

The Devil (Weed) is in the Details:
the Spread and Ecology of
an Invasive Seaweed

Lindsay Marks, Ph.D.

*National Oceanic and Atmospheric Administration (NOAA)
Channel Islands National Marine Sanctuary*

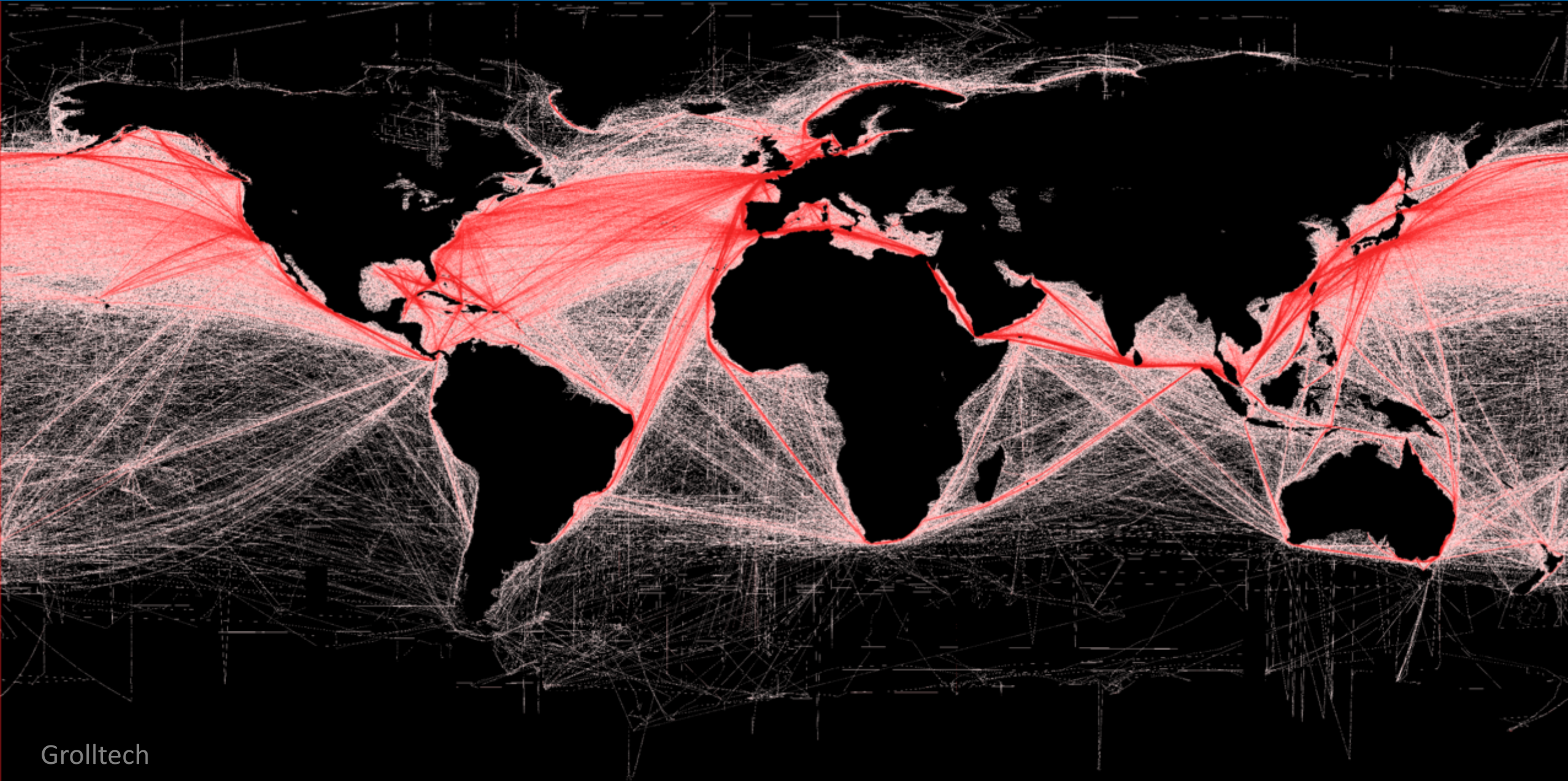
What are invasive species?

- Introduced by humans
- Proliferate/spread
- Unwanted impacts

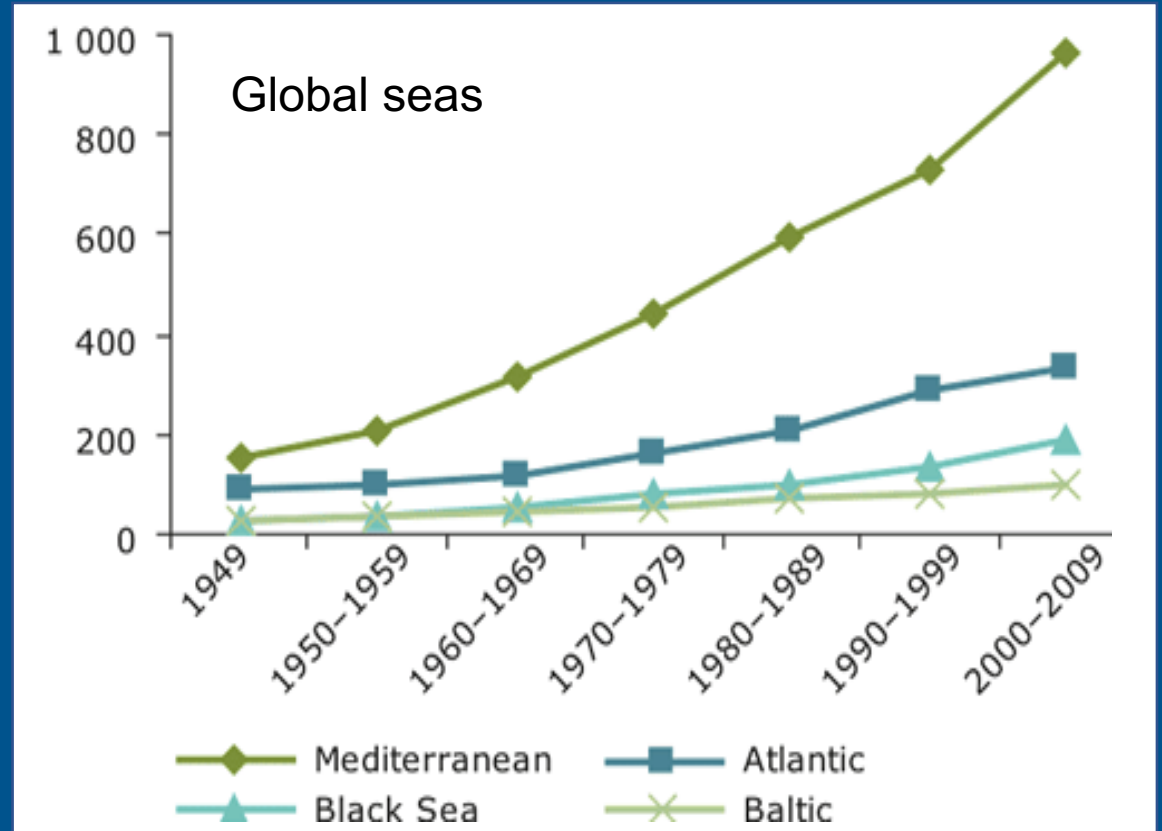
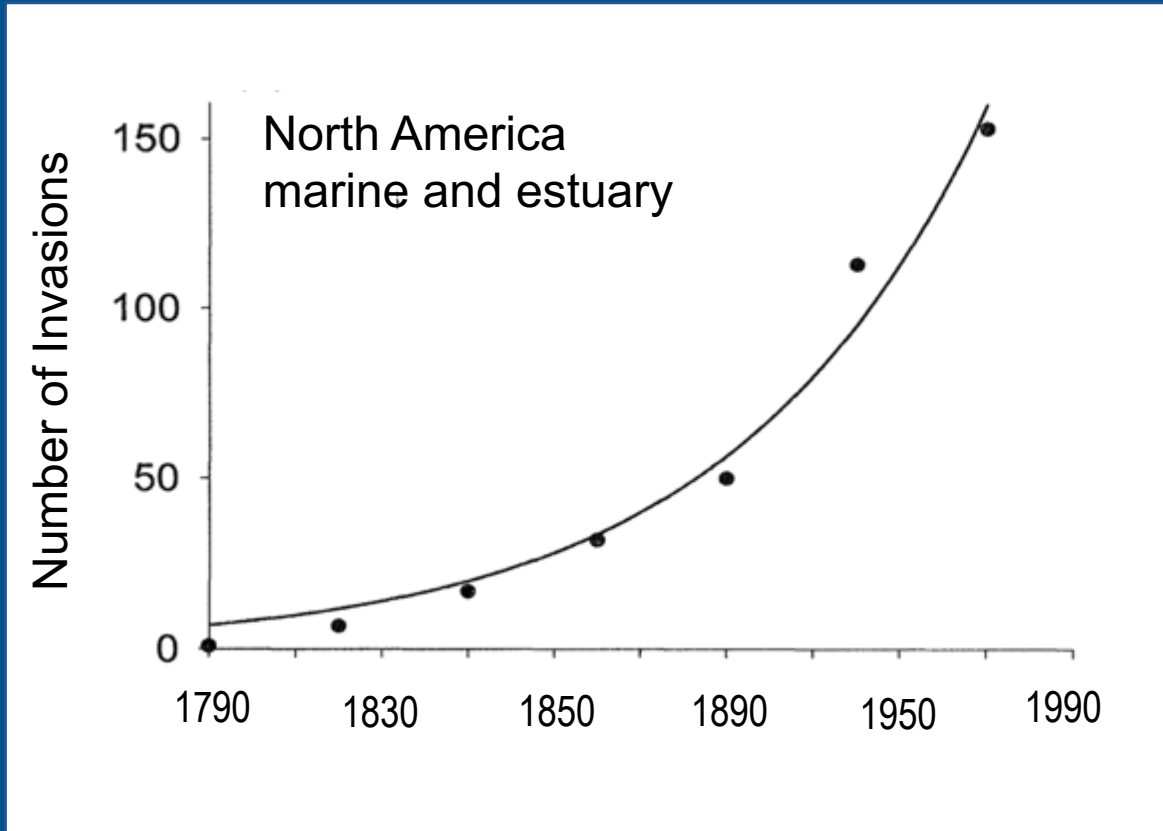
Introduced species can have negative impacts

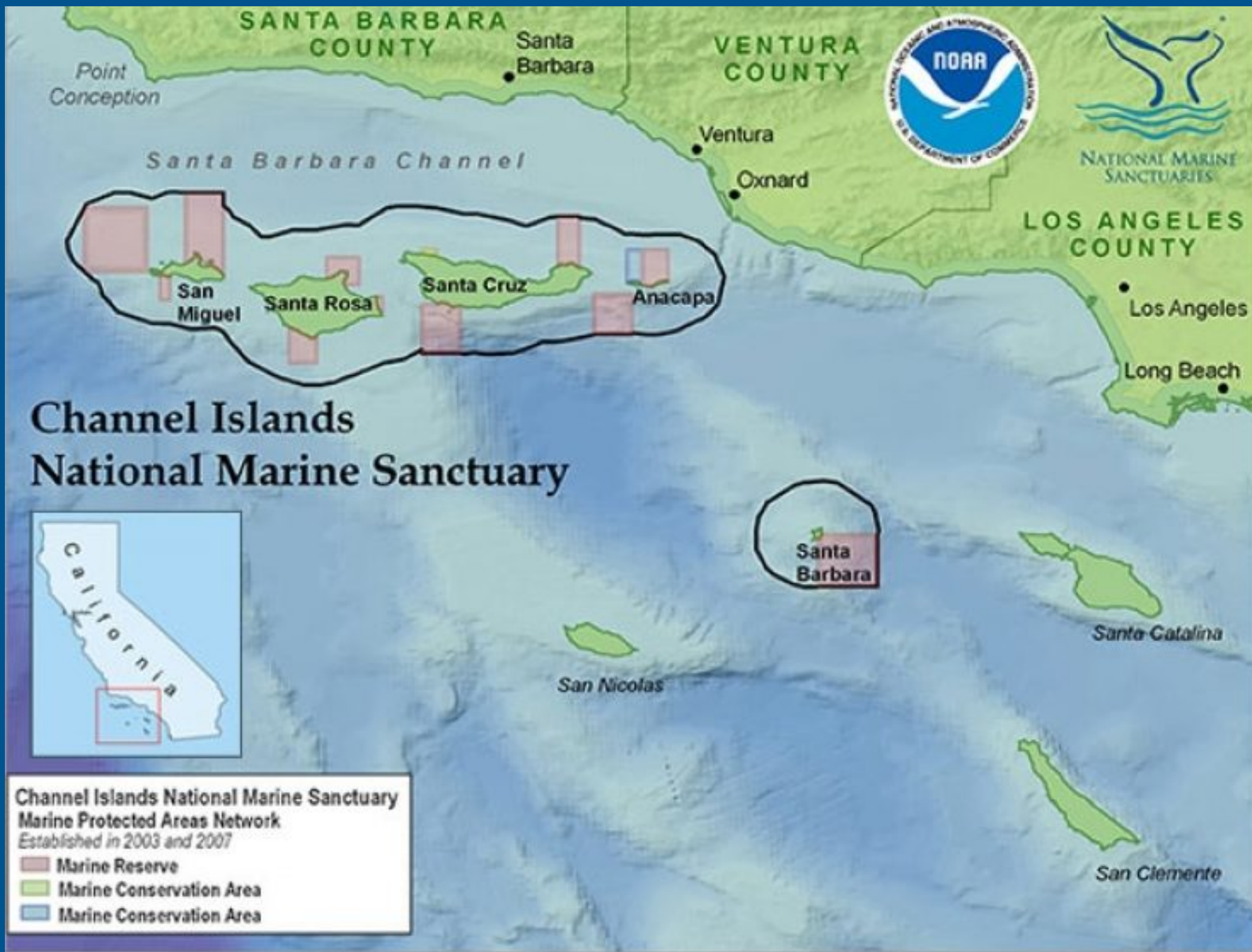


Global coastlines are increasingly connected



Aquatic Invasive Species are increasing globally



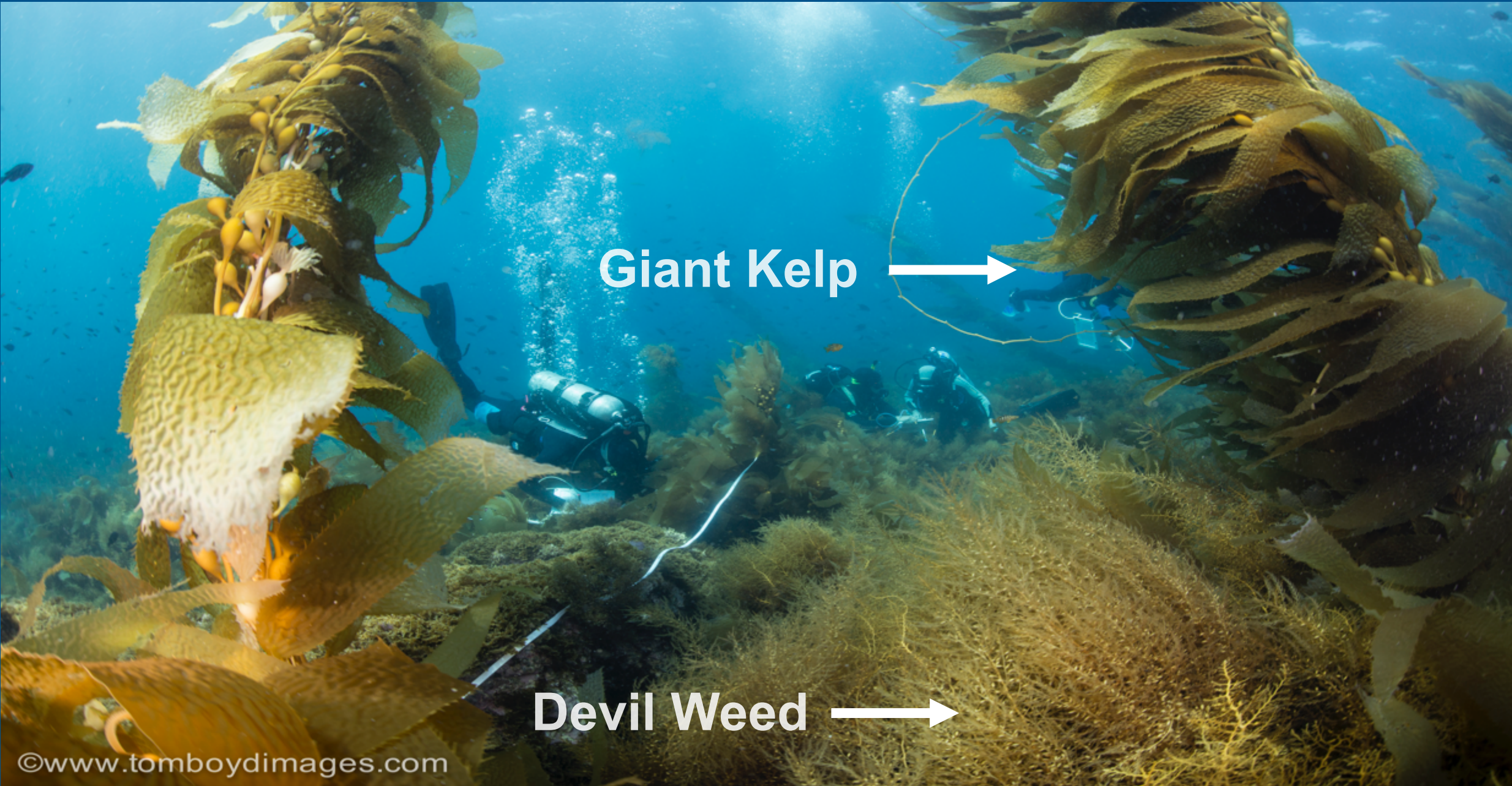






Devil Weed
Sargassum horneri

Katie Davis



Giant Kelp



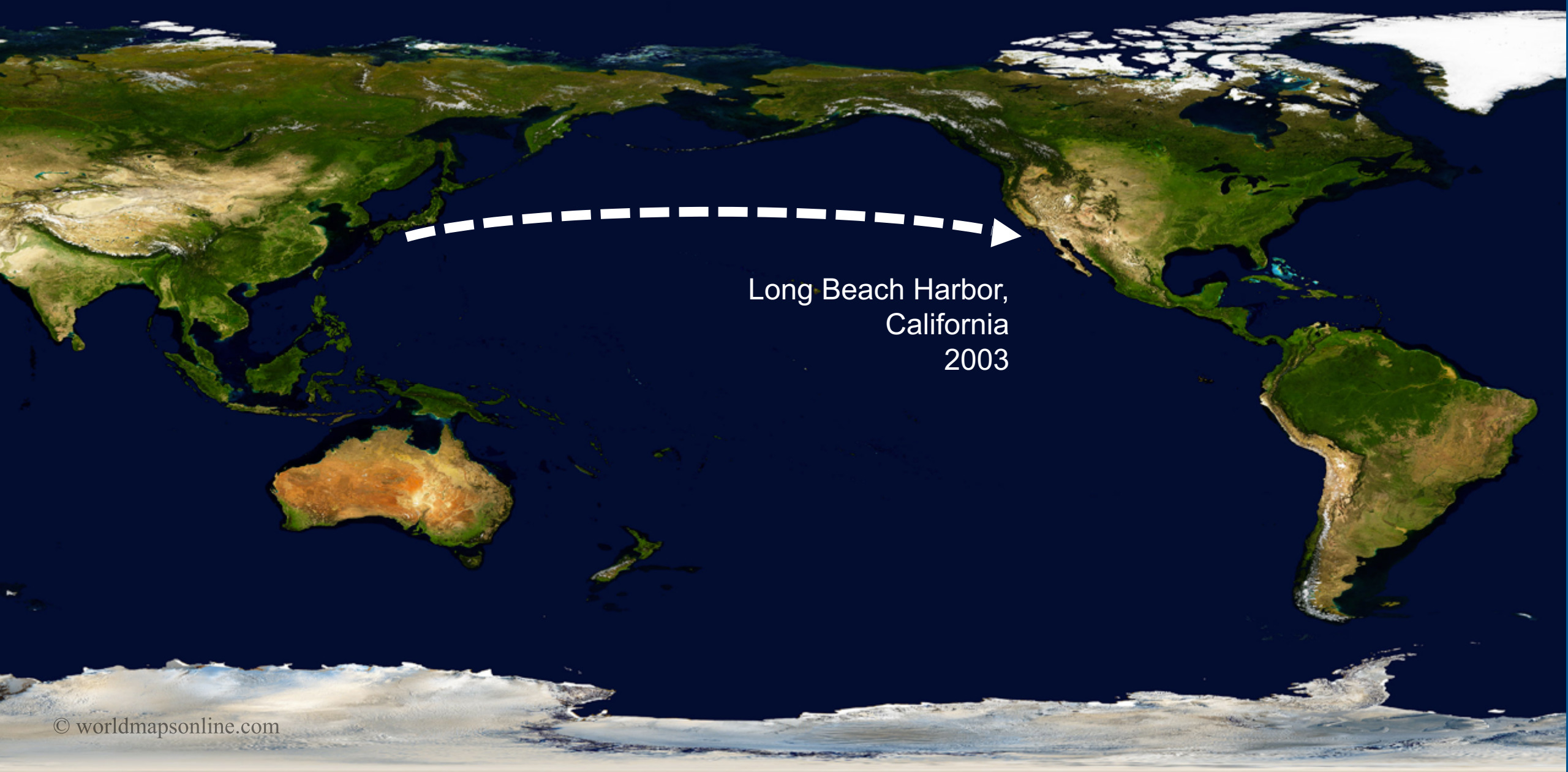
Devil Weed





Lindsay Marks

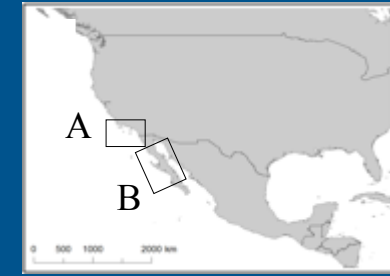
History of Invasion



Long Beach Harbor,
California
2003

History of Invasion

Marks et al. 2015 *BioInvasion Records*

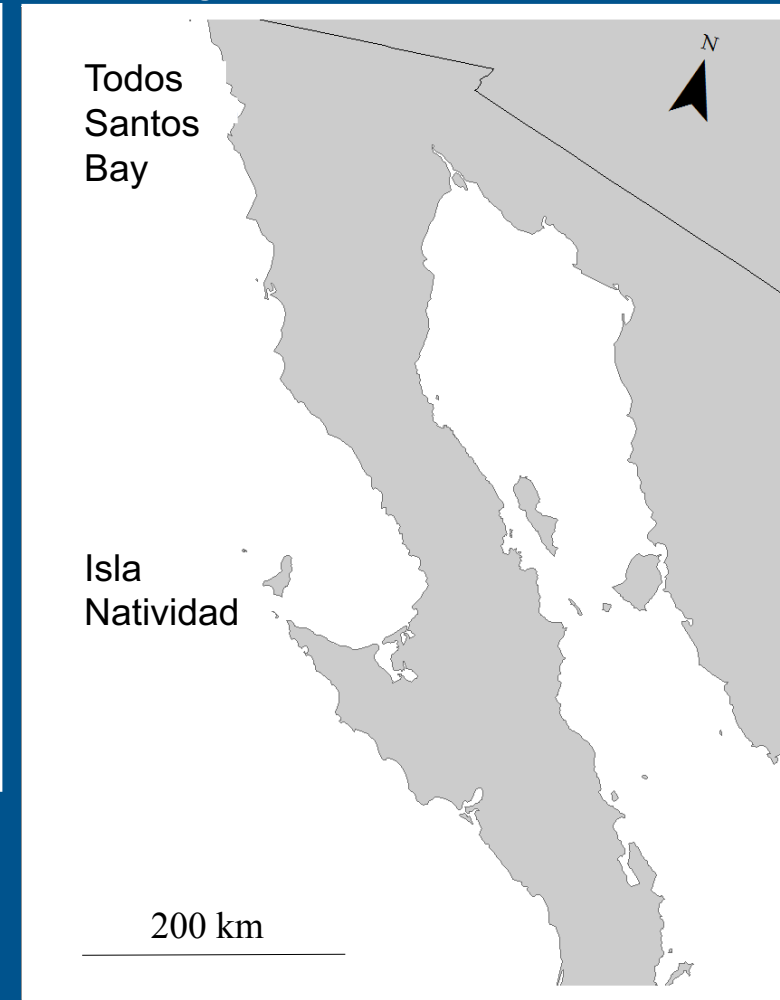


A. Southern California



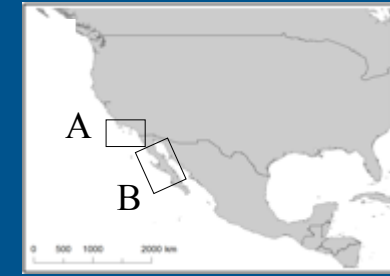
2003

B. Baja California, Mexico



History of Invasion

Marks et al. 2015 *BioInvasion Records*



A. Southern California



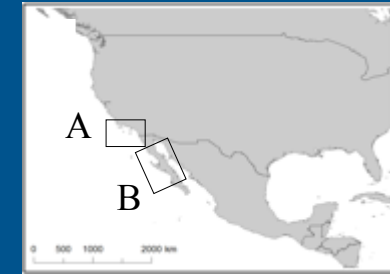
B. Baja California, Mexico



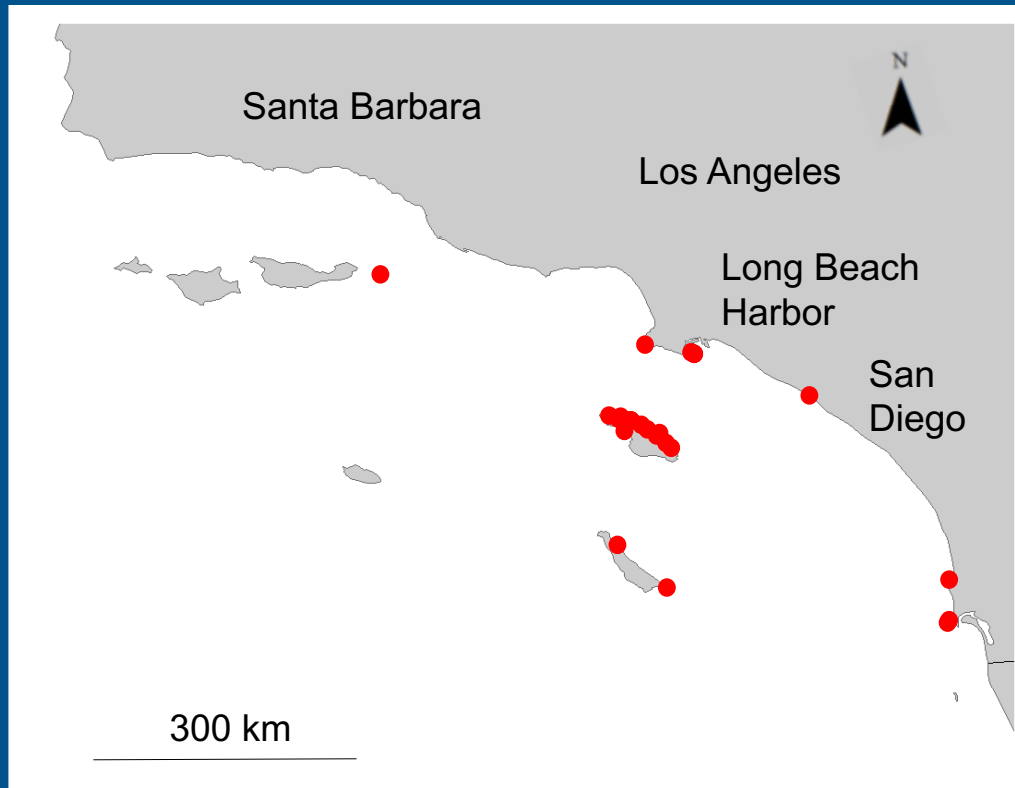
2006

History of Invasion

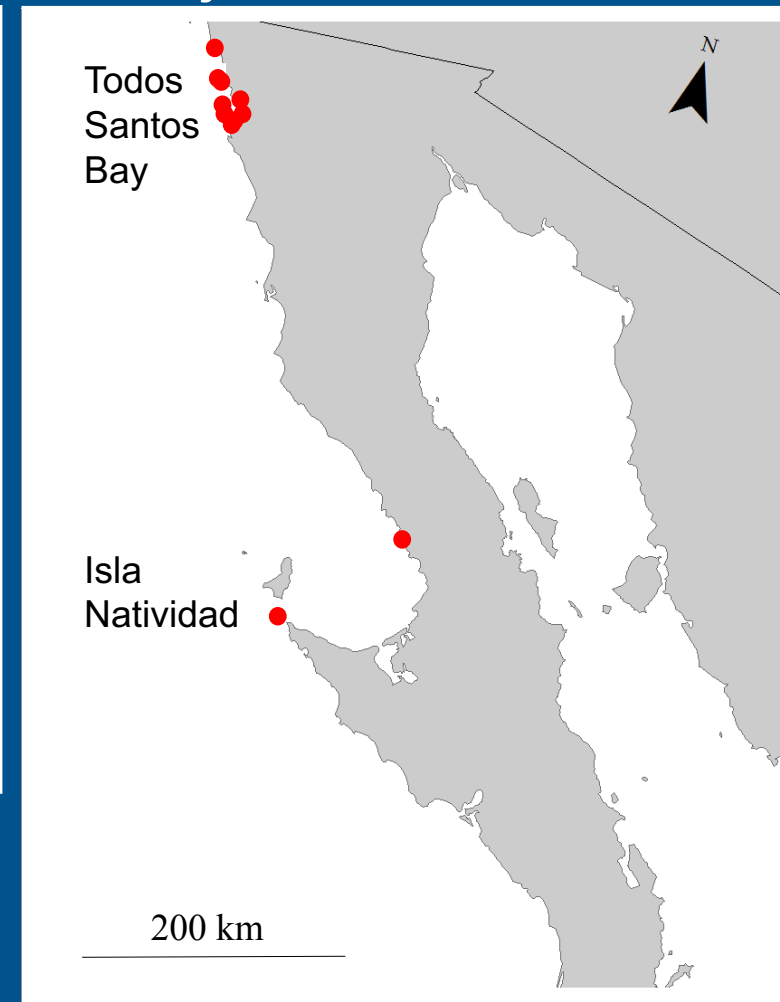
Marks et al. 2015 *BioInvasion Records*



A. Southern California



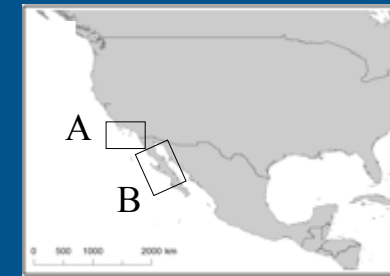
B. Baja California, Mexico



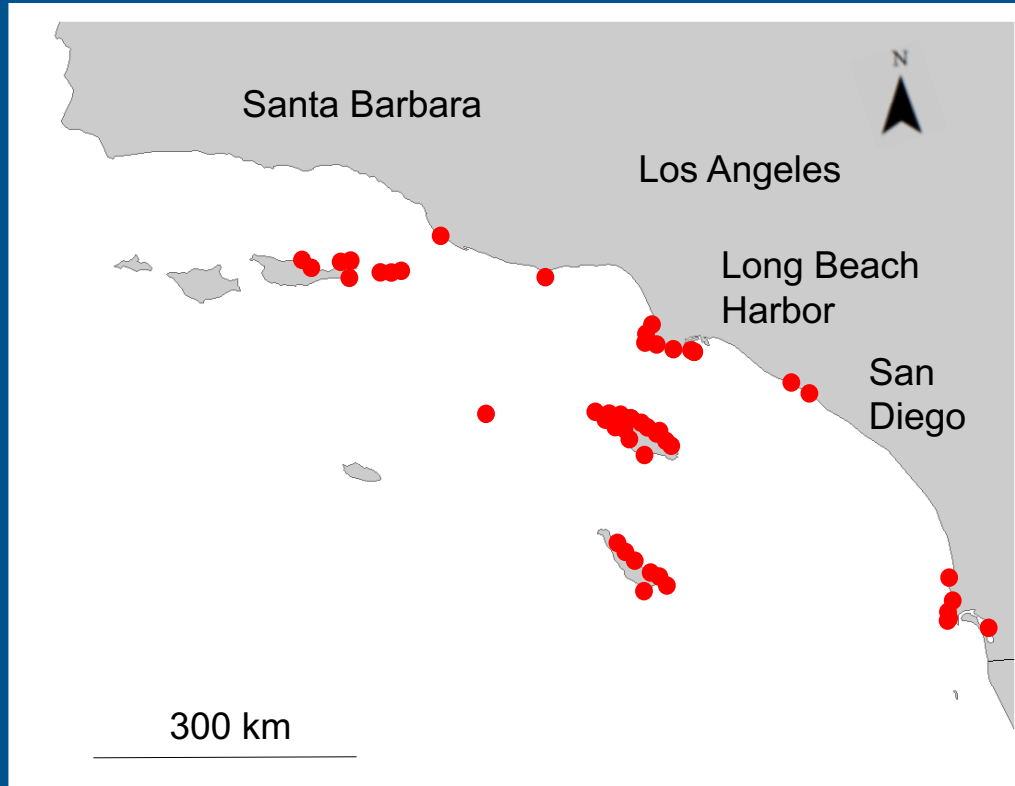
2009

History of Invasion

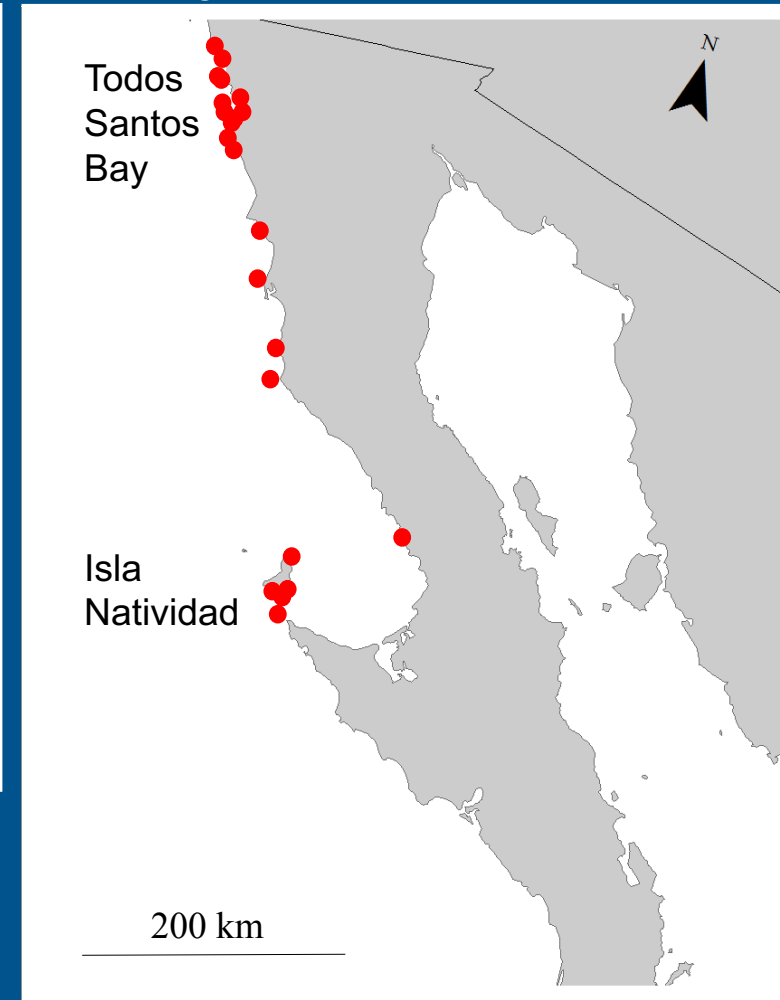
Marks et al. 2015 *BioInvasion Records*



A. Southern California



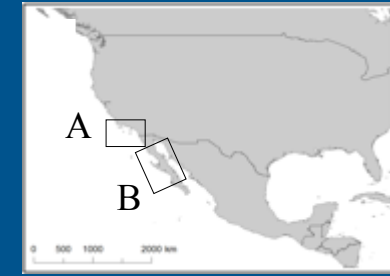
B. Baja California, Mexico



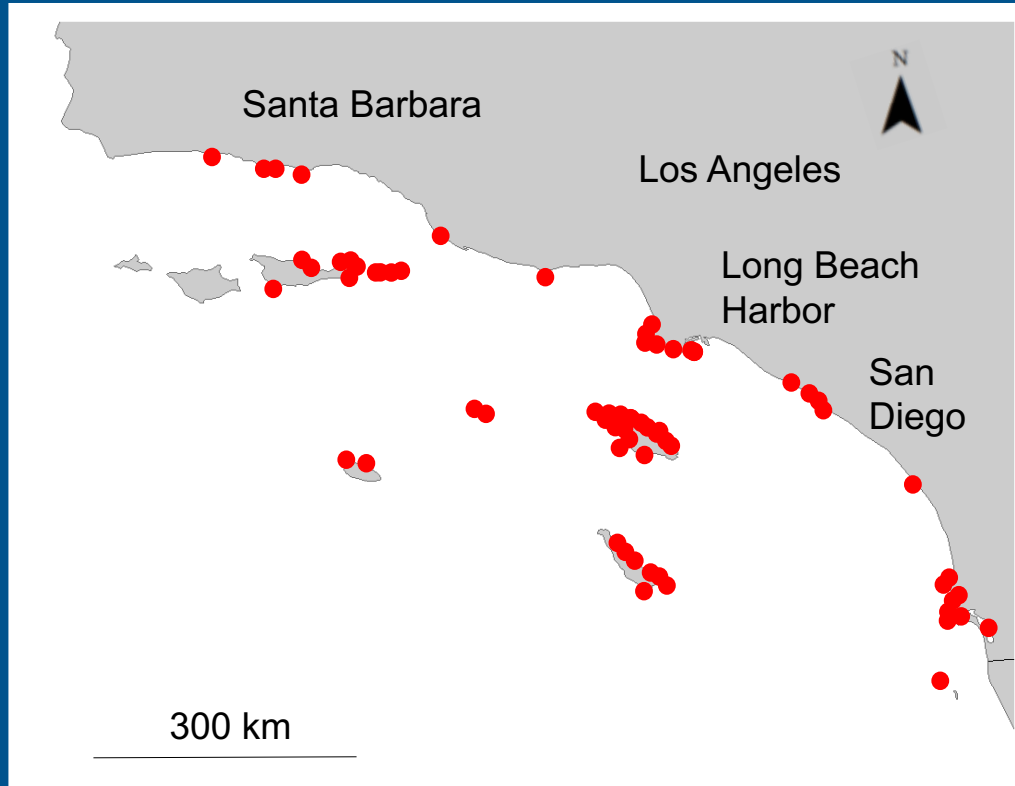
2012

History of Invasion

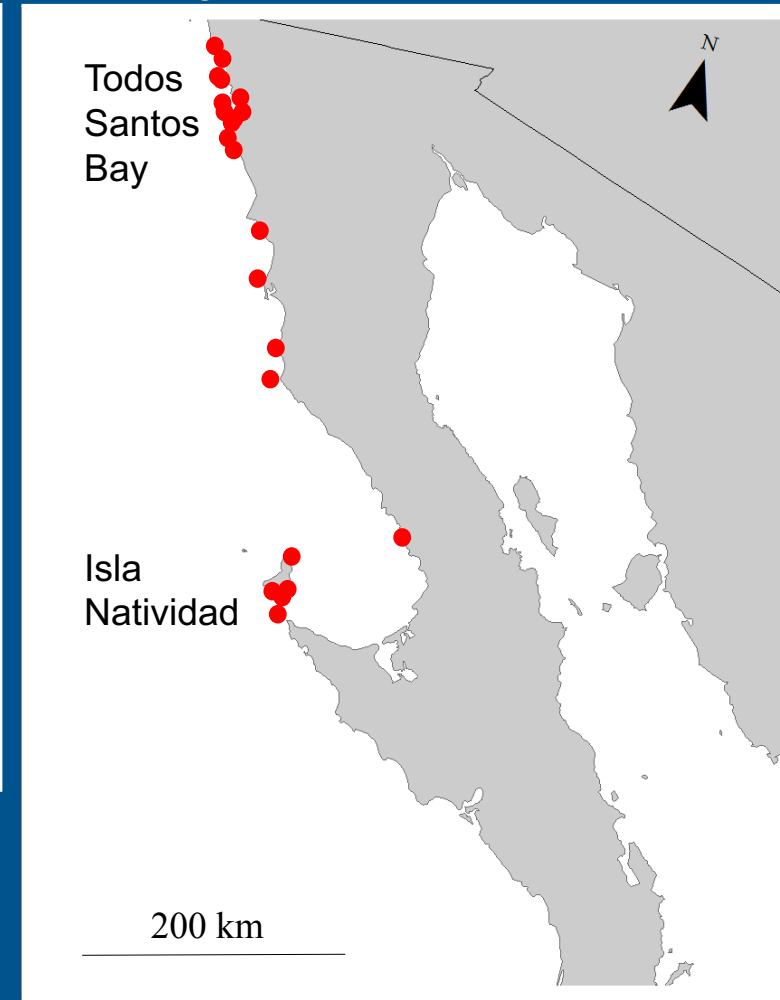
Marks et al. 2015 *BioInvasion Records*



A. Southern California



B. Baja California, Mexico



2016

Annual Life Cycle



Senescent



Mature



Immature



Recruit

Annual Life Cycle



Senescent



Mature

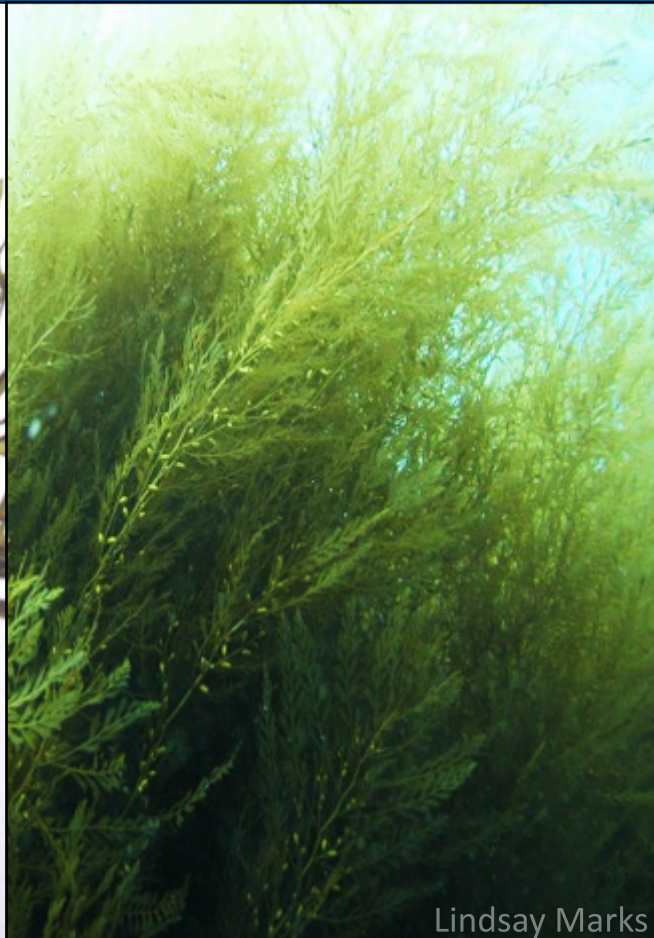


Immature



Recruit

Annual Life Cycle



Senescent



Mature



Immature



Recruit

Annual Life Cycle



Senescent



Mature



Immature



Recruit

Annual Life Cycle



Lindsay Marks

Senescent



Mature



Immature



Recruit

Annual Life Cycle



Senescent



Mature



Immature



Recruit

Annual Life Cycle



Senescent



Mature



Immature



Recruit

OUTLINE

Why is *S. horneri* so successful?

Can you weed a seaweed?

How can we fight marine invasive species?



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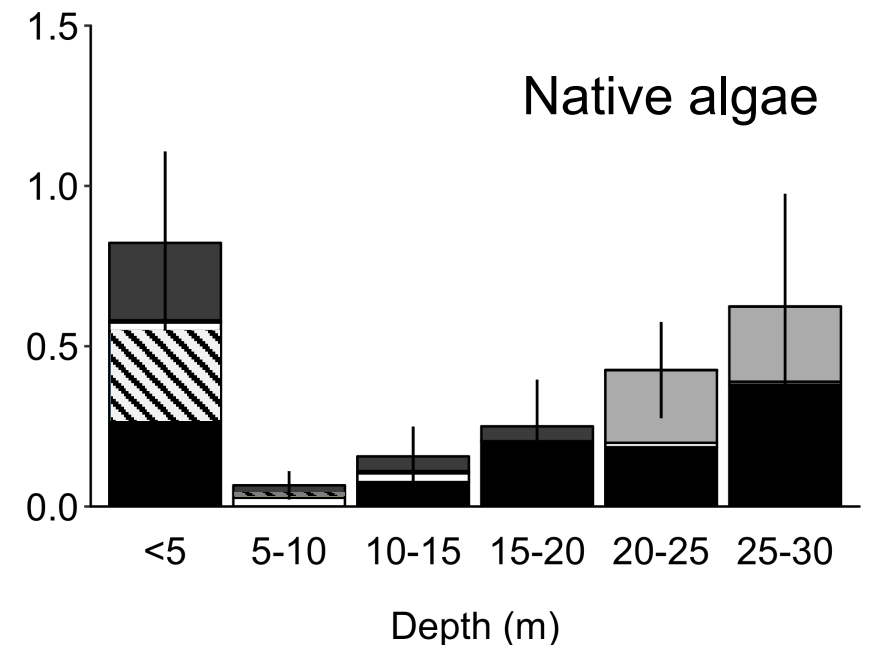
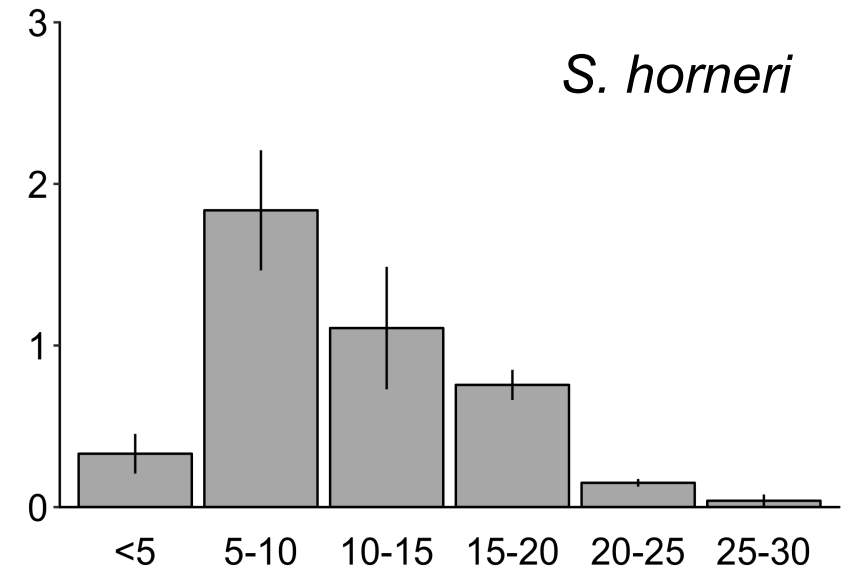


Surveys to characterize
natural history of
S. horneri and native algae
at Santa Catalina Island

S. horneri vs. Native Algae: Depth distribution

- *S. horneri* spans range where native algae found
- *S. horneri* and native algae inversely related

Biomass
(kg/m²)

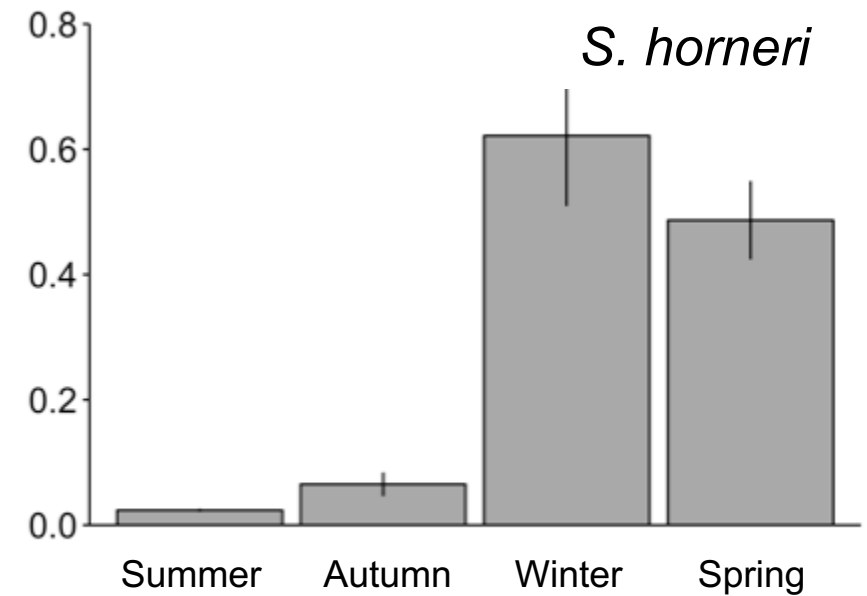


S. horneri vs. Native Algae: Seasonality of biomass

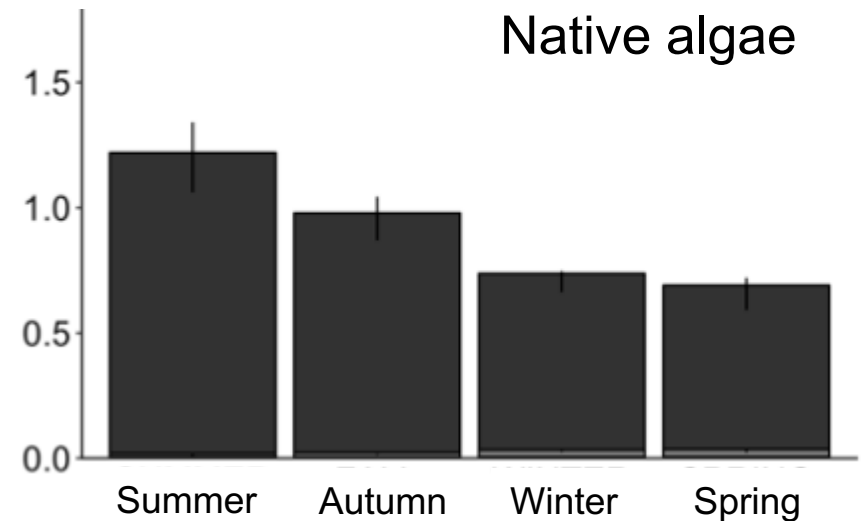
- *S. horneri* is highest when native algae is lowest



Biomass
(kg/m²)



Native algae



Do herbivores prefer native kelps to invasive *Sargassum*?

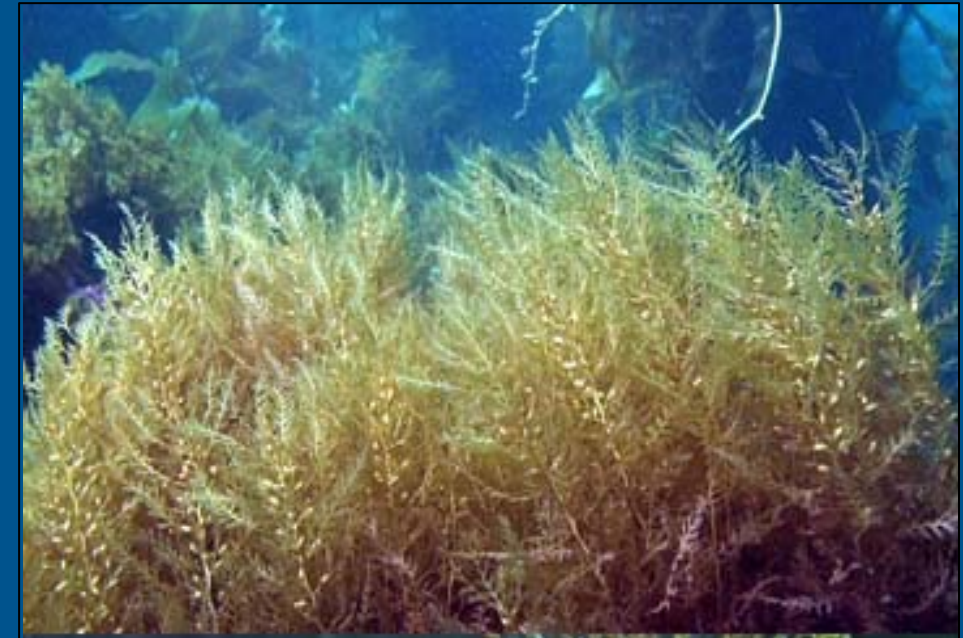


Giant Kelp



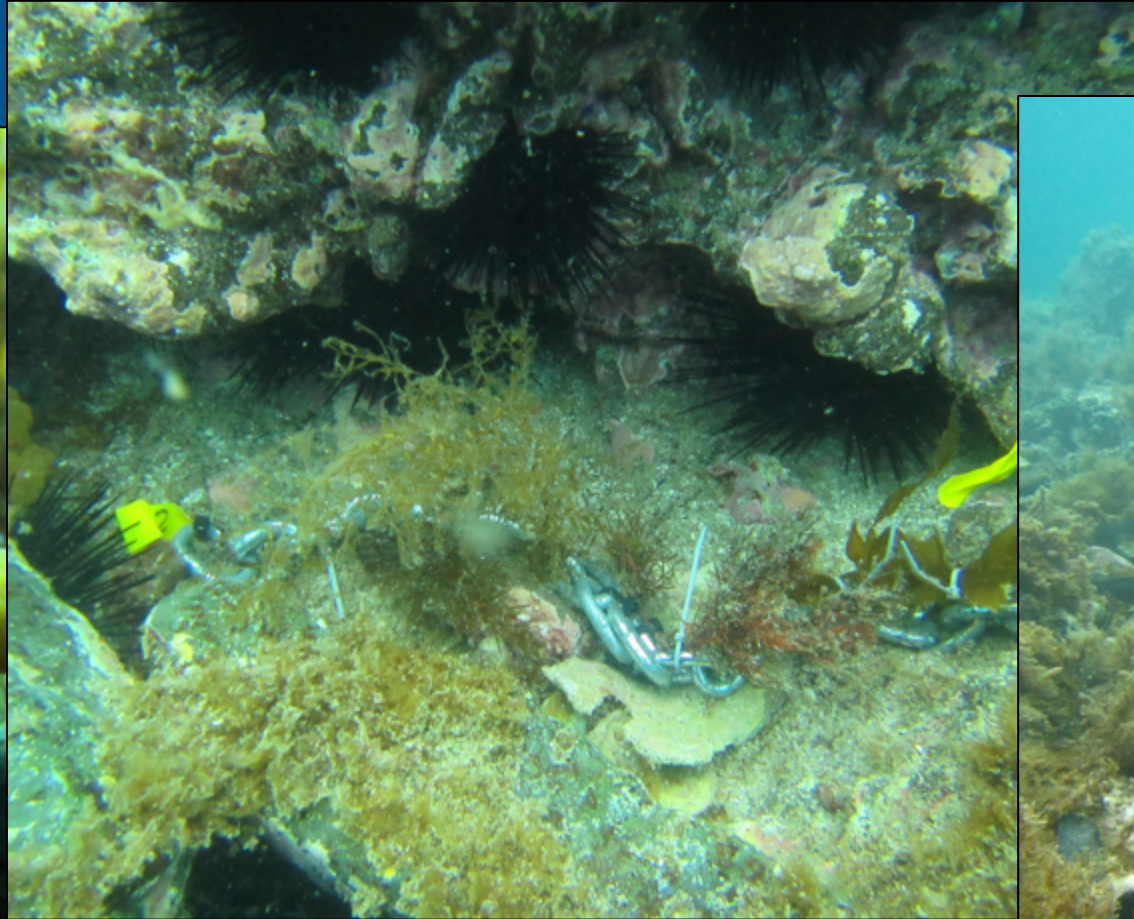
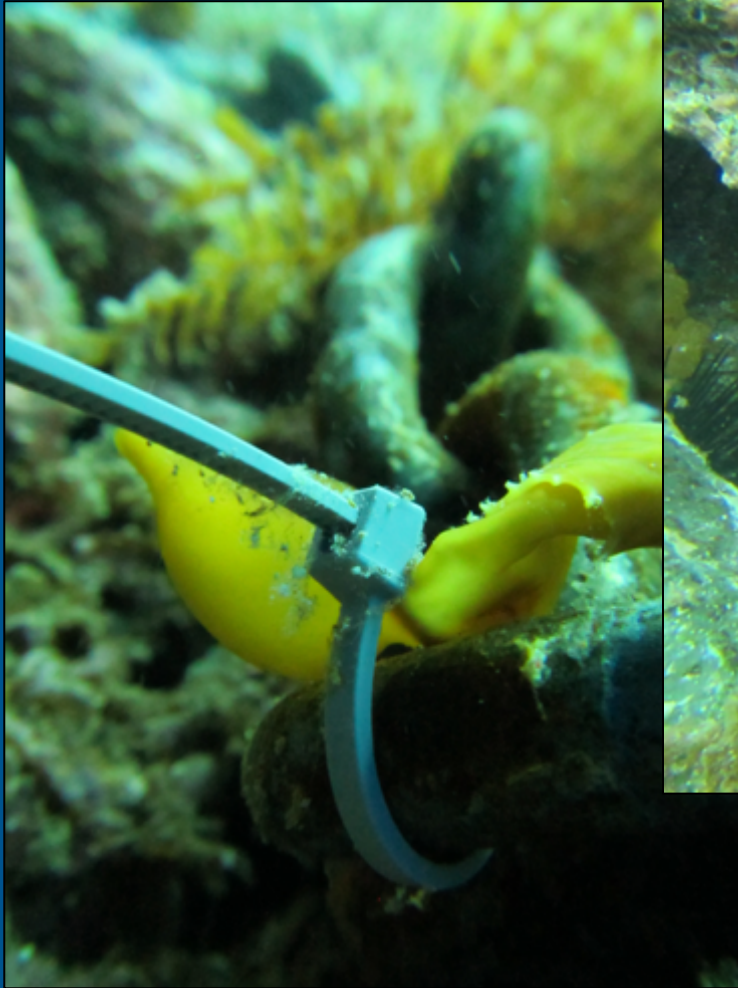
Southern Sea Palm

VS

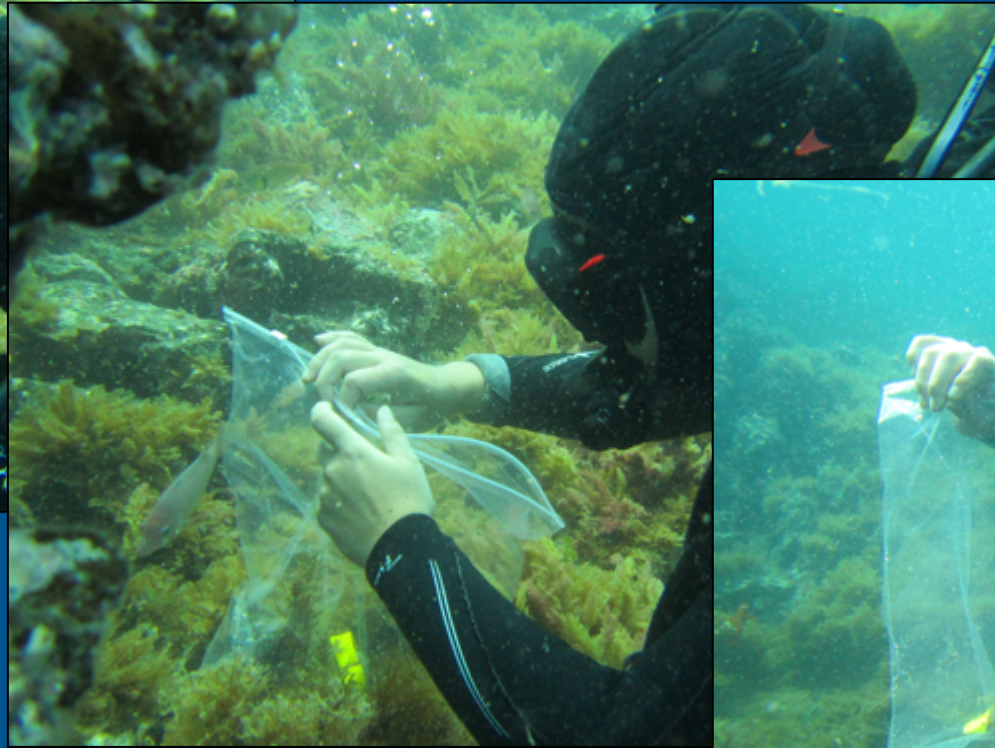
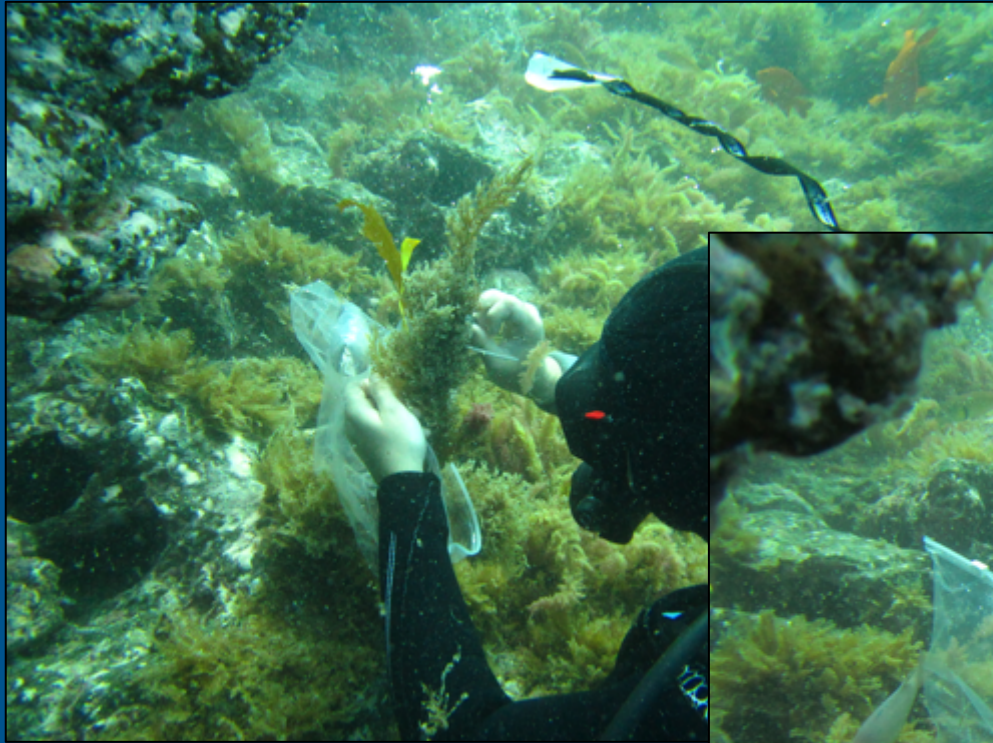


Devil Weed

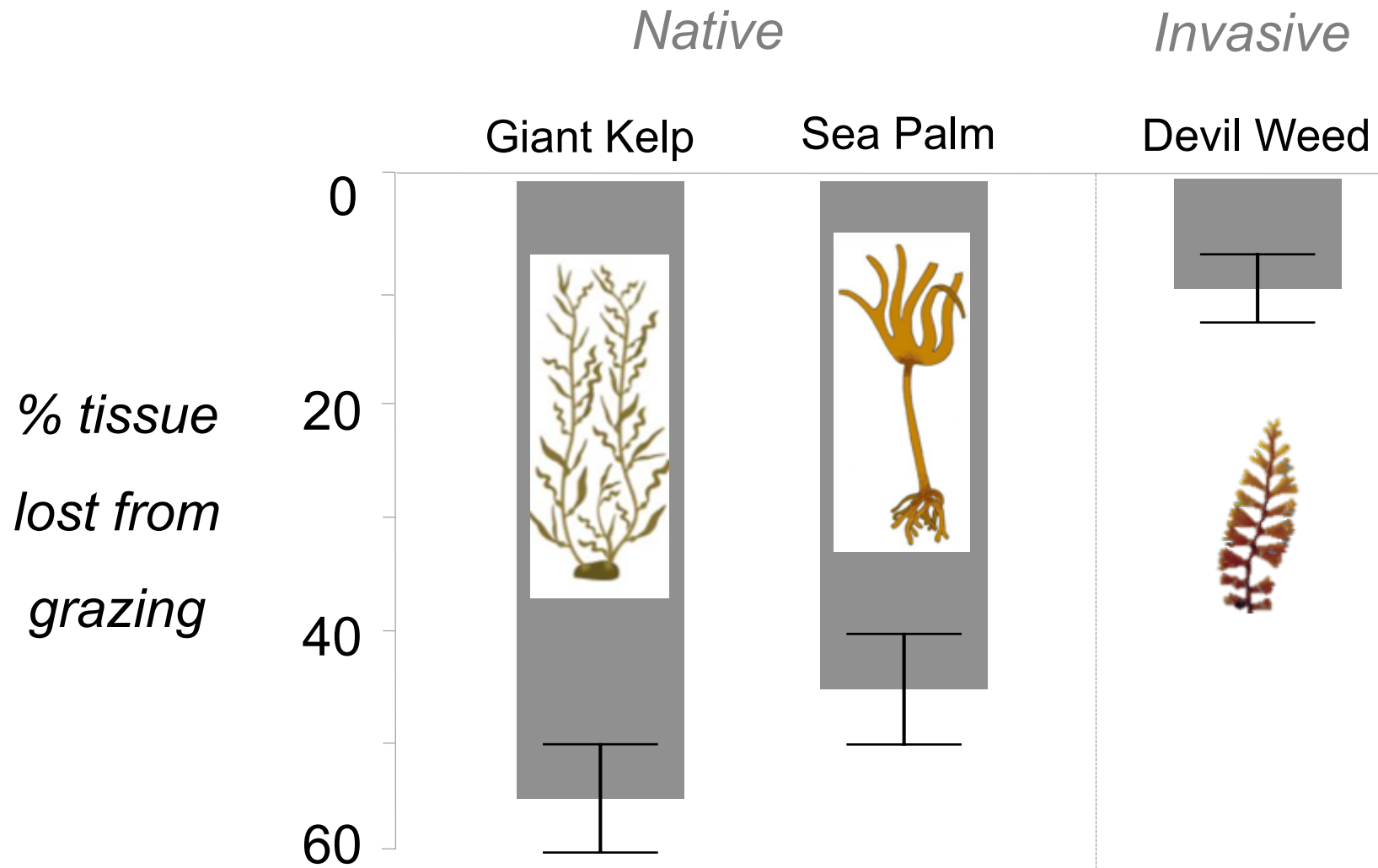
Algae Buffets



Algae Buffets



Algae Buffets



Herbivores prefer to eat native kelp over Sargassum



OUTLINE

Why is *S. horneri* so successful?

Can you weed a seaweed?

How can we fight marine invasive species?



Hyperlink to video of Sargassum removal project:

<https://vimeo.com/121626476>

What is the feasibility of *S. horneri* removal?



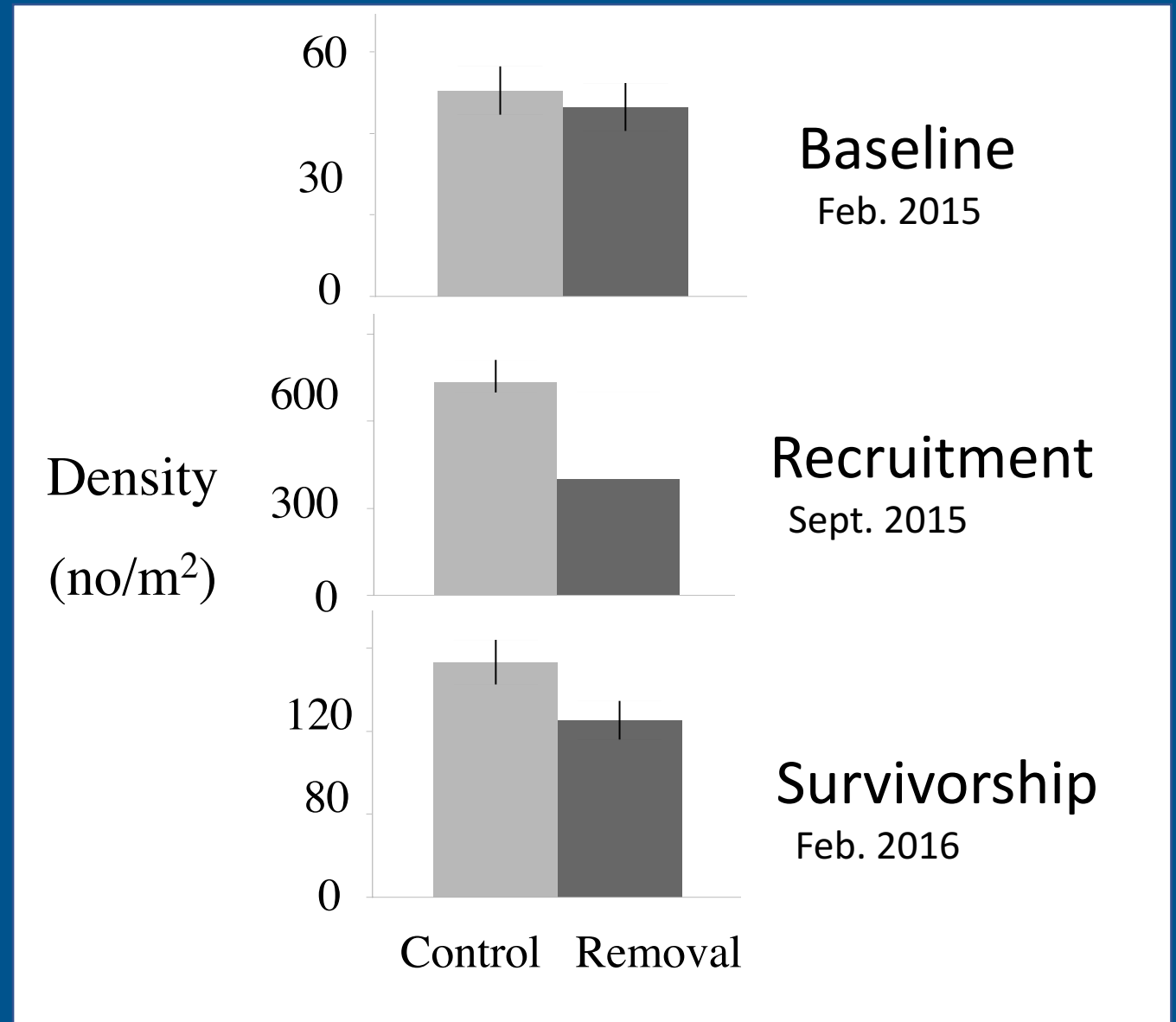
- 1/3 mile² cleared
- > 4 tons removed
- 3 days

Does *S. horneri* removal reduce the next generation?



Does *S. horneri* removal reduce the next generation?

- Recruitment reduced by 50% in removal plots
- Survivorship 25% lower in removal plots vs. controls
- Only slowed population growth



Continuing *S. horneri* removal efforts



[About Us](#) ▾ [Our Work](#) ▾ [Get Involved](#) ▾ [Volunteer](#) [Take Action](#) ▾ [Media Center](#)

Sargassum Abatement



Photo by Tom Boyd

There is a growing number of non-native species being introduced into the marine environment. Today, we are faced with *Sargassum Horneri*, an invasive species that has proliferated along the California coastline that is displacing native habitat, and threatening to undermine the kelp forest restoration we have worked so hard to accomplish. In 2003, this algae was introduced to our coastal waters in Long Beach harbor and has since spread as far north as Santa Barbara, south into Baja, and is now found on many of the Channel Islands. Originating in the warm waters of Japan and Korea, Sargassum's distribution and persistence along the West Coast has generated concern as it poses a potential serious threat to our native ecosystems.

Continuing LA Waterkeeper's mission to protect and restore our marine resources through community action and fieldwork, **Waterkeeper has launched a new dive program that will contribute to the understanding of how sargassum is impacting our nearshore ecosystems.**

OUTLINE

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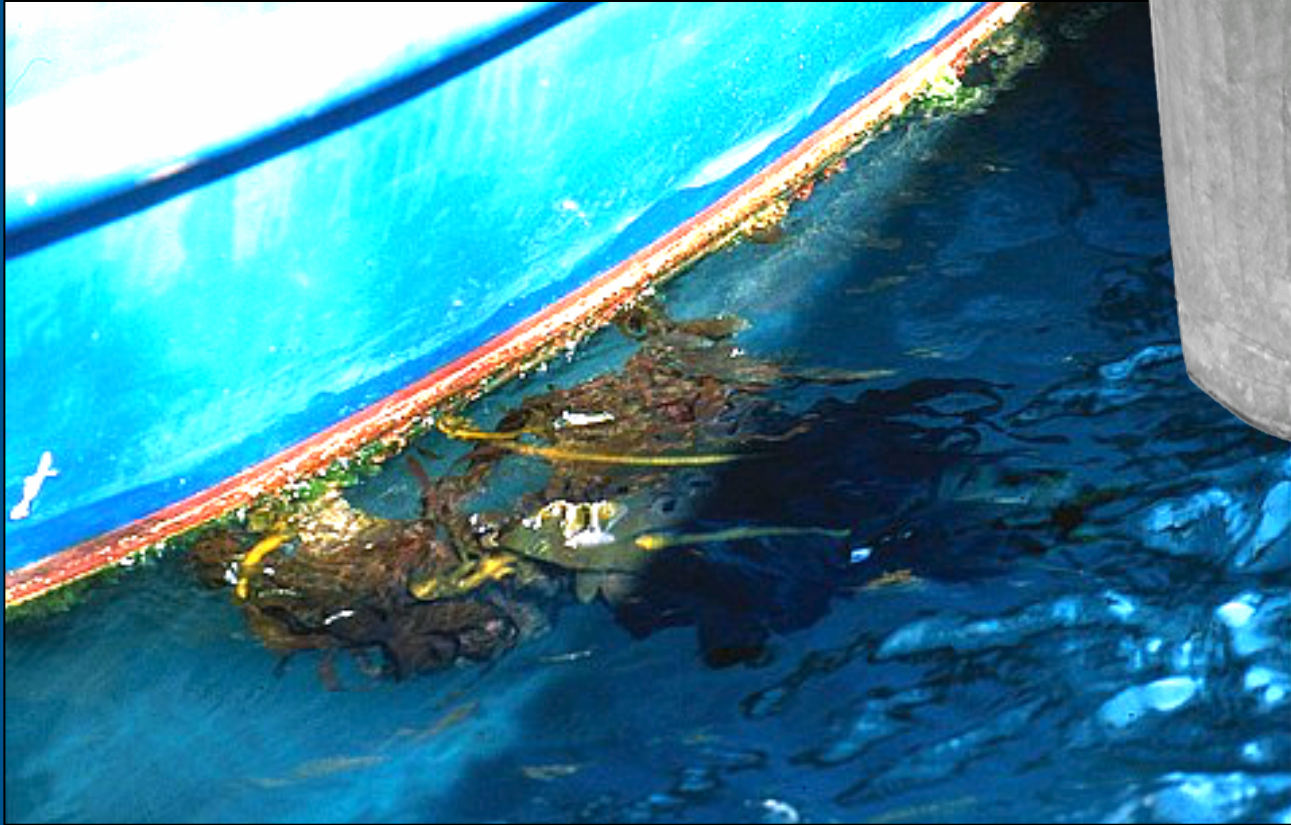
How can we fight marine invasive species?



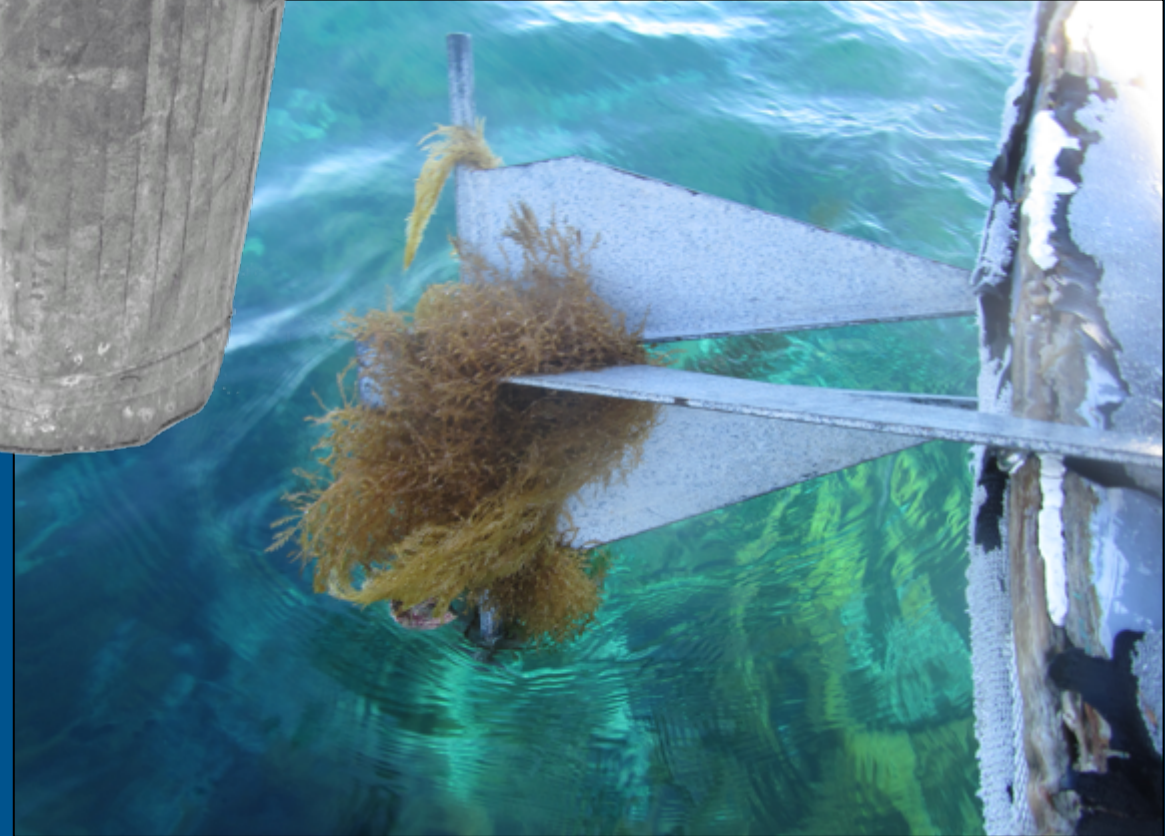
Hyperlink to Marine Invasives video:

<https://sanctuaries.noaa.gov/earthisblue/wk124-help-fight-invasives-species.html>

Regulate Local Vectors



Undaria pinnatifida
grows on boat hulls



Sargassum horneri
ripped out by anchors

Regulate Local Vectors

Spread the Word,
Not the Weed!

ATTENTION BOATERS AND DIVERS

Help protect kelp beds and reefs from invasive seaweeds!

LOOK FOR and REPORT sightings* of two non-native seaweeds in California

DEVIL WEED
Sargassum horneri



ASIAN KELP
Undaria pinnatifida



PREVENT the SPREAD of invasives from harbors and other infested sites*



Clean your hull before leaving harbor

Navigate slowly (no wake) through seaweed infested areas*

Remove seaweed fragments from anchor, lines, and boat deck before moving to new locations



Plan to dive uninfested sites first*

Remove seaweed fragments from yourself, your gear, and boat deck before moving to new locations

DO NOT DISTURB OR REMOVE INVASIVES UNDERWATER, THEY CAN BE EASILY SPREAD!

*VIEW MAP OF INFESTED SITES, REPORT SIGHTINGS AND LEARN MORE AT

MarineInvasives.org



Website



App

Monitor and Report

IDENTIFICATION GUIDE

Invasive Seaweeds

IDENTIFY PHOTOGRAPH REPORT

Help scientists and managers by identifying, photographing and reporting sightings of TWO invasive marine seaweeds in California waters. The species look different and are found at different times of the year depending on their age. Refer to the photographs for identification tips, size and seasonality.

If sighted, take a close-up photograph and record which species it was, how many you observed, and relevant additional information*.

SITE NAME _____

DATE _____

GPS COORDINATES _____

SPECIES DEVIL/ASIAN	NUMBER OBSERVED	ADDITIONAL INFORMATION*	<input checked="" type="checkbox"/>

*Additional information: depth, substrate (e.g. slip, trap, boat hull, buoy)

PLEASE SUBMIT YOUR PHOTOS AND FINDINGS AT
MarineInvasives.org (website)
 or [iNaturalist.org](https://www.inaturalist.org) (app)



Website

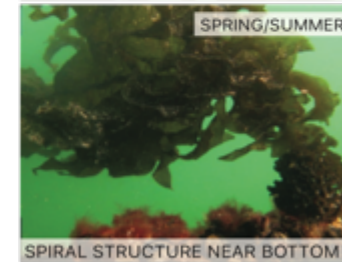
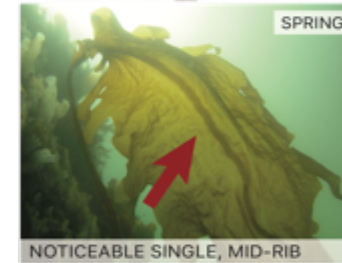


App

DEVIL WEED *Sargassum horneri*



ASIAN KELP *Undaria pinnatifida*



↑ JUVENILE
 < 6 inches
 ↓ ADULT
 1 - 10 feet

**DO NOT DISTURB OR REMOVE INVASIVES UNDERWATER,
 THEY CAN BE EASILY SPREAD!**

PHOTOS: JESSIE ALSTATT, DAN RICHARDS CAROLYNN CULVER, LINDSAY MARKS
 DESIGN TEAM: JACLYN MANDOSKE, CAROLYNN CULVER, LINDSAY MARKS

Monitor and Report

MarineInvasives.org

www.eeb.ucsc.edu/pacificrockyintertidal/data-products/invasive-species/

- invasive species
 - Sea Star Wasting Syndrome
 - Biodiversity Findings
- Publications
- Research Groups
- Data Requests & Contact Info
- Funding Partners
- Acknowledgements
- References




photo credits: T. Boyd (left), C. Culver (right)

Help Monitor Invasive Seaweeds

We at *MarineInvasives.org* are overseeing the monitoring of seaweeds that have invaded coastal and island reefs of California. We encourage you to help keep track of these invasions by reporting your sightings when you find them. Continue reading to learn more about these invasive species and how you can help us determine where they have spread.

Why Monitor?

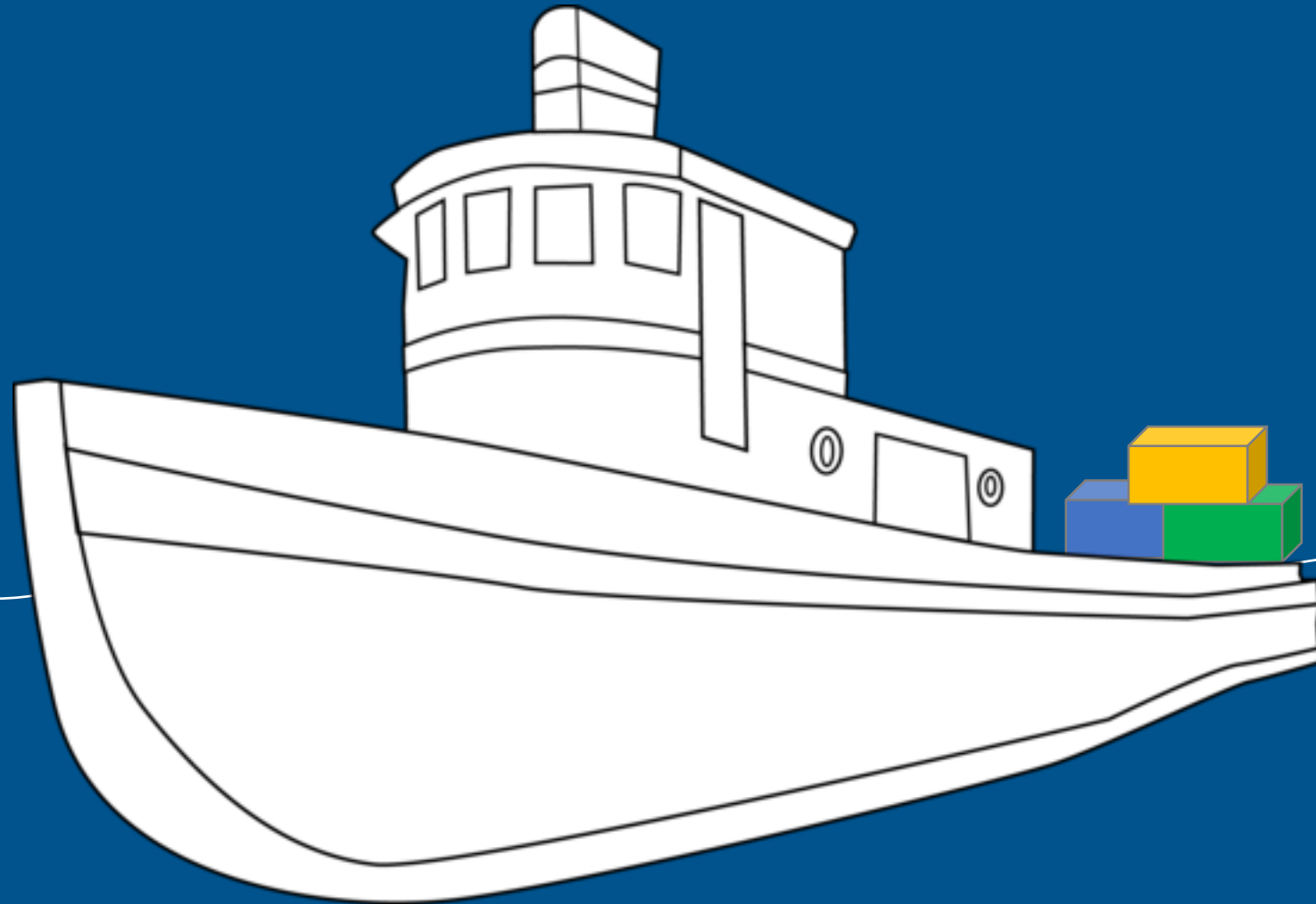
Invasive species are plants or animals that have been introduced to a new region where they are not native, typically become widespread and abundant, and result in negative impacts on native species, habitats

Marine Dispersal Vectors

Marine Dispersal Vectors

ballast water

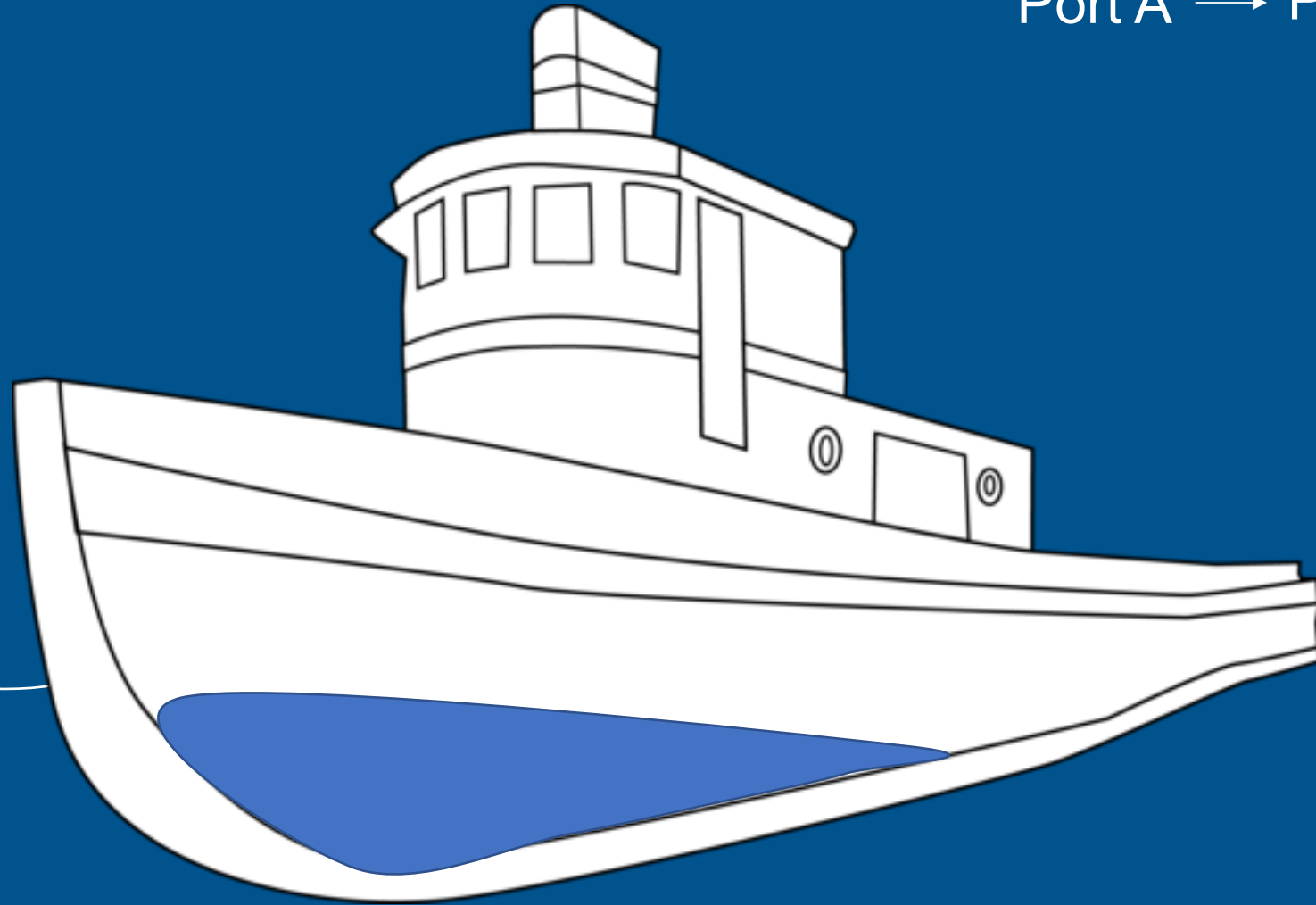
Port A



Marine Dispersal Vectors

ballast water

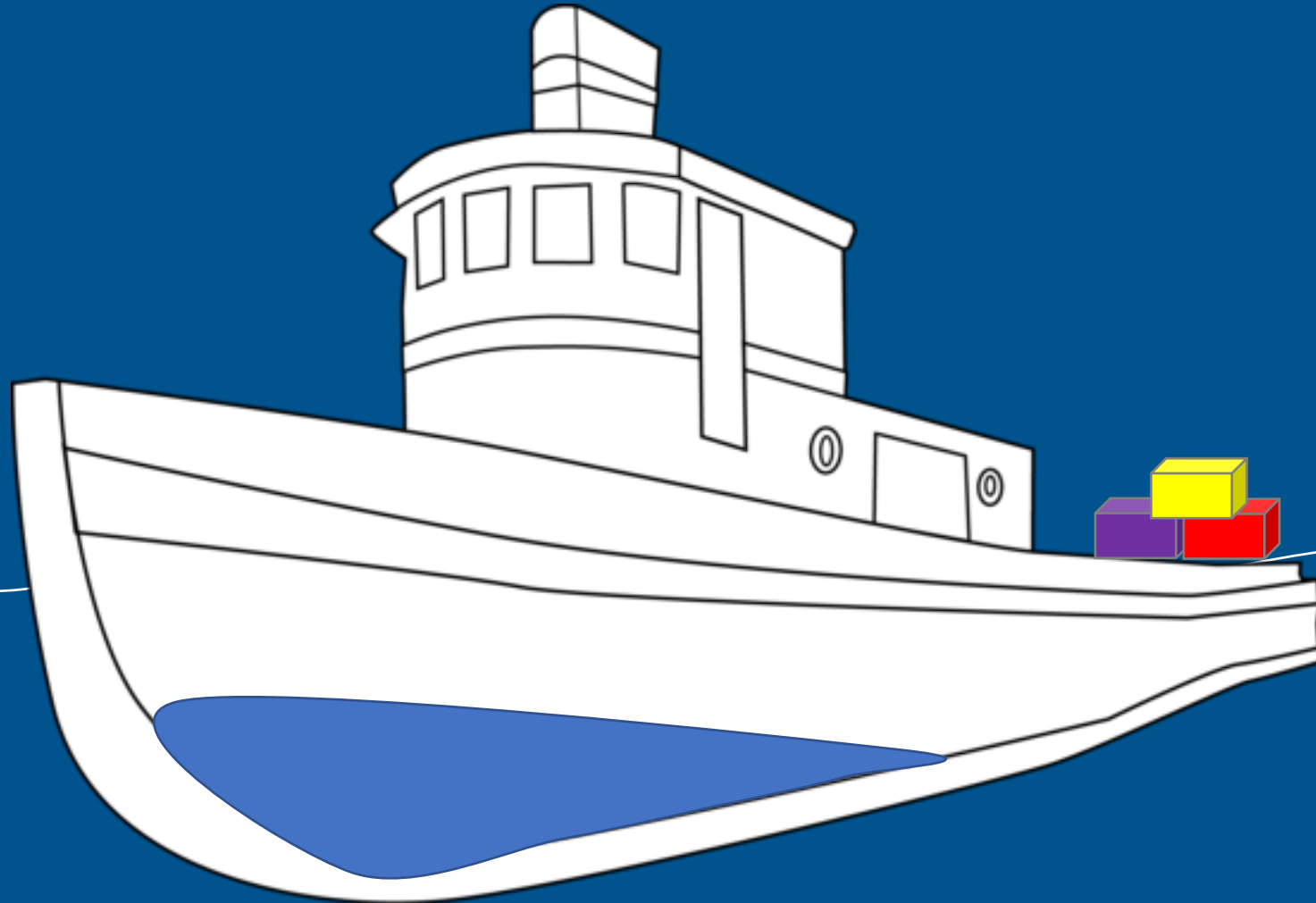
Port A → Port B



Marine Dispersal Vectors

ballast water

Port B



Marine Dispersal Vectors

ballast water
hull fouling



Marine Dispersal Vectors

ballast water
hull fouling
boat anchors



Lindsay Marks



Lindsay Marks

Marine Dispersal Vectors

ballast water

hull fouling

boat anchors

aquarium trade



Marine Dispersal Vectors

ballast water
hull fouling
boat anchors
aquarium trade
aquaculture



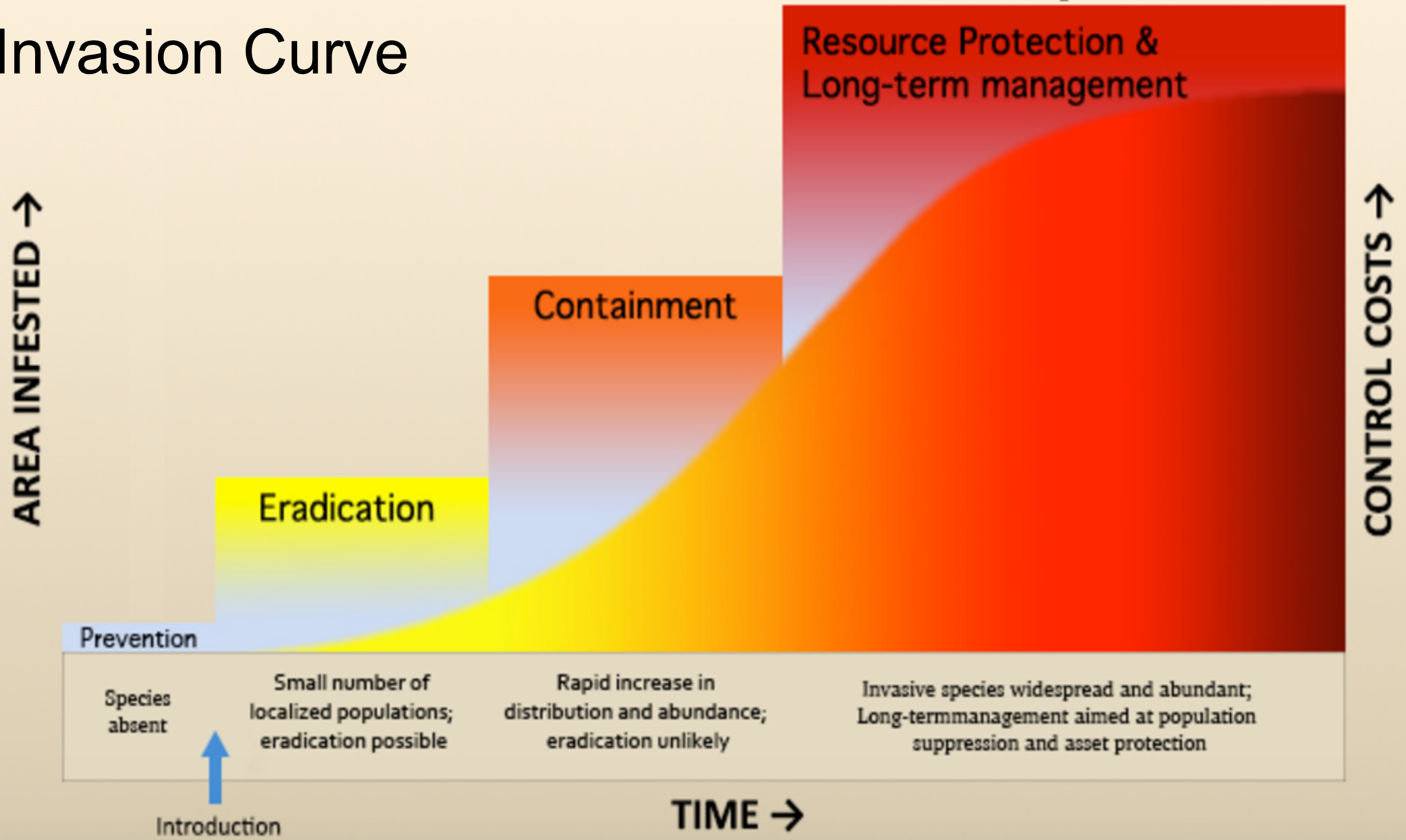
Marine Dispersal Vectors

ballast water
hull fouling
boat anchors
aquarium trade
aquaculture
packaging material



Monaca Noble

Invasion Curve



Prevention is the best policy



Protect Your Park

Biosecurity measures are in effect to prevent the introduction of nonnative species and protect native species and ecosystems.

Help protect your park by conducting a biosecurity check prior to loading the boat to ensure you are not bringing any of the items listed below to the islands.

Biosecurity Check



Brush Your Boots
Use boot brushes provided on the deck to clean your shoes.



Pest-Proof Packing
Pack your gear in pest-proof containers.



Inspect and Clean
Inspect and clean your clothing and gear.

Prohibited Items



Soil or Seeds
Clean and inspect clothing and gear. Use boot brushes provided at end of deck.



Tools or Equipment with Attached Soil



Aquatic Hitchhikers
Includes plants and animals such as the New Zealand mud snail and Asian kelp.



Corrugated Boxes
Pack gear in pest-proof containers.



Unfinished Wood
Includes untreated wood, firewood, and hiking sticks.



Single Use Plastic Bags



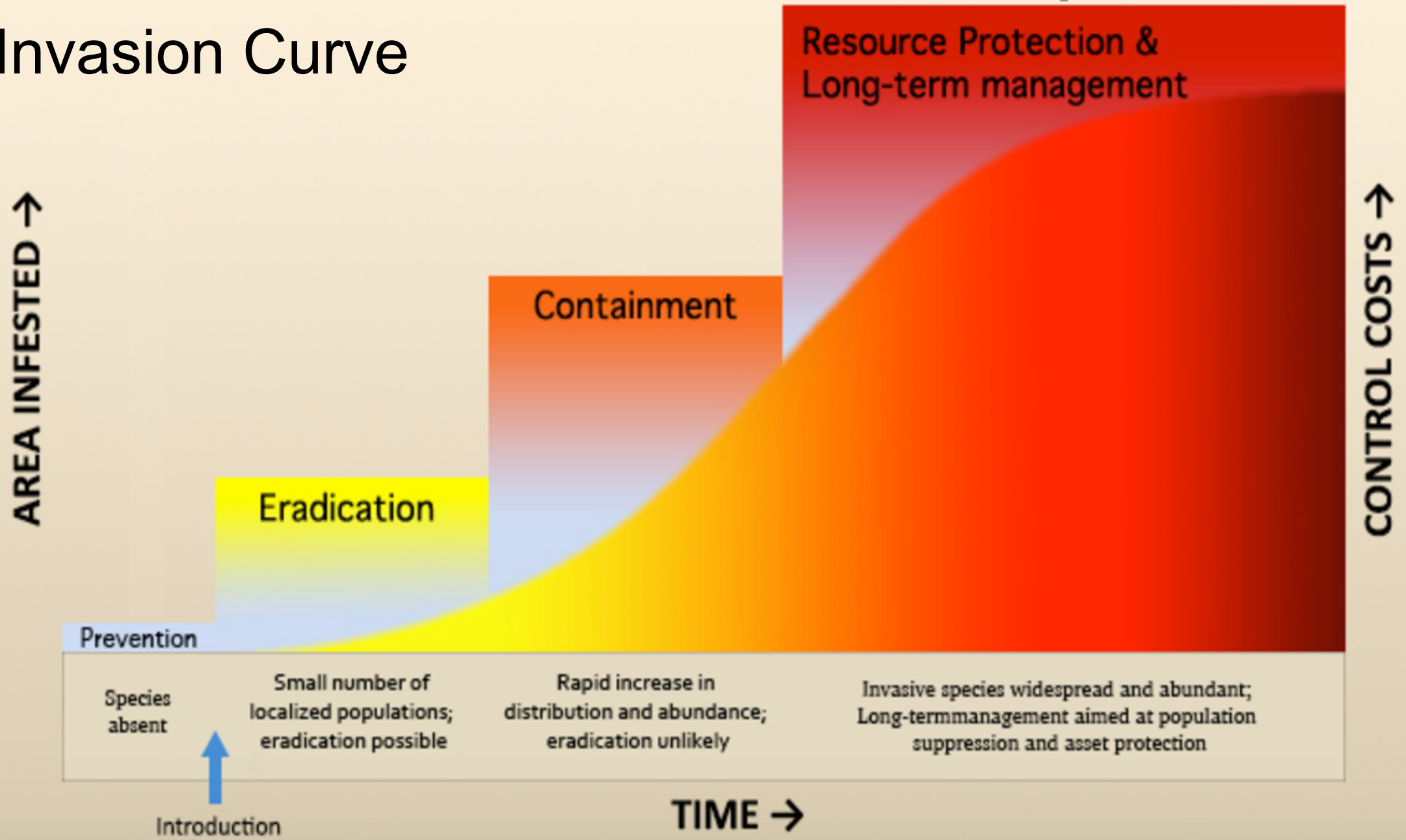
Live or Potted Plants and Cut Flowers



Pets



Invasion Curve



Eradication is possible with rapid response



Reef to Rainforest

Caulerpa taxifolia



Anderson (2005) *Biological Invasions*

Eradication is possible with rapid response



Chemical pollution containment



Biological pollution containment

OUTLINE

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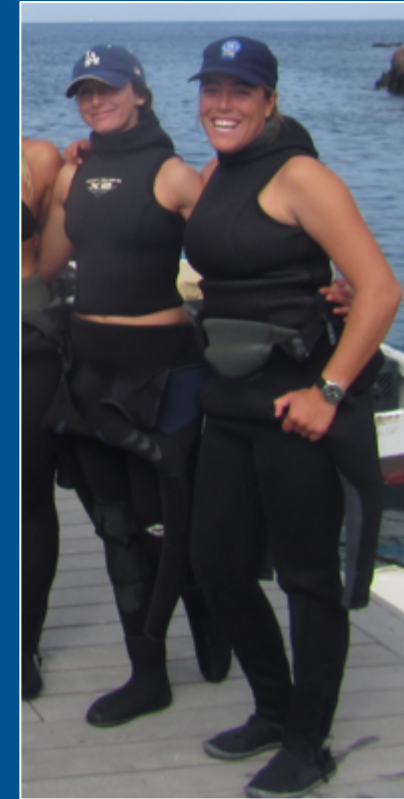
DR. NANCY FOSTER SCHOLARSHIP PROGRAM



Volunteer and Staff Divers

Paulina Salinas-Ruiz
 Christen Santschi
 Katharine Magana
 Liam Zarri
 Clint Nelson
 Shannon Harrer
 Lauren Parker
 Ed Romero
 Allie Kahler
 Jaclyn Mandoske
 Sam Ginther
 Stephanie Spross
 Dylan Bradey
 Bill Wright
 Ryan Kabala
 Tom Boyd
 Alyssa Lind
 Evan Barba
 Cristiane Elfes

Matt Silbert
 Niko Kaplanis
 Adam Obaza
 Brian Meux
 Mike Anghera
 Ben Barnes
 Allyson Landfield
 Taylor Traxler
 Nicholas Lorenzen
 Laura Berseford
 Christian Orsini
 Eric Hessell
 Jordan Gallagher
 Allyson Bailey
 Shoshana Lescht-Smith
 Marc Rosenfield
 Ian Jacobson
 Michael Quill
 Nyssa Silbiger
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 Josh Jensen
 Maureen Oudin

Lauren Czarnecki Oudin
 Kellie Spafford
 Lorraine Sadler
 Karen Erickson
 Holly Gallagher
 Sean Conner

Resources

NOAA Invasive Species lesson plan

https://oceanservice.noaa.gov/education/lessons/alien_invasion.html

Webinar on Invasive Lionfish

<https://sanctuaries.noaa.gov/education/teachers/lionfish-alien-invaders-from-the-indo-pacific.html>

Information and Resources on Marine Invasive Species

MarineInvasives.org



Thank You!

for more information:

Visit *MarineInvasives.org*

or

Contact *lindsay.marks@noaa.gov*