



Georgia Aquarium



PADI
Manta Ray
Distinctive Specialty
Certification
at
Georgia Aquarium
—
Student Manual



Notes:

PADI Manta Ray Specialty - Course Objectives



Course Overview

The purpose of the PADI Manta Ray Distinctive Specialty Certification at the Georgia Aquarium is to familiarize student divers with physical characteristics, habitat, and conservation efforts for manta rays, the world's largest ray, as well as to learn the skills, procedures, techniques and excitement of diving within the largest aquarium habitat in the world. This course promotes manta ray conservation by allowing the student diver to closely observe these gentle giants, thereby establishing a stronger emotional connection with them. This connection and the conservation messages presented in the class will inspire the student diver to more actively support and promote manta ray conservation.

This course is intended as a safe, supervised, diving experience with emphasis on safety, excitement, education and conservation. The Georgia Aquarium is the only facility in North America to offer this unique and distinctive specialty, guaranteeing that the student diver will have the opportunity to dive with manta rays and closely observe them first-hand. The diver will also be able to see whale sharks and over 50 other species of marine fishes.

Course Objectives

Upon completing the PADI/Georgia Aquarium Manta Ray Distinctive Certification course the student diver will be able to:

- Demonstrate diving skills and procedures, including recognizing and avoiding potential hazards, while making diving among manta rays safe and fun.
- Demonstrate proper diving techniques with an emphasis on buoyancy control needed for diving within the environment of the Georgia Aquarium while among the manta rays.
- List the physical characteristics and names of the Aquarium's four manta rays.
- Describe the conservation efforts and values of the program as embodied in the manta ray conservation program at Georgia Aquarium.



PADI Manta Ray Specialty - Overview

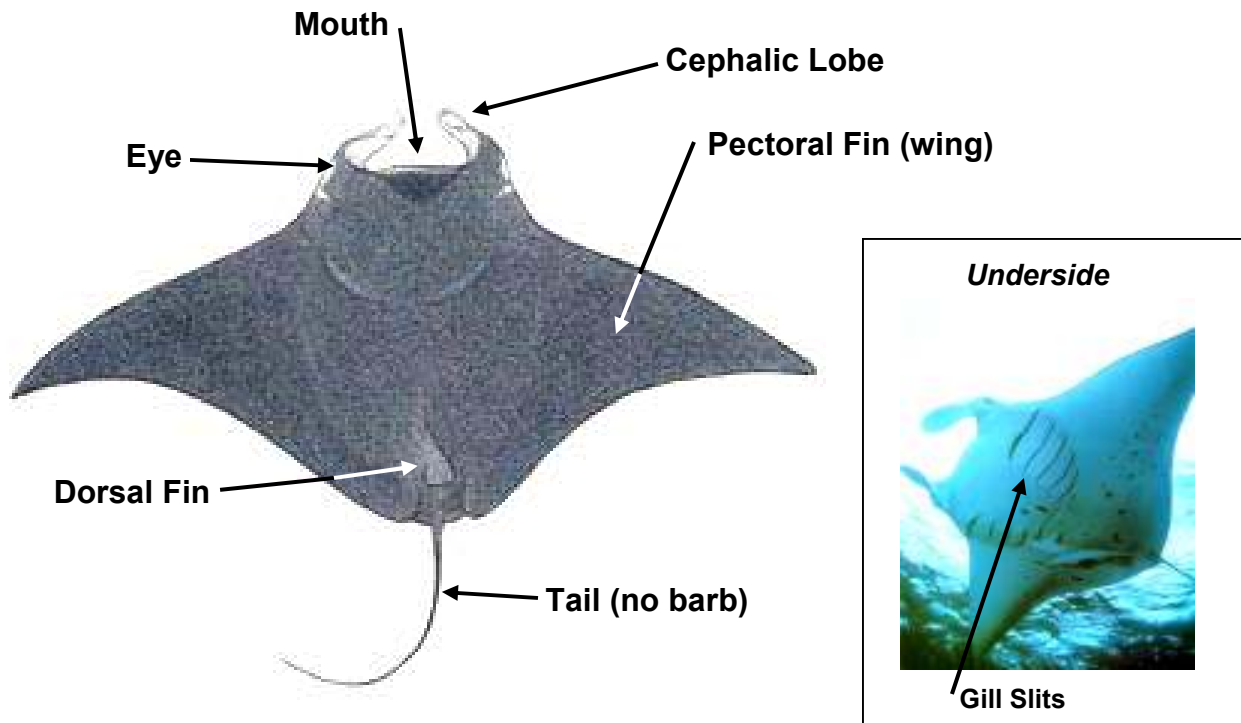
Manta Ray Overview

The Georgia Aquarium manta rays came from South Africa and Florida. Our first manta (“Nandi”) was acquired from the South African Association for Marine Biological Research. In 2007, Nandi became entangled in shark nets protecting a beach near Durban. She was originally brought to uShaka Marine World to recover from minor injuries she incurred in the nets. When she outgrew her habitat there, GAI arranged to have her shipped to Atlanta. She arrived in August 2008.

Our other three manta rays were acquired from the waters off the east coast of Florida where mantas congregate each spring. After a short period in quarantine, they were released into the Ocean Voyager habitat. They were introduced into the exhibit between July 2009 and August 2010.

Georgia Aquarium has received awards for our work with mantas. We continue to educate the public about this magnificent species and the need for establishing conservation measures to protect it.

Manta Ray Anatomy



PADI Manta Specialty - Our Mantas

Georgia Aquarium Manta Ray Program

The Aquarium is advancing scientific understanding of manta rays by combining field research with in-house study through our 4R Program.

Georgia Aquarium performed aerial surveys of manta rays off the east coast of Florida for six weeks during spring 2010, in collaboration with the Associated Scientists at Woods Hole.

The aerial surveys were flown over a specific tract of ocean near St. Augustine in an area known for its spring-time aggregation of manta rays. The flights followed fixed lines parallel to the coast, called ‘transects’, and were repeated 12 times throughout May and June to capture movement patterns of the manta rays in both space and time.

The goal of the aerial surveys was to collect baseline data on the abundance, distribution and possible migration patterns of manta rays for this section of Florida coastline.

Mantas were counted, their direction of travel noted and each was photographed to record the black/white pattern on the animal’s back. It may be possible to use these patterns to determine which species of manta ray are present.



Georgia Aquarium’s Manta Rays

The Georgia Aquarium is the only facility in North America to house and exhibit manta rays. We are one of only four venues in the world to house these graceful rays. The 6.3 million gallon Ocean Voyager habitat was designed specifically to accommodate large marine animals, based on the many years of experience of aquariums in Japan, Taiwan and elsewhere. We expect all of our animals to have a long life here in Atlanta.

Our Mantas

- Three sub-adult females, **Nandi**, **Tallulah** and **Billi** plus one juvenile male, **Ricky**
- Nandi has a dark back with white patches on her “shoulders”
- Nandi’s belly is all white with a very few dark spots
- Nandi is also our largest manta at almost 13 feet across
- Tallulah has a solid black back , a white belly and broad grey splotches near the leading edge of her wings.
- Billi closely resembles Tallulah: black back and white belly, but with four distinct dark, oval spots.
- Ricky resembles the latter two females: black back and white belly, but with two distinct dark, oval spots.
- We estimate their weights to be between 300 and 500 lbs.
- The females range from 10-13 ft across, the male is about 9.5 ft wide.
- They each eat approximately 20 to 25 lbs. of food per day.
- Each are target-fed krill and small fish using ladles on poles. Feeding is done from the edge of the habitat.

What’s in a Name?

Nandi was named for the mother of *Shaka*, king of the Zulu kingdom, in deference to Nandi’s land of origin.

Tallulah is derived from a Cherokee Indian word meaning “leaping waters”. Tallulah Gorge is a Georgia state park .

PADI Manta Specialty - Our Mantas



Nandi

- Largest of the four mantas ~ 11 feet+ (measured wingtip to wingtip)
- ID: Gallery or Tunnel View**
- Mostly white belly with grey freckles in center of body between rows of gill slits

ID: Top side

- White “saddle” pattern on her back



Tallulah

- Second largest manta ~11 feet
- ID: Gallery or Tunnel View**
- Dark black cephalic lobes that blend into black areas around gills
 - Black around edge of the belly and wings

ID: Topside

- Dark black back



Billi

- Smallest manta ~ 8 feet
- ID: Gallery or Tunnel View**
- Four dark circles that blend into the grey of the belly

ID: Topside

- Dark black back; light marks on leading edge of wings near the tips



Ricky

- About 9 feet
- ID: Gallery or Tunnel View**
- Only male (look for claspers)
 - Two small dark circles behind last gill slits
 - White under belly

ID: Topside

- Dark black back

PADI Manta Specialty - Manta Biology

Range/Habitat

- The manta ray occurs in warm temperate and tropical waters in all major oceans and the Mediterranean Sea.
- It is found from the surface to 394 feet (120 m).
- This species is an open ocean swimmer. It is frequently observed around reefs and near oceanic islands, often in small groups when it is in pursuit of food.

Physical Characteristics

- The manta ray has a unique body shape. It has an extremely broad head with an enormous, wide mouth flanked by two broad, flexible, fleshy cephalic lobes. These lobes are kept rolled and pointed forward except when the manta is feeding and they are opened and extended downward to direct a flow of water into the mouth.
- It is the largest of all rays with weights ranging up to three tons (about 3000 kg).
- At birth, the width of its wings is about 6 feet (125 cm), growing to an average width of 13 feet (4 m) as an adult. The maximum known size is about 26 feet (8 m).
- The top surface is blackish in color. Its underside is mostly white. Color patterns on the shoulders and underside exhibit wide variations and help researchers to identify individual animals.
- Its tail is whip-like, but short and does not have a barb.

Diet/Feeding

- The manta ray is primarily a plankton feeder, but also consumes small and moderate-sized fishes.
- Its two cephalic lobes are unrolled and held at a downward angle to create a funnel guiding prey into its enormous mouth.
- This species feeds alone or in small schools near or at the surface where plankton and schooling fish accumulate. The small prey that enter the mouth are filtered from the water by the gill rakers (filter plates), located on the internal gill arches, and then swallowed.
- During feeding the manta ray repeatedly executes reverse somersaults under water and also occasionally breaks the surface. It also feeds in a horizontal orientation.

Ocean Voyager Exhibit At -a- Glance

There are 6,000 to 7,000 fish in the habitat.

They represent species found in the Atlantic, Pacific and Indian Oceans.

Sixty percent of all the animals were farm-raised.

Habitat is 284 feet long by 126 feet wide by 30 feet deep near the big window and 20 feet at the opposite end.

The water is maintained at about 77°F.

Salinity is 32 - 33 parts per thousand (ppt.).

Main window is 63 feet long, 26 feet high and 2 feet thick.

Main window is made of acrylic, a plastic up to 17 times stronger than glass.

Tunnel acrylic is 6.25 in. thick and its arched structure better withstands water pressure.

Filtration system can process all 6.3 million gallons in about 60 min.

The system contains 70 high-speed pumps, 72 sand filters, 34 protein skimmers.



PADI Manta Specialty - Manta Biology



Conservation Status

- The manta ray is classified as “near threatened” on the IUCN Red List.
- In certain regions of the world, it is listed as “vulnerable” (see page 7).

Additional Information

- The manta ray has been observed jumping clear of the water, mainly in spring and autumn. This seems to be associated with mating displays, although it may also be social behavior or actions related to dislodging skin parasites.
- This species does not have a stinging spine and is generally harmless to humans.
- The only natural enemies of the manta ray are large sharks and man.
- Fishing pressure and by-catch in drift and set nets are depleting local populations.
- It is harpooned and harvested in some areas for its flavorful meat, sandpaper skin and oil-rich liver.
- The branchial arches of its gills are dried and used in Asian medicine. This is contributing to additional harvesting.
- This ray is ovoviviparous, meaning that the embryo develops within eggs retained in the mother’s uterus. The embryo is nourished by its egg’s small yolk, but also receives nourishment from the mother through small projections in the uterus called “villi” (trophonemata).
- The female manta gives birth to one or two live young. The pups are born with their wings folded around their body to allow easier passage through the birth canal.
- This species is estimated to live as long as 20 years.
- The manta ray has 3,000 to 4,000 tiny, peg-like teeth on the front of the lower jaw, but these are not used for feeding. These small teeth are non-functional, in contrast to the grinding plate dentitions present in the related eagle and cownose rays.
- The manta ray also is called the “devil ray” because when rolled and projected forward, the cephalic lobes have the appearance of horns.

Notes:



PADI Manta Specialty - Conservation



Manta Ray Conservation Status

The manta ray is listed as “near threatened” in the IUCN Red List. This means that the species is close to reaching the state of being threatened with a risk of extinction in the wild. (See box at bottom right of the page)

The IUCN describes the known conservation risks to this unique animal as follows:

- Fishing for the manta ray occurs in a few areas and it is not a major component of by-catch in any fishery for other species.
- The manta is the target of fisheries in about nine areas of the world: Philippines, Mexico, Mozambique, Madagascar, India, Sri Lanka, Brazil, Tanzania, and Indonesia.
- It is caught for fins, skin, liver, meat, and branchial filaments (for the Asian medical market).
- Population declines have been observed in the Philippines, Mexico, Sri Lanka-India and Indonesia.
- There is a risk of extinction of local populations of manta rays by overfishing because of the nature of biology of the species:
 - Local populations are small in size
 - There is limited migration between populations
 - Gestation takes about 12 –14 months
 - Females give birth to one pup (occasionally two)
 - Mantas live about 20 years and mature late.

The IUCN expects that the conservation status of the manta ray will further deteriorate due to increased fishing pressure, pollution and exploitation of coastal environments.

Commitment

The **Georgia Aquarium** is committed to advancing the scientific community’s understanding of manta rays and to increasing public awareness of this species in order to promote its conservation. These goals are greatly enhanced by having manta rays on display at the Aquarium. The Georgia Aquarium’s commitment focuses on the education, research, conservation and the future of manta rays.

The IUCN Red List

Every four years, the World Conservation Union (formerly the International Union for the Conservation of Nature or IUCN) publishes the **IUCN Red List**, which is an inventory of the current conservation status of plant and animal species worldwide. The Red List is intended to raise awareness of species that are threatened with extinction and promote their conservation. Of the total number (284) of marine fish assessed by IUCN, 57 percent are designated as “threatened”, (i.e. listed as ‘Critically Endangered’, ‘Endangered’ or ‘Vulnerable’.)

Conservation and the Future

In the long term, our manta ray program can help to better understand the species and work toward its long-term survival in the oceans.

- Marine animal and breeding behaviors are mostly understood through work in zoological facilities.
- Funding and support of research at GAI and our field research programs continue to build on an extensive program.



PADI Manta Specialty - FAQs

Frequently Asked Manta Questions

1. How was the Aquarium's first manta ray transported to Atlanta?

Georgia Aquarium used the same technology and similar equipment used to transport the whale sharks from Taiwan to Atlanta. Nandi made the 9,000-mile journey on a 747-200 aircraft from Durban, South Africa through Cape Verde to Atlanta. The manta ray was under the care and supervision of Georgia Aquarium and uShaka Marine World professional staff and maintained by a highly advanced marine life support system.

2. How long did the transport take?

The transport took about 30 hours from South Africa to Atlanta.

3. Where did the other manta rays come from?

We acquired them from off the east coast of Florida

4. What kind of container and life support was used?

Each manta was maintained in a large transport unit that incorporated the sophisticated marine life support system first employed in transporting the whale sharks to Atlanta. The animals were closely monitored by Aquarium specialists while on route.

5. Are there other manta rays found in U.S. aquariums?

Georgia Aquarium is the only aquarium in the U.S. to exhibit manta rays.

6. What other facilities have manta rays on display, and how many are there?

There are three facilities displaying manta rays: Kaiyukan Aquarium Osaka, Japan (1 adult); Churaumi Aquarium Okinawa, Japan (3 adults, 1 pup); and Atlantis Resort Bahamas (2 adult males).

7. What is the largest manta ray that has been kept in an aquarium?

The largest manta ray in an Aquarium had a disk width of approximately 16.4 feet (5 m).

8. How long have manta rays been kept in an aquarium environment? Were they released or did they pass away?

In Japan, manta rays have been managed in aquariums for nearly two decades. The Churaumi Aquarium in Okinawa, Japan has had two manta rays bred and born in their facility. Atlantis Resort Bahamas cares for manta rays for up to two years before releasing them as the habitat is too narrow to maintain them at larger sizes.

9. How big will the aquarium's mantas get?

There is no known maximum size for how big manta rays can grow while in an aquarium setting. We expect Nandi could grow to be between 13-20 feet wide.

10. Is Ocean Voyager big enough for the four mantas?

Ocean Voyager is big enough for all of our mantas and the other animals. The habitat is 2.5 times larger than the next largest facility that cares for manta rays.

11. What do you feed the manta rays?

Our mantas are fed a diet very similar to that of the whale sharks: krill, small fishes and vitamin supplements in the form of a gel.

PADI Manta Specialty - Manta FAQs

12. How fast do manta rays grow in an aquarium environment?

Data from Japan reveal that the size of mantas at birth to be 6.2 feet and growth rate varies from 21 inches to 36 inches per year. Nandi has grown more than three feet since arriving at the Georgia Aquarium in the summer of 2008.

16. At what size do manta rays become sexually mature?

It has been suggested that they need to be more than 13 feet (4 m) in disc width to reproduce, but to date, this part of their life history is not understood.

17. Have manta rays ever reproduced in an aquarium environment?

The Churaumi Aquarium in Okinawa, Japan has had two manta rays bred and born in their facility, on March 14, 2007 and June 17, 2008.

18. If a manta ray has reproduced in an aquarium environment, did the offspring survive and for how long?

The first pup lived for three days. The second pup is still alive.

19. How will the manta rays get along with the whale sharks and other animals?

Based on the experiences of the Japanese, Bahamian and Portuguese aquariums, the manta ray gets along very well with its aquarium mates. During the two years Nandi has been in the Ocean Voyager habitat, she has gotten along well with the whale sharks and other animals.

20. Are there more than one species of manta ray?

Yes. Scientists have identified two different species and it is believed that there is at least one more undescribed species: *Manta birostris* is the “true” giant manta (the Aquarium does not have an example of this species), *Manta alfredi* or “Prince Albert’s manta” found in the Indian Ocean (Nandi is this species) and *Manta* sp. The undescribed “Atlantic manta” (Tallulah, Billie and Ricky belong to this species). See page 10.

21. Can manta rays be a danger to divers or swimmers in the immersion program and vice versa?

Manta rays are filter feeders like the whale sharks. Also, they do not have a barb/spine at the base of their tail. They are not a danger to our team or guests. We do not expect the divers or swimmers in Ocean Voyager to impact the manta ray. Additionally, uShaka Marine World, where Nandi lived for about a year, had an immersion program and there were never any issues with either Nandi or the participants having a negative impact on each other.

Manta Ray Photo IDs

The black and white color patterns on the manta’s back and underside are unique to each animal. They act as “fingerprints” that researchers use to identify individuals and track their movements. Photo catalogs of mantas worldwide have been assembled to assist in tracking their movements over large areas of ocean. Tracking and photographing of the animals is done from aircraft, as well as from boats and by divers.

PADI Manta Specialty - Other OV Animals

Some Other Animals in the Ocean Voyager Habitat

Two sub-adult female whale sharks that arrived in June, 2006

- Alice*: About 24 feet, ~2000 lbs
Numerous marks and spots on her white belly
- Trixie*: About 25 feet, ~2000 lbs
Pure white belly, few markings
White stripe on front edge of dorsal fin

Two juvenile male whale sharks that arrived in June, 2007

- Yushan* : About 17 feet, ~1600 lbs
U-shaped notch on back edge of dorsal fin
White stripe on front of dorsal fin
Name means “jade mountain”
Claspers between pelvic fins
- Taroko*: About 16 feet, ~1600 lbs
Name means “the magnificent and splendid”
Claspers between pelvic fins

Great hammerhead sharks

- Largest of hammerhead species
Can grow to 15-20 feet (our largest is about 8 feet long)

Sand tiger sharks

- Fearsome looking teeth, but harmless unless provoked
Common along the mid-Atlantic coast
Can grow to 10-11 feet (our largest is about 6 feet long)

Zebra sharks

- Tan colored with small spots
Vertical black stripes when young (hence their name)
Will lay on the bottom because it has a functional spiracle

Wobbegong sharks (several species)

- Despite its appearance it is a “real” shark
Has a functional spiracle , which allows it to lie still

Giant grouper

- All are born female and some change gender later in life
Largest of coral-reef dwelling bony fish; can grow to 8 feet and weigh over 800 lbs.

Large tooth sawfish

- Looks like a shark but is a ray (note the gill slits are on its underside)

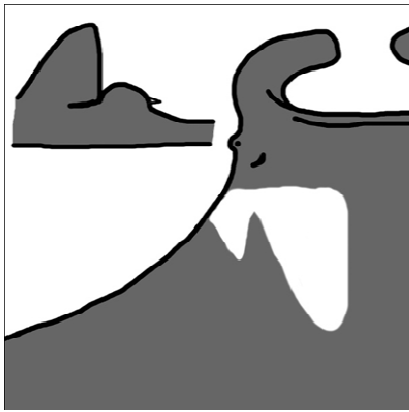
Bowmouth guitarfish

- Is also a ray, despite its appearance
Can grow to 10 feet and weigh 300 lbs.

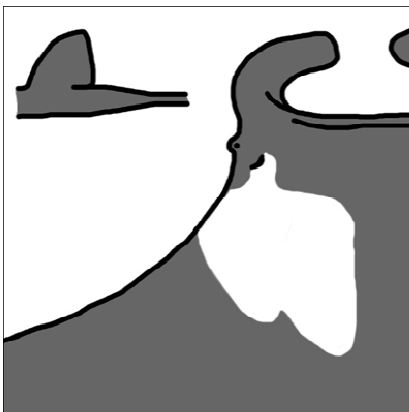
Giant guitarfish

- Is also a ray
Can grow to 10 feet and weigh 500 lbs.

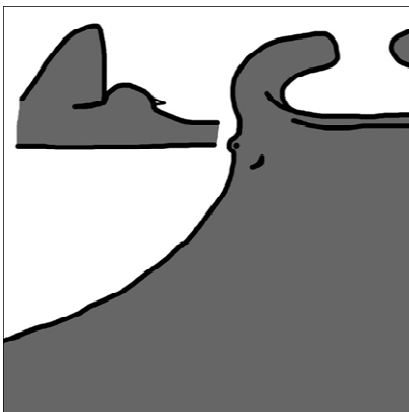
PADI Manta Specialty - Three Species



Manta birostris – “true” giant manta ray.
None at the Aquarium



Manta alfredi – Prince Alfred’s ray .
“Nandi”-type



Manta sp. Undescrbed “Atlantic manta”.
“Tallulah”-type

Distinguishing the Three Species of Manta Rays

New work on the taxonomy of manta rays shows that there are at least three species (see page 12). The illustrations on the left show how to tell them apart.

Manta birostris has a **bony mass** on the top of the base of the tail, about the size of a large goose egg, with a short spine embedded in it. There are usually white patches on the shoulders that may look like one or two triangles or wedges, but they **do not meet the back of the spiracle** (the breathing hole behind the eye). We do not have any *Manta birostris* at Georgia Aquarium.

Manta alfredi lacks the bony mass on top of the base of the tail. The white shoulder patches form a short hook on the leading edge that meets the back edge of the spiracle in a bright and clear edge. **Nandi is a *Manta alfredi***, or Prince Alfred manta ray.

Manta sp. is an undescrbed species, which means it has not gone through the formal naming process yet. However, it can be distinguished from the other two by its smaller size, all black coloration on the back, and the presence of the bony mass on the top of the base of the tail. In this way it is more similar to *Manta birostris*. so it is sometimes referred to as *Manta sp. cf. birostris*, which is taxonomy-talk for “undescrbed, but most like *Manta birostris*”. **Tallulah, Billi and Ricky** are of the *Manta sp.* type. This species only occurs in the tropical Atlantic and Caribbean.

There are other differences among the three types than those that are shown here (to do with teeth and spots on the belly), but these are sufficient for the purpose of distinguishing among our mantas.



PADI Manta Specialty - Unanswered Questions

How Many Species of Manta?

A recent publication by Dr. Andrea Marshall and colleagues from the Manta Ray and Whale Shark Research Centre in Mozambique reveals that there are definitely two, and possibly three, species of manta rays in the world ocean. One species, *Manta birostris*, is an oceanic manta and is not among the mantas in Ocean Voyager. Our first and largest manta, “Nandi” has been identified as the “Alfred manta”, *Manta alfredi*.

According to Marshall *et al.*, this species can be recognized by a variety of features, including the spotting pattern on the underside of the body. The photo of Nandi shows that there is a small black patch just behind the last (fifth) gill slit on each side of her body and a few small black spots in the center of the body between the gill openings. Also, she has a pattern of spots along the trailing edge of her wings that is characteristic of the Alfred manta.

The Atlantic-Caribbean mantas are an enigma. There is good evidence that they represent a separate species and Dr. Marshall is working to confirm this suspicion. The photos of Tallulah, Billi and Ricky show a spotting pattern on their undersides that differs from that on Nandi. Even though each of the three have different patterns, none has spots in the midline of the body between the gill slits. That area is solid white on all three animals. All three have black patches behind the last gill opening, but these are much larger than on Nandi. Lastly, the rear half of the wings on all three are a uniform gray or black, whereas Nandi has numerous spots.

If the Atlantic manta is indeed found to be a distinct species, it will receive a scientific name that was applied to a manta in the literature in the past.

Nandi



Tallulah



Billi



Ricky



PADI Manta Specialty - References



Some References

www.fishbase.org

www.iucnredlist.org

www.flmnh.ufl.edu/fish/gallery/descript/mantaray/mantaray.html

Sharks and Rays of Hawaii. Crow, G. L. and Crites, J., pgs. 41, 119-120

The Shark Almanac. Allen, T. B., pg. 169

Sharks and Rays. Hennemann, R. M., 2001

