

## Eradication of Destructive, Invasive, Non-native Seaweed Announced

In mid-2000, infestations of *Caulerpa taxifolia*, an extremely destructive and invasive non-native seaweed, were found in two locations in southern California. The Southern California *Caulerpa* Action Team (SCCAT), which was convened shortly after the first infestation was discovered, established a goal of eradicating *Caulerpa* in southern California. After much work, eradication of the two known southern California infestations was announced in July 2006.

Both *Caulerpa* infestations found in southern California were in coastal embayments. The first infestation was found in Agua Hedionda Lagoon, in San Diego County, about 30 miles north-northwest of downtown San Diego. The second infestation was found in Huntington Harbour, in Orange County, about 60 miles northwest of Agua Hedionda Lagoon



and about 25 miles south-southeast of downtown Los Angeles. These were the first infestations of *Caulerpa taxifolia* found in North America. *Caulerpa taxifolia* has been widely used in saltwater aquariums, and both southern California infestations are likely to have originated from improper disposal of the contents of home aquariums.



Before the southern California infestations were found, *Caulerpa taxifolia* invaded the Mediterranean Sea, resulting in severe adverse effects on habitat for native marine life, as described in the book *Killer Algae*, by Alexandre Meinesz, and shown on the PBS science programs NOVA (see <http://www.pbs.org/wgbh/nova/algae/>) and Scientific American Frontiers (see <http://www.pbs.org/saf/1204/features/caluerpa.htm> and

<http://www.pbs.org/saf/1204/resources/resources-2.htm>). “Marine habitat” is a “beneficial use” of all coastal waters in southern California, including the waters where the infestations were found, other coastal embayments, and the Pacific Ocean. Healthy habitat for native marine life is extremely important ecologically, recreationally, and economically in southern California. SCCAT concluded that the threat posed by *Caulerpa* was so great that eradication of existing infestations and prevention of new infestations was of critical importance.

### Project Highlights:

Although infestations of water environments (including wetlands and riparian areas) by invasive non-native organisms have not typically been viewed as “water quality” problems, SCCAT recognized that:

- a. The infestations of *Caulerpa* in southern California resulted from discharges of wastes;

## Eradication of Destructive, Invasive, Non-native Seaweed Announced

- b. *Caulerpa* is a “living pollutant” capable of growing, spreading, and causing damage to coastal waters;
- c. Damage caused by *Caulerpa* can be as severe and long-lasting as – or even more severe and long-lasting than – damage that might be caused by “traditional pollutants;” and
- d. Efforts to protect coastal waters from damage caused by “traditional pollutants” would be for naught if *Caulerpa* were to spread.

Since there had been no successful previous efforts to eradicate *Caulerpa taxifolia* infestations elsewhere in the world, SCCAT recognized that new treatment methods



would need to be used. In southern California, eradication work involved intensive surveys of the infested waters using teams of scuba divers to search for *Caulerpa*. Where *Caulerpa* was found, plastic tarps were placed over it, chlorine was put under the tarps, and sandbags were placed on top of the tarps to keep them in place. SCCAT concluded that short-term losses of native marine life associated with the treatment of *Caulerpa* would be considerably less than long-term losses that would occur if *Caulerpa* were to spread in and/or beyond the infested waters.

The work undertaken by SCCAT, including but not limited to the eradication effort, has been characterized by collaboration and cooperation between SCCAT participants. Communication and coordination with stakeholders (lagoon users and others) and their cooperation were important components of the eradication effort.



To help prevent new infestations, legislation was enacted that banned *Caulerpa taxifolia* and several other species of *Caulerpa* in California. [Assembly Bill No. 1334](#) prohibits the sale, possession, importation, transportation, transfer, releasing alive in the state, or giving away *Caulerpa* species.

### Results:

Eradication of the *Caulerpa* infestations in both Agua Hedionda Lagoon and Huntington Harbour was announced on July 12, 2006. Governmental agencies and community-based environmental organizations came together to celebrate the successful eradication of the invasive seaweed, *Caulerpa taxifolia*, from the two locations where it was detected nearly six years ago. The \$7 million battle against the *Caulerpa taxifolia* algae included chlorine treatments and years of scuba-diver surveys. Biologists will continue to monitor conditions in the years to come to make certain it doesn't come back. (See news release

## **Eradication of Destructive, Invasive, Non-native Seaweed Announced**

at [http://www.sccat.net/news\\_release.pdf](http://www.sccat.net/news_release.pdf), , and final eradication report at [http://www.sccat.net/eradication/FINAL\\_Eradication\\_Declaration\\_Recommendation\\_FULL\\_PACKAGE.pdf](http://www.sccat.net/eradication/FINAL_Eradication_Declaration_Recommendation_FULL_PACKAGE.pdf).) As of the end of 2006, no other infestations of *Caulerpa* had been found in California, and there were no known infestations of *Caulerpa* in California.

Eradication efforts were initiated – and eradication was accomplished – without the infested waters having been listed as impaired because of *Caulerpa* and without TMDLs having been developed. Neither of the infested waters was ever listed as impaired because of the infestations – due to resistance to the idea that an invasive non-native organism could be considered a “pollutant” – despite the characteristics of *Caulerpa*, the likely origins of the infestations, and the threat posed by the infestations.

Eradication efforts were initiated promptly after discovery of the infestations, and SCCAT considers that rapid response to have been critical to the success of the eradication efforts. If eradication efforts had been delayed until the infested waters were listed as impaired because of the infestations, eradication efforts might never have been initiated. Even if the infested waters had been listed as impaired because of the infestations, if eradication efforts had been delayed pending such listings or pending development of TMDLs, it is likely that the infestations would have spread within the infested waters and possibly – perhaps probably – beyond those waters. Allowing the infestations to spread would have increased the cost of eradication – or could have made eradication infeasible.

Fortunately, timely and adequate funding made it possible to respond rapidly and effectively to the *Caulerpa* infestations in southern California. Unfortunately, other efforts to prevent invasive non-native species from damaging waters in California and elsewhere could be hindered by criteria of some funding programs that give funding priority to (or provide funding only for) fixing problems (not preventing problems) – or to waters officially listed as impaired – or to waters for which TMDLs has been completed. Since the best approach for preventing damage from invasive non-native organisms is to prevent infestations; since waters with infestations of invasive non-native organisms are sometimes not officially listed as impaired; since substantial time can elapse before “new” impairments are added to the official list of impairments; and since it can take years to start and additional years to complete a TMDL, such funding program criteria could delay or preclude funding of important work to prevent damage from invasive non-native organisms. It is possible that such funding program criteria will result in infestations of invasive non-native organisms getting started and/or spreading while funding is provided to address less urgent, less severe, and/or less long-lasting problems.

### **Partners and Funding:**

The SCCAT Steering Committee consists of representatives of five federal and state agencies:

- a. California Department of Fish and Game (state);
- b. Santa Ana Regional Water Quality Control Board (state);
- c. San Diego Regional Water Quality Control Board (state);

## **Eradication of Destructive, Invasive, Non-native Seaweed Announced**

- d. NOAA National Marine Fisheries Service (federal); and
- e. U.S. Department of Agriculture, Agricultural Research Service (federal).

The Agua Hedionda Lagoon Foundation (a non-profit organization) and Cabrillo Power I, LLC (a for-profit business) have been key participants in SCCAT. The City of Carlsbad also played an important role in eradication efforts.

Initial funding for the eradication effort was provided by Cabrillo Power I, LLC, which operates a power plant that draws cooling water from Agua Hedionda Lagoon. Funding for the eradication effort and other work in southern California related to *Caulerpa* has come from a number of private and public sources.

- a. Cabrillo Power I, LLC (~\$282K)
- b. Foundations
  - 1. Agua Hedionda Lagoon Foundation (~\$5K)
  - 2. Fish America Foundation (~\$30K)
  - 3. National Fish and Wildlife Foundation (~\$95K)
- c. State of California
  - 1. Department of Parks and Recreation (~\$15K)
  - 2. Department of Fish and Game (~\$944K)
  - 3. State Coastal Conservancy / Southern California Wetlands Recovery Project (~\$1.3M)
  - 4. State Water Resources Control Board (~\$4.366M)
- d. Federal government
  - 1. U.S. Fish and Wildlife Service (~\$254K)
  - 2. NOAA Fisheries Service (~\$349K)
  - 3. U.S. Environmental Protection Agency (CWA §319(h) funds) (~\$1.1M)

CWA §319(h) funding was used or is being used to support the following work:

- a. Agua Hedionda Lagoon field work (surveys, treatment, and post-eradication removal of tarps, sandbags, etc. used in treatment) (~\$424K) (treatment work completed; other work ongoing);
- b. Education and outreach to prevent new infestations and help find undetected infestations (~\$76K) (work ongoing); and
- c. Development of methods suitable for treating infestations if/when they are found in high-energy open coastal waters (in contrast to the protected coastal embayments where the two known infestations were found) (~\$600K) (work ongoing).

The remaining funds available to SCCAT are expected to be used up in the first half of 2008. Nevertheless, the threat of new infestations will continue for as long as *Caulerpa* is sold, distributed, and used in aquariums. Although it is now illegal to possess, sell, give away, and transport *Caulerpa taxifolia* and several other species of *Caulerpa* in California, such activities continue. (See newspaper article at [http://www.nctimes.com/articles/2006/08/13/science/15\\_47\\_198\\_12\\_06.txt](http://www.nctimes.com/articles/2006/08/13/science/15_47_198_12_06.txt).)

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### **Photos:**

Photos showing (a) close-up views of *Caulerpa taxifolia*, (b) a bed of native eelgrass (*Zostera marina*) (with taller growth) which was invaded by *Caulerpa taxifolia* (with lower growth), and (c) SCUBA divers working to treat the infestation are at <http://www.sccat.net/photos.php>. Photos showing some of the equipment and materials used to treat the infestations are at <http://swr.nmfs.noaa.gov/hcd/calpix.htm>.

### **Table/graph/chart:**

A figure showing the decline over time of the area of *Caulerpa taxifolia* in Agua Hedionda Lagoon is in the final eradication report at [http://www.sccat.net/eradication/FINAL Eradication Declaration Recommendation FULL PACKAGE.pdf](http://www.sccat.net/eradication/FINAL_Eradication_Declaration_Recommendation_FULL_PACKAGE.pdf) (see Appendix A, page 7, Figure 3).

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