

## ***Caulerpa taxifolia*: The West Coast Marine Invader**

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### **Introduction**

In June, 2000, California once again became the leading edge in dealing with a new invasive weed: the marine alga, *Caulerpa taxifolia*. This exotic, tropical and commonly available aquarium plant was discovered just 30 miles north of San Diego, California, in Agua Hedionda lagoon, a stone's throw from the City of Carlsbad. The discovery was the result of the sharp-eyed awareness of biologist Rachel Woodfield, who was conducting revegetation work with Merkel and Associates. Within days after noting the presence of this bright-green alga, various state and federal agencies were notified and the identification was confirmed at UC Berkeley. Just weeks later, an ad-hoc advisory group met and shortly thereafter the first treatments were made. This group included representatives from California Dept. of Food and Agriculture, California Dept. of Fish and Game, San Diego Regional Water Quality Control Board, US Dept. of Agriculture-ARS, National Marine Fisheries Service, an Agua Hedionda citizen representative and several other stakeholders. Now called the Southern California Caulerpa Action Committee, or SCCAT, the group has spearheaded the eradication effort over the past year and a half. Since the first eradication applications were made within just a month of finding *Caulerpa taxifolia* in the northern hemisphere, this event provides a model for a true "rapid response".

### **Why Worry about *Caulerpa*?**

In the mid 1980s' this unusual, single-celled alga spread in the Mediterranean off the coast of Monaco from a few square meters to over 20,000 hectares over the past 17 years. It's aggressive growth overtops and smothers native algae and eelgrasses while at the same time providing almost no forage for herbivores due to its toxic constituents. With the ability to grow several inches per day and achieve lengths from 0.5 to 1.5m, it creates a kind of tough Astro turf-type mass that disrupts the normal ecological functioning of mid and lower tidal areas to depths of 200 to 300 ft in clear water. It can become established on a variety of substrates from sandy to rocky shores and can tolerate temperatures from about 8C to 30C. Therefore, allowing the alga to become established would threaten coastal marine waters from probably as far north as Santa Barbara (perhaps even San Francisco) to well into Mexican shores and bays. With its rapid clonal growth, and the ability to become dislodged and transported, stopping it immediately is critically important.

Thanks to Dr. Meinesz's book and other publications, US scientists were enough aware of the threat from *Caulerpa* to get it placed on the Federal Noxious Weed List in 1999. However,

as is unfortunately typical, public awareness and enforcement from this action was nearly non-existent. In fact, when the discovery was made in California in 2000, a survey of aquarium shops quickly revealed that the plant was widely available for sale. This is no surprise since the alga is so easily transplanted from small pieces and grows readily, this “weedy” characteristic has made it a popular plant for the marine aquarium hobbyists. And, in spite of much improved awareness of this pest, it is still available on the internet without much search time needed.

Not satisfied with the limitations of the Noxious Weed List enforcement (pertaining only to inter-state movement), the SCCAT and California stakeholders prompted the California state legislature to pass and the Governor (Gray Davis) to sign into law a very important bill last September 24 (AB 1334) that completely bans the sale, possession and transport of 8 species of the genus *Caulerpa*. The importance of including several “look-alike” species in the ban cannot be underplayed. Enforcement depends upon timely, correct identification, and even knowledgeable phycologists often cannot easily distinguish between the variety of growth forms of *C. taxifolia* and related species. This bill, coupled with the newly activated role of the California Dept. of Fish and Game and leadership of CDFG’s new Invasive Species Coordinator, Susan Ellis, should help tremendously in keeping further introductions from occurring.

### **California’s Action: A True “Rapid Response”**

In spite of what seemed (to some) to be a clear threat to the marine habitat off Monaco, the response to the Mediterranean spread was plagued with delays and disagreements about the severity of the situation. While this unfortunate circumstance still persists to some degree in Europe, it was clear to agency scientists and managers in California in June, 2000, that delays could not be tolerated. In fact, the San Diego Regional Water Quality Control Board took the creative and expeditious stance that *C. taxifolia* was in fact a “pollutant” and this triggered the release of emergency funding. That decision, coupled with additional support from the local power generator, Cabrillo Power, LLC, and NMFS, provided the initial funding needed.

Coincident with the obtaining funding, the combined experience of federal, state scientists and managers involved with California’s hydrilla eradication program, and the Merkel staff, were able to weigh practical options, quickly test potential algicides, and develop the operational method of choice: cover each colony and inject liquid chlorine. Although hydrilla (*Hydrilla verticillata*) is a flowering, freshwater aquatic plant, its growth habit, mode of spread by rhizomes and shoot-fragments, provided a reasonable model. Three key elements allowed the *Caulerpa* eradication to move ahead quickly: **Consensus to act (Eradicate!)**, **Consensus of Authority to act** (i.e. Lead Agency), and **Immediate Availability of Resources** (emergency funds from the Water Quality Control Board, Cabrillo Power, and the in-field action team (Merkel and Associates). The success of this approach could serve as a model for broader Rapid Response strategies for other incipient invasive species.

## Current Status of the Eradication Program

Shortly after the discovery of *C. taxifolia* in Agua Hedionda, a small populations was found in Huntington harbor south of Los Angeles. It was surveyed and treated in much the same way as the Carlsbad infestation. Additional surveys have been conducted in near-shoreline areas-both bays and some open-coastal areas using SCUBA divers, side-scan sonar and aerial photography. So far, no evidence of other infestations has been found. However, the survey will continue since there are many potential sites along the southern California coast and bays.

Over the first full year since its discovery, additional, small colonies of *C. taxifolia* have been detected and treated in Agua Hedionda. Over time, the search- pattern in this lagoon has been tightened and now is conducted on a one-meter grid by divers. This is time-consuming, but necessary due to often poor visibility and the need to detect any new (or previously missed) colonies. In Hunting Harbor (a very small, nearly-enclosed area, well-removed from the open ocean), 10 colonies were covered separately in an overall site of approximately 6 acres . In Agua Hedionda, about 45 colonies over 100sq.ft (0.3 acres of colonies) have been covered and treated in a total area of about 350 acres in the total lagoon. So far, all the infestations have been found only the inner-most part (about one-third the total area) of the lagoon.

As part of the eradication program, use of the lagoon by vessels (e.g. jet skis, “wave riders” and other boats, as well as fishing activities have been greatly curtailed. Further restrictions are likely as the potential of moving small fragments and colonies through wave-action, as well as the need for efficiency and safety for surveillance heightens. With the current fine-scale search grids, it’s likely that any new colonies will be detected and treated quickly.

In December 2001, sediment core samples were taken from representative treated areas in Agua Hedionda to assess the effectiveness of the earlier chlorine treatments. Intact cores were transported to the USDA-ARS Exotic and Invasive Weed Research laboratory at UC-Davis and placed under grow-out conditions (20C, 14:12 LD under 300  $\mu\text{E m}^{-2} \text{sec}^{-1}$  fluorescent light). Additionally, cores from untreated areas were inoculated with either stolons with rhizoids, or stolons with rhizoids and emergent fronds of *C. taxifolia* to serve as controls. This study is ongoing, but as of 30 days post planting, no *C taxifolia* has emerged in the cores from the treated areas, and the inoculated plants are growing well.

The costs of *Caulerpa taxifolia* in Agua Hedionda Lagoon will probably exceed \$1.1million for the first year, and will probably be similar for the second year since a major effort is surveillance and monitoring. Expenditures for Huntington Harbor site are similar. These funds have come from a variety of sources including the Sand Diego Water Board, National Marine Fisheries Service, California Dept. of Fish and Game, Cabrillo Power, LLC. Not included are significant resource as “in kind” support, including security from the City of

Carlsbad, staff and scientists' time from the dozen or so agencies involved at the onset of the program.

Most recently, the SCCAT has formalized its advisory task under the leadership of a Steering Committee with representatives of the following agencies: California Dept. of Fish and Game (Co-Chair), San Diego Regional Water Quality Control Board (Chair), National Marine Fisheries Service, and the US Dept. of Agriculture-Agricultural Research Service. The Steering Committee is now establishing a working dialogue with a newly formed citizen group of stakeholders, the Agua Hedionda Recreation Advisory Group. Their first formal meeting will be held in January, 2002.

#### References:

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Komatsu, T., Meinesz, A., Buckles, D. 1997. Temperature and light responses of alga *Caulerpa taxifolia* introduced into the Mediterranean Sea. *Marine Ecol. Prog. Ser.* 146: 145-153.

For more information, log on to the following websites:

[http://www.swrcb.ca.gov/rwqcb9/News/Caulerpa\\_taxifolia/caulerpa\\_taxifolia.html](http://www.swrcb.ca.gov/rwqcb9/News/Caulerpa_taxifolia/caulerpa_taxifolia.html)

<http://swr.ucsd.edu/hcd/caulerad.htm>

<http://www.anstaskforce.gov/Caulerpa.htm>

<http://www.sbg.ac.at/ipk/avstudio/pierofun/ct/caulerpa.htm>