



Aquarius Reef Base

Fact Sheet: 2019

Designer: Perry Submarine Builders (Florida)

Construction: Victoria Machine Works (Texas); start: 1986 | complete: 1987

Estimated construction cost: \$5.5M

Operational Timeline:

St. Croix Deployment:

Deployment in Salt River Canyon, St. Croix: 1987

Owner: NOAA

Operator: Farleigh Dickenson University

Interim Period:

Recovered: 1990 by the University of North Carolina Wilmington

Refurbished: 1990-1993 at North Carolina State Ports, Wilmington, NC

Owner: NOAA

Operator: University of North Carolina Wilmington

Florida Keys Deployment:

Initial deployment on Conch Reef, Florida Keys: 1993 (baseplate deployed 1992)

Recovered for refurbishment: 1996-1998 - Harbor Branch Oceanographic Institution, Ft. Pierce, FL

Redeployment on Conch Reef, Florida Keys: 1998 – present

Owner: NOAA: 1986-2014; Florida International University: 2014 – present

Operator: FDU: 1987-1989; UNCW: 1990-2012; Florida International University: 2013 - present

Aquarius Siting: Conch Reef, Florida Keys (Florida Keys National Marine Sanctuary):

Distance From Islamorada shore base: 15.4 km (8.5 nm)

Distance offshore: 9 km (5.4 nm)

Hatch depth/storage depth: 14 m (46 fsw) 35 psi

Depth of bottom directly below Aquarius: 18 m (60 fsw)

Habitat Specifications:

Aquarius weight: 82-ton double-lock pressure vessel

Baseplate weight: 120 tons

Dimensions: 14-meters long by 3-meters in diameter (46 ft x 10 ft)

Crew: 4 scientists and 2 technicians

Amenities: kitchen facilities that include a microwave, instant hot water dispenser, refrigerator, sink, dining and work areas; computer work stations and Internet access.

Telecommunications:

- 1 GB Ethernet from Aquarius to the LSB via umbilical.
- From LSB to Shore – Ubiquiti Airmax (maximum: 150 Mbps @ 15+ km).
- A DS3 (50Mbps) connection to the world from base
- Multiple video feeds via web cams in and outside Aquarius
 - Internal video feeds (3): Wet porch, entry lock and main lock
 - External video feeds (4): Gazebo, starboard aft, (2) repositionable
- Polycom, Skype and Google video conferencing capabilities
- Diver underwater communications
 - Diver-to-diver
 - Diver-to-Aquarius
 - Diver-to-Shore

Independent life support: Solar power backup aboard LSB, high-pressure air, oxygen and onboard carbon dioxide removal (72-hours minimum).

Productivity:

Number of missions conducted aboard the Aquarius undersea laboratory (1988-present).

Years	Location	Owner	Operator	# of Missions
1988-89	St. Croix, USVI	NOAA	FDU	13
1993-2012	Key Largo, FL	NOAA	UNCW	117
2013-2014	Key Largo, FL	NOAA	FIU	7
2015-	Key Largo, FL	FIU	FIU	16
Total				153

Peer reviewed publications resulting from Aquarius Reef Base support: 700+

Aquanaut Statistics:

Number of people who have saturated aboard the Aquarius undersea laboratory (1988-present).¹

	Male	Female	Total
Staff	47	2	49
Scientists	316	106*	422
Total			471
<i>* includes all-female science crews in 1994 & 2019</i>			
<i>¹ Totals include unique individuals; many aquanauts have saturated multiple times</i>			

Programmatic:

Mission manning levels: Average 10 staff members (permanent, temporary and volunteer)

Annual operating costs: ~\$1.1M (does not include mission support costs)

Optimal operations year: 80 days while in saturation

Average mission length: 7-10 days

Longest mission conducted onboard Aquarius: 31 days (2014: Mission 31)

Longest continuous saturation mission conducted onboard Aquarius: 18 days (2006: NEEMO-9) (note: two 20-day missions were conducted while Aquarius was deployed off St. Croix, USVI).

Life expectancy for Aquarius: System is certified annually by ABS and is structurally sound to remain on the bottom for the foreseeable future.

Links:

<http://aquarius.fiu.edu>

<http://www.facebook.com/AquariusReefBase>

<https://www.flickr.com/photos/aquariusreefbase/sets/>

<https://www.youtube.com/user/AquariusReefBase>

Interactive:

Catlin Seaview 360: <http://bit.ly/1MQcN0D>

Northeastern U. Aquarius 360: <http://bit.ly/1Uf1lqw>

Time Magazine: <http://time.com/cousteau/>

Aquarius Reef Base: Mission Themes

Marine Ecosystem Science and Long-Term Monitoring

Aquarius provides scientists with the opportunity to conduct crucial research covering a variety of areas including water quality, coral reef biology, ecology, and physiology, long-term ocean monitoring, restoration science, ocean acidification, and global climate change.

Undersea Equipment Testing

Aquarius provides extended presence in a real underwater environment, which exceeds the capabilities of scuba diving or shore-based facilities for equipment testing. In this capacity, Aquarius can evaluate the latest technologies in ocean observing, forecasting and modeling, reef monitoring, and extreme environment equipment.

Training and Procedure Development

Through partnerships with NASA, the United States Navy, and others, Aquarius serves as a space analog, training platform, and remote telemedicine testing facility. Studies include human physiological responses to extreme environments, spacewalk and lunar excursion procedures. Robotic geological sample retrieval and remote tele-robotic surgical procedures have also been tested during Aquarius saturation missions.

Outreach and Engagement

With each mission, Aquarius is inspiring the next generation of researchers and explorers through innovative education and outreach programs that reach millions of students globally. Leveraging onboard video conferencing capabilities, scientists taking up residence in Aquarius are able to engage audiences worldwide through interactive classes and live chats. Researchers are able to teach classes from the depths of the ocean and visit with schoolchildren by offering virtual fieldtrips of the undersea research lab. Aquarius also features the Teacher Under the Sea program, which provides unique experiential learning opportunities to engage today's explorers and tomorrow's problem solvers.

Value of Aquarius

- Sited in the Florida Keys Marine Sanctuary off Key Largo for 26 years, Aquarius has proven to be instrumental in the advancement of oceanic research - especially in assessing long-term ecological changes, engaging America's future leaders through ocean-inspired learning, and serving as a catalyst for development of the next generation of marine and extraplanetary explorers and exploration technologies.
- Research at Aquarius has helped guide the stewardship of not just the Florida Keys National Marine Sanctuary, but also other coral reef ecosystems both in the US and worldwide.
- Aquarius provides an ideal platform for long-term monitoring of coastal oceans and coral reefs. The laboratory provides stable power, has a scalable IT infrastructure that facilitates innovative sensor deployment, utilizes the latest industry communication technology that offers a reliable means to transmit data and video, and is the only manned ocean observing platform that allows for data groundtruthing and sensor design and testing.
- As a saturation diving laboratory, scientists working from Aquarius can dive for up to nine hours a day at depths down to 29 meters (95 feet). This represents a nine-fold productivity increase in the amount of bottom time as compared to divers working from the surface. This facilitates intensive, manipulative studies that require extensive time underwater. Scientists conduct as much research in one, 10-day saturation mission as they could in 3-6 months diving from the surface.
- Because of its ability to capture the imagination of an entire country and world through the eyes of people living under the sea, Aquarius can play an important role in ensuring American competitiveness for generations to come.
- The Aquarius Reef Base staff has extensive experience working with marine scientists engaged in scientific diving operations - including project management, logistical and technological expertise, dedicated safety oversight and training and an intimate knowledge of the local environment.

Aquarius Timeline: 1986-2019

- 1986: Aquarius designed by Perry Submarine Builders and built by Victoria Machine Works
- 1987 (September): Deployed in Salt River Canyon, St. Croix USVI
- 1988 (January): First mission under management of Fairleigh Dickenson University
 - January – December: 6 missions conducted
- 1989 (January – August): 7 Missions conducted
- 1989 (September 17): Hurricane Hugo destroys shore base infrastructure
- 1990: Aquarius recovered from seafloor and moved to North Carolina for refurbishment under management of University of North Carolina Wilmington
- 1991 (May): UNCW establishes shore base in Key Largo and begins supporting day boat projects
- 1992: Baseplate deployed on Conch Reef, Key Largo
- 1993: Aquarius deployed on Conch Reef, Key Largo
 - September – First mission under UNCW management
 - 22 Missions conducted from September 1993 – May 1996
- 1996: Aquarius recovered and refurbished; unmanned Life Support Buoy replaces manned Mobile Support Base offshore
- 1997: Aquarius redeployed on Conch Reef
- 1998: (July) - NOAA mission to certify revised protocols of operation
 - 95 Missions conducted from July 1998 – July 2012
- 2013: Florida International University assumes operational control of Aquarius Reef Base assets
 - 7 Missions conducted from September 2013 – September 2014
- 2014: (October) FIU assumes ownership of Aquarius and Reef Base assets from NOAA
 - 5 Missions conducted
- 2015: 3 Missions conducted
- 2016: 5 Missions conducted
- 2017: 4 Missions conducted; Hurricane Irma makes landfall in the Keys (September 10); LSB towed to Miami for refurbishment; repairs on Aquarius commence
- 2018: LSB relocated from Miami to Conch Reef
- 2019: (May) Aquarius recertified by ABS; 4 Missions conducted

Medina Aquarius Program



FLORIDA INTERNATIONAL UNIVERSITY



AQUARIUS

THE WORLD'S ONLY UNDERSEA RESEARCH LABORATORY

LIFE SUPPORT BUOY

On the surface, the life support buoy supplies power and communications data to the Aquarius through its umbilical cord. The structure contains a working space, communication tower, two diesel-powered generators and two air compressors.

138-foot long umbilical cord

FLORIDA
Fort Lauderdale
Miami
Key Largo shore base
Key West
Atlantic Ocean

SATURATION DIVING

By going back to Aquarius instead of the surface after diving, aquanauts can spend nearly unlimited time in the water and avoid decompression sickness (the bends), which they couldn't do under regular diving conditions.

HOW IT WORKS

- After 24 hours on Aquarius, the aquanauts' bodies get accustomed to the ocean bottom's pressure, and they can't resurface quickly without decompressing.
- At the end of their mission, aquanauts decompress for 16 1/2 hours until the pressure inside Aquarius is equal to that of the surface.
- The Aquarius is quickly repressurized from surface to ocean pressure to allow its door to open.
- The aquanauts are escorted on a two-minute ascent to the surface by divers and returned by boat to shore. They remain in the vicinity of a recompression chamber for 12 hours in case any decompression sickness occurs.

THE 82-TON DOUBLE-LOCK PRESSURE VESSEL INCLUDES:

BUNK ROOM

The sleeping area is also used during the decompression stage as the aquanauts' breathing is observed by an onboard staff member sent down, and monitored by support staff at the shore base.

MAIN LOCK

Area where aquanauts cook, eat their meals and work. The computer workstations are tied into shore-based computers via wireless communication. It also houses the primary power and life support controls.

ENTRY LOCK

Scientific experiments are carried out here. It houses the power and life support controls for itself and the entryway.

WET PORCH

The entryway where the aquanauts enter and exit the habitat by an opening to the ocean called a moon pool. Because the air pressure inside is equal to the pressure of the ocean outside, water doesn't come in.

BASEPLATE

The 116-ton structure acts as a docking station and anchor, keeping the habitat at a level and stable position. The added security and weight it provides helps Aquarius withstand severe weather such as hurricanes.

UPCOMING MISSION

In November, researchers will track the species shown below to study the effectiveness of designated conservation zones and their rate of spillover into active fishing areas.

SPECIFICATIONS

- Mission: Ocean and space research.
- Affiliation: National Oceanic and Atmospheric Administration Fisheries Research Center at the University of North Carolina at Wilmington.
- Location: 21/2 miles off the coast in the Florida Keys National Maritime Sanctuary.
- Operational depth: 63 feet.
- Living space: 2,600 cubic feet.
- Mission length: 10-30 days.
- Cost per mission: \$12,500 a day.
- Dimensions:
 - 32 feet (width)
 - 40 feet (length)
 - 43 feet (depth)

AQUARIUS' HULL

- 3/4-inch steel hull
- 1-inch fiberglass-covered hard foam insulation

INTERNAL FEATURES:

- Battery pods provide backup and emergency DC power
- Moat pool
- 8,000-lb. lead weight
- Toilet
- 12 ft. x 12 ft. deck
- The emergency evacuation gazebo fits seven people, with equipment that allows them to pre-breathe pure oxygen. This enables them to directly surface without decompression for transport to the decompression chamber.
- Waterlight doors connect the locks and can seal one from the other in an emergency.
- 300-gallon fresh water tank
- Lead weight box
- Two oxygen tanks each hold 2,000 psi of oxygen used during decompression.
- Hydraulically embedded anchors for extra hold
- Communications, workstations, and electrical and gas controls
- Sink
- Galley table
- AC unit, refrigerator
- Viewport
- Entry lock sanitation tank (main lock tank on other side)
- Waterlight doors connect the locks and can seal one from the other in an emergency.
- Sleeping quarters for up to six people
- Waystations based hundreds of feet from Aquarius provide divers with air pockets to check in with the habitat every two hours, refill their scuba tanks, have a snack and talk.

FIU
Medina Aquarius Program
aquarius.fiu.edu