Potential impacts of non-native aquatic plants in Tomales Bay, CA

Jennifer Gamurot
May 9 2018
Greater Farallones National Marine Sanctuary
Advisory Council

Research Objectives

- Evaluate impacts of two non-native aquatic plants
- Analyze prevention and control methods
- Synthesize research into suitable management strategies for introductions into Tomales Bay


M O L

Economic impacts

- $120 billion in annual losses to the U.S. (Pimentel et al. 2005)
  - Aquatic plants: $500 million
  - Green Crab: $100 million

- Hampers recreational boating and fishing in navigable waters

Terminology

Introduced species: Non-native to California coast and sanctuary (GFNMS 2014)

Invasive species: Non-native species whose introduction does or is likely to cause economic, environmental harm, or human harm (US DOI 2016)

Vectors

Human-mediated

- Vessel hull fouling
- Ballast water transport
- Live trade

Natural dispersal

- Drifting
- Transported in strong water currents
- …and natural disasters

Undaria fouled on boat in Australia

Japanese tsunami marine debris in Oregon 2012

Cohen and Carlton 1989, Ruiz et al. 2011

The Perfect Storm: Establishment

- Species travels from one region to another
- Match between biotic and abiotic conditions
- Resource availability
- No natural predators

Allendorf and Lundquist 2003

Invasion traits of seaweeds

- Tolerate wide range of environmental conditions
- High dispersal rates
- Rapid growth rate
- High reproduction rate
- Easily fragment

Williams and Smith 2007, Williams 2007

Japanese wireweed (*Sargassum muticum*)

- Native to Southeast Asia
- Invasive in USA, England
- Grows up to 10 meters
- Disperses as drift fragments and fouls on boats
- Present in Tomales Bay (Jepson Herbaria, Cal-NEMO)


Andrew Cohen

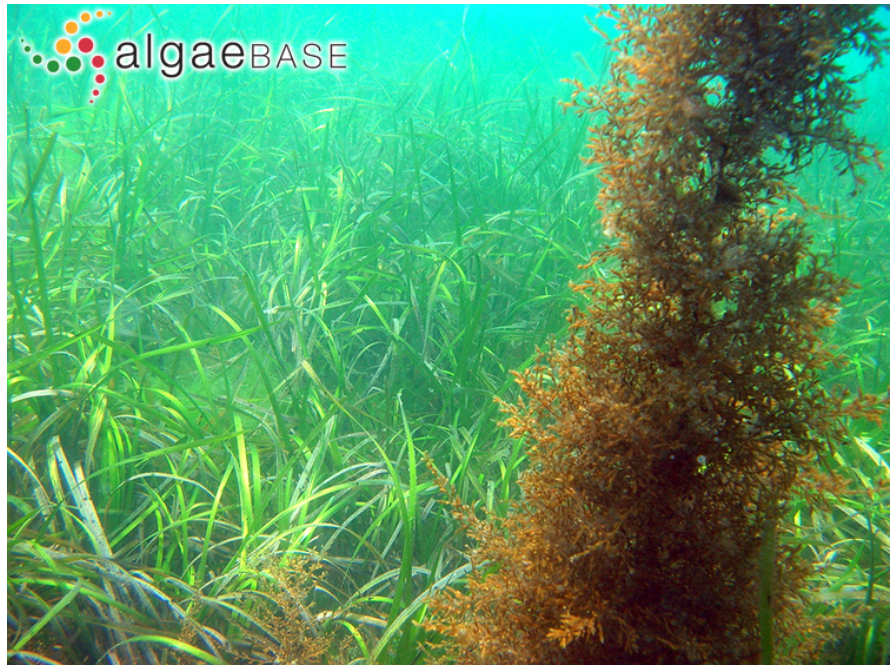

Andrew Cohen

Wallentinus, Critchley et al. 1986

Wireweed threats

Ecological

- Forms dense canopies and shades understory species
- Competes for space and light



Economic

- Fouls on boat hulls and equipment
- Hinders transportation

Wallentinus, Critchley et al. 1986

Recorded locations (estimated) of Sargassum in Tomales Bay (from University and Jepson Herbaria (1984-1997)

Wakame, Asian Kelp *(Undaria pinnatifida)*

- Native to Southeast Asia
- Invasive in Australia, New Zealand, USA
- Disperses naturally and transported through hull fouling
- Grows up to 3 meters
- Not present in Tomales Bay
- Present in San Francisco Bay and Monterey

Hunt et al. 2009, Thornber et al. 2004

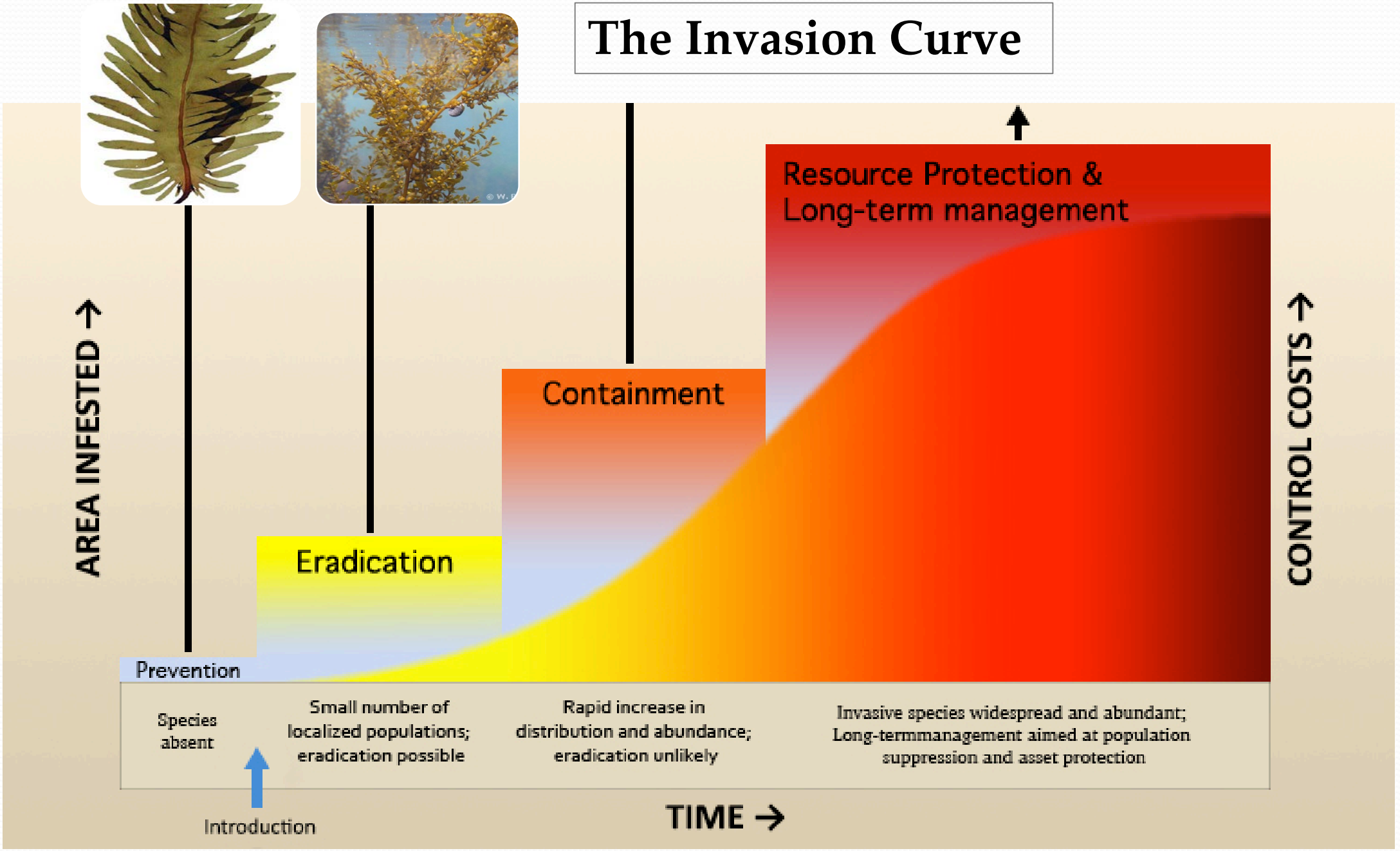
Asian kelp threats

<u>Ecological</u>

- Competes with native giant kelp and red algae for resources
- Reduces biodiversity in understory
- Shading effects

<u>Economic</u>

- Fouls on boat hulls and equipment
- Washes up and rots on beaches



Harvey and Mazzotti 2014

Hand removal for Wireweed

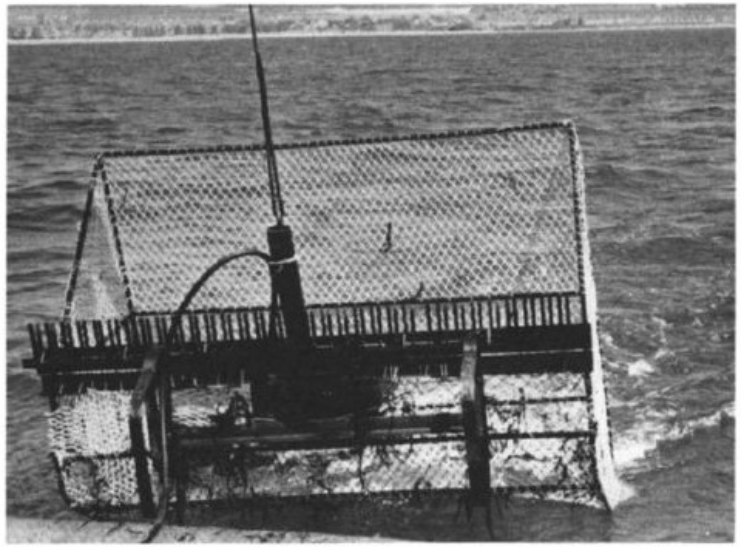
- Small to medium invasions
- Accessible from shore
- Selective
- Least expensive

- Labor intensive
- Time consuming
- Effective only on mature plants

Critchley et al. 1986

Mechanical removal for Wireweed

- Ideal for medium to large invasions
- Offshore populations accessible
- Non-selective
- Expensive
- May propagate further



Mechanical cutter removing *Sargassum muticum* in Bembridge, England

Critchley et al. 1986

Hand removal for Wakame

- Small invasions
- Accessible from shore
- Selective
- Least expensive
- Labor intensive
- Time consuming
- Effective only on mature plants

Volunteer diver removing *Undaria* by hand in Monterey Bay, CA

Hunt et al. 2009, Thornber et al. 2004

Chemical/hot water treatment for Wakame

- Preventative measure or small invasions
- Accessible from shore
- Very effective on all life cycle phases
- Expensive
- Non-selective

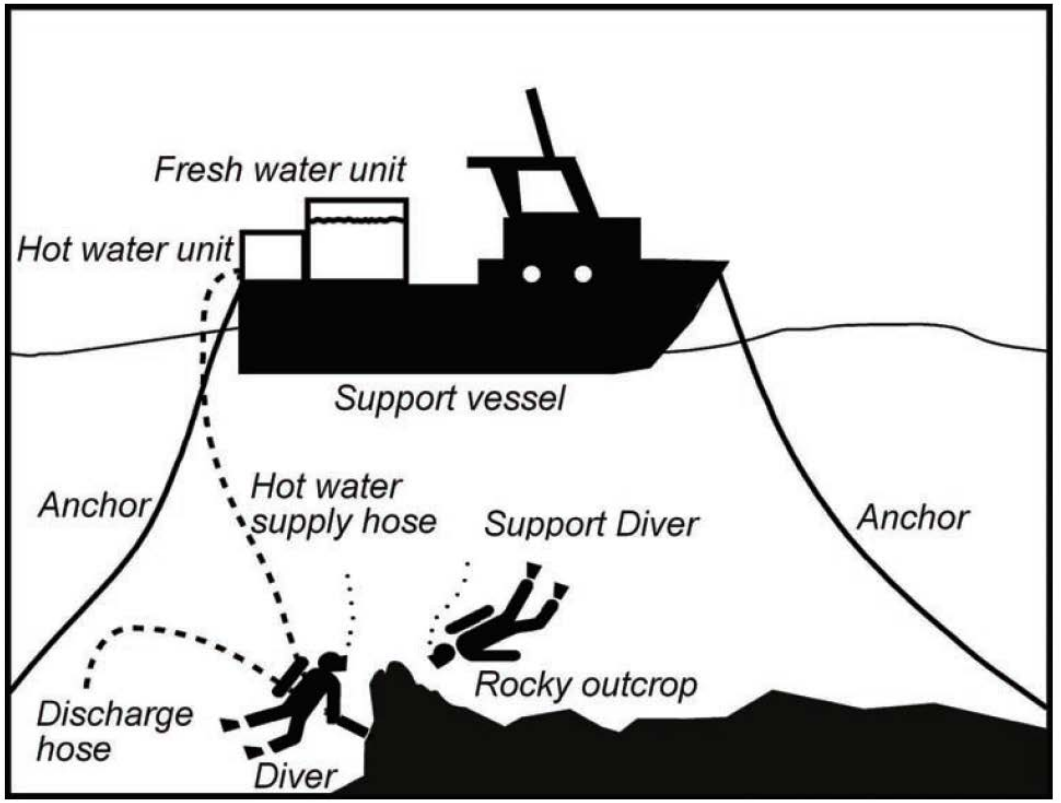


Diagram of hot water treatment (Hunt et al. 2009)

Hunt et al. 2009

Recommendations for control in Tomales Bay

Align management goals and research objectives to conduct eradication experiments

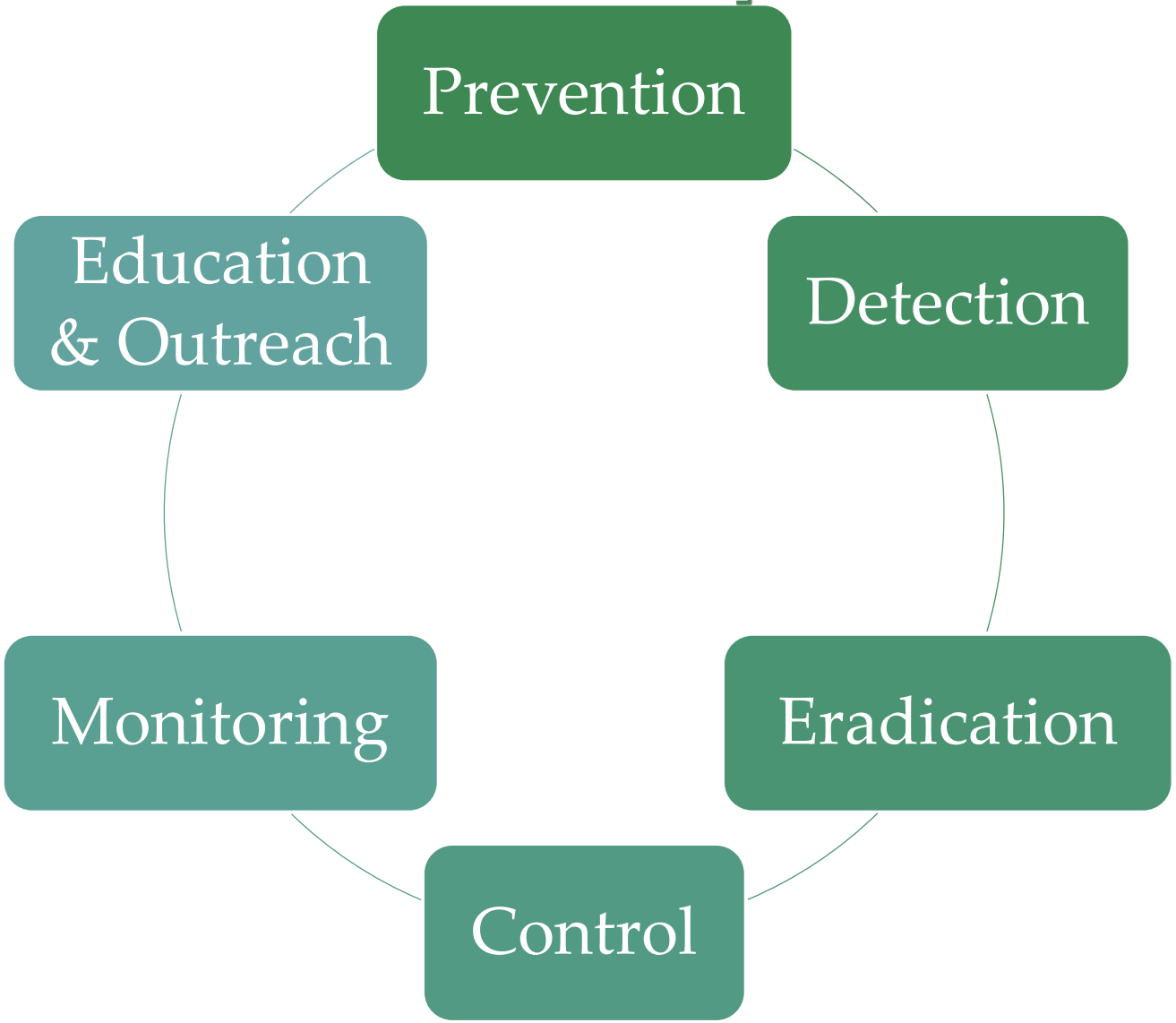
Wireweed

- Detection is priority
- Hand removal (small to medium)

Wakame

- Prevention is priority
- Hand removal (small to medium) and hot water sterilization (medium to large)

Comprehensive invasive species management



Recommendations

- Consider impacts of introduced aquatic plants in ecosystem restoration efforts
- Prioritize detection and eradication in areas susceptible to invasion including eelgrass beds
- Partner with existing plant detection programs in Tomales Bay and Point Reyes National Seashore for up-to-date monitoring
- Integrate education and awareness of invasive species in sanctuary programs


Questions?