Invasive Algae Mobile Rapid Response Vacuum (HI)
NFWF # 2005-0133-001
Final Report

Project Summary

The development of a mobile rapid response algal "Supersucker" will enable the State of Hawaii with the assistance of the University of Hawaii and The Nature Conservancy to quickly respond to algal bloom threats in multiple locations in a short timeframe. This capability will allow more effective management of alien algal blooms in areas not currently accessible.

The development of a new more portable algae vacuum named Supersucker Jr. was based on the prototype (named Supersucker Sr.) currently being used by the University of Hawaii, The Nature Conservancy, and the Department of Land and Natural Resources (see figure 1). The current system being used requires a large barge and pump in order to vacuum algae from the reef. However, this system has limitations including 1) the barge is large enough that it can not be pulled out of the water and transferred to new sites, 2) the pump used to remove the algae is very expensive (estimated $15,000) and pumps a tremendous amount of water compared to the amount of algae removed, and 3) it can be awkward to maneuver due to its size. Despite these limitations, this system has proven successful during the ongoing testing phase. The system has been able to remove approximately 1500 pounds of algae everyday of operation.

Results

This project had three main objectives. These objectives include the following: 1) construct a mobile rapid response algal "Supersucker," 2) test the feasibility and versatility in multiple locations on the island of Oahu particularly Waikiki to Maunalua Bay and remote patch reefs in Kaneohe Bay, and 3) determine the rate of removal and effectiveness of the unit in different environments.

Objective 1 was accomplished by constructing the system as shown in Figure 2. The construction of the "Supersucker" barge proved to have difficulties, however, in the end; its construction was completed with the existing expert staff. The Supersucker Operations Manager for the University of Hawaii at Manoa, Brian Parscal, worked with both the Department of Land and Natural Resources and The Nature Conservancy in constructing the barge. This afforded an opportunity to design and build the barge in a way that reassured the system was built to our desired and sometimes changing specifications. The design of the Supersucker Jr. barge was based on the intended goals of the system as well as past experience with an existing Supersucker Sr. currently under operation. The major differences between Supersucker Jr. and Supersucker Sr. are the size, type of pumps, method of propulsion, and mobility. Supersucker Jr. is a 16' x 8' platform and uses 2 diaphragm pumps simultaneously. It has a 25 hp Yamaha outboard engine mounted to the stern that allows the barge to be autonomous. However, the most

significant difference is that it can easily be loaded onto a normal pontoon boat trailer and moved between sites just like any small vessel.

After the system was finished and field-tested, it has obviously been a success, but further has shown that certain key design features have exceeded our expectations. Particularly, the 25 hp outboard engine has proven to be invaluable and provide the versatility that was desired. One potential feature that has been shown to be less desirable, although not a major problem, is the pontoon hull design. In an attempt to allow the barge to move forward or backward with ease, the pontoons have a bow shape on both ends. The issue with this design is that there is a slight loss of buoyancy at the stern due to the weight of the outboard engine. There are no safety issues with this feature but does make the barge oscillate more in surge environments. If there was increased buoyancy under the engine (a stern pontoon as opposed to a bow pontoon), the barge may be more stable under increased these conditions.

The second objective was to test the feasibility and versatility in multiple locations. This was achieved by testing the barge in both Kaneohe Bay and Waikiki. The weather conditions at each site can be very different. Waikiki area is susceptible to wave conditions that can limit the safe operating conditions of the barge. This condition is not unexpected and the expected barge's handling under these conditions was uncertain. However, one of the first trials was under moderate to small wave conditions. The barge was able to enter and exit under these conditions without problems. This experience showed that the barge cannot operate in rough conditions, but can handle conditions that may not be ideal. However, it is important to note that the barge was designed and will be operated in calm water conditions due to safety concerns.

In addition, the barge was tested with 2 different species of algae for removal. The significance of this is that of the 5 main alien algae in Hawaii, each one has very different growth characteristics. While the pump may work well on one, it may not work well on another. During testing, both *Gracilaria salicornia* and *Kappaphycus* spp. was tested. While the barge worked very well on *G. salicornia*, the pumps experienced minor problems with *Kappaphycus*. The pumps can remove both species, but *Kappaphycus* due to its more robust growth characteristics interfere with the diaphragm of the pump to a small degree. However, it should be noted that the pump is still effective with either species. The next trial that is being planned, but yet to occur is testing the pumps of *Avrainvillea amadelpha*. This alga typically forms large mats in soft sediment habitats and may react differently to manual removal with diaphragm pumps.

The third objective was to determine the rate of removal and effectiveness of the unit in different environments. The "Supersucker" testing was not able to compare removal rates between habitats. However, it was determined that a comparison between the Supersucker Jr. to Supersucker Sr. would be a more appropriate comparison. This would allow the productivity and efficiency of the barge to be compared against a system that has been operational for approximately 2 years. The barge was operated in Kaneohe Bay for 3 days of work and the number of pounds of removed algae was compared to the 3 most productive days of the Supersucker Sr. operations. Supersucker Sr. can remove

9.89 lbs/ diver minute of operation while Supersucker Jr. can remove 4.81 lbs/ diver minute of operation. However, since Supersucker Jr. can operate with 2 divers, the removal rate can be doubled to compare with the Supersucker Sr. The total removal rate of Supersucker Jr. is 9.62 lbs/ 2-diver minute operation. This shows that both Supersucker barges are almost equivalent in removal rate.

Another significant difference between both barges is the storage capacity of algae on the barge deck. Supersucker Sr. can hold more weight and remain stable due to its increased size. For Supersucker Jr. to remove the same amount of algae on a daily basis requires additional support from a vessel that can hold the algae biomass without returning to shore. This is not expected to present any problems for increased operations

Evaluation

The measure of success with this is fairly straightforward. First, the successful completion of the barge was a major success as it was built and tested without any significant problems or issues. The second measure of success is the removal rate of Supersucker Jr. to Supersucker Sr. The removal rates are almost identical and show that each barge has a similar capability. Supersucker Jr. has nearly the same capability of algae removal yet increased versatility. This is a success by any measure.

Partnerships

Supersucker Jr. was built and designed by a strong partnership between the University of Hawaii at Manoa, The Nature Conservancy, and the Department of Land and Natural Resources. Particularly, funding from NOAA via Senator Inouye help fund the staff time of Brian Parscal to construct the barge. In addition, funding from the Hawaii Invasive Species Council funded staff time to operate the barge. Funding from the National Fish and Wildlife Foundation to build this barge will undoubtedly help leverage future funds to continue managing Hawaii's problem with alien algae.

During the final stage of construction and testing, Supersucker Jr. was a centerpiece for a press release on the management of alien algae in early April 2007. A few news reports can be viewed at the following sites:

http://www.hawaii.gov/dlnr/chair/pio/HtmlNR/07-N034.pdf
http://www.thehawaiichannel.com/video/11535566/detail.html
http://66.180.128.240/news/2007/04/070404.html
http://starbulletin.com/2007/04/05/news/story05.html

News stories aired on all 4 main TV stations and both major papers in Hawaii on April 4 and 5, 2007.

The partnerships and press received during this project has been the key to the overall success. The project would not have been completed without participation from all partners.

The Future

Although the large-scale management of alien algae would require several barges working simultaneously, the future of this project is to strategically deploy the system and work on maintaining staff to operate the barge over a long time period. Eventually, we would like to be able to expand this system to include several barges that can work in key areas. Unfortunately, we have many areas that need to be addressed, so we must prioritize the areas in order to have a positive impact rather than stretching ourselves too thin and not have any positive impacts anywhere.

Funding from the National Fish and Wildlife Foundation has been extremely important and critical in building a capacity in Hawaii for alien algae management.

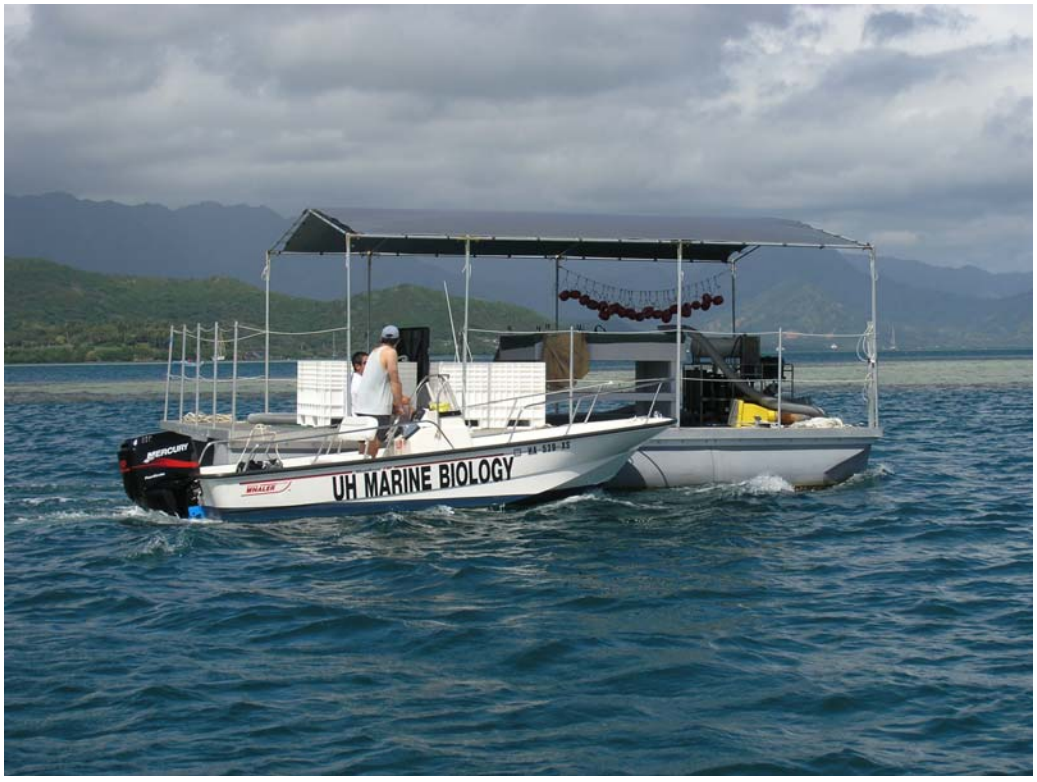

Figure 1. Supersucker Sr. underway to removal site.

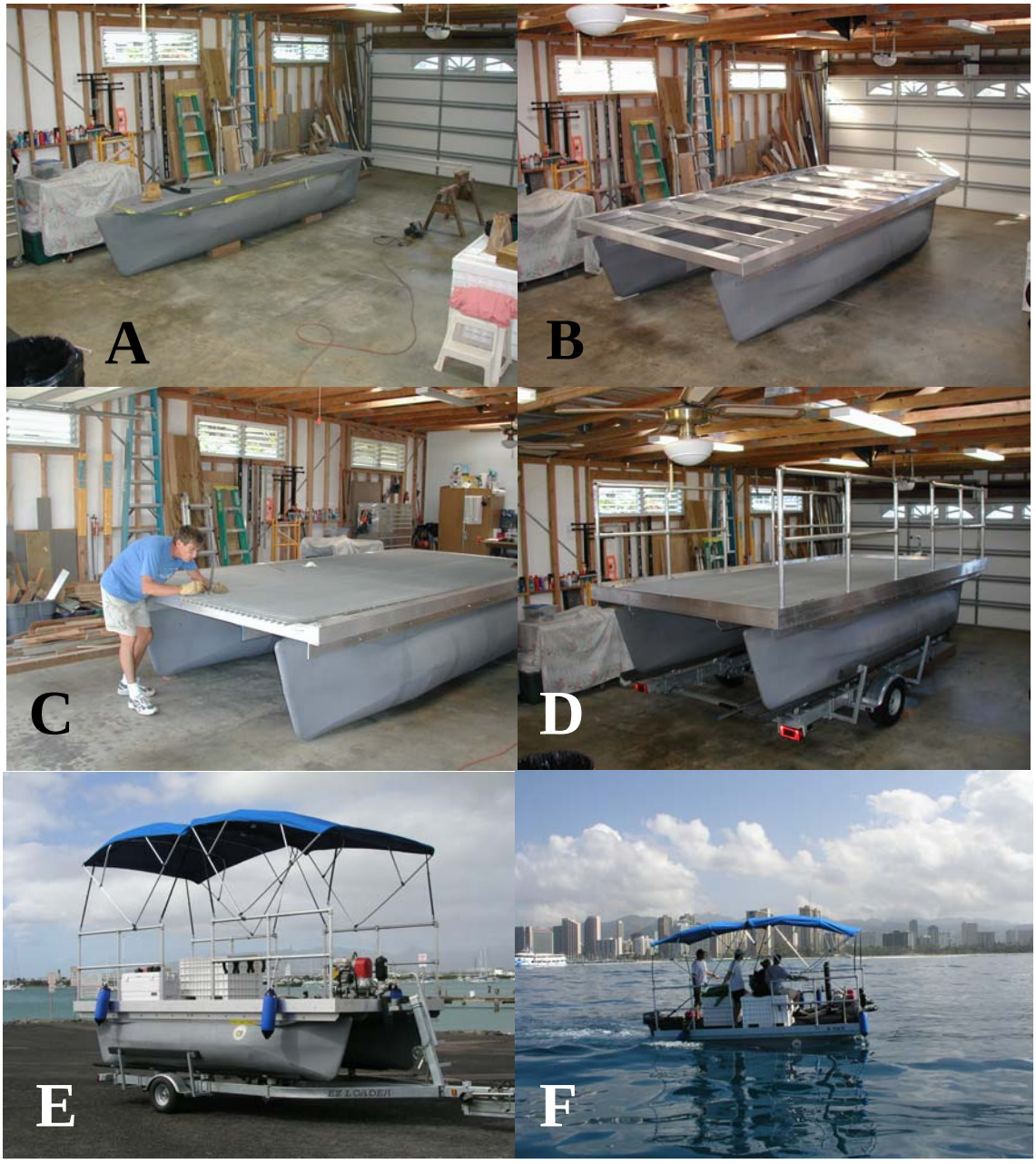

Figure 2. Various stages of barge construction for Supersucker Jr. A) Construction of 2 bow pontoons; B) Construction of framing for deck material; C) Installation of the deck material; D) Installed rails for barge deck; E) Completed barge at boat ramp; and F) Functional barge during first field test.

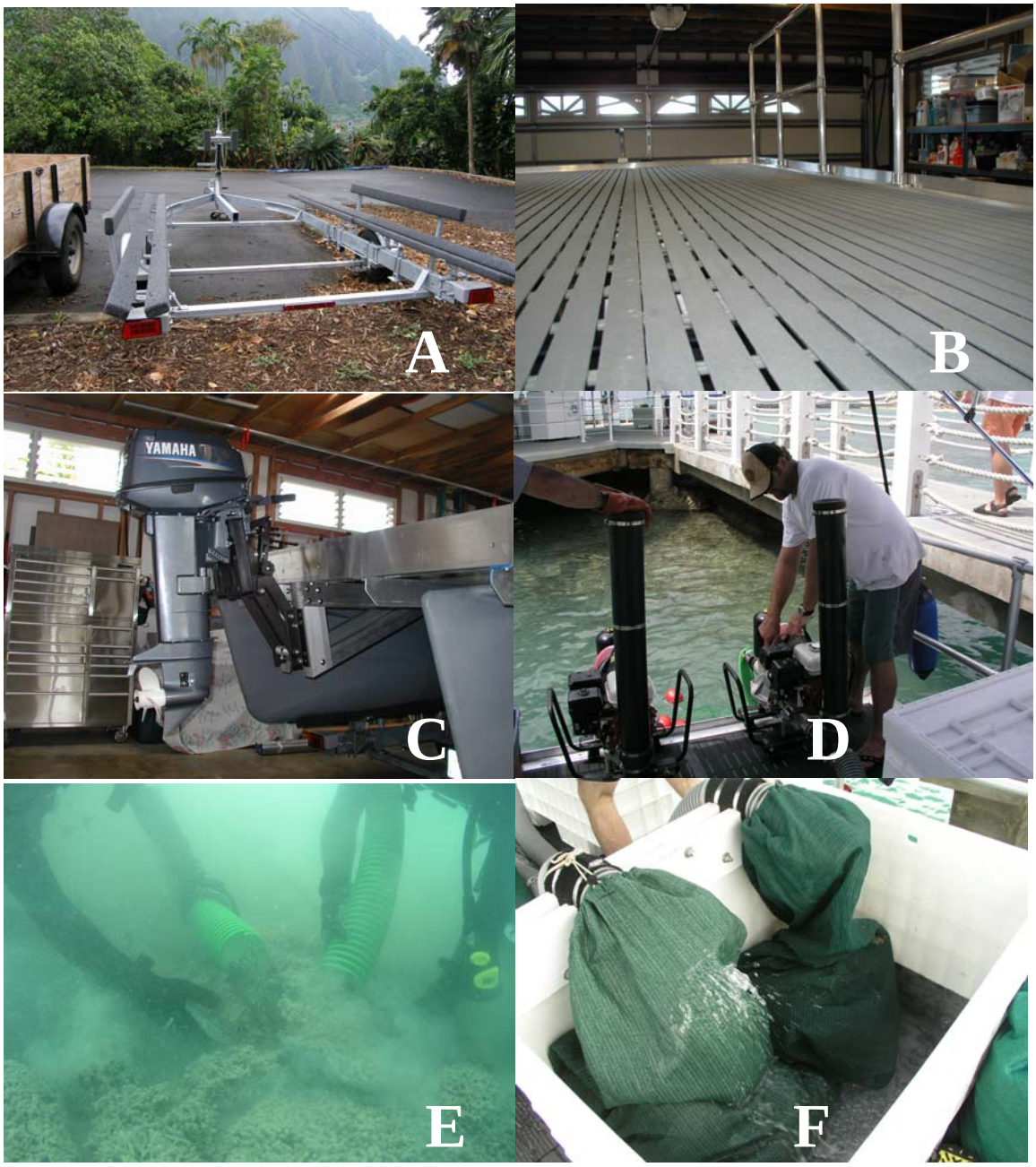

Figure 3. Various components and features of Supersucker Jr. A) Standard pontoon trailer used for Supersucker Jr.; B) 100% permeable decking material to allow water to drain; C) 25 hp outboard engine to allow barge to power itself: D) 2 diaphragm pumps that can run simultaneously; E) 2 divers operating at the same time to remove algae; and F) Collection algae in a container holding bags and/sorting table.