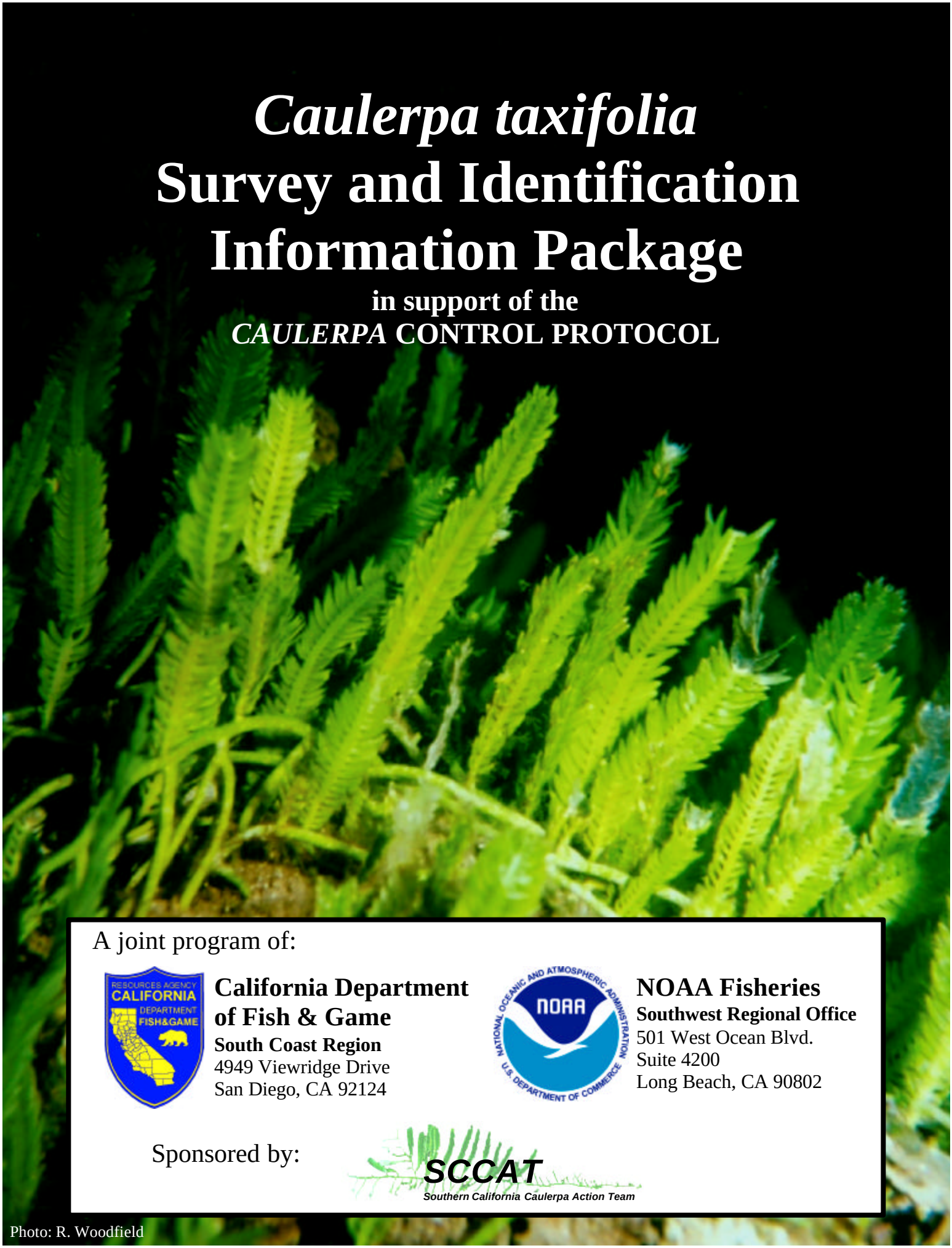
Caulerpa taxifolia Survey and Identification Information Package

in support of the
***CAULERPA* CONTROL PROTOCOL**



A joint program of:

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Sponsored by:

SCCAT
Southern California Caulerpa Action Team

Photo: R. Woodfield

Introduction

The highly invasive Mediterranean strain of the tropical marine alga, *Caulerpa taxifolia*, was discovered in Agua Hedionda Lagoon, Carlsbad, California in June 2000. Its discovery represented the first known occurrence of this strain within the Western Hemisphere and is believed to pose a major threat to coastal ecosystems and recreational and commercial uses dependent upon coastal resources. This species has also been identified at a second site in California (Huntington Harbour, Orange County). It is not known whether other infestations also exist elsewhere in the United States. The continued wide availability and use of this species by saltwater aquarists is cause for concern.

In the Mediterranean, this species has been reported to grow to depths in excess of 150 feet, and given its ability to survive in high energy areas, consideration should be given to its potential to expand from coastal lagoons onto nearshore reefs and into kelp forests of California. The dense carpet that this species can form can smother natural communities on both soft and hard bottoms. *Caulerpa* contains toxins that make it unpalatable to grazing species that typically keep seaweeds under control. Its establishment offshore could seriously impact recreational and commercial fisheries, as well as marine trade with non-infested nations. Due to its cold tolerance this clone could likely survive north of Southern California. The concern at Agua Hedionda Lagoon was *Caulerpa's* apparent displacement of native eelgrass beds, *Zostera marina*, which are well documented to be an important habitat for many species of fish and invertebrates that are recreationally and commercially important.

In the United States, the Mediterranean strain of *Caulerpa taxifolia* has been banned from importation and interstate commerce since 1999 through the Federal Noxious Weed Act. Legislation banning the transport, sale, and possession of nine potentially invasive species of *Caulerpa*, including *Caulerpa taxifolia*, was enacted in the State of California in September 2001. Earlier in 2001, the City of San Diego adopted an ordinance with similar restrictions applicable to the entire genus of *Caulerpa*.

The distribution of *C. taxifolia* in California is restricted enough that successful eradication at the two known infestations sites is achievable with diligence. Experts in the study of *Caulerpa*, as well as federal and state agencies responsible for dealing with exotic invasions, have formulated a response plan for locating, removing and preventing the spread of this alga, and have implemented an aggressive eradication effort at both known California sites.

Since the discovery of *C. taxifolia* in Agua Hedionda Lagoon in June 2000, eradication, surveillance, public outreach efforts, eradication research, and legislative efforts have been initiated and are on-going under the direction of the Southern California *Caulerpa* Action Team (SCCAT). The SCCAT is chaired by the San Diego Regional Water Quality Control Board, with other members including NOAA Fisheries, California Department of Fish and Game, Santa Ana Regional Water Quality Control Board, US Department of Agriculture, the City of Carlsbad, Agua Hedionda Lagoon Foundation,

Cabrillo Power, and others. Intensive treatment and surveillance efforts at the two infested sites have had promising results, with no *Caulerpa* found at either site since 2002.

An important goal of SCCAT is the detection of other infestations of *C. taxifolia* or other invasive species of *Caulerpa*, and the prevention of their spread. This is best achieved through the requirement placed by CDFG and NOAA Fisheries on any work that could potentially fragment or spread *Caulerpa* to survey for *Caulerpa* species prior to initiation of the work. It critical that personnel conducting these surveys be qualified in the identification of *Caulerpa* species and in the design of systematic underwater surveys. This guide in intended to provide background, survey design suggestions, reporting guidance, and identification materials to assist in preparation for conducting surveys for *Caulerpa* under the *Caulerpa* Control Protocol and for the certification exam to be administered by NOAA Fisheries or CDFG.

Also in this section is included a fact sheet about *C. taxifolia* and an informational brochure about *C. taxifolia*, which includes an update on the status of the two eradication efforts in Carlsbad and Huntington Beach.

Facts about *Caulerpa taxifolia*

February 2003

The problem: The aquarium strain of *Caulerpa taxifolia* is an extremely invasive seaweed that is currently infesting tens of thousands of acres in the Mediterranean Sea and has now been found in two coastal water bodies in southern California.

Aquarium use: Due to its fast-growing, hardy nature and attractive appearance, *C. taxifolia* is used as a decorative saltwater aquarium plant. The variety of this species cultured for use in aquaria, known as the "aquarium strain," tolerates colder water and grows more rapidly than the native strain. The native strain is not known to be invasive, and is genetically distinct from the aquarium strain. It is now illegal to possess, sell, or transport *C. taxifolia* in California.

Description: *C. taxifolia* is bright green, with feathery, fern-like fronds that extend upward from a main stem.

Distribution: *C. taxifolia* is native to tropical waters, including the Caribbean, Indo-Pacific, and Red Sea. Infestations of the aquarium strain have been found in the Mediterranean Sea, Australia, and California.

Growth: The aquarium strain of *C. taxifolia* has the ability to form a dense carpet on any surface including rock, sand, and mud. It is capable of extremely rapid growth; up to one half inch per day (1 cm/day).

Depth: *C. taxifolia* can grow in shallow coastal lagoons as well as in deeper ocean waters, possibly to depths of greater than 150 feet (nearly 50 meters).

Ecological risks: Plant and animal diversity and abundance are reduced where *C. taxifolia* has invaded. The aquarium strain of *C. taxifolia* has been documented to displace native vegetation, particularly seagrass beds, and become the dominant plant life.

Human health threat: There are no human health risks associated with *Caulerpa taxifolia*.

Natural control: Outside of the tropics where *Caulerpa* occurs naturally, there is no known marine life that eats *C. taxifolia* in any significant quantities. *C. taxifolia* contains toxins that are distasteful to species that might feed on it.

Source and spread: Genetic evidence indicates that the most likely source of infestations in areas where *C. taxifolia* is not native is through release from aquaria. Once introduced, *C. taxifolia* spreads by fragmentation, and even a small, broken-off fragment can form a new plant. Distances between colonies can be great due to transport on boat anchors and fishing gear. *C. taxifolia* does not float, has never been observed to grow on boat hulls, and is unlikely to be transported in ballast water. Sexual reproduction has not been observed in the aquarium strain of *C. taxifolia*.

Mediterranean infestation: The aquarium strain of *C. taxifolia* was first found in the Mediterranean Sea off Monaco, adjacent to the Oceanographic Museum of Monaco, around 1984. Since then, *C. taxifolia* has spread along the Mediterranean coast and dramatically altered and displaced native plant and animal communities. Early eradication was not attempted in the Mediterranean, and the infestation is now

considered beyond control. As of 2001, it was estimated that *C. taxifolia* had infested over 30,000 acres of seafloor in Spain, France, Italy, Croatia and Tunisia. *C. taxifolia* infestations have negatively impacted tourism, commercial and recreational fishing, and recreational activities such as SCUBA diving.

Australian infestation: The invasive aquarium strain of *C. taxifolia* has been reported in South Australia and New South Wales and is invading in a pattern similar to the Mediterranean infestation. Efforts are being made to control its spread.

Southern California infestations: *C. taxifolia* was first identified in June 2000 in Agua Hedionda Lagoon, a coastal marine lagoon located in Carlsbad in San Diego County. Its growth pattern was similar to that observed in the Mediterranean Sea, having spread to many areas and displaced the native seagrass. In July 2000, another infestation of *C. taxifolia* was reported in a portion of Huntington Harbour in Orange County. Test results indicate that the *C. taxifolia* in both Huntington Harbour and Agua Hedionda is genetically identical to the aquarium strain. Releases from aquaria, either directly into the water body, or indirectly through a storm drain, are the most likely sources of both southern California infestations of *C. taxifolia*.

Legislation and regulations: Assembly Bill 1334 (Harman), signed into law by the Governor in September 2001, prohibits the possession, sale, and transport of *C. taxifolia* throughout California. This bill also establishes the same restrictions on several other species of the genus *Caulerpa* that are similar in appearance to *C. taxifolia* and that are believed to have the ability to become invasive. Earlier in 2001, the City of San Diego adopted an ordinance banning the possession, sale, and transport of the entire genus of *Caulerpa* within city limits. Furthermore, the importation, interstate sale (including Internet sale), and transport of the Mediterranean strain (i.e., aquarium strain) of *C. taxifolia* is prohibited under the federal Noxious Weed Act (1999) and the federal Plant Protection Act (2000).

Eradication effort: The Southern California *Caulerpa* Action Team, SCCAT, is a committee established to respond quickly and effectively to the discovery of *C. taxifolia* in southern California. The group consists of representatives from local, state, and federal governmental entities, as well as private organizations. The goal of SCCAT is to completely eradicate all *C. taxifolia* infestations and to prevent new infestations. As part of the eradication effort, divers periodically conduct surveys in Agua Hedionda and Huntington Harbour. Wherever *C. taxifolia* is found, it is contained and treated with chlorine. Long-term monitoring will be necessary to assure complete eradication.

Prevention of new infestations: Aquarium water and other contents should never be emptied into or near any gutter, storm drain, creek, lagoon, bay, harbor, or the ocean. Aquarium water should be disposed of only in a sink or toilet. Rock and other solid material from an aquarium should be disposed of in a trash can. *C. taxifolia* from an aquarium (and anything it is attached to), should be placed in a plastic bag, put in a freezer for at least 24 hours, and then disposed of in a trash can. If any seaweed suspected to be *C. taxifolia* is found on fishing gear, anchoring gear, or vessels, it should be removed, carefully bagged (since even a small fragment has the potential to regenerate into a new plant), and reported. In order to prevent new infestations and comply with the law, *Caulerpa taxifolia* should not be purchased, sold, or distributed.

Contact information: Any sightings of *Caulerpa taxifolia* should be immediately reported to the California Department of Fish and Game at (858) 467-4218 (wpaznokas@dfg.ca.gov) or National Marine Fisheries Service at (562) 980-4043 (bob.hoffman@noaa.gov). For further information, please visit www.caulerpa.cjb.net and www.sccat.net.

Protocol – *Caulerpa* Surveys

A copy of the most recent *Caulerpa* Control Protocol is included in this section. It is important to check the NOAA Fisheries web-site frequently in order to obtain the most current version of the protocol.

http://swr.nmfs.noaa.gov/hcd/caulerad.htm

When reviewing the protocol, be careful to note the intensity levels and required timing of the surveys based on the status of the water body. References to an infected system indicate an bay, harbor, estuary, or lagoon in which *Caulerpa* has been previously identified. Currently Agua Hedionda Lagoon in San Diego County and Huntington Harbour in Orange County are designated as infected. Surveys in ANY portion of these water bodies must be conducted following the guidelines for Infected Systems. Check the above web-site to obtain information about the addition or removal of systems from this designation.

CAULERPA CONTROL PROTOCOL
(Version 1.2b, adopted January 31, 2003)

A. Background Information:

Caulerpa taxifolia (*"Caulerpa"*) is a green alga native to tropical waters that typically grows in limited patches. A particularly cold tolerant clone (tolerant of temperatures at least as low as 10 ?C for a period of three months) of this species has already proven to be highly invasive in the Mediterranean Sea and efforts to control its spread have been unsuccessful. In areas where the species has become well established, it has caused ecological and economic devastation by overgrowing and eliminating native seaweeds, seagrasses, reefs, and other communities. In the Mediterranean, it is reported to have harmed tourism and pleasure boating, devastated recreational diving, and had a significant impact on commercial fishing both by altering the distribution of fish as well as creating a considerable impediment to net fisheries.

This alga and potentially other *Caulerpa* species pose a substantial threat to marine ecosystems in California, particularly to the extensive eelgrass meadows and other benthic environments that make coastal waters such a rich and productive environment. The eelgrass beds and other coastal resources that could be directly impacted by an invasion of *Caulerpa* are part of a food web that is critical to the survival of numerous native marine species including those of commercial and recreational importance..

Currently, *Caulerpa* has been detected in two locations in southern California and other infestations may also exist but remain undetected. In order to minimize the spread and introduction of this species and other potentially invasive species of this genus to other systems, the following provisions have been established for California nearshore coastal and enclosed bays, estuaries, and harbors from Morro Bay to the U.S./Mexican border.

B. Definitions:

Disturbing Activity – a work activity initiated by a permit holder which could fragment or disseminate *Caulerpa.*

Area of Potential Effect (APE) – the area surrounding an authorized project site that could be affected by a Disturbing Activity related to the implementation of the project work. This includes the project footprint, areas where equipment is stored, areas where vessel prop-wash could occur in association with work, or in-water disposal areas used by the project. It does not include EPA designated deep-ocean disposal sites.

High Growth Period – May 1 to September 30.

Infected System – any bay, harbor, estuary, or lagoon in which *Caulerpa* has been identified , regardless of where the infestation occurs geographically within the system. Following eradication and subsequent verification surveillance for at least two High Growth Periods, an Infected System may be re-designated as a "*Caulerpa*-Free System" by the National Marine Fisheries Service (NOAA Fisheries) and California Department of Fish and Game (CDFG). Currently identified infected systems are:

Agua Hedionda Lagoon
Huntington Harbour

NOAA Fisheries/CDFG Contacts – the designated federal and state agency contacts for submittal of survey reports and reports of *Caulerpa* findings. All submitted material must be provided to these agencies at the following addresses:

National Marine Fisheries Service	**Calif. Dept. of Fish & Game**
Southwest Regional Office	**South Coast Region**
501 West Ocean Boulevard, Suite 4200	4949 Viewridge Drive
Long Beach, CA 90802	San Diego, CA 92124
Attn: Robert Hoffman	Attn: William Paznokas
ph.: (562) 980-4043	ph.: (858) 467-4218
fx.: (562) 980-4092	fx.: (858) 467-4299
e-mail: Bob.Hoffman@noaa.gov	e-mail: wpaznokas@dfg.ca.gov

Survey Area – the area over which surveys are conducted, typically synonymous with the Area of Potential Effect.

Survey Level – the level of intensity of the survey within the survey area. Survey levels are defined as either:

1) *Surveillance Level* – General survey coverage providing a systematic sub-sampling of the entire APE during which at least 20% of the bottom is inspected and widespread occurrences of *Caulerpa* would be expected to be identified if present. Surveys may be accomplished using diver transects, remote cameras, and acoustic surveys with visual ground truthing. Other proposed methodologies may be approved on a case-by-case basis by NOAA Fisheries and CDFG.

2) *High Intensity Level*– More intensive survey using a systematic sub-sampling of the entire APE during which at least 50% of the bottom is inspected. Surveys may be accomplished using diver or remote camera transects. Other proposed methodologies may be approved on a case-by-case basis by NOAA Fisheries and CDFG.

3) *Eradication Level* – This is the most intensive survey using a systematic and comprehensive survey of the entire APE during which 100% of the bottom is inspected. Surveys must be accomplished using divers moving at a rate

appropriate to the site conditions to ensure that all areas are comprehensively searched irrespective of site conditions which may complicate surveys. Other proposed methodologies may be approved on a case-by-case basis by NOAA Fisheries and CDFG.

C. Reporting Requirements:

1. Surveys conducted in accordance with requirements outlined in this document shall be submitted to the NOAA Fisheries/CDFG Contacts within 15 days of completion of each survey. Surveys shall be submitted on the attached survey form or in a suitable reproduction of the form fields.

2. If *Caulerpa* is identified at a permitted project site during a survey or at any other time prior, during, or within 120 days after completion of authorized activities, the NOAA Fisheries/CDFG Contacts shall be contacted within 24 hours of first noting the occurrence.

3. For survey actions requiring input or coordination with NOAA Fisheries/CDFG Contacts, please provide information in a timely fashion and allow at least 5 working days for agency coordination and feedback.

D. Surveys within *Caulerpa*-Free System:

The following survey conditions shall apply to permitted Disturbing Activity within *Caulerpa*-Free Systems.

1. Prior to initiation of any permitted Disturbing Activity , a pre-construction survey of the project APE shall be conducted to determine the presence or absence of *Caulerpa*. This survey shall be conducted at a Surveillance Level. Survey work shall be completed not earlier than 90 days prior to the Disturbing Activity and not later than 30 days prior to the Disturbing Activity.

2. In the event that *Caulerpa* is detected, the Disturbing Activity shall not be conducted until such time as the infestation has been isolated, treated and the risk of spread from the proposed Disturbing Activity is eliminated in accordance with section F.

3. Exemptions – Individual, privately owned boat docks and related structures are exempt from provisions 1and 2 of this section when such facilities are found in *Caulerpa*-Free Systems and permitted activities are limited to structural repairs, replacement, modification, and pile driving and do not include dredging or other significant bottom disturbing activities.

E. Surveys within Infected Systems:

The following survey conditions shall apply to permitted Disturbing Activity within Infected Systems.

1. Prior to initiation of any permitted Disturbing Activity within an Infected System, two surveys, initiated not less than 60 days apart, shall be conducted within the project APE during the High Growth Period. The first survey shall be conducted using High Intensity Level techniques and the second survey shall be conducted using Eradication Area Level techniques.

2. At least one survey shall be conducted within 45 days of initiation of permitted Disturbing Activity dredging (a "Pre-Act Survey"). This survey could be the second (Eradication Area Level) survey conducted during the High Growth Period. However, project timing may require that a third survey be conducted prior to initiation of Disturbing Activity in order to meet this 45 day requirement. If a third survey is required, this survey shall be conducted at a either a High Intensity Level or Eradication Area Level as determined by the NOAA Fisheries/CDFG Contacts based upon site circumstances and proximity to infestations. To determine appropriate survey level, please contact the NOAA Fisheries/CDFG Contacts with project specific information.

3. If the Disturbing Activity extends for over 90 calendar days, the portions of the APE that would be expected to be impacted by a Disturbing Activity within the subsequent 90 days must be surveyed at a High Intensity Level. This subsequent survey must be conducted within 15 days following the first 90 days. Prolonged activities would require a repetition of this phased survey requirement.

4. If dredged material is removed from the APE and placed elsewhere in the marine environment, then no sooner than 60 days after placement of the dredged materials and during the next High Growth Period, the applicant shall conduct a Surveillance Level survey at all disposal areas except where material is disposed of within an existing EPA designated deep ocean disposal site. The specific survey requirements shall be determined by NOAA Fisheries and CDFG on a case-by-case basis.

F. If Caulerpa is Found:

1. If *Caulerpa* is found, then the NOAA Fisheries/CDFG Contacts shall be notified within 24 hours of the discovery.

2. All *Caulerpa* assessment and treatment shall be conducted under the auspices of the CDFG and NOAA Fisheries as the state and federal lead agencies for implementation of *Caulerpa* eradication in California.

3. Within 96 hours of notification, the extent of the *Caulerpa* infestation within the project APE shall be fully documented. *Caulerpa* eradication activities shall be

undertaken using the best available technologies at the time and will depend upon the specific circumstances of the infestation. This activity may include in situ treatment using contained chlorine applications, and may also incorporate mechanical removal methods. The eradication technique is subject to change at the discretion of NOAA Fisheries and CDFG and as technologies are refined.

4. The efficacy of treatment shall be determined prior to proceeding with permitted activities. To determine effectiveness of the treatment efforts, a written Sampling and Analysis Plan (SAP) shall be prepared. The plan shall be developed in conjunction with the CDFG and NOAA Fisheries and shall be approved by these agencies prior to implementation.

5. This policy does not vacate any additional restrictions on the handling, transport, or disposal of *Caulerpa* that may apply at the time of permit issuance or in the future. It is incumbent upon the permittee to comply with any other applicable State or Federal regulations, restrictions, or changes to the Protocol that may be in effect at the time of initiation of permitted activities.

Reporting - *Caulerpa taxifolia* Surveys

Reports of conducted surveys should be submitted on the Protocol survey form or a suitable reproduction. A copy of the reporting form is included in this section. The most current version of this form is also available electronically at:

http://swr.nmfs.noaa.gov/hcd/caulerad.htm

Reports should be sent to NOAA Fisheries and CDFG at the addresses listed on page 2 of the Protocol. The reports may be sent on paper or electronically. Electronic formats are strongly encouraged. The submitted reports will be entered into a coast-wide database that will be made available to the public.

Also included in this section are demonstration reports that can be reviewed as an example. The reporting form is self-explanatory, however there are a few guidelines and tips discussed below to complete the form thoroughly so the collected data are most useful to NOAA Fisheries and CDFG.

Site Name - this is specific to survey area: e.g. Santa Clara Boat Ramp, Shelter Island Yacht Club, Berth 200- Port of Los Angeles.

Hydrographic System - name of water body e.g. Mission Bay, San Diego Bay, Los Angeles Harbor.

Specific Location – this should be very specific, with highly detailed geographical coordinates, especially for small sites. This allows for pinpointing small surveys in the larger database.

Survey type and methods - include the survey level used and details of the selected methodology (number of transects, compass or GPS, etc.).

Survey density - report the percent cover achieved by the employed method.

Caulerpa Survey Reporting Form

This form is required to be submitted for any surveys conducted for the invasive exotic alga *Caulerpa taxifolia* that are required to be conducted under federal or state permits and authorizations issued by the U.S. Army Corps of Engineers or Regional Water Quality Control Boards (Regions 8 & 9). The form has been designed to assist in controlling the costs of reporting while ensuring that the required information necessary to identify and control any potential impacts of the authorized actions on the spread of *Caulerpa*. Surveys required to be conducted for this species are subject to modification through publication of revisions to the *Caulerpa* survey policy. It is incumbent upon the authorized permittee to ensure that survey work is following the latest protocols. For further information on these protocols, please contact: Robert Hoffman, National Marine Fisheries Service (NOAA Fisheries), (562) 980-4043, or William Paznokas, California Department of Fish & Game, (858) 467-4218).

Site Name: (common reference)	
Survey Contact: (name, phone, e-mail)	
Permit Reference: (ACOE Permit No., RWQCB Order or Cert. No.)	
Hydrographic System: (name of bay, estuary, lagoon, or harbor)	
Specific Location: (UTM, Lat./Long., datum, accuracy level, and an electronic survey area map or hard copy of the map **must** be included)	
Was *Caulerpa* Detected: (if *Caulerpa* is found, please immediately contact the permitting agency project staff and NOAA Fisheries or CDFG personnel identified above)	**_____Yes, Caulerpa was found at this site and** **_____has been contacted on _____ date.** **_____No, Caulerpa was not found at this site.**
Description of Permitted Work: (describe briefly the work to be conducted at the site under the permits identified above)	

Description of Site: (describe the physical and biological conditions within the survey area at the time of the survey and provide insight into variability, if known. Please provide units for all numerical information).	*Depth range:*	
	Substrate type:	
	Temperature:	
	Salinity:	
	Dominant flora:	
	Dominant fauna:	
	Exotic species encountered (including any other Caulerpa species):	
	Other site description notes:	
Description of Survey Effort: (please describe the surveys conducted including type of survey (SCUBA, remote video, etc.) and survey methods employed, date of work, and survey density (estimated percentage of the bottom actually viewed). Describe any limitations encountered during the survey efforts.	*Survey date and time period:*	
	Horizontal visibility in water:	
	Survey type and methods:	
	Survey personnel:	
	Survey density:	
	Survey limitations:	
Other Information: (use this space to provide any additional information or references to attached materials such as maps, reports, etc.)		

Sample Report

Caulerpa Survey Reporting Form (Version 1.0, September 18, 2001)

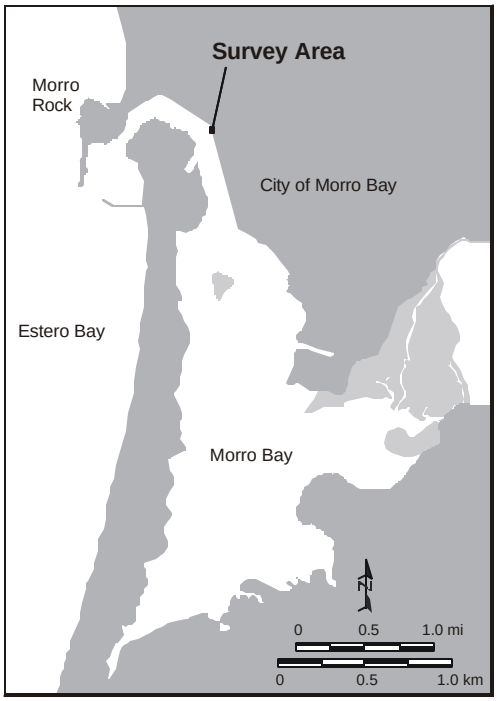
Site Name: (common reference)	Galley Restaurant. 899 Embarcadero, Morro Bay, California (see map	
Survey Contact: (name, phone, e-mail)	Scott Kimura (Tenera Environmental): (805) 541-0310, skimura@tenera.com	
Permit Reference: (ACOE Permit No., RWQCB Order or Cert. No.)	Not Applicable	
Hydrographic System: (bay, estuary, lagoon, or harbor)	bay/harbor	
Specific Location: (UTM, Lat./Long., datum, accuracy level, attach electronic survey area map if possible)	Galley Restaurant. 899 Embarcadero, Morro Bay, California (see map)	
Was *Caulerpa* Detected: (if *Caulerpa* is found, please immediately contact the permitting agency project staff and NMFS or CDFG personnel identified above)	**No Caulerpa was found at this site.**	
Description of Permitted Work: (describe briefly the work to be conducted at the site under the permits identified above)	**See Map:** The 75 ft (23 m) wide restaurant presently extends approximately 50 ft (15 m) over water to the outer boundary of the rock revetment that armors the shoreline. The owner of the restaurant has submitted plans to the City of Morro Bay to completely remove and construct a new building and to add a bayside boardwalk. The new building and boardwalk are to extend 16 ft farther over the water than the existing building, but the width will not change. The work is to include the removal of 20 piles, most of which are presently embedded in the revetment. They would be replaced by 8 new piles. The outer row of 4 piles will be embedded in the sand-mudflat. The inner row will also be placed in the sand-mudflat, but some piles may occur immediately next to the revetment, depending on the configuration of the revetment at the piling locations. The work may also necessitate the removal of several individual 2 ft x 5 ft segments of steel pipe debris that are scattered about on the sand-mudflat in the area of the proposed new piles.	
Description of Site: (describe the physical and biological conditions within the survey area at the time of the survey and provide insight into variability, if known. Please provide units for all numerical information).	*Depth range:*	Substrate: Rock revetment that terminates at a depth of approx. -9 ft (-3 m) MLLW. Sand-mudflat offshore. The survey area included revetment and sand-mudflat habitats, and was based on a 50 ft (15 m) perimeter surrounding all areas of finished building dimensions. The depth of the offshore survey boundary on the sand-mudflat was -12 ft (-4 m) MLLW. Nothing is known on biological variation at this site or descriptions of this particular area from previous studies.
	Substrate type:	Rock revetment in the area of the existing piles. Sand-mud in the area of the proposed piles.
	Temperature:	N/A

	Salinity:	N/A
	Dominant flora:	Eelgrass *(Zostera marina)* and sea lettuce (*Ulva/Enteromorpha*) on the revetment in open unshaded areas between decks, buildings, and floating docks. One patch of eelgrass (0.75 m^2, 8.1 ft^2) in the area underneath the proposed building extension.
	Dominant fauna:	Barnacles, limpets, and hermit crabs in all areas of the revetment. Clams, burrows, and *Diopatra* on the sand mudflat offshore of the revetment.
	Exotic species encountered:	*Watersipora* (bryozoan) and few *Sargassum* (bladder kelp) on the revetment and pilings.
	Other site description notes:	Appropriate visibility during the survey.

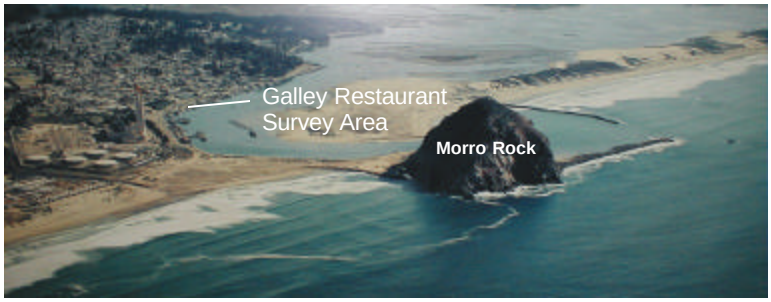
Description of Survey Effort: (please describe the surveys conducted including type of survey (SCUBA, remote video, etc.) and survey methods employed, date of work, and survey density (estimated percentage of the bottom actually viewed). Describe any limitations encountered during the survey efforts.	*Survey date and time period:*	A SCUBA survey was completed on September 9, 2003 during the late morning hours. The survey area (174 ft x 100 ft, 53 m x 30 m) was based on a 50 ft (15 m) perimeter encompassing all construction and finished dimensions of the new building and deck. The purpose of the survey was to map the occurrence of *Zostera marina* (eelgrass) and to search for the presence of *Caulerpa taxifolia*. The occurrences of other species were also noted.
	Horizontal visibility in water:	8 ft (2.4 m) horizontal visibility
	Survey type and methods:	Meter tapes were used to partition the study area into manageable search areas. The area was thoroughly searched using SCUBA by swimming transect swaths in the study area. Visibility and transect spacing was sufficient to provide a 100 % area search.
	Survey personnel:	Scott Kimura, Andrew Harmer (Tenera Environmental)
	Survey density:	Meter tapes were used to delineate the survey area into manageable sampling blocks.
	Survey limitations:	There were no limitations of the survey.
Other Information: (use this space to provide any additional information or references to attached materials such as maps, reports, etc.)	Attached map A separate report on eelgrass will be submitted to the National Marine Fisheries Service.	

Caulerpa Survey Reporting Form (version 1.0, 9/18/01)

Project Location



Oblique Aerial View of Project Location



LOCATION: Galley Restaurant
899 Embarcadero,
Morro Bay, CA.

MARINE CONSTRUCTION :
- 16 ft deck extension over the water
- Removal of 20 piles
- Installation of 8 new piles
- Removal of several discarded pipe segments in the area of the proposed piles

PURPOSE OF STUDY:
Survey for *Caulerpa taxifolia*

SURVEY DATE AND CONDITIONS:
September 9, 2003
Tide level ~ +3.4 ft MLLW
Horizontal visiblity = 8 ft

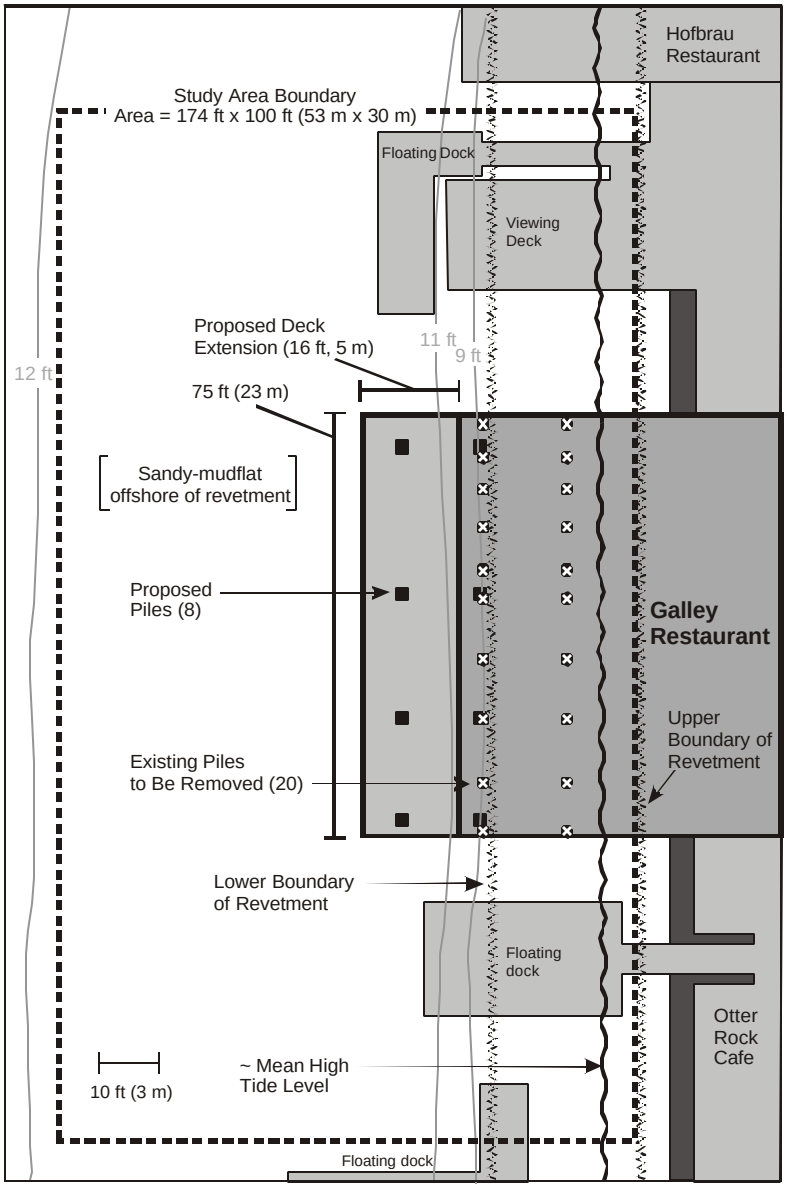
METHODS:
Study area = 50 ft (15 m) perimeter around all proposed construction/finished work (high water mark on revetment to -12 ft MLLW).

Meter tapes were used to delineate and subdivide the survey area.

Two divers using SCUBA visually searched 100 % of the survey area.

CAULERPA FINDING:
No *Caulerpa* was observed at this site.

Caulerpa Survey Map



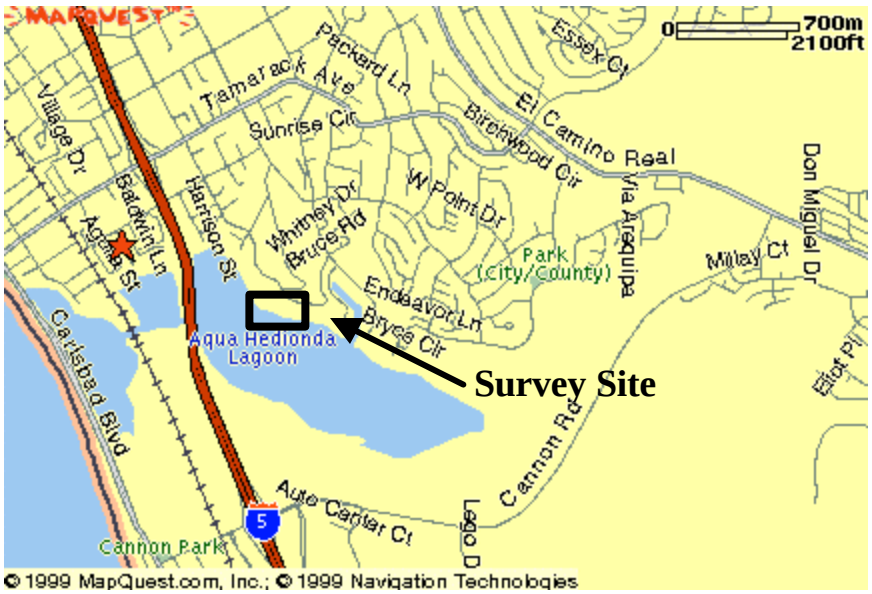
Caulerpa Survey Reporting Form
(Version 1.0, September 18, 2001)

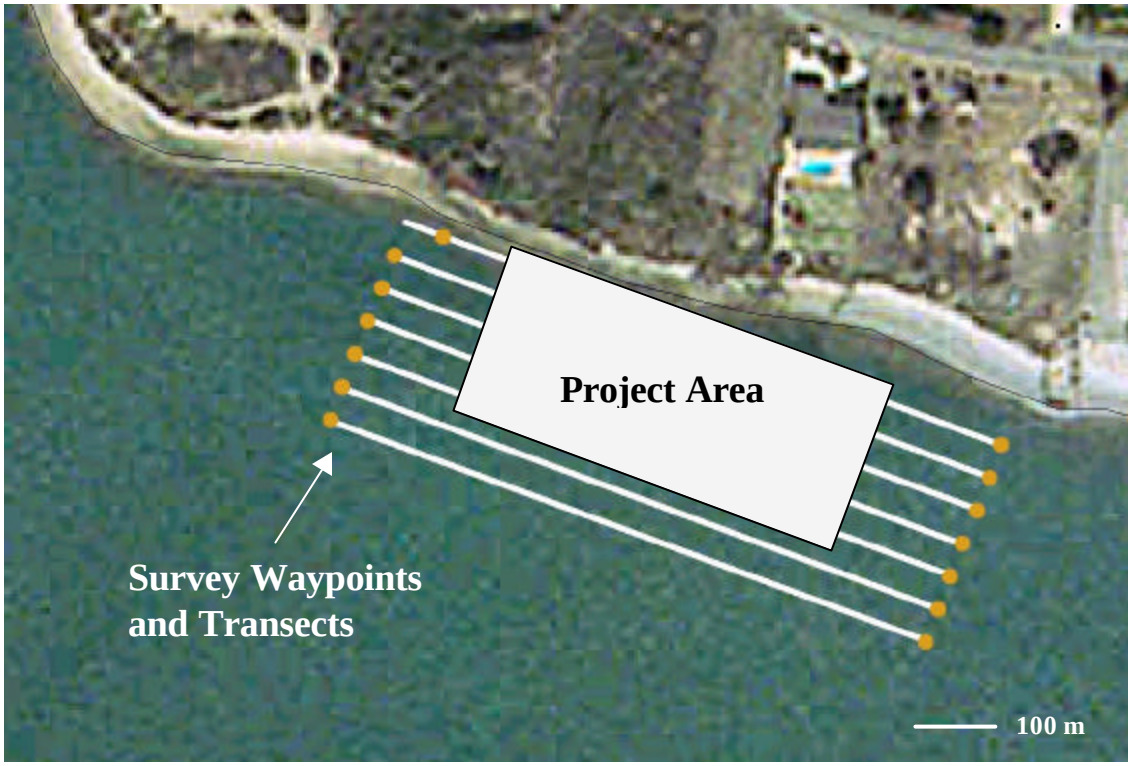
This form is required to be submitted for any surveys conducted for the invasive exotic alga *Caulerpa taxifolia* that are required to be conducted under federal or state permits and authorizations issued by the U.S. Army Corps of Engineers or Regional Water Quality Control Boards (Regions 8 & 9). The form has been designed to assis[SAMPLE REPORT NOT A REAL PROJECT]he required information necessary to identify tions on the spread of *Caulerpa*. Surveys o modification through publication of revision authorized permittee to ensure that survey wo tion on these protocols, please contact: Robert Hoffman, National Marine Fisheries Service, (562) 980-4043, or William Paznokas, California Department of Fish & Game, (858) 467-4218).

Site Name: (common reference)	East Basin of Agua Hedionda Lagoon
Survey Contact: (name, phone, e-mail)	John Doe, Project Manager JohnDoe@abc.com Cell: 760/XXX-XXXX; ph. 760/XXX-XXXX; main 760/XXX-XXXX
Permit Reference: (ACOE Permit No., RWQCB Order or Cert. No.)	ACOE (# XXXXXX) RWQCB-SDR (# XXXXXX) Coastal Comm. (#XXXXXXX)
Hydrographic System: (bay, estuary, lagoon, or harbor)	Agua Hedionda Lagoon
Specific Location: (UTM, Lat./Long., datum, accuracy level, attach electronic survey area map if possible)	Lat. 33.1428; Long. -117.3390 North shore of east basin at foot of Hoover St.
Was *Caulerpa* Detected: (if *Caulerpa* is found, please immediately contact the permitting agency project staff and NMFS or CDFG personnel identified above)	_____Yes, Caulerpa was found at this site and _____has been contacted on _____ date. _____X_____**No, Caulerpa was not found at this site.**
Description of Permitted Work: (describe briefly the work to be conducted at the site under the permits identified above)	Installation of a temporary dock that is 400 m long and extends subtidally to a depth of –4 m MLLW. The APE includes the dock footprint plus a 50 meter buffer on all sides. Construction is anticipated to begin July 1, 2002 and last for two months.

Description of Site: (describe the physical and biological conditions within the survey area at the time of the survey and provide insight into variability, if known. Please provide units for all numerical information).	*Depth range:*	+0 m MLLW to –6 m MLLW
	Substrate type:	mud bottom
	Temperature:	20-21 degrees C
	Salinity:	34-36 ppt
	Dominant flora:	Eelgrass
	Dominant fauna:	Round stingray, bat ray, sandbasses, and topsmelt
	Exotic species encountered:	*Musculista senhouseii, Bunodeopsis*
	Other site description notes:	This site supports eelgrass in a narrow band fringing the shoreline. *Caulerpa* has been previously identified in this system.
Description of Survey Effort: (please describe the surveys conducted including type of survey (SCUBA, remote video, etc.) and survey methods employed, date of work, and survey density (estimated percentage of the bottom actually viewed). Describe any limitations encountered during the survey efforts.	*Survey date and time period:*	15June2002 0800 to 1600
	Horizontal visibility in water:	1-2 m depending upon location and tidal conditions
	Survey type and methods:	Eradication level survey. Diver transect along anchored baselines. Navigation was dGPS controlled at sub-meter accuracy. Divers were spaced 1m apart to provide 100% coverage.
	Survey personnel:	Jim Doe (jdoe@abc.com) (ph. xxx/xxx-xxxx); Jane Doe David Doe Tom Doe Jennifer Doe
	Survey density:	100% survey density
	Survey limitations:	Heavy recreational boat use caused the survey to halt survey work from 1200-1245 until conditions allowed the dive team to work safely.
Other Information: (use this space to provide any additional information or references to attached materials such as maps, reports, etc.)	A map of the proposed project, survey site and transects surveyed is attached.	

Figure 1. Map of Agua Hedionda Lagoon and *Caulerpa* survey site.





Caulerpa taxifolia Survey Methodology

The *Caulerpa* Control Protocol calls for three levels of survey intensity, based on the current status of the marine system (infected or *Caulerpa* free). Approved methodologies for conducting *Caulerpa* surveys at each level are discussed below. Other methodologies may be approved on a case-by-case basis by NOAA Fisheries and CDFG.

SURVEILLANCE LEVEL

This survey intensity level is to be used at sites not previously known to be infested with *Caulerpa* and at dredged material placement sites. Surveys are intended to detect large occurrences of *Caulerpa* that may be present at the site. A minimum of 20% of the bottom must be inspected. It is expected that the survey coverage will be uniformly distributed throughout the Area of Potential Effect (APE), rather than being confined to a 20% portion of the APE. This inspection may be completed by using SCUBA divers, remote cameras, or acoustic equipment paired with visual ground truthing. Visual surveys of subtidal APEs from the surface are not acceptable.

SCUBA

A surveillance level survey can be conducted through systematic inspection by SCUBA divers. Divers should evenly cover a minimum of 20% of the APE, using a compass to swim transects. Visibility conditions should be used to determine the width of the visual coverage achieved. A record should be made of the portion of the site surveyed, preferably on a site map.

Remote Camera

A surveillance level survey can be conducted using a remote camera. The camera should be towed from above at an appropriately slow speed to allow thorough examination of the bottom, using a compass or GPS to view transects that evenly cover a minimum of 20% of the APE. Visibility and the view width of the camera should be used to determine the width of the visual coverage achieved on each transect. A record should be made of boat speed and the portion of the site surveyed, preferably showing transects on a site map.

Acoustic Equipment

Where appropriate, sidescan sonar equipment may be used to survey the APE. The collected images should be examined for suspect returns, typically expected to appear as monotypic, low-growing vegetative patches, likely exhibiting circular colonial growth patterns. All suspect patches should be ground-truthed by a SCUBA diver or remote camera.

HIGH INTENSITY LEVEL

This survey intensity level is to be used when conducting the first of the two required surveys at sites previously identified as infected. At this level a minimum of 50% of the bottom must be sub-sampled. It is expected that the survey coverage will be uniformly distributed throughout the APE. This inspection may be completed by using SCUBA

divers or remote cameras, using the methods discussed above. Visual surveys of subtidal APEs from the surface are not acceptable.

ERADICATION LEVEL

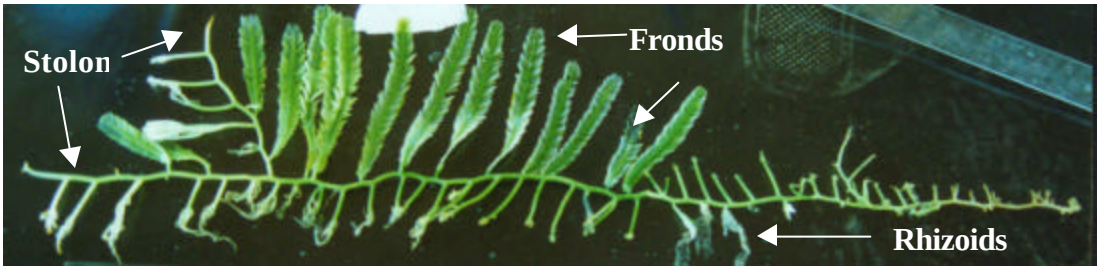
This survey intensity level is to be used when conducting the second of the two required surveys at sites previously identified as infected. This is the most intensive survey level and requires that 100% of the bottom must be systematically inspected. This inspection must be completed by SCUBA divers. Unless the APE is very small or visibility is excellent, it is recommended that diver transects be surveyed using transect lines deployed using a GPS, in order ensure comprehensive coverage. This is most efficiently achieved using a team of divers. A map of the APE should be prepared showing the transects surveyed by the survey team.

Identification

Caulerpa taxifolia is a very distinctive green alga. It can be identified by the following features:

- bright green
- feathered fronds
- rubbery texture
- long stolon or stem

Patches typically grow low to the bottom, typically 6-12 inches high, with individual fronds up to 24 inches in length. It can grow in calm or rough waters, on rock, mud, or sand. Fragments do not float and it has not been observed on floating docks or boat hulls. It typically displays colonial growth patterns, with stolons extending out from the patch, secured to the substrate by rhizoids.

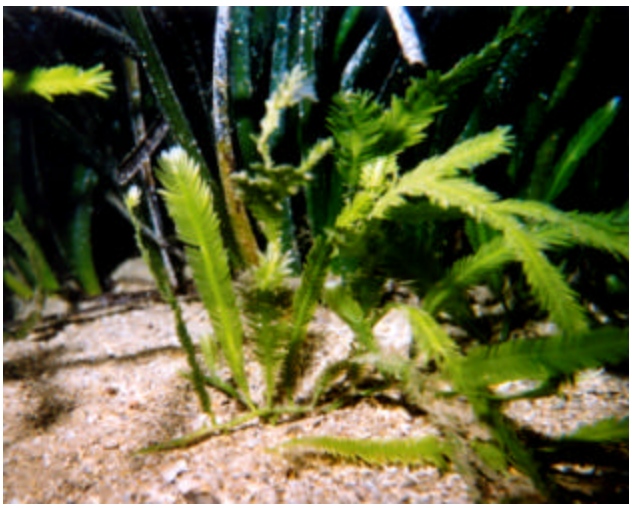


The following pages will present *C. taxifolia* as it looks out of the water, as small plants in the water, and as large, dense patches. Also will be included pictures of other species of *Caulerpa* that are also banned in California due to their potential to be invasive. In addition pictures of other benthic plants and animals that have been mis-identified as *Caulerpa* is the past will be presented.

a) Close-up of *C. taxifolia* fronds (photo: Greig Peters)

b) Close-up of *C. taxifolia* fronds (photo: A. Meinesz)

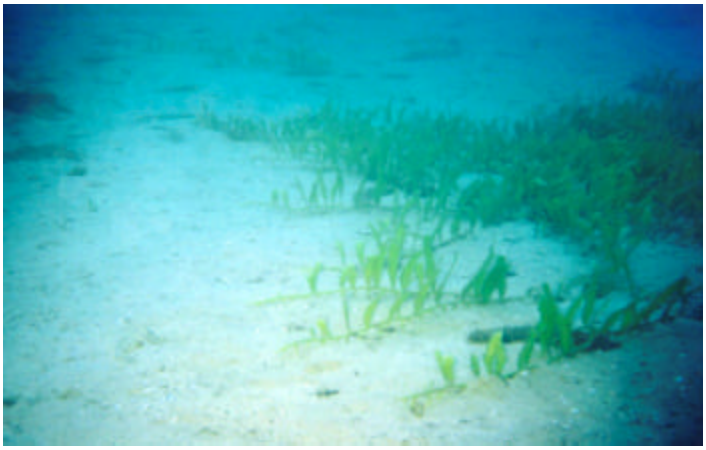
c) *C. taxifolia* laid out (photo: R. Woodfield)



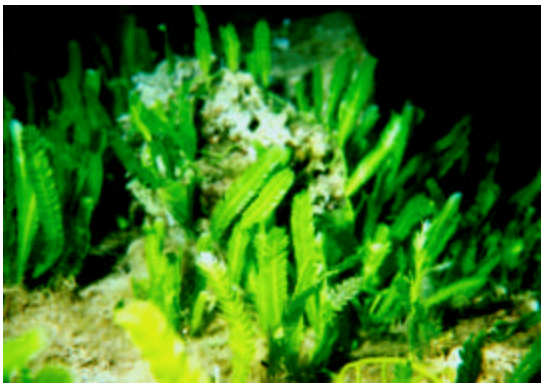
d) *C. taxifolia* becoming established in an eelgrass bed (photo: R. Woodfield)

e) *C. taxifolia* growing among rocks
(photo: A. Meinesz)

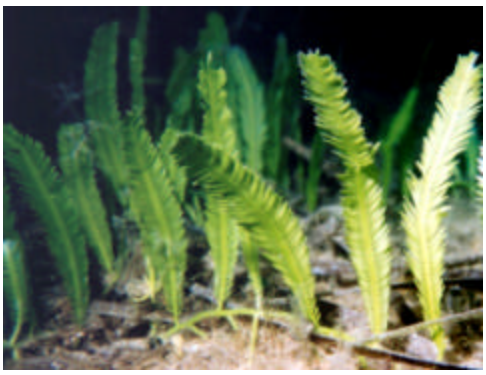
f)*C. taxifolia* growing in sand
(photo: J. Huisman)



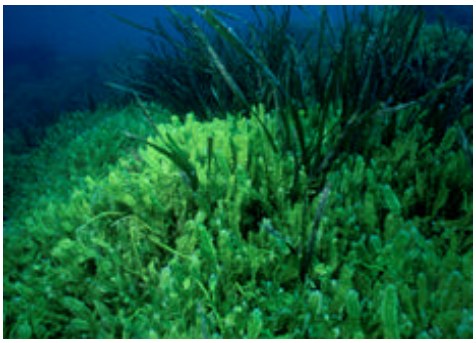
g) a small colony of *C. taxifolia* expanding by stolon elongation
(photo: R. Woodfield)



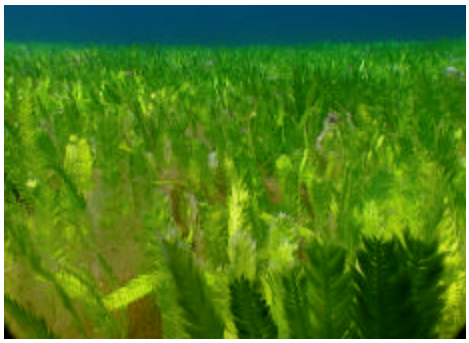
h) *C. taxifolia* overtaking a sponge (photo: R. Woodfield)



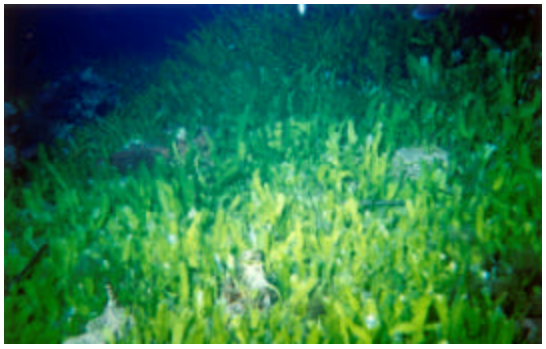
i) *C. taxifolia* (photo: R. Woodfield)



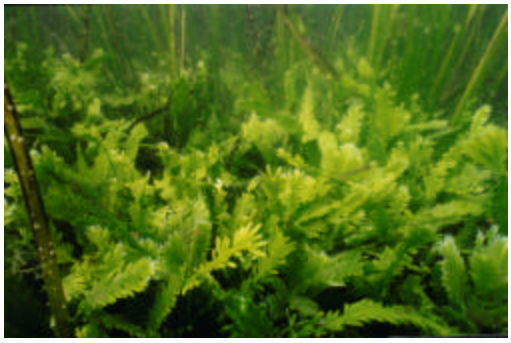
j) *C. taxifolia* overtaking seagrass bed (photo: A. Meinesz)



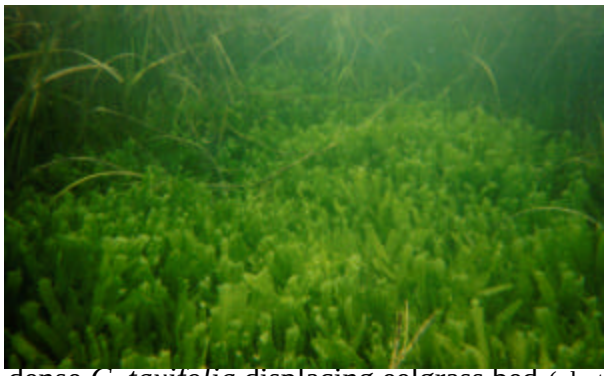
k) monotypic bed of *C. taxifolia* (photo: A. Zuljevik)



l) dense *C. taxifolia* (photo: R. Woodfield)



m) dense *C. taxifolia* in eelgrass bed (photo: R. Woodfield)



n) dense *C. taxifolia* displacing eelgrass bed (photo: R. Woodfield)

THE FOLLOWING SECTIONS ARE NOT AVAILABLE ON-LINE

Other genera potentially mis-identified as *Caulerpa:*

Other species of *Caulerpa* to be familiar with:

Surveyors should be able to identify all species of *Caulerpa* banned in California:

Caulerpa taxifolia
Caulerpa racemosa
Caulerpa sertulariodes
Caulerpa scalpelliformis
Caulerpa verticillata
Caulerpa ashmeadii
Caulerpa cupressoides
Caulerpa floridana
Caulerpa mexicana

Certification - *Caulerpa taxifolia* Survey Staff

All personnel conducting surveys under the *Caulerpa* Control Protocol must be certified by either NOAA Fisheries or California Department of Fish and Game. Survey reports with non-certified survey personnel will not be accepted. The certification process will include passing an exam on identification of *Caulerpa taxifolia.* This exam will be given by NOAA Fisheries and CDFG. Certification will be valid for two years, at which time the exam must be retaken and surveyors will be provided with updated information on protocols, reporting requirements, target species, and known infestation locations.

Contact the agencies at the addresses listed in the Resources section of this binder to schedule an exam. The exams will be given at the discretion of NOAA Fisheries and CDFG.

Caulerpa taxifolia Identification Certification

Caulerpa Control Protocol

_____ has successfully passed the *Caulerpa taxifolia* Identification exam and is a Certified *Caulerpa taxifolia* Surveyor under the *Caulerpa* Control Protocol.

Certified by:

_____	_____
(print name)	(agency)
_____	_____
(date)	(signature)

This certification is valid for two years from the above date. This certification will be kept on file by NOAA Fisheries and CDFG.

Signed by applicant:

_____	_____
(signature)	(date)

Additional information on *Caulerpa taxifolia* is available on-line at:

- http://sccat.net
- http://www.caulerpa.cjb.net
- http://swr.ucsd.edu/hcd/Caulerpa.htm
- http://swr.nmfs.noaa.gov/hcd/caulerad.htm
- http://www.caulerpa.org
- http://www.isima.fr/ecosim/ct.html
- http://www.divebums.com/General/Caulerpa/index.html

The book Killer Algae, by Alexandre Meinesz, University of Chicago Press, 1999, relates the Mediterranean experience with *Caulerpa taxifolia*.

Any questions regarding site status, survey requirements, or reporting can be directed to:

NOAA Fisheries
Southwest Regional Office
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802
Attn: Robert Hoffman
ph.: (562) 980-4043
fx.: (562) 980-4092
e-mail: Bob.Hoffman@noaa.gov

Calif. Dept. of Fish & Game
South Coast Region
4949 Viewridge Drive
San Diego, CA 92124
Attn: William Paznokas
ph.: (858) 467-4218
fx.: (858) 467-4299
e-mail: wpaznokas@dfg.ca.gov