SEA TECHNOLOGY®

www.sea-technology.com

SEPTEMBER 2020



Ocean Resources Development & Coastal Zone Management

FEATURING:

ROV-Based Coring

Measuring Mining Plume Sediment

Capturing Invasive Lionfish

ROV Combats Invasive Species

ReefSweeper Captures Lionfish in US, Caribbean Waters

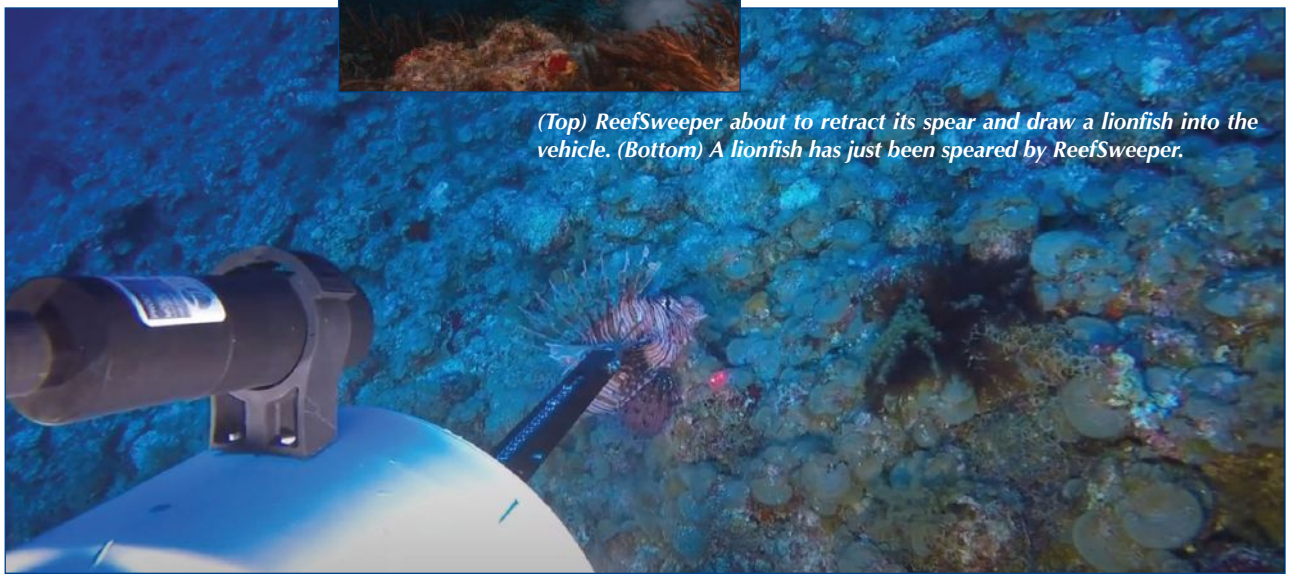
By Marla Isenstein

Since their discovery off the North American coast in 1985, invasive lionfish, native to the South Pacific and Indian Oceans, have had a calamitous impact on marine ecosystems. Ichthyologists suspect the invasion began when aquarium fish were released into the wild off the coast of Florida. This species is particularly threatening because of their broad diet of native fish and crustaceans. The problem is compounded by the lionfish's ability to reproduce rapidly and their lack of natural predators. They compete with native organisms for limited resources, alter habitats, and can cause extinctions of indigenous animals and plants.

Past methods of catching lionfish using divers were limited by depth and subsurface time restrictions and could be cost prohibitive. Alternative methods such as trapping techniques presented the undesired consequence of bycatch.

After the first sightings, lionfish exploded in population and are appearing in ever increasing geographic ranges. Flash forward to present day and lionfish have been observed from as far north as Rhode Island to as far south as Brazil; in the Atlantic Ocean, Caribbean Sea, Mediterranean Sea and the Gulf of Mexico. These voracious predators are known to consume over 50 species of fish, and postmortems show large numbers of fishlings in their stomachs. Their range extends from depths of less than 1 to over 300 m. Lionfish can thrive throughout a variety of habitats, including natural and artificial reefs, hard bottom, seagrass beds and mangroves. Lionfish distribution data have been collected by the U.S. Geological Survey since 1992, along with data





(Top) ReefSweeper about to retract its spear and draw a lionfish into the vehicle. (Bottom) A lionfish has just been speared by ReefSweeper.





(Top) A successful field trial yields a full containment cage. (Right) A bevy of lionfish ready to send to local restaurateurs.

from NOAA as well as other government agencies, academic researchers and community organizations, and the trend is clear: Lionfish are taking over.

Partnership

The loss of habitat and indigenous fish in seas around their hometown of Somerset, Bermuda, was especially poignant for Liz Martin and her husband Darius Martin. "Our community was really seeing changes caused by the increase in lionfish populations," said Liz. "For commercial fishermen, sport fishermen and the tourist trade, the erosion of our native fish populations and their replacement with lionfish was really starting to have an impact."

In 2017, Liz and Darius decided to take action, co-founding Atlantic Lionshare Ltd. with the goal of fending off the ever-increasing population of lionfish and a strategy to build a solution that could be rolled out wherever the invasive species was present. Their mission was two-fold: to diminish the damage lionfish are currently inflicting on marine habitats by harvesting them in sufficient quantities with no bycatch, and to promote the consumption of lionfish and establish them as both a delicious and nutritious food source (lionfish has a white, flaky, mild, tender and tasty flesh that has been compared to snapper and can be prepared in numerous ways, including ceviche, grilling or pan-frying).

"After studying the problem for a while, it was evident that due to the depth the lionfish prefer, an ROV was the way to proceed," Liz said. So she set out on a quest to find a company that could help build an ROV to hunt lionfish.

The search led Atlantic Lionshare to SeaView Systems Inc., a Michigan-based underwater technology company with expertise developing a diverse range of custom ROVs and a track record of solving unconventional problems.

Atlantic Lionshare joined forces with SeaView Systems in late 2017 to design a custom ROV to eradicate lionfish populations and halt further degradation of delicate ecosystems.

Custom ROVs

SeaView's robust 20-plus-year history with ROVs illustrated its capabilities in designing and building custom ROV technologies. Expertise in control electronics, unique mechanical systems and overall ROV configuration/modification has been SeaView's mainstay from the company's inception. SeaView also designs and markets a range of specialty electronics for various oceanographic and underwater applications.

SeaView's previous experience with custom ROVs includes the design of Chiton, a segmented, flexible ROV with ligaments that slacken and tighten to fit through narrow spaces and inspect up to 20,000 ft. (6.1 km) of tunnel; Titan, a battery-powered ROV that enables full video and profiling sonar survey for distances up to 32,000 ft. (10 km) of tunnel; and SurfROVer, a subsea crawler designed to operate in sea states up to level three, with the ability to traverse from the challenging environment of the nearshore littoral zone to depth.

"We have been modifying inspection- and observation-class ROVs like the Saab Seaeye Falcon and the BlueROV2 from Blue Robotics for years," said SeaView's Matthew Cook. "This particular project presented a unique combination of challenges, from exploiting our fiber-optic upgrades using our in-house designed mul-

tiplexers to solving the interesting challenge of capturing and containing lionfish using an ROV."

"SeaView brought together all the pieces for us," said Darius. "From experience with a wide range of mechanical and electronics systems, an innovative spirit, and a roll-up-your-sleeves culture, SeaView was the team we wanted to work with to bring our vision to fruition."



The ReefSweeper's record depth to date is 140 m/490 ft.

ReefSweeper Design

In order to take advantage of as much readily available technology as possible and keep the focus on the new innovations needed for this unique vehicle, SeaView and Atlantic Lionshare decided early on to build on a framework from an existing ROV for the prototype. They selected the industry standard Saab Seaeye Falcon based on its rugged design and SeaView's longstanding familiarity with the platform based on the design of many previous modifications.

Early on, SeaView recognized that the final ROV design would pose complicated data requirements from a variety of inputs to support the operator.

While the standard copper umbilical used on Falcons had insufficient bandwidth, SeaView had vast experience upgrading Falcons to fiber-optic communications. "We knew this would be a particularly sticky wicket and would take a lot of ingenuity," said SeaView's Geoff Cook.

"Our industry-proven fiber-optic umbilical upgrade kit was the perfect solution to get the data bandwidth we needed."

The ReefSweeper custom ROV features backbone hardware designed to take advantage of two of SeaView's 2.4-kW, 48- to 375-VDC subsea power supplies, the SVS-109 fiber multiplexers, and the SVS-309 two-channel HD-SDI video-to-fiber converter.

Then, the real work began. The design called for an extracting chamber, a spearing mechanism and a containment cage capable of carrying a payload of 150 lionfish. In addition, the design provides a wide-angle HD video camera for spotting fish, an HD camera for targeting the fish and two SD cameras, one for monitoring the fish extraction chamber and one for the containment cage.

The ReefSweeper adds three vertical thrusters to the standard Falcon, which provides a more stable platform, plus one more thruster for the fish extraction chamber. The operating system designed by SeaView builds on the Pixhawk flight controller and a customized version of ArduSub, once again leveraging existing technologies to get as far and as fast as possible.

Making Hydrographers' Tasks Easier



Navsight Marine Solution

State-of-the-art Motion & Navigation Solution

+

Qinertia

The Next Generation INS/GNSS Post-processing Software

www.sbg-systems.com

SBG SYSTEMS

Success in the Field

Initial field trials were conducted in the summer of 2018 in Bermuda. After some learning experiences, ReefSweeper's performance met the primary goals of all parties involved, first and foremost, catching lionfish. Secondary goals such as seamless deployment off a vessel of opportunity, easy operation by a novice operator and general ease of maneuverability were also met.

"We are thrilled about the performance of the ReefSweeper," said Darius. "The ability to deploy the vehicle from a boat with only two crew members helps keep costs manageable."

For the past two years, the ReefSweeper has been operating in the Atlantic and Gulf of Mexico, pulling in fish from depths down to 140 m/490 ft.

Liz and her crew sell the lionfish to local restaurateurs, with profits going right back to Atlantic Lionshare to fund the operation.

"It really is satisfying seeing a slew of lionfish on the deck of the boat," said Liz. "We hope to have a fleet of our patented ReefSweepers working to control lionfish populations in the near future."



Lionfish for sale at a local market in Bermuda.

SeaView plans to continue to push the envelope with innovative engineering designs, especially when used in combination with off-the-shelf products where suitable. This approach has been proven to be a win-win for SeaView and customers, saving time and money.

SeaView's Geoff Cook has literally tasted the rewards of this project at a Bermudian restaurant, where he was happy to see lionfish on the menu. "It's been a challenging but rewarding project to work on," he said. "How many problems can you name where you can ultimately eat your way to a solution?" **ST**

Marla Isenstein received her B.S. in environmental engineering from the University of Michigan. Her responsibilities at SeaView Systems Inc. include testing and quality control of SeaView products, as well as technical writing.

