



D. J. ROLLER/LIQUID PICTURES 3D

The Aquarius Reef Base enables ocean scientists to spend up to two weeks at a time living on the sea bed, conducting research on the coral reef nearby.

OCEANOGRAPHY

End of an age for Aquarius

Iconic underwater research base set to close its airlocks for the last time this year.

BY MARK SCHROPE IN KEY LARGO, FLORIDA

Floating 17 metres below the surface of the Atlantic, oceanographer and environmentalist Sylvia Earle is gazing affectionately at a loggerhead turtle dubbed Little Joe. Earle often campaigns to save endangered marine creatures such as loggerheads, but now she wants to protect a steel cylinder that looms not far behind her: the Aquarius Reef Base, which for the past week has been Earle's home on the sea bed just off Florida's Key Largo.

Two weeks living in Aquarius allows scientists to stay close to a coral reef, and to spend as much time underwater as they would in a year of sequential dives. Marine biologists say that no other facility gives them a chance to study reef ecosystems so intimately for extended periods. "You become a resident, not a visitor," says Earle. But to the dismay of many, Aquarius looks set to close its airlocks for good this year — a victim of tight budgets and waning political support.

The base has been operating in Florida

since 1992, and at just over 13 metres long and 5 metres wide it comfortably accommodates a crew of six. Owned and largely funded by the US National Oceanic and Atmospheric Administration (NOAA) as part of its National Undersea Research Program (NURP), Aquarius is run by the University of North Carolina Wilmington. Over the past decade, the facility's budget has ranged from about US\$800,000 to \$3 million.

But the Aquarius team got a shock in US President Barack Obama's budget request for 2013 this February. NOAA had recommended that Congress eliminate funding for Aquarius and terminate NURP. "Never once did they mention that this was coming down," says Thomas Potts, Aquarius's director.

NATURE.COM
Watch a video of Mark Schroppe's visit to Aquarius:
go.nature.com/dqhg17

To draw attention to the lab's plight, Potts and Mark Patterson, a long-time Aquarius user from the Virginia Institute of Marine Science in

Gloucester Point, planned a high-profile final mission. They hoped to win back government support or attract private donations to a new Aquarius Foundation that would support the facility. Patterson recruited Earle, a former NOAA chief scientist who consulted on Aquarius's location two decades ago and is now an explorer-in-residence for the National Geographic Society; oceanographer Dale Stokes from the Scripps Institution of Oceanography in La Jolla, California; and underwater filmmaker D. J. Roller to join the mission. Countless reporters and members of the support crew also visited the site on each day of the 15–21 July expedition.

Earle and Patterson say that the lab makes a unique contribution to ocean science because it is the only place where researchers can stay on the bottom for long stretches — saturation diving — and reach surrounding undersea study sites in mere minutes. They and other supporters point to a long list of research accomplishments, including assessing the

GENOMICS

Contest to sequence centenarians kicks off

First entrant pins hopes on semiconductor technology.

BY MONYA BAKER

role of sponges in filtering water around reefs (see *Nature* 457, 141–143; 2009); the discovery of huge waves of cool water from deeper areas offshore that wash over reefs (J. J. Leichter *et al.* *J. Phys. Oceanogr.* 35, 1945–1962; 2005); and the development and testing of instruments that enable such work. Supporters also say that the lab is invaluable for ocean outreach. And since 2001, NASA has been renting Aquarius as a training proxy for space operations, because working in water offers one of Earth's closest analogues to working in microgravity.

But Andrew Shepard, who directed Aquarius from 2004 to 2009, was not surprised by the cut. "It's the age-old battle of extramural versus intramural costs," he says. In recent years, NOAA's Ocean Exploration and Research programme, which supports NURP, has struggled to adequately fund core priorities such as the ship *Okeanos Explorer*, and Shepard says that extramural programmes such as Aquarius are typically a lower budget priority. He also acknowledges that "not everybody thinks that Aquarius is indispensable to the coral-reef-science community. Some people say it's in the wrong place, that it might be useful if you could move it around."

"I think the big questions are, should it keep going, and if so, for how much longer, and what should it look like?" he adds.

Aquarius has faced major budget crises before, including complete funding elimination in past presidential budget requests. But congressional supporters have always restored funding. Now, with the current drive to rein in government spending, "that's taboo", says Shepard.

NOAA declined *Nature's* requests for an interview, but in an e-mailed statement, spokesman David Miller said that Aquarius has been a "vital part" of fulfilling the agency's core missions. "Unfortunately, our budget environment is very, very challenging and we are unable to do all that we would like," he adds. Although the president's 2013 budget request calls for an increase of almost \$160 million for NOAA, much of that is designated for weather-satellite programmes.

Last week's mission did generate substantial attention, including visits from several Florida legislators. But barring the arrival of a last-minute saviour, the Aquarius team will disband in December.

Joe Deppen, a habitat technician and diver for Aquarius for the past three years, is already planning to train at a commercial diving school. "I wish people would realize what an asset Aquarius is," he says, pausing to consider his words while rocking on a support boat in choppy seas just above the base. "Everyone that comes down realizes what an amazing place this is." ■

The first competitor has swaggered up to the starting line for a contest that aims to push the limits of genome-sequencing technology. The X Prize Foundation of Playa Vista, California, is offering a US\$10-million prize to the first team to accurately sequence the genomes of 100 people aged 100 or older, for \$1,000 or less apiece and within 30 days. Ion Torrent, part of Life Technologies of Carlsbad, California, believes that its semiconductor-based technology gives it a shot, and on 23 July it announced that it will compete.

The Archon Genomics X Prize competition, to be held in September 2013, is intended to spur technology, boost accuracy and drive down costs — currently \$3,000–5,000 per genome. Peter Diamandis, the X Prize Foundation's chief executive, says that the contest will help to establish a standard for a "medical grade" genome, with the high accuracy needed to diagnose or treat a patient. Eventually, says Michael Snyder, a geneticist at Stanford University in California, "I do see a world where you'll have a funny-looking mole and they'll pull that off and want to sequence its genome."

The contest will also test the claims that sequencing companies have made. "I call it the truth serum for the genome-sequencing field," says genome maven Craig Venter, co-chairman of the competition.

Entries can be made until May next year, and organizers hope that the competition will be keener than in past events. An earlier incarnation of the competition, launched in 2006, drew several registrants, but none came close to winning.

This time, the X prize Foundation has relaxed the time frame, allowing competitors 30 days — rather than the 10 specified by the 2006 contest — and focused on centenarians, who might carry gene variants promoting longevity. The winning team will be the first to sequence all 100 genomes to 98% completion, with less

than one error per million base pairs, and to determine which variants appear on which of the paired chromosomes. In case there is no outright winner, lesser 'best in class' awards are on offer. "It would surprise me if one team gets all of the criteria," says Kevin Davies, editor-in-chief of *Bio-IT World* and author of the book *The \$1000 Genome* (Free, 2010).

Ion Torrent believes that its edge will come from its technology, which measures a tiny change in pH each time a specific base is added to a growing DNA strand. Most sequencing technologies rely on light emitted as bases are incorporated, which requires higher built-in costs for optical equipment.

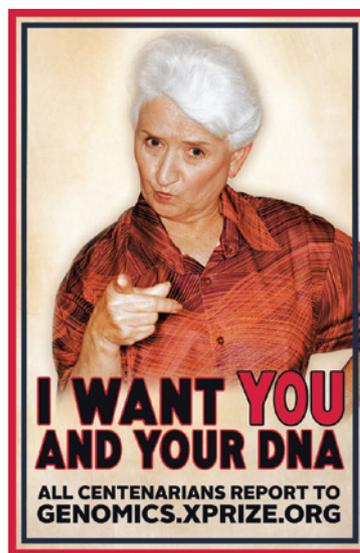
Davies regards Oxford Nanopore Technologies in Oxford, UK, as a potential rival. Earlier this year, the company said that it would soon be able to sequence a human genome in 15 minutes. Its technology threads a DNA strand through a nanometre-scale hole and senses

each base as it passes through. But the company would not say whether it intends to enter the competition. Spokespeople at the sequencing-services companies BGI in Shenzhen, China, and Complete Genomics in Mountain View, California, said that the firms had not yet decided whether to enter.

Clifford Reid, chief executive of Complete Genomics, worries that it will be difficult for the judges to assess the accuracy of the newly sequenced genomes. "The technologies participating in the competition are the only technologies for judging the competition,"

he says, adding that he is hopeful that contest organizers can come up with "a clever solution that makes everyone happy".

Although the contest will reward technological prowess, Venter says the key challenge is not amassing sequence, but understanding what it means for biology and medicine. "The trivial part of the equation to solve is the sequencing technology," he says. "It's necessary, but not sufficient." ■



A poster used to recruit DNA donors.