

The National Aquarium Blacktip Reef

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<http://www.zoolex.org/zoolex/cgi/view.py?id=1610>

LOCATION

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AWARDS

2014 AZA Exhibit Award

DESCRIPTION

This project was the first major renovation completed under our 2012 Blue Wonders Exhibition 5-Year Master Plan. The plan focuses on the major renovation of older exhibits to better meet aquarium goals for continued excellence in animal care, exhibit design and guest experience—and to better reflect the aquarium's mission to inspire conservation of the world's aquatic treasures. The space that previously housed stingrays was transformed into the new Great Barrier Reef exhibit, Blacktip Reef. The concept of Blacktip Reef is: "There is a surprising diversity of life in a healthy reef." The exhibit builds on the vastness of the existing, four-story atrium and expansive, lower pool with new transparent railings that offer wide, open views of the space and animals.

Exhibit goals in support of the concept were: 1. meet or exceed visitor expectations for a visually spectacular exhibit of sharks and other ocean animals that visitors won't get anywhere else; 2. attract visitors to the Aquarium by offering unique and compelling experiences; 3. support the Blue Wonders exhibition's big idea that water connects all living things; 4. communicate the Blacktip Reef exhibit big idea — "There is a surprising diversity of life in a healthy reef."; 5. support the Aquarium's mission to inspire conservation of the world's aquatic treasures and leave visitors



Displaying more than 800 specimens representing 70 species, Blacktip Reef visually communicates the exhibit's Big Idea: "There is a surprising diversity of life in a healthy reef." ©National Aquarium, 2014



Interpretative talks along a new "reef crest" introduce diverse Blacktip Reef animals, explore threats facing coral reefs and provide resources for guests to take conservation action on behalf of reef animals. ©National Aquarium, 2014



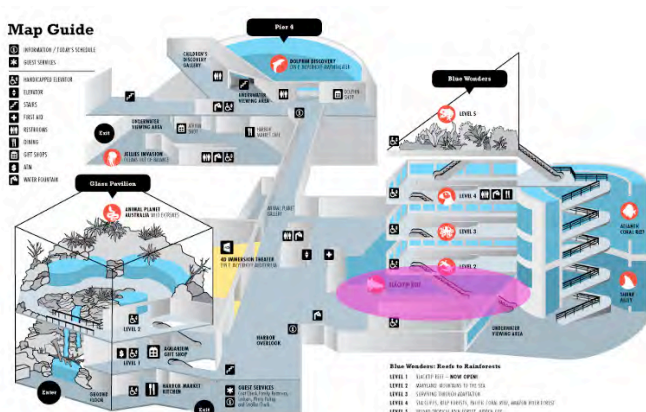
Rescued green sea turtle, easily recognizable by her missing front flipper, is a popular Blacktip Reef denizen. Aquarium divers enter the exhibit several times a day to care for her and all the other reef animals. ©National Aquarium, 2014

ANIMALS

Family	Species	Common Name	Capacity
Acanthuridae	<i>Acanthurus</i> sp.	Surgeonfish (3 sp.)	42
Acanthuridae	<i>Naso lituratus</i>	Orangespine Unicornfish	18
Acanthuridae	<i>Naso unicomis</i>	Bluespine Unicorn Tang	11
Acanthuridae	<i>Naso vlamingii</i>	Bignose Unicornfish Tang	14
Acanthuridae	<i>Paracanthurus hepatus</i>	Palette Surgeonfish	21
Acanthuridae	<i>Zebrasoma veliferum</i>	Sailfin Tang	8
Apogonidae	<i>Sphaeramia nematoptera</i>	Pajama Cardinalfish	24
Balistidae	<i>Balistoides</i> sp.	Triggerfish (2 sp.)	3
Balistidae	<i>Melichthys vidua</i>	Pinktail Triggerfish	1
Balistidae	<i>Odonus niger</i>	Redtooth Triggerfish	3
Balistidae	<i>Xanichthys auromarginatus</i>	Gilded Triggerfish	2
Carcharhinidae	<i>Carcharhinus melanopterus</i>	Blacktip Reef Shark	18
Chaetodontidae	<i>Chaetodon kleinii</i>	Blacklip Butterflyfish	6
Chaetodontidae	<i>Hemitaenichthys polylepis</i>	Pyramid Butterflyfish	5
Cheloniidae	<i>Chelonia mydas</i>	Green Sea Turtle	1
Cirrhitidae	<i>Neocirrhites armatus</i>	Flame Hawkfish	4
Cirrhitidae	<i>Oxycirrhites typus</i>	Longnose Hawkfish	8
Cirrhitidae	<i>Paracirrhites forsteri</i>	Freckled Hawkfish	6
Dasyatidae	<i>Himantura uarnak</i>	Honeycomb Stingray	3
Ephippidae	<i>Platax</i> sp.	Batfish (2 sp.)	14
Haemulidae	<i>Plectorhinchus vittatus</i>	Oriental Sweetlips	2
Labridae	<i>Bodianus anthioides</i>	Lyretail Hogtail	2
Labridae	<i>Cheilinus fasciatus</i>	Redbreasted Wrasse	6
Labridae	<i>Cheilinus undulatus</i>	Humphead Wrasse	1
Labridae	<i>Choerodon</i>	Tuskfish (2 sp.)	3
Labridae	<i>Coris gaimard</i>	Yellowtail Coris	3
Labridae	<i>Epibulus insidiator</i>	Slingjaw Wrasse	2
Labridae	<i>Thalassoma</i> sp.	Wrass (6 sp.)	35
Lutjanidae	<i>Symphoricarthus spilurus</i>	Highfin Snapper	3
Monodactylidae	<i>Monodactylus argenteus</i>	Diamond Fish	48
Muraenidae	<i>Gymnothorax meleagris</i>	Turkey Moray	1
Nemipteridae	<i>Scolopsis bilineata</i>	Two Lined Monocle Bream	41
Orectolobidae	<i>Eucrossorhinus dasypogon</i>	Tasselled Wobbegong	1
Orectolobidae	<i>Orectolobus ornatus</i>	Wobbegong	2
Pomacanthidae	<i>Centropyge</i> sp.	Angelfish (4 sp.)	17
Pomacanthidae	<i>Genicanthus melanospilos</i>	Blackspot Angelfish	6
Pomacanthidae	<i>Pomocanthus</i> sp.	Angelfish (4 sp.)	7
Pomacentridae	<i>Amblyglyphidodon aureus</i>	Golden Damselfish	8
Pomacentridae	<i>Amphiprion</i> sp.	Anemonefish (2 sp.)	9
Pomacentridae	<i>Chromis retrofasciata</i>	Blackbar Chromis	25
Pomacentridae	<i>Chromis viridis</i>	Blue-green Chromis	261
Pomacentridae	<i>Chrysiptera cyanea</i>	Blue Devil	43
Pomacentridae	<i>Dascyllus trimaculatus</i>	Domino Damselfish	11
Pseudochromidae	<i>Pseudochromis porphyreus</i>	Magenta Dottyback	3
Scaridae	<i>Cetosarus bicolor</i>	Bicolor Parrotfish	2
Serranidae	<i>Cephalopholis</i> sp.	Grouper (3 sp.)	5
Serranidae	<i>Cromileptes altivelis</i>	Panther Grouper	3
Serranidae	<i>Epinephelus lanceolatus</i>	Queensland Grouper	1
Serranidae	<i>Pseudanthias pleurotaenia</i>	Squarespot Anthias	35
Stegostomatidae	<i>Stegostoma fasciatum</i>	Zebra Shark	1
Tetraodontidae	<i>Arathron</i> sp.	Puffer (3 sp.)	3

inspired and empowered to take action to protect reefs. The naturalistic Great Barrier Reef exhibit includes over 3,000 pieces of authentic-looking fabricated coral. The rich reef habitat is enlivened with more than 800 reef animals representing 70 species, 47 of which are new to the National Aquarium collection. Among the new species are 20

blacktip reef sharks, two species of rarely exhibited wobbegong sharks and a Napoleon wrasse. Blacktip Reef offers guests the opportunity to discover for themselves how life survives and thrives in every nook and cranny of a reef — from giant honeycomb rays and zebra sharks to schools of tiny blue-green chromis.



An overview of the aquarium. The Blacktip Reef aquarium is highlighted in pink. ©National Aquarium, 2014

SIZE

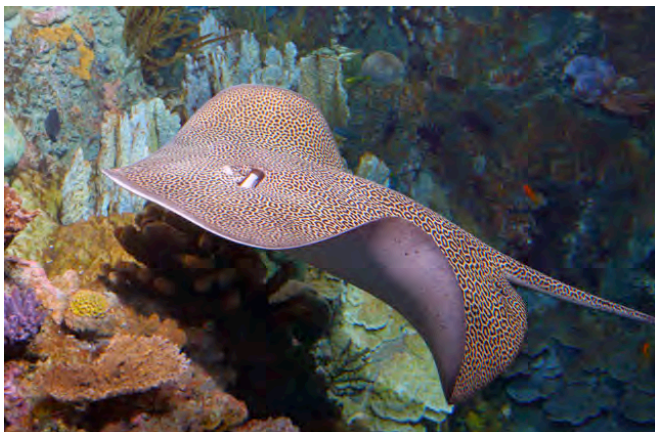
Total renovation, including the Blacktip Reef exhibit and Blue Wonders introduction and conclusion areas: 1137 m². Exhibit animals: 385 m², public viewing space: 270 m² interpretative space:136 m² guest amenities: 80 m² staff work areas:70 m² mechanical support areas:190 m² There are no holding areas specifically for Blacktip Reef animals.

Space allocation in square meters:

use	indoors		outdoors		total exhibit
	accessible	total	accessible	total	
animals	385	385			385
visitors	486	486			486
others	260	260			260
total		1,137			1,137

COSTS

Dollars 12,600,000 including 12 % for design. Design: Architecture and engineering - \$1,535,398; Construction - \$8,076,445, Construction Acrylic - \$281,510; Construction Aquarium Interior \$1,057,035; Construction Interpretation and Installation - \$170,000; Miscellaneous - \$1,479,612



Reticulated Whiptail Ray ©National Aquarium, 2014

OPENING DATE: 8 August 2013

PLANTS

The naturalistic Great Barrier Reef exhibit includes over 3,000 pieces of authentic-looking fabricated coral. Every piece was created from molds taken from real coral skeletons. The different pieces were then mounted on a recreated reef in densities, groupings, orientations and at water depths similar to how they grow in the wild.

FEATURES DEDICATED TO ANIMALS

Currently, over 800 specimens utilize the exhibit space, its coral zones and varying depths much as these 70 species would in the protected Great Barrier Reef Marine Park. The naturalistic reef provides ample hiding space for the smaller teleost collection while showcasing our predatory elasmobranch species, including the exhibit's namesake, the blacktip reef sharks. The exhibit encourages close viewing of our complex reef community, revealing the role the animals play in it.

Special attention was paid to designing critical shelter and nighttime refuge for smaller fish species and encouraging sedentary or secretive species to nestle within view of guests. The abundance of physical refuge provided by this dense coral reef habitat was key to successfully housing a school of 20 blacktip reef sharks (i.e. apex predators) with schools of smaller fish species, such as blue-green chromis, blue devils and anthias. The artificial coral was constructed of material that was durable yet flexible



Shark Release ©National Aquarium, 2014



Coral Fabrication ©National Aquarium, 2014

enough to withstand the activity of the animals over time.

In order to accommodate our six species of elasmobranchs on exhibit (i.e., blacktip reef, zebra, ornate and tasseled wobbegong sharks, plus reticulated whiptail and blackblotched fantail rays), target training and enrichment began soon after acquisition. Target training takes into account the feeding strategy of each species, location in the exhibit and diet management while being safe for both the animals and staff. A combination of colored targets and feeding apparatus are used from topside, as well as during in-water diver feedings.

The green sea turtle feeds from lettuce holders that allow her to forage, a natural behavior demonstrated by green sea turtles in sea grass beds. Teleosts are offered a variety of bivalves daily, stimulating a foraging behavior throughout the reef system.

In the event of a power outage or if life-support operations cease in the exhibit, an in-exhibit emergency air system was installed that includes 17 air stones and airline drops throughout the exhibit. In addition, emergency oxygen is staged in a nearby exhibit space for rapid deployment. The fishes department has two dissolved oxygen meters for daily and emergency operations.



Blacktip Reef's floor-to-ceiling bump-out window offers underwater views of the reef. Here, in the underwater viewing area, guests find a place to rest and reflect on the beauty and diversity of reef life. ©Kwesi Budu-Arthur / Cambridge Seven Associates, Inc., 2014

FEATURES DEDICATED TO KEEPERS

Safety provisions for the staff include locked exhibit access gates; behind-the-scenes safety equipment for in-water incident response, including throw rings (three locations), throw ropes (two locations), a Sheppard's hook (one location) and lifeguard PDFs (two locations); emergency response equipment, including land-line phone access, a backboard and neck brace, an AED and oxygen; and an on-site first-aid room and response team staff. Staff utilizing the exhibit was trained on both location and use of equipment, as well as emergency response protocols. In addition, an in-water dive safety alarm system links to a pager system alerting the security team and dive safety staff of an in-water exhibit emergency.



"Your Connection" links reveal connections between human and Blacktip Reef worlds to inspire conservation of reefs and reef animals. QR codes offer guests the opportunity to download tools to take immediate action on their smartphones — from carbon footprint calculators to discount coupons toward the purchase of a reusable bag. ©National Aquarium, 2014

Husbandry safety (topside and divers) includes gloves and target feeding poles and/or apparatus. Chain-mail gloves were employed during our wobbegong shark moves. The elasmobranchs were habituated to having divers in the tank with them, prior to the exhibit's introduction.

FEATURES DEDICATED TO VISITORS

The Blacktip Reef exhibit offers guests a variety of engaging and distinctive guest experiences — from remarkable underwater views of colorful coral and unusual reef animals to the opportunity to witness a shark feeding first hand. Transparent acrylic railings, large underwater viewing windows and an underwater bump-out window offer guests close-up views of the reef and reef animals from multiple locations. A bridge takes guests across the reef for another perspective. In the underwater viewing, guests find themselves below water in a darkened room. Large windows offer views of the reef and reef animals not seen from the surface. A floor-to-ceiling



Rendering of Blacktip Reef Exhibit ©National Aquarium, 2014

curved window invites guests to step into the reef. There, suspended several feet into crystal-clear water, they have different views of Blacktip Reef. One minute, they are nose to nose with a sleek blacktip reef shark; the next, they are directly beneath the broad wing of an elegant reticulated whiptail ray.

Nearby computer touchscreens and staff-led programs — stations specially designed to fold discreetly away when not in use — help identify reef animals and encourage exploration of the diverse ways they survive and thrive in a healthy Indo-Pacific reef.

On the National Aquarium website, a “Shark Cam” offers 24-hour, real-time video of Blacktip Reef and a daily reef presentation. Visitors to the website also have the opportunity to tweet to aquarium staff about Blacktip Reef using #sharkcam.

INTERPRETATION

Blue Wonders and Blacktip Reef exhibits employ an integrated, multidisciplinary approach to interpretation that combines immersive design, interpretative graphics, computer interactives, multimedia and personally facilitated programming. Guests have the opportunity to enjoy interactive presentations, including a newly developed Marine



This interactive installation concludes the Aquarium’s Blue Wonders experience in a commemorative way by inviting guests to celebrate and share their personal connections to water on a giant, undulating “Water Wall.” ©National Aquarium, 2014

Sanctuary iPad presentation, shark feedings, diver talks and conservation education carts (approximately eight presentations per day).

A Blue Wonders video wall and other introductory messages reveal the many ways water connects all living things, prompt guests to ponder their own connection to water, and invite them to join the aquarium in protecting the water we all share. Immersive lighting and sound were included to foster personal connections to water. An interactive Water Wall at the exhibition’s conclusion offers guests the opportunity to celebrate and share their connection to water on a giant screen.

Computer interactives in 10 locations invite discovery of diverse reef adaptations, encourage new perspectives and emotional connections that are



Staff Interpretation ©National Aquarium, 2014

meant to inspire conservation of reefs and reef animals. Downloadable tools allow to take immediate reef conservation action.

Staff help guests locate reef animals, interpret animal adaptations and engage in conservation conversations. Two hundred divers, 200 exhibit guides and 470 staff from various Aquarium departments were trained on reef animals, coral habitat, cognitive and affective conservation messaging that matched conservation actions, and the value of personally facilitated experiences on overall guest satisfaction.

MANAGEMENT

Exhibit specimens were chosen to support the Great Barrier Reef display, to avoid the unnatural mixing of species not indigenous to the region and to provide examples of biological concepts, adaptations and conservation stories in an interesting and accurate way.

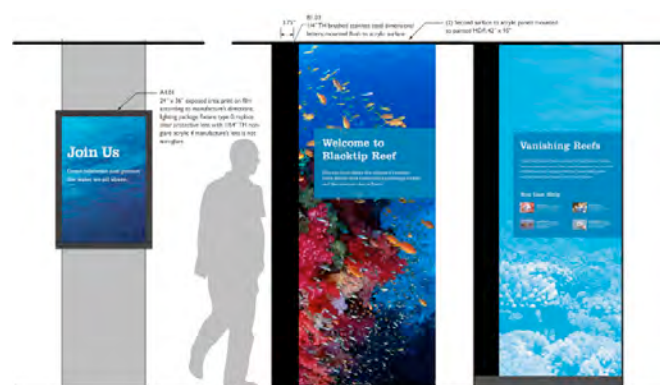
In preparation for animal acquisition, critical infrastructure improvements were made to the Aquarium’s Animal Care Center. Elasmobranch quarantine tanks were upgraded to handle the large

bioload of sharks and rays; filtration adjustments were made to conserve saltwater; and jump barriers were installed to mitigate jump risk from blacktip reef sharks and rays. Several freshwater quarantine tanks were converted to saltwater holding systems, and a new 2,500 gallon mixing tank was constructed to facilitate the increased saltwater demand resulting from long quarantine and holding durations of up to 18 months. Safety provisions for the specimens included acquisition of new transport equipment such as stretchers, confinement boxes, chain-mail gloves, rolling bins and nets. Animal confinement and transport techniques were greatly enhanced with this new equipment and helped manage the overall specimen moves efficiently and effectively.

To ensure high water clarity similar to that found in a healthy Indo-Pacific reef — and essential to an exceptional guest experience — changes and upgrades were made to the life support system. New life support systems included a drum filter that removes particles in exhibit water as small as 30 microns and a denitrification system developed by aquarium staff that is seven times more effective in removing nitrates from exhibit water than typical zoo and aquarium systems. In-tank plumbing and tank flow improvements also help to maintain water quality and water clarity by eliminating any dead zones, improving overall circulation and providing desired water flow without disturbing bottom sand or creating surface turbulence. Increasing the number of surface skimmers from two to four and adding additional mid-level tank returns to more efficiently remove particulates from the mid-water level also help to maintain water clarity.

RESEARCH

Development of the main message was informed through front-end testing with over 50 guests using a free-association technique called personal meaning mapping. Extensive content research, front-end studies by IMPACTS and surveys with our guests informed the decision to feature sharks in a Great Barrier Reef tank and focus on the extraordinary biodiversity of this aquatic treasure.



Interpretive Panels ©National Aquarium, 2014

CONSERVATION

With the Blacktip Reef and Blue Wonders exhibits, the aquarium aims to engage visitors in the mission and how they can specifically help conserve the world's aquatic treasures. The exhibits offer multisensory and layered experiences that were designed to engage guests emotionally and intellectually to this purpose. Blacktip Reef animal interactives link conservation action to exhibit animals by providing information on threatened reef animals and habitats and offering tools for taking immediate action to protect them — including QR codes for downloading carbon footprint calculators, Sustainable Seafood Watch cards and discount coupons toward the purchase of reusable shopping bags. Other interactive links take guests to a landing page where, among other conservation actions, they can sign timely petitions against shark finning, donate to the Aquarium's marine animal rescue program or join an upcoming Aquarium conservation initiative. Conservation education carts and other personally



Large, durable 17-inch touchscreens and multiple layers of family-friendly content encourage conversation are provided to help guests build connections to reef animals and each other. ©National Aquarium, 2014

facilitated experiences are provided to maintain a consistent conservation voice by focusing on the same four reef conservation issues as exhibit interactives and graphics: overfishing, climate change, plastic pollution and habitat destruction including the importance of marine sanctuaries. All available captive-born specimens were acquired. Wild-caught specimens were acquired from reputable, government-regulated suppliers that collect in a sustainable manner, such as Cairns Marine Aquarium Fish in Queensland, Australia.

The aquarium recycled 89.3% of construction waste over the course of the renovation, totaling 239.53 tons. Other sustainability practices include replacement of life-support system pumps and horizontal sand filters with larger, vertical sand filters and pumps with variable frequency drives (an energy-saving component). All existing incandescent lighting—except theatrical presentation lighting—were replaced with environmentally friendly LED lighting.