

# Aquatic Weed Ecology and Influence on Ecosystem Services in Lakes: A Case Study from Emerald Bay, Lake Tahoe

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Zach Hymanson- Alpine Solutions



## Invasive Weeds Are **Spoiling** Lake Tahoe



## Neighbors: Yaphank Lake Has Been **Ruined** By Algae, Invasive Plants

Eurasian milfoil responsible for **drowning**

A 22-year-old man died when he apparently became entangled in thick milfoil...



“In recent years the **weeds have sprouted to the surface all the way out to the middle of the lake.** (Clear Lake, CA)”

It was a new lake for us, but the pictures looked good. Imagine our disappointment upon arriving to find the entire shoreline choked with Eurasian Milfoil. Swimming along the shoreline was impossible, which ruined the experience for the kids...plants wrapped around our propeller...

**No summer vacation is free from invasive species anymore... they are everywhere.**

“My grandkids, I don't even let them swim in the lake anymore, you know, they itch and stuff like that when they get out.”

He said the lake was becoming **“unusable”** due to the weeds...

Asian water plant that has taken over and ruined homeowners' lakeside dreams. “It's getting ridiculous,”

said a lakeside resident... **“It's everywhere. You can't even see the water.”**

Aquatic invasive plants multiply rapidly and their effects can be **“devastating,”**

Doug Freeland said. “It's interesting to see...

**people not believe this is going to be a problem...**



*Small Sample of Aquatic Weed Headlines from Papers Across U.S.*









## Milfoil Ecology and Invasion Potential – Smith and Barko 1990

- Water Clarity
- Temperature
- Nutrients – *nuisance growth usually limited to fertile lakes*  
*OR FERTILE LOCATIONS IN LOW FERTILITY LAKES*
- Sediment Texture
- Water Movements

Smith, Craig S., and J. W. Barko. 1990. Ecology of Eurasian Watermilfoil. *J. Aquat. Plant Manage.* 28: 55-64

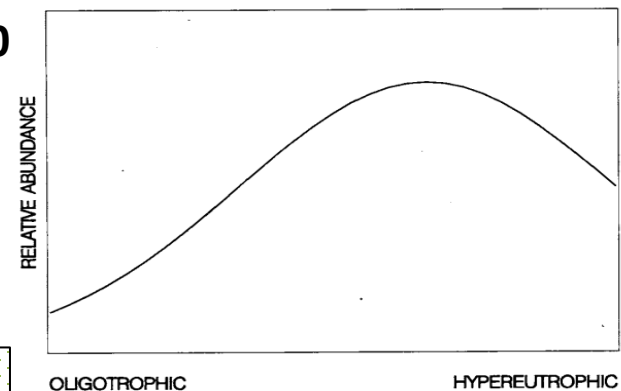


Figure 1. Influence of trophic status on Eurasian watermilfoil abundance.



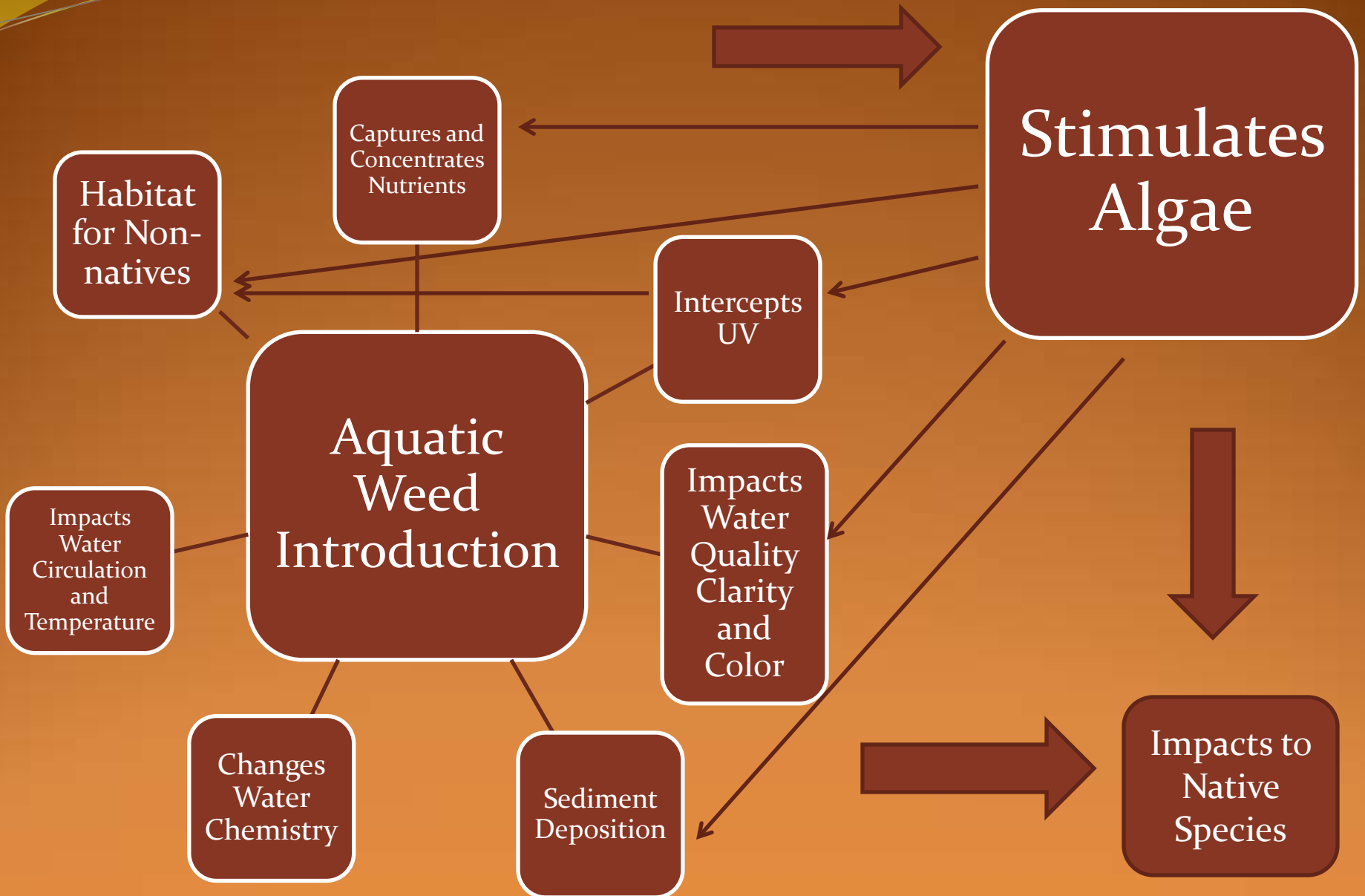
# Frequently Referenced Aquatic Weed Influences on Ecosystem Services:

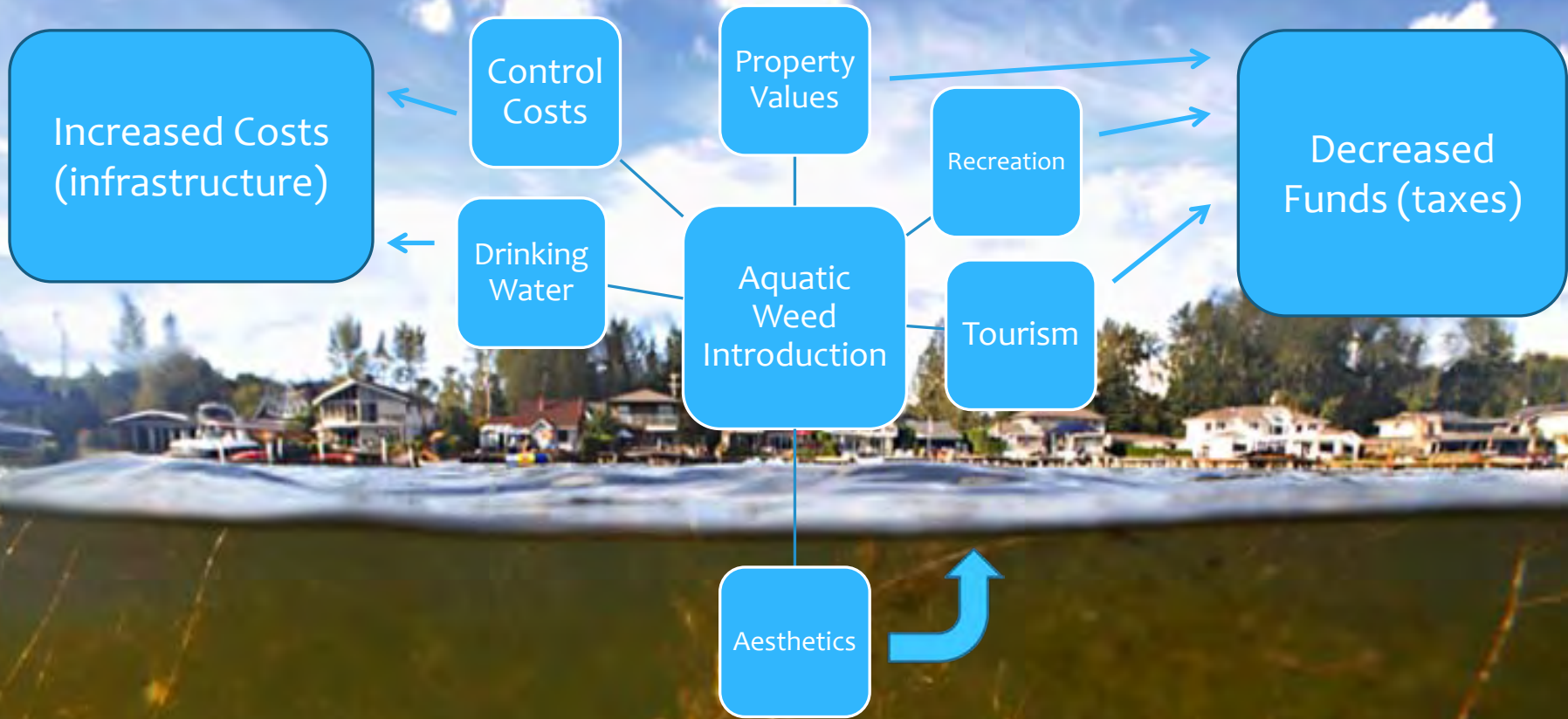
- Water Quality
- Water Clarity
- Water Color
- Water Chemistry
- Water Temperature
- Water Circulation
- Non-native Species
- Native Species
- Tourism
- Property Values
- Recreation
- Health and Safety
- Aesthetics



Photo – Phil Caterino  
Tahoe Divers Conservancy

Photo – Zach Hymanson

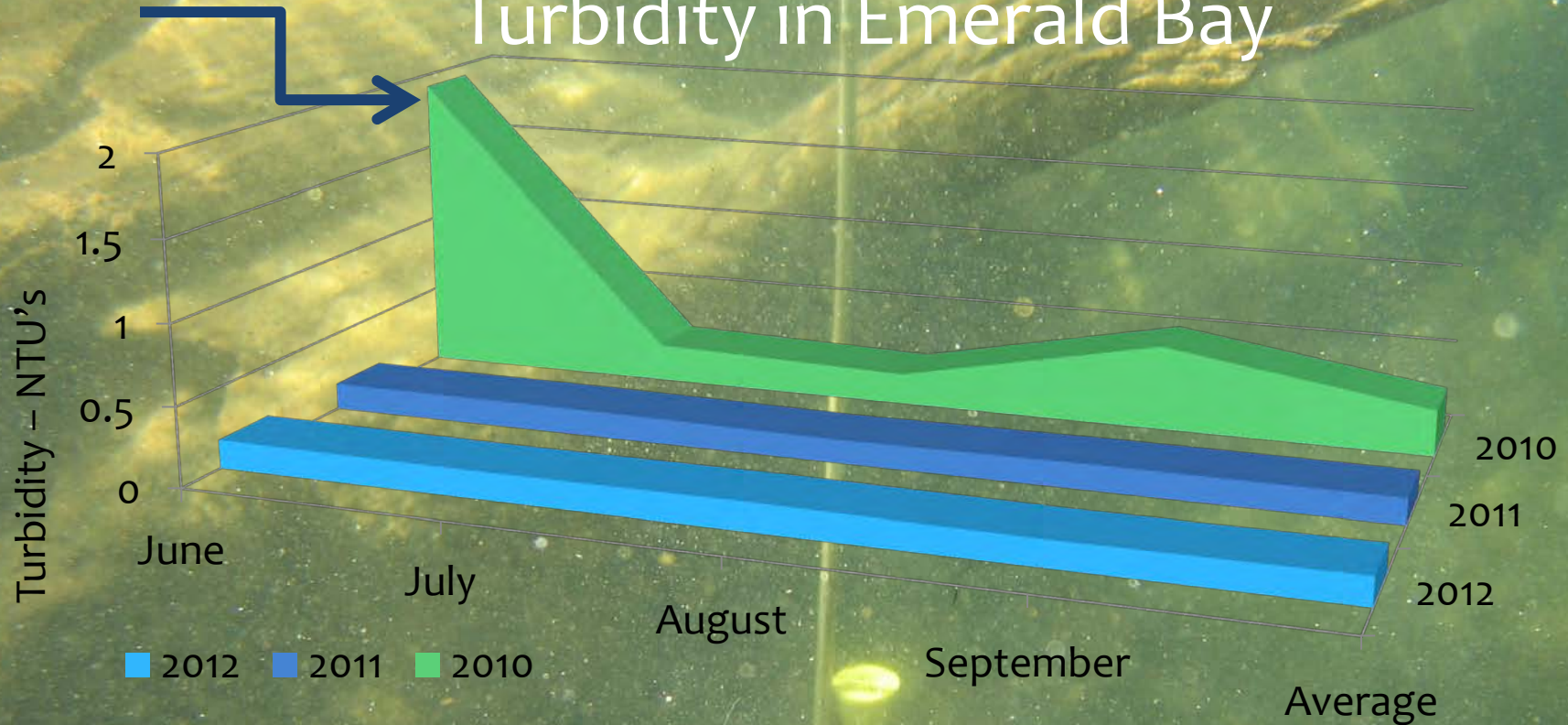






May 2010  
Treatment

# Drinking Water- Water Quality Turbidity in Emerald Bay



## Turbidity-

- How much material is suspended in the water
- Includes sediment, microbes, algae, plankton etc.
- Affects passage of light through water
- Affects water color
- Increases water temperature
- Decreases dissolved oxygen



Photo- Shawn Murphy



## Water Clarity and Blueness



Avalanche infestation Pre.....



and Post-treatment

Water clarity depends on two factors, light absorption and scattering. In Lake Tahoe, light is absorbed by algae and dissolved organic materials. Algae need nutrients such as phosphorus and nitrogen to grow, linking water clarity directly to the levels of nutrients entering the lake through streams, runoff, and atmospheric deposition (My Insert- and aquatic weeds?). Light scattering is caused by fine, inorganic particles that enter the lake (My Insert- local concentration in weed beds?) in the same manner. *From Tahoe TMDL (<http://www.tiims.org>)*

"Tahoe: State of the Lake Report 2013," Tahoe Environmental Research Center at the University of California, Davis. Measurements of Water Clarity since 1960's - now measuring blueness. Tremendous resource for Management Agencies in Tahoe.





## Non-native animals



*Fish photos courtesy of Christine Ngai- University of Nevada- Reno*





## Influence on Native Species–

### Food Chain

Sharp decline in native Lake Tahoe **benthic macro-invertebrates** due to invasive species, increased nutrients, and decreased water clarity – *Annie Caires, Univ. of Nevada Reno*



*Native blind amphipod shrimp*  
**3500/m<sup>2</sup> 1960's**  
**6/m<sup>2</sup> now**



### Fish

Sharp decline in native Lake Tahoe **fish** attributed to invasive species, nutrient loading, algae growth, and habitat alteration – *Dr. Sudeep Chandra, Univ. of Nevada Reno*  
*Mr. Chandra's study found that 58 percent of the 26 historically sampled locations surveyed around the lake showed a decline of species or no native species at all*

July 2013 fish surveys in Emerald Bay

Christine Ngai Univ of Nevada Reno

1 bluegill

Lots of native Tahoe Suckers

Lots of native Lahontan redbreast



Native Lahontan cutthroat trout extirpated from Lake Tahoe



## Other Reported Changes in Ecosystem Services



- Water Circulation interference
- Water Temperature Change
- Dissolved Oxygen Change
- Parasite Habitat- swimmers itch (*Cercarial dermatitis* and *Schistosoma dermatitis*)
- Transportation Impacts
- Irrigation Ditches







Economic Consequences of Aquatic Invasive Species in Lake Tahoe: Summary

November 2012

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**Cumulative economic losses and program costs over the next 50 years**

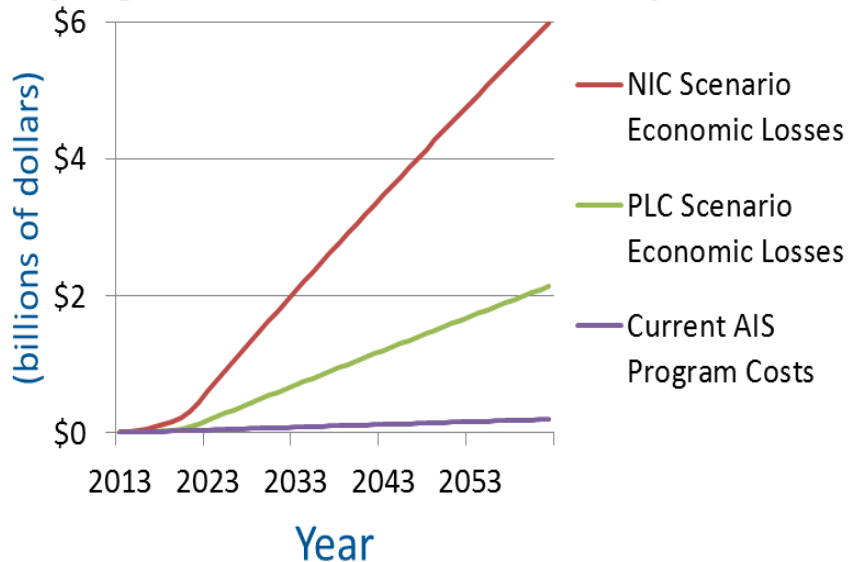


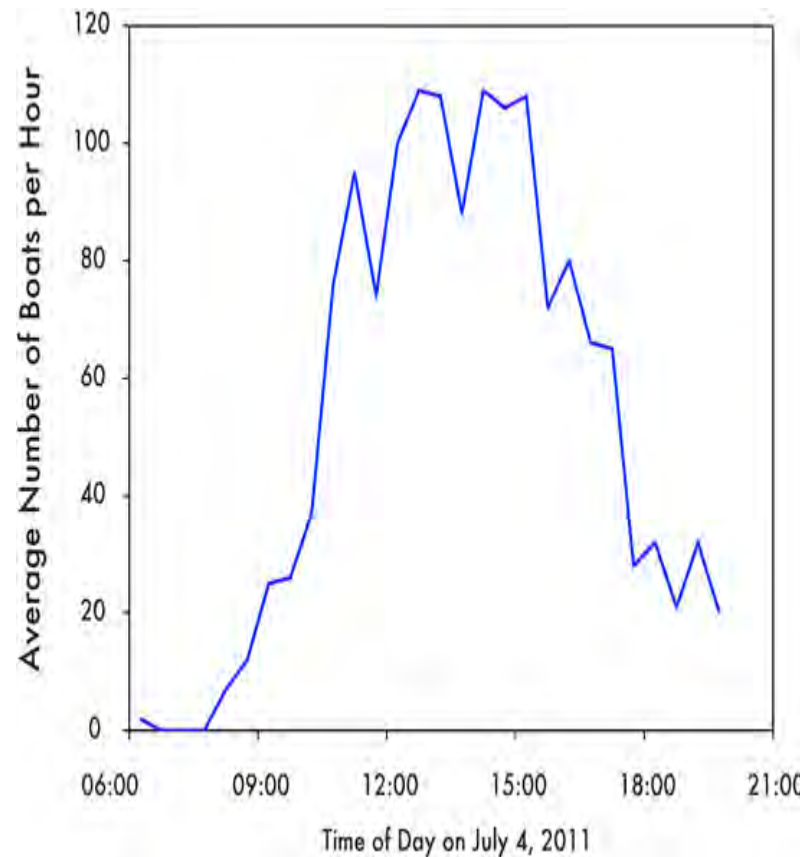
Table 1. Average **annual** economic costs of AIS under the two scenarios, 2013-2062 (millions of dollars)

Areas of Impact	No Inspection Or Control (NIC)	Prevention/ Limited Control (PLC)
Recreation	91.9	37.7
Tourism	20.5	4.1
Water Supplies	0.9	0
Property Taxes	5.7	0.3
Other Costs	0.8	0.8
<b>Total</b>	<b>119.8</b>	<b>42.9</b>

**Estimated Annual Cost of Lake Tahoe AIS Program- 2.5 Million**

*Information courtesy of the Tahoe Regional Planning Agency*





- 1000 boats a day at peak use.
- 95% of all boaters visiting Lake Tahoe go to Emerald Bay.
- Proportional economic cost of weeds here is very high.
- Emerald Bay presents challenges as a weed source.

Camera recordings and data – UC Davis Tahoe Environmental Research Center





# *Frequently Referenced Aquatic Weed Influences on Ecosystem Services:*

- **Water Quality**
- **Water Clarity**
- **Water Color**
- **Water Chemistry**
- **Water Temperature**
- **Water Circulation**
- **Non-native Species**
- **Native Species**
- **Tourism**
- **Property Values**
- **Recreation**
- **Health and Safety**
- **Aesthetics**

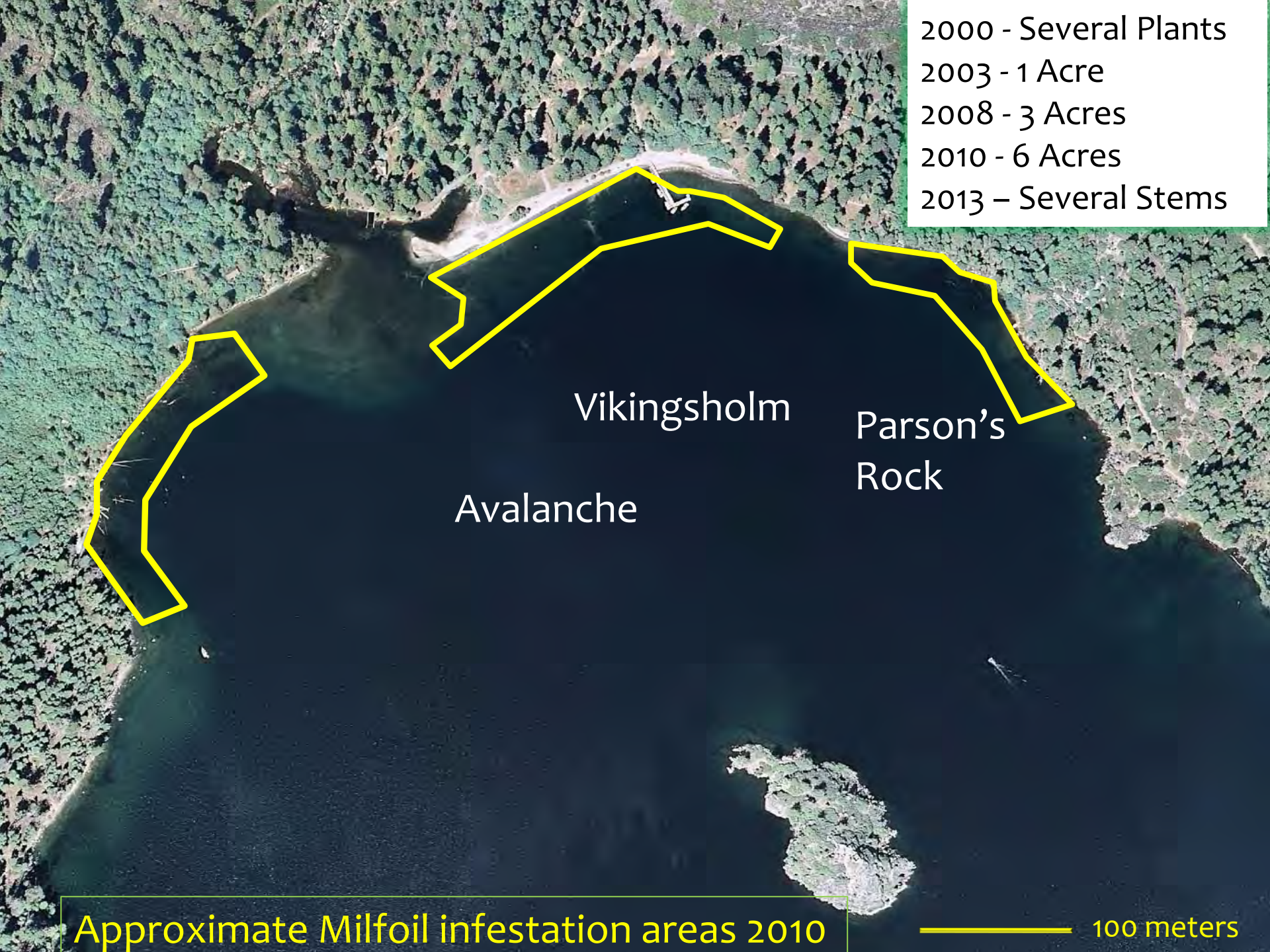


Photo – Phil Caterino  
Tahoe Divers Conservancy

Photo – Zach Hymanson



2000 - Several Plants  
2003 - 1 Acre  
2008 - 3 Acres  
2010 - 6 Acres  
2013 - Several Stems



Vikingsholm

Parson's  
Rock

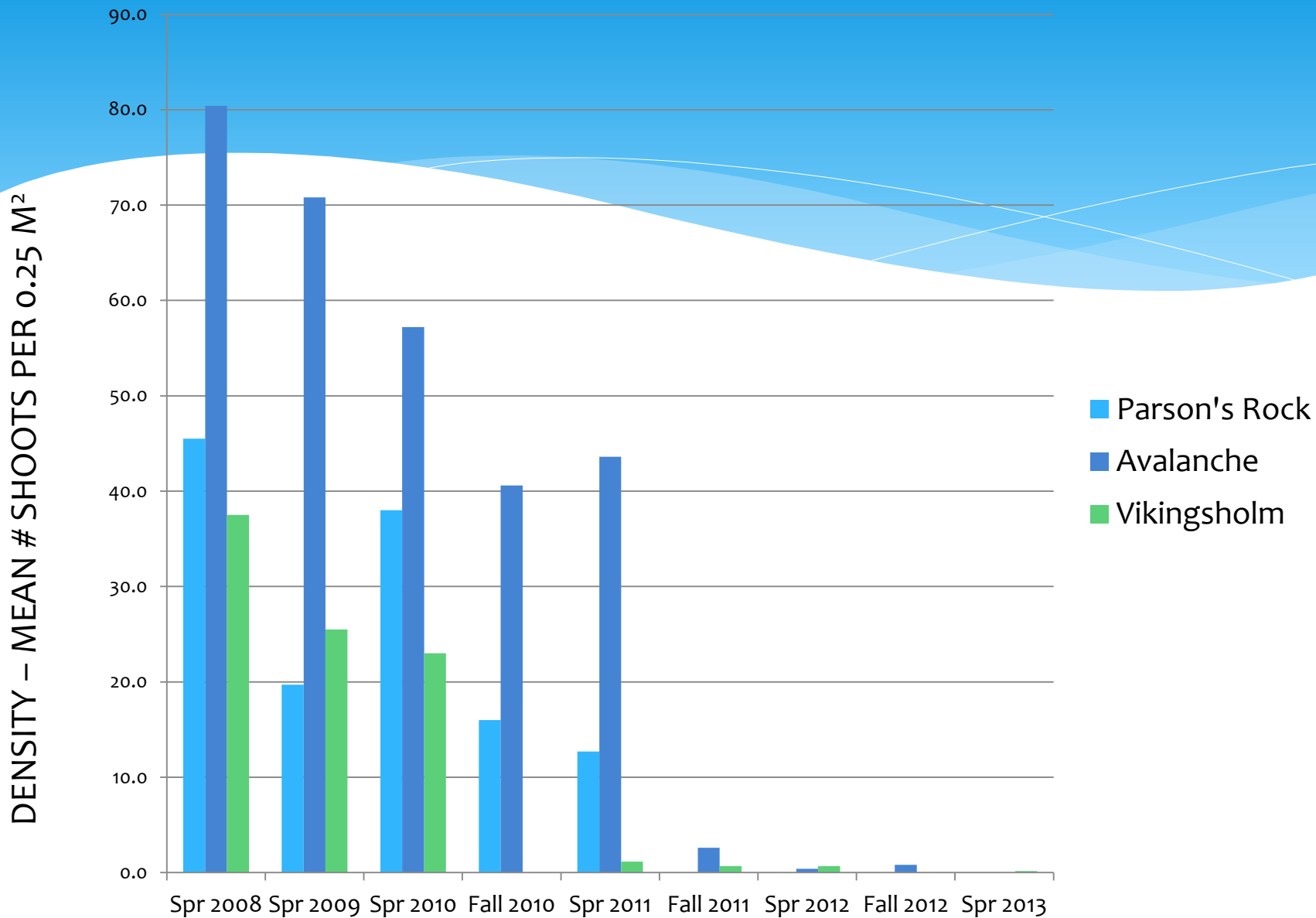
Avalanche

Approximate Milfoil infestation areas 2010

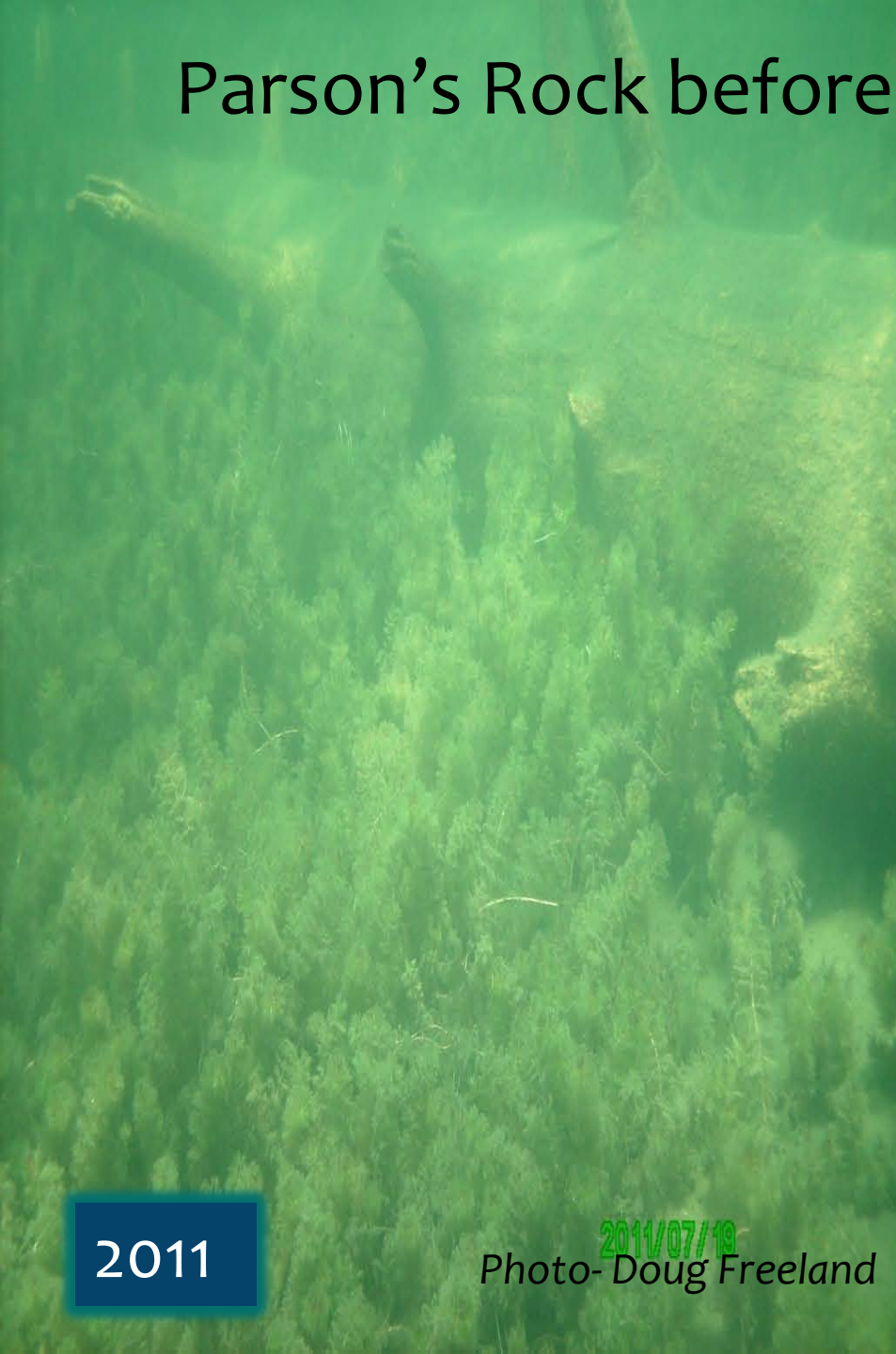
100 meters



# EMERALD BAY MILFOIL DENSITY



# Parson's Rock before and after treatment



2011

2011/07/19  
Photo- Doug Freeland



2012

Photo- Shawn Murphy



*Photo- Shawn and  
Angie Murphy*

2013



2011



Avalanche Beach before and after

*Photo- Doug Freeland*



2010



2013



Vikingsholm Pier and Swim Beach



2009



2012

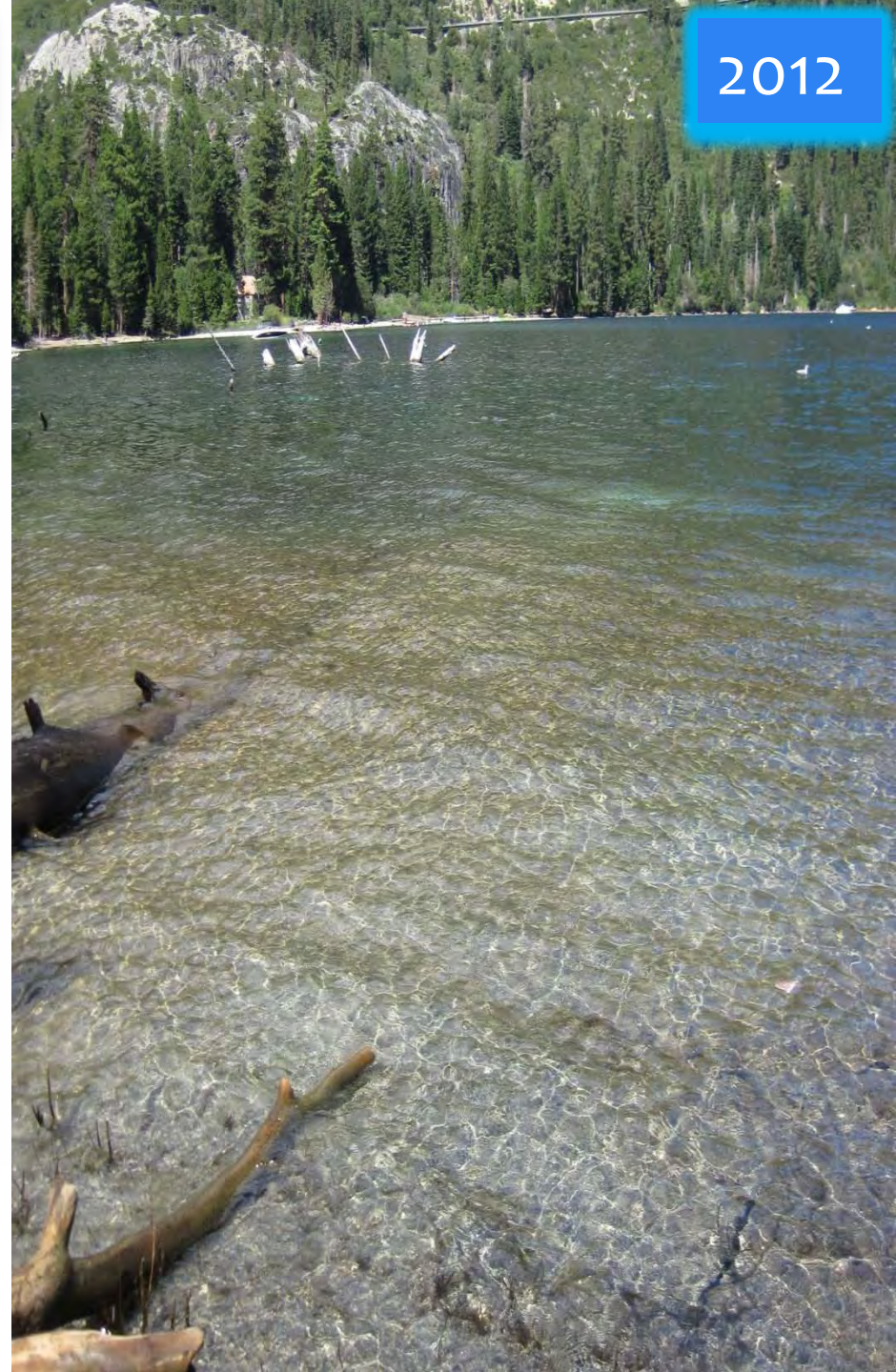


Photo – Phil Caterino Tahoe Divers Conservancy



“I thought it must surely be the fairest  
picture the whole earth affords”

Mark Twain- *Roughing It*







- ❖ Zach Hymanson, Tamara Sasaki, Denise Jaffke – California State Parks Sierra Dive Team/ Alpine Solutions
- ❖ Shawn and Angie Murphy, Doug Freeland – Professional Divers
- ❖ Jim Brockett, Kim Boyd (Tahoe Resource Conservation District)
- ❖ Patrick Stone (Tahoe Regional Planning Agency)
- ❖ Brant Allen, Katie Webb, Marion Whittman (UC Davis)
- ❖ Christine Ngai and Sudeep Chandra (Univ. Nevada, Reno)
- ❖ Tahoe Weed Control Partners ([http://www.fws.gov/nevada/nv\\_species/invasive\\_species/lt\\_index.htm](http://www.fws.gov/nevada/nv_species/invasive_species/lt_index.htm))
- ❖ Proposition 84 Clean Water, Parks and Coastal Protection Act



RESTORATION IN PROGRESS  
LAKE TAHOE ENVIRONMENTAL IMPROVEMENT PROGRAM

*continuing the commitment*

