



MONTEREY BAY NATIONAL MARINE SANCTUARY **Sanctuary Integrated Monitoring Network (SIMoN)**

Materials and methods for volunteers conducting
Undaria removal at Monterey Harbor
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Steve Lonhart, Ph.D.
SIMoN Scientist

Background

This is a brief overview of the program to manage the invasive Asian kelp *Undaria pinnatifida* in the Monterey Harbor. This program is a collaborative effort between the Sanctuary Integrated Monitoring Network (SIMoN) at the Monterey Bay National Marine Sanctuary (MBNMS), Elkhorn Slough National Estuarine Research Reserve (ESNERR), Department of Fish and Game (DFG), City of Monterey (Volunteer Services and Office of the Harbormaster), Moss Landing Marine Laboratories (MLML), and the University of California at Santa Cruz (UCSC).

A native of Japan, *Undaria* was first noted in the Monterey Harbor in August 2001. Since then the alga has been detected by others, including Dr. Pamela Roe (California State University, Stanislaus), who in the summer of 2002 removed many large, fully-grown individuals during a class field trip. However, until recently a concerted effort to study, and if possible, remove the seaweed was lacking. SIMoN and its partners are leading an effort to remove as much of the nascent population as possible, to monitor its spread, and understand its ecology in this new habitat.

There are three main components to the removal effort in Monterey Harbor. First, in September 2002 UCSC undergraduate divers conducted a completely randomized survey of all floating docks in the harbor. Based on the results of this survey, several "hot spots" were noted, which became the focal point of subsequent efforts. Second, volunteer divers from the City of Monterey under the direction of Dr. Steve Lonhart, SIMoN scientist, and Scott Pryor (Field Assistant, Office of the Harbormaster) began to target the hot spots for *Undaria* removal and systematically search the surrounding area. And third, initially all removed *Undaria* were measured, reproductive status noted, and spatially referenced.

Materials and methods

Below is a summary of the equipment and methods used to remove the invasive alga *Undaria pinnatifida* from Monterey Harbor. This sheet is a guide for City of Monterey volunteers involved with the management effort. Should you have any questions, contact Dr. Steve Lonhart at the Monterey Bay National Marine Sanctuary by phone 831.647.4222 or via email Steve.Lonhart@noaa.gov.

1. Equipment

Divers must provide all of their own SCUBA gear. Divers also need:

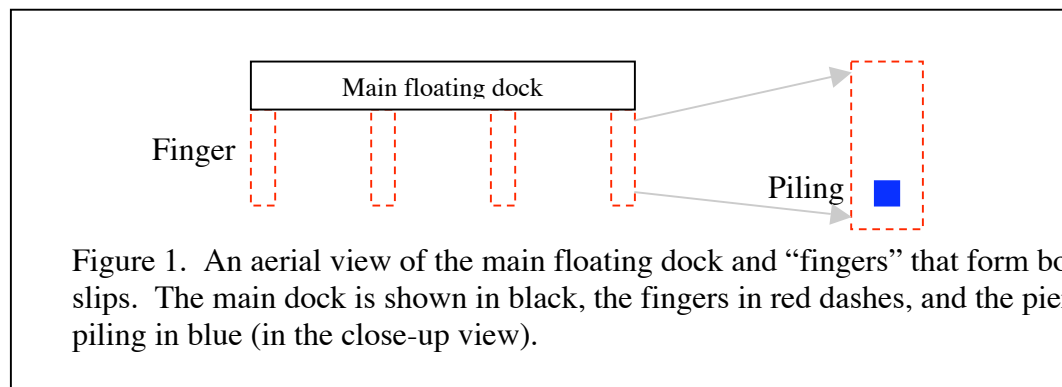
- a scraping tool (e.g., putty knife) with a lanyard;
- a collection/goodie bag with an attachment;
- **extra weight** for shallow diving.

Dockside helpers need the following:

- underwater paper datasheet (from Harbor office), clipboard and pencil;
- meter tape;
- scraping tools (from Harbor office);
- trash bags to hold measured *Undaria*.

2. Study site

Management sites in the harbor are selected by MBNMS and harbor staff; always check-in to determine where you should be working. There are three types of structure sampled within the marina. The first is the cement pier piling at the end of the dock “finger”. These cement pilings have four sides and are usually in 20 feet water or less. The entire submerged piling must be sampled. Perpendicular to the main floating dock are “fingers” that create the boat slips. This second type of structure has a bottom (not sampled) and three sides (east, west, and tip). The third structure is the main dock itself, but only the portion between the fingers. To date, no *Undaria* (or any other alga) has been found on the bottom of the floating docks (main or fingers), suggesting there is not enough light to support the growth of juveniles.



3. Sampling units

We have three main “sampling units” in this study: fingers, main docks, and pier pilings. A sampling unit is the lowest level of replication in a study. In order to make comparisons between sampling units, it is crucial that *Undaria* from a given sampling unit are not mixed in with *Undaria* from other sampling units. For example, the pier piling labeled H33H32 (i.e. the piling between slips 33 and 32 on H-tier) has several *Undaria* but there are also *Undaria* growing on the finger immediately adjacent to and supported by that piling. Since all of the *Undaria* removed from the piling consist of one sample, and all of the *Undaria* removed from the adjacent finger make up a different sample, the two samples must be collected, measured and recorded separately.

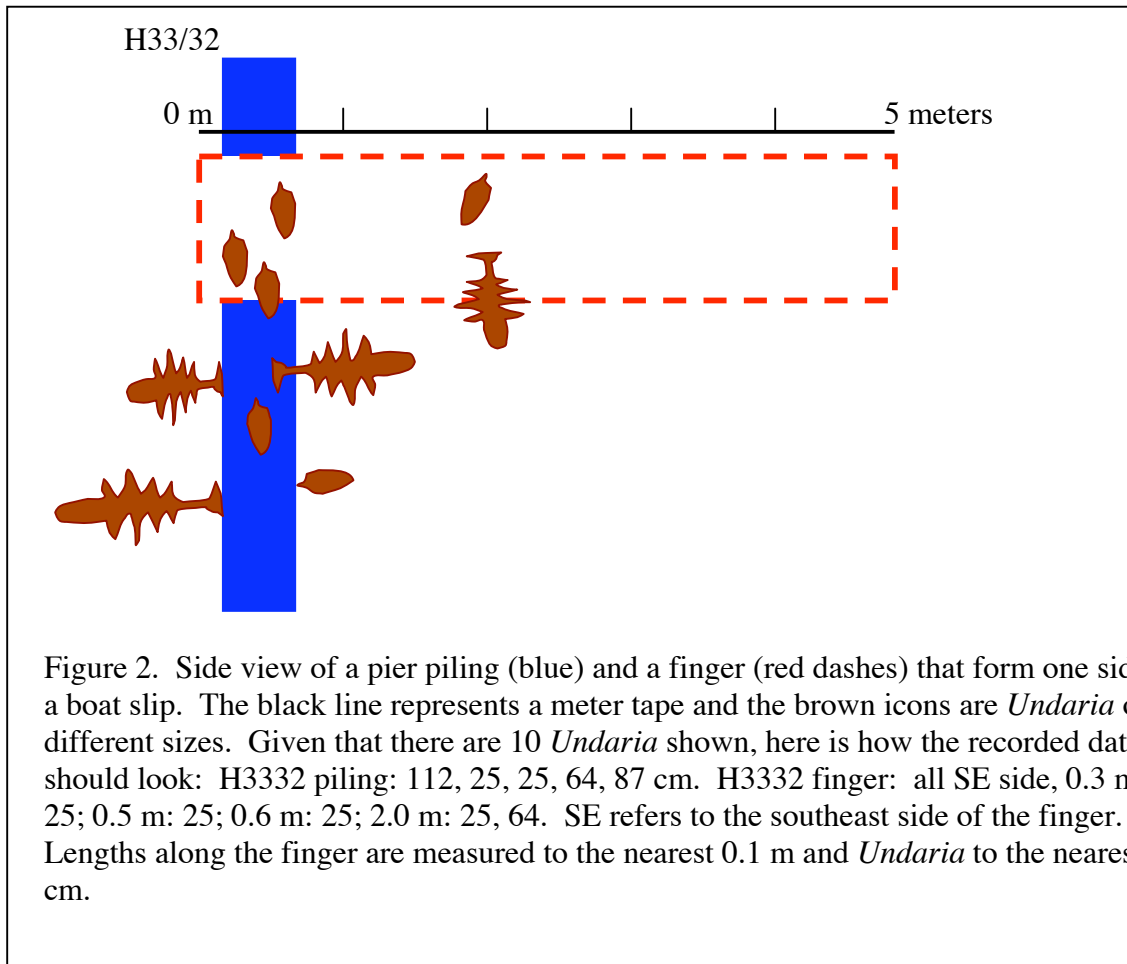


Figure 2. Side view of a pier piling (blue) and a finger (red dashes) that form one side of a boat slip. The black line represents a meter tape and the brown icons are *Undaria* of different sizes. Given that there are 10 *Undaria* shown, here is how the recorded data should look: H3332 piling: 112, 25, 25, 64, 87 cm. H3332 finger: all SE side, 0.3 m: 25; 0.5 m: 25; 0.6 m: 25; 2.0 m: 25, 64. SE refers to the southeast side of the finger. Lengths along the finger are measured to the nearest 0.1 m and *Undaria* to the nearest cm.

Pier piling procedure

Once divers are in the water, they need to carefully and methodically cover the entire pier piling. All *Undaria* observed must be removed and placed into the collection bag. Once a piling has been completed, and if the diver collected any material, then the bag must be emptied at the surface (e.g., hand it up to the dockside person) and the contents measured. If nothing was collected the diver should continue on to the next pier piling.

Finger and main dock procedure

Once divers are in the water, they need to carefully and methodically cover all three sides of the finger. All *Undaria* observed must be removed and placed onto the surface of the finger immediately above the removal site. The dockside observer must place the meter tape down the center of the finger, with 0 m at the end of the finger. For all *Undaria* placed on top of the finger, the dockside observer must record the following: the distance along the finger, the side of the finger (W or E), and the sizes of all individuals for that position on the finger. If a sampling unit was surveyed but nothing was removed, be sure record this information on the data sheet (e.g., H24 piling: none seen, or H24 piling: a few small ones seen, none removed).

4. Measuring *Undaria*

The dockside observer needs to record the maximum length for each of the removed individuals. Length is measured from the base of the holdfast to the most distal part of the thallus (the body of the alga). Since the holdfast is typically planar, it often lines up perpendicular to the plane of the meter tape when the rest of the thallus is flattened along the meter tape. If you imagine the alga as a feather attached to a disc, the disc will be placed on edge at the zero meter mark on the tape. The thallus needs to be flattened along the rest of the meter tape. Measure to the nearest centimeter.

In most cases the thallus is damaged, and only part of the blade remains. If this is the case, record the maximum length and write “d” (for damaged) after the measurement (e.g., 32d for a 32 cm, damaged individual). In contrast, if only the holdfast and part of the stipe (with no blade) remain, then measure it and add “hf” (for holdfast) after the measurement (e.g., 12hf for a 12 cm holdfast and piece of stipe).

5. Undaria reproductive status

If the individual has sporophylls (the hard, ruffled edges near the base), then write an “S” after the size (e.g., 67ds is a 67 cm long, damaged adult with a sporophyll). If you have been trained to tell whether a sporophyll has shed spores, then note spore release as “M” for mature (e.g., 98dm is a 98 cm long, damaged adult that has released spores).

6. Removal without measurements

In some cases, you will be directed to simply remove the *Undaria* without measuring it. Measuring *Undaria* is time consuming, and it is not necessary to measure every single *Undaria* removed. Once a large enough sample size has been reached (e.g., 300 individuals) for a particular area, further measurements are not needed. Be sure to check with Steve or Scott to determine whether measurements are needed.

Undaria must be placed in a dumpster after they have been removed and measured. Turn in your completed datasheet to Scott Pryor. Be sure to record your names, work interval, and the date (e.g., John Doe, dockside observer and Jane Smith, diver; Jan 2, 2004; 1030-1345 hr).