Maui County. We blamed the developers and the pineapple companies. We even blamed the GTFP researchers for failing this turtle. We blamed everyone, including ourselves.

Forrest Gump: "A promise is a promise, Lt. Dan."

Then came the promise. Ursula's exact words were: "We're gonna blab Clothahump's story to the whole world." Not an eloquent vow, but by speaking here tonight, we're keeping that promise. We've always told Clothahump's story to anyone who would listen, but it took a while to discover how to do this most effectively.

Ernest Hemingway: "Never mistake motion for action."

Never underestimate motion, either, even if you're going nowhere. Sometimes, if you move around randomly for enough time, you find your path just because you've been moving. In our case, we happened upon the World Wide Web. Many of you are familiar with the Web. If you're not, think of the Web as a vast collection of online documents that you can search for any word or phrase that you like. These can be linked so that clicking your mouse on a key phrase can fetch the whole document that is being referenced. This makes the Web an important new medium for the distribution of information. The Web differs from other media in many ways, but one stands out: anyone can place information on the Web. It's a way to communicate your ideas to the world. Fools and philosophers have equal access to this new medium--your audience decides which category to put you in. By luck, the Web blossomed just when we needed it. At first it was so new that a search for "sea turtle" found fewer than 200 references. Today you'd find almost 30,000. There were no pages devoted to marine turtles. When we searched for fibropapilloma, we found nothing at all. We decided to change that. We began work on Turtle Trax--our Web document. We could see the potential of the Internet, but what we hadn't grasped was just how to use it--until we saw the World Wide Web. We knew then we'd found our vehicle, but we also needed wisdom and guidance. For that, we looked to the sea turtle community.

We looked first to the Caribbean Conservation Corporation. We admire the CCC, so we decided to make our own three Cs. For us, these came to represent three requirements for success at anything, not just keeping Web pages online.

Richie Moretti: "These poor babies keep dying in our arms and they can't yell and scream so we've decided to do the yelling and screaming for them."

Our first C is for Compassion. We think that you have to care deeply. Only then do you stand a chance of getting someone else to care. For us, the Hidden Harbor Turtle Hospital symbolizes that kind of compassion.

Dr. Archie Carr: "[The CCC's] most important attributes are a single-minded resistance to any distraction... and a determination to make [the Tortuguero colony] the most thoroughly studied sea turtle population in the world."

Our second C is for Commitment. No commitment, no completion. Dr. Carr's description says it best: "...single-minded resistance to any distraction..."

Mimi Carr: "...he was a man who lived to write and he worked hard to refine and craft his words so that they were true for him."

Our third C is for Communication. We never had the privilege of meeting Dr. Archie Carr, but we've read his words. He was the best: a Master Communicator. We couldn't help but to love, respect, and even envy him for his gift. The fact is, you can feel powerfully about something and be focused and committed, but if you can't communicate that, the message plops down around your feet and refuses to go anywhere. Communication implies not just that noises are being made and received, but they that are understood. Through his writing, Dr. Carr taught us that and more.

He taught us that anyone is a potential friend of sea turtles, so we designed Turtle Trax to be useful to a wide audience. That's why we keep Turtle Trax simple--no animation, no bells, no whistles. Although we use lots of pictures of turtles with tumours, we try to make the text useful even without images. We also try to appeal to a wide range of educational backgrounds. For us, kids are the most important. For them, we include poems, sea turtle photos, colouring pages, the writing and art of other kids, and inspiring stories like Jean Beasley's account of Huffy, the turtle that wouldn't give up. The first thing on the kids' page, though, is our essay, "Why Howzit Is Dying." It's a grim introduction, but it's

effective. It's one of our most requested pages. At the other end of the spectrum, we wanted to provide a resource for people conducting research into GTFP. For this, we developed The Sickbay. Here we include examples of GTFP in various stages of development. We thought that images showing GTFP on turtles in their native habitat, turtles that we've seen and documented over several years, would be of interest. Again, the reaction has been positive and encouraging. It's satisfying to know that our images have more than just shock value. We're greedy. We want to reach everybody, so we use "hooks" to get people interested in our information. Lots of people want to learn about sea turtles but have no idea that a disease as horrible as GTFP exists. We therefore provide general information about sea turtles to bring people in, and when they show up, we try to teach them about GTFP. That gets those who are already interested in sea turtles, but we don't stop there.

Bob Alexander: "The first thing they go for is the stupid stuff."

Bob Alexander is an Internet consultant on Maui, and he was commenting upon the typical reaction of people new to the Web. In recognition of that, we made sure Turtle Trax had some "stupid stuff"--the Awesomely Way Cool BogusCam(TM), for example. People like to be entertained, so we created a weekly sea turtle comic strip. The idea is to provide material that brings in people who ordinarily wouldn't be interested in sea turtles--and to keep them coming back. Once in a while, someone decides to poke around a bit more, and we've hooked another one. People don't want just disease, sadness and death--that's like watching Senate debates all day. Turtle Trax might be a vehicle for GTFP education, but we can't just wallow in disease and tragedy. We must celebrate that we still have sea turtles, and make an affirmation to help them. We've experienced a full range of emotions underwater, and we want our audience to experience that too. While the fate of GTFP is in the hands of scientists and a few administrators, funding and support must come from the many, so we try to get our message to the masses in any way possible.

George Balazs: "The usual outcome for most affected turtles in Hawaii is debilitation over a protracted period, followed by death."

That is the message. We deliver this message in a way that isn't scientific at all. We try to make people care about the effect GTFP has on individuals. Although GTFP threatens green turtles everywhere, the impact is on individuals. Suffering and dying happens one turtle at a time. The biographies we've placed on the Web introduce people to individual animals. We show how the disease affects them, year by year. When Tutu, our grand dame, showed regression, we rejoiced, and people visiting Turtle Trax rejoiced with us. When we suffered the loss of Howzit, the epitome of Honokowai juveniles, people on the Internet suffered with us, and yes, they wept too.

Howzit's story is actually more tragic than the loss of a single turtle. Howzit was a juvenile in 1992. He--we called Howzit "he" because somehow he seemed male--he was curious and not at all bashful, and he behaved as though he owned the place. We knew that Howzit had GTFP, but we hoped that he'd be one of the lucky ones. It was not to be. In 1995, Howzit was emaciated. Although he wasn't covered with tumours like some, we knew he wouldn't survive. Howzit wasn't in his usual place in 1996. We think Howzit is dead. The importance of Howzit's story is this: he is typical of the juveniles at Honokowai. They all have tumours. They arrive at Honokowai, they get tumours, they disappear--all of them. No exceptions. We can't produce bodies, but given the site fidelity of Hawaiian green turtles, we don't think they've just wandered away. We're certain that they die. The effect of the loss of youth on a long-lived, slow-breeding species is easy to see. If Howzit is really a typical juvenile Hawaiian green turtle, the species is in grave danger.

Howzit's story, and the stories of the turtles he lived with, are the stories we're telling the world through the Web. Turtle Trax is more successful than we dared to imagine, and we have pretty good imaginations. It won't amount to much, however, if we can't turn this into increased funding and direct improvement in the health and lives of these turtles. A few years ago, a Ph.D. from Hawaii referred to us as "hysterical environmentalists." Since then, we've tried to temper our words with the help of science, but we still focus what we do on basic human instinct. What is the worst thing a human can envision? Not disease, not death, but dying without anyone noticing! Had we not been at Honokowai, a lot of turtles would die from GTFP and no one would notice. Well, we noticed and that is what Turtle Trax is: 24 hour, 7 day a week testimony to the fact that they're gone. Mourning their loss this way has converted our mutual rage into something productive and therapeutic. Please support GTFP research. Thank you.



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**Compilers:  
Sheryan P. Epperly  
Joanne Braun**

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75 Virginia Beach Drive  
Miami, FL 33149**