
Quagga Mussel Collections On the Colorado River

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(MarroneBio)

Quagga Collections

- Who is Sea Wonders ?
- Quagga information
- Introduction to Colorado River
- Collections for Marrone Bio Innovations Inc.
- Observations
- Quagga adaptation to environment
- Current underwater conditions

Sea Wonders LLC.

- Research and development company focused on dive safety, analysis, and underwater exploration and research.
- Create educational materials from research and observation of incidents and activities.
- Conducts sample collections of both biological and man made objects from oceans, rivers and lakes.

Quagga Mussel

- Bi-valve mussel
- Filter Feeder via siphon
 - Filters 1 liter water per day
 - 1 meter² = 206,000 gallons day
 - 75.2 million gallons year !
 - Outputs crystal clear water
 - Strips water of nutrients
 - Leaves waste product – pseudo-feces

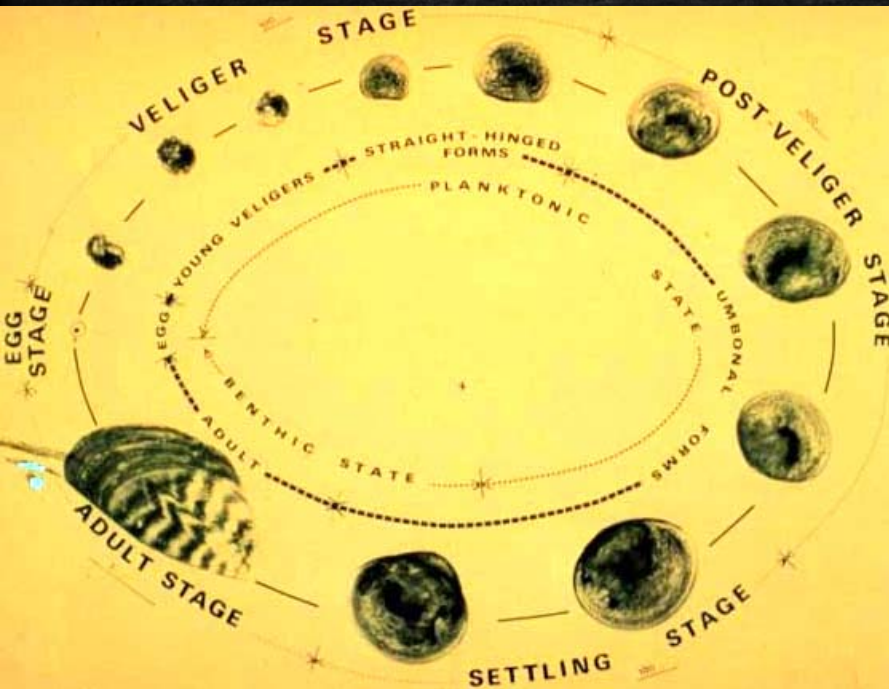


(NOAA)



(MarroneBio)

Life Cycle of Quagga Mussel



- Growth Rate
 - Veliger to Adult
- .4mm to 19mm
- Fully mature in 90 days
- attach to structures
- 1 million eggs / year
- Lives 3 to 5 years
- Few viable predators



(Wong, Gerstenberger, Baldwin & Moore, 2010)

The Invasion

Native to Russia and Ukraine



(US Geological Survey)

- **Zebra** mussel (*Dreissena polymorpha*)
 - First sighting – **Lake Erie 1988** (Launce, 2007)
- **Quagga** mussel (*Dreissena rostriformis bugensis*)
 - First sighting – **Lake Meade 2007**
 - @ 100 meters depth on hull of sunken boat – small black dots

Why should we be concerned?

- Quaggas **consume** large portions of the microscopic plants and animals that form **the base of the food web**.

Phytoplankton removal causes a shift in native species and **disrupts** the **ecological balance** of the lake.

- Economic Impact



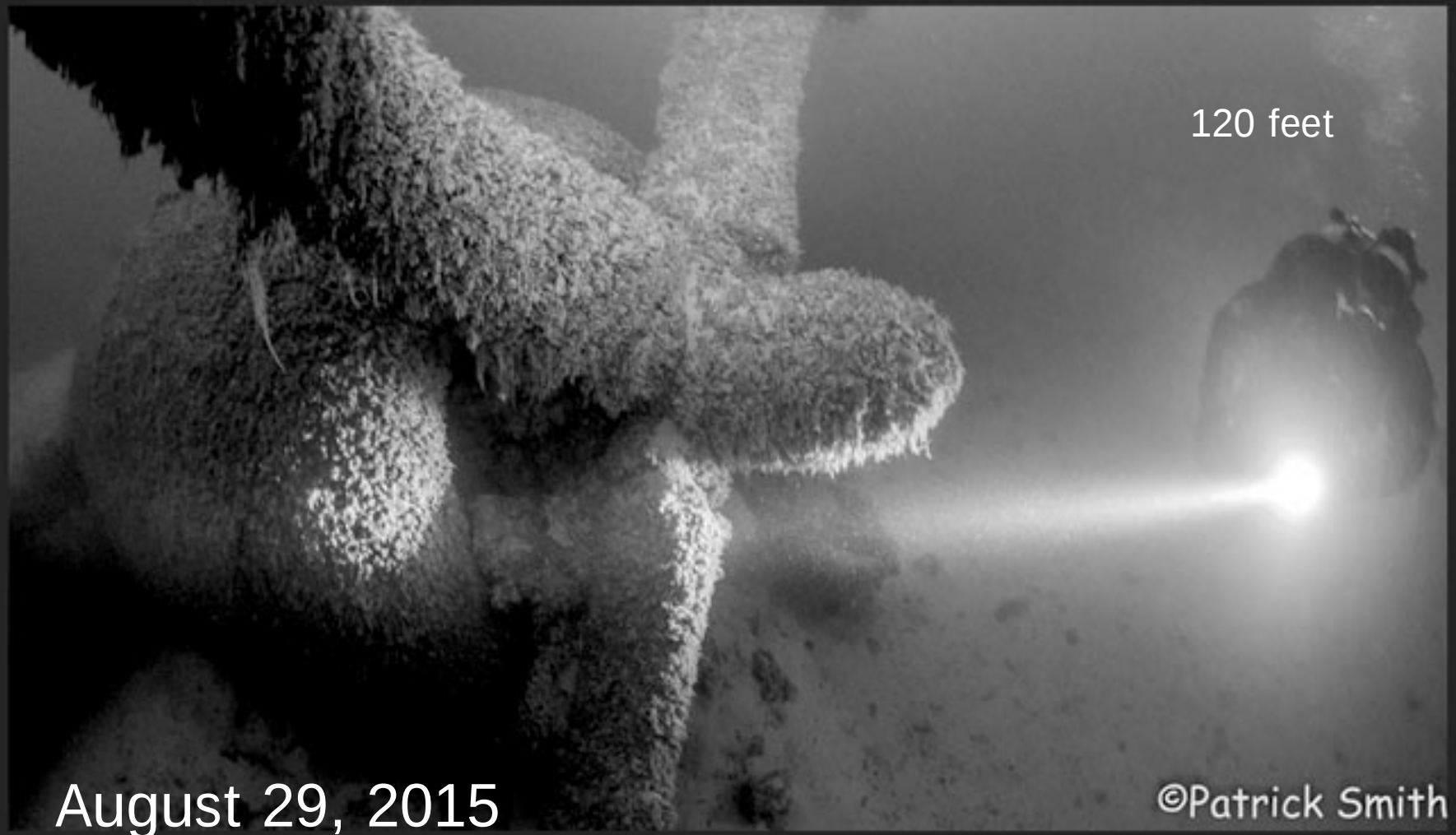
(Weydig, 2012)

B-29 Bomber -- Lake Mead

185 feet

December 30, 2007 No Quaggas

Copyright Mel Clark



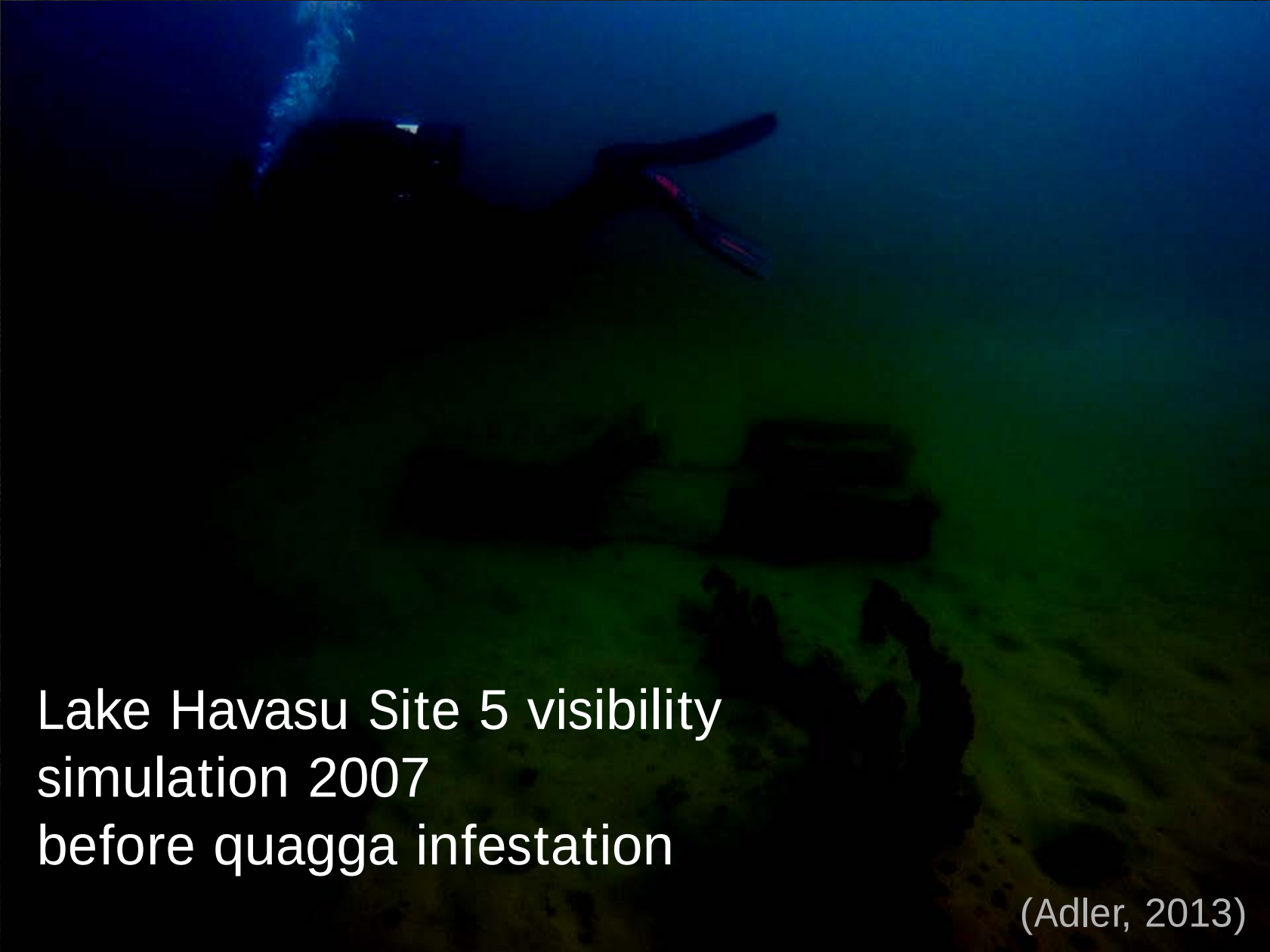
August 29, 2015

Encrusted with Quaggas and Psuedofeces

(No Collections from B-29, shown for comparison purposes only.) 9

Quaggas Move Down The River.

- First seen in Lake Havasu in 2008
- Prior to that horizontal lake visibility was in the 3-5 meter (10-15 foot) range.
- Water was clearer in cold winter (10c / 50f) and very limited visibility in hot (26c / 82f) in summer.

An underwater photograph showing a diver in the upper left, swimming towards the right. The water is a deep blue-green color, indicating low visibility. The seabed is visible in the lower half of the frame, showing some rocky structures and a sandy bottom. The overall scene is dimly lit, typical of an underwater simulation.

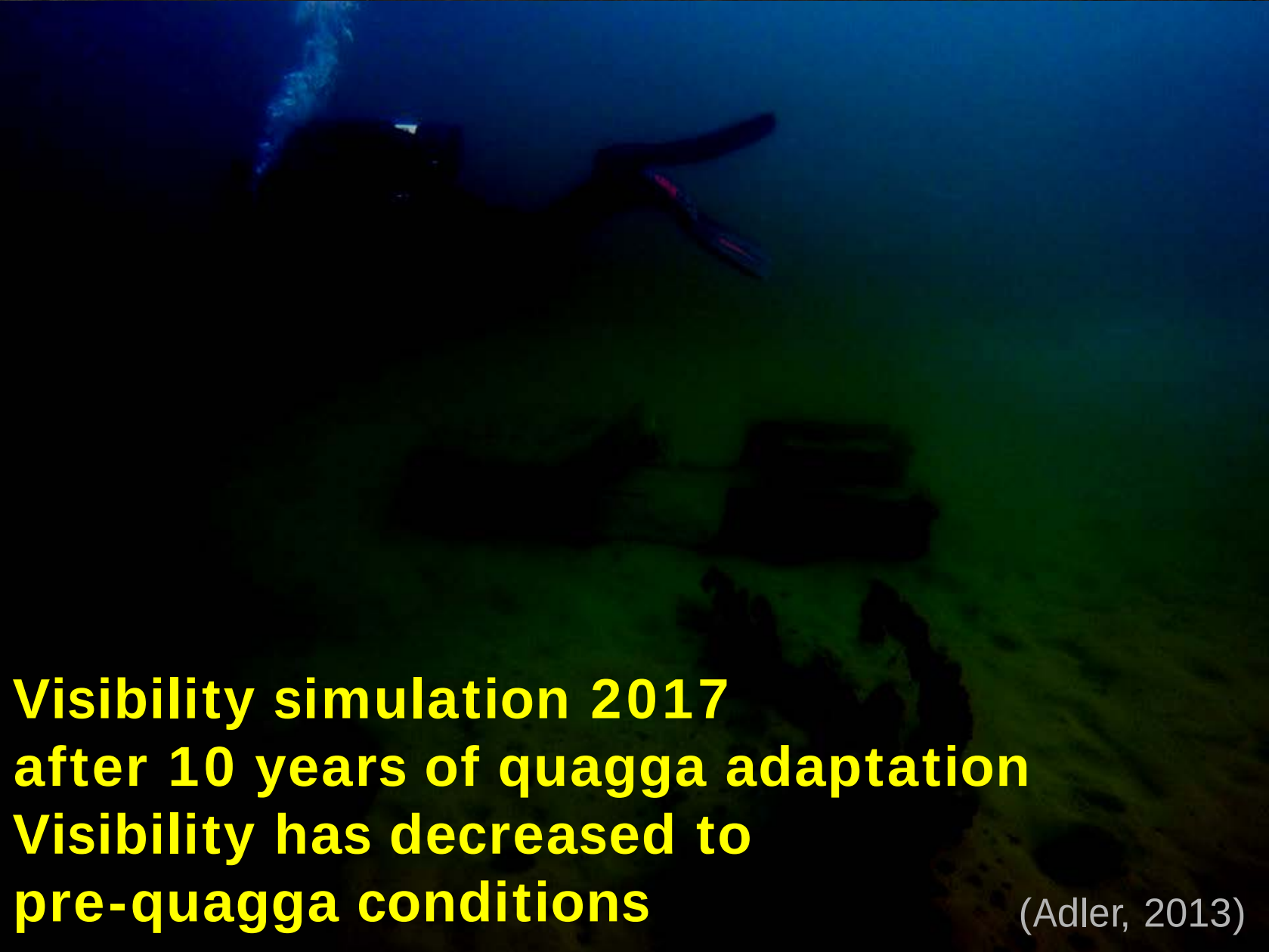
Lake Havasu Site 5 visibility
simulation 2007
before quagga infestation

(Adler, 2013)



**Actual Visibility after six years
of quagga infestation June 2013**

(Adler, 2013)



**Visibility simulation 2017
after 10 years of quagga adaptation
Visibility has decreased to
pre-quagga conditions**

(Adler, 2013)

Collecting for Marrone Bio Innovations



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- Under permit, Sea Wonders LLC. collects quaggas from the Colorado River for **Marrone Bio Innovations** for testing **Zeaquanox**, a natural molluscicide for the eradication of Zebra and Quagga mussels.
 - Collections in:
 - Lake Meade 5%
 - Lake Mohave 10%
 - Lake Havasu 85%

Collection Method

- Hand removal
- Depths of 6-30 m / 20-100 ft.
- SCUBA - conventional or rebreather
- Mechanical scrape off abandoned boats
- Pick off from dead tree limbs
- Equipment decontaminated after collections using vinegar and hot water

Current Control Solutions

■ Chemicals

- Oxidizing chemicals
 - chlorination
- Non oxidizing chemicals
 - ammonium compounds
- Chlorine –
 - threatening food source

■ Non Chemical

- Zequanox[®]
 - Composed of dead cells of a naturally occurring microbe (*Pseudomonas fluorescens*), which, are perceived as a nonthreatening food source.
 - Zebra and quagga mussels readily consume the product along with their normal phytoplankton diet – kills quagga through stomach organ.

Collections

- 23 Collections
- Began May 2013
- Every 75 days
- Next collection Feb 20, 2018

Over 2 million collected

Shipped to Davis, CA lab

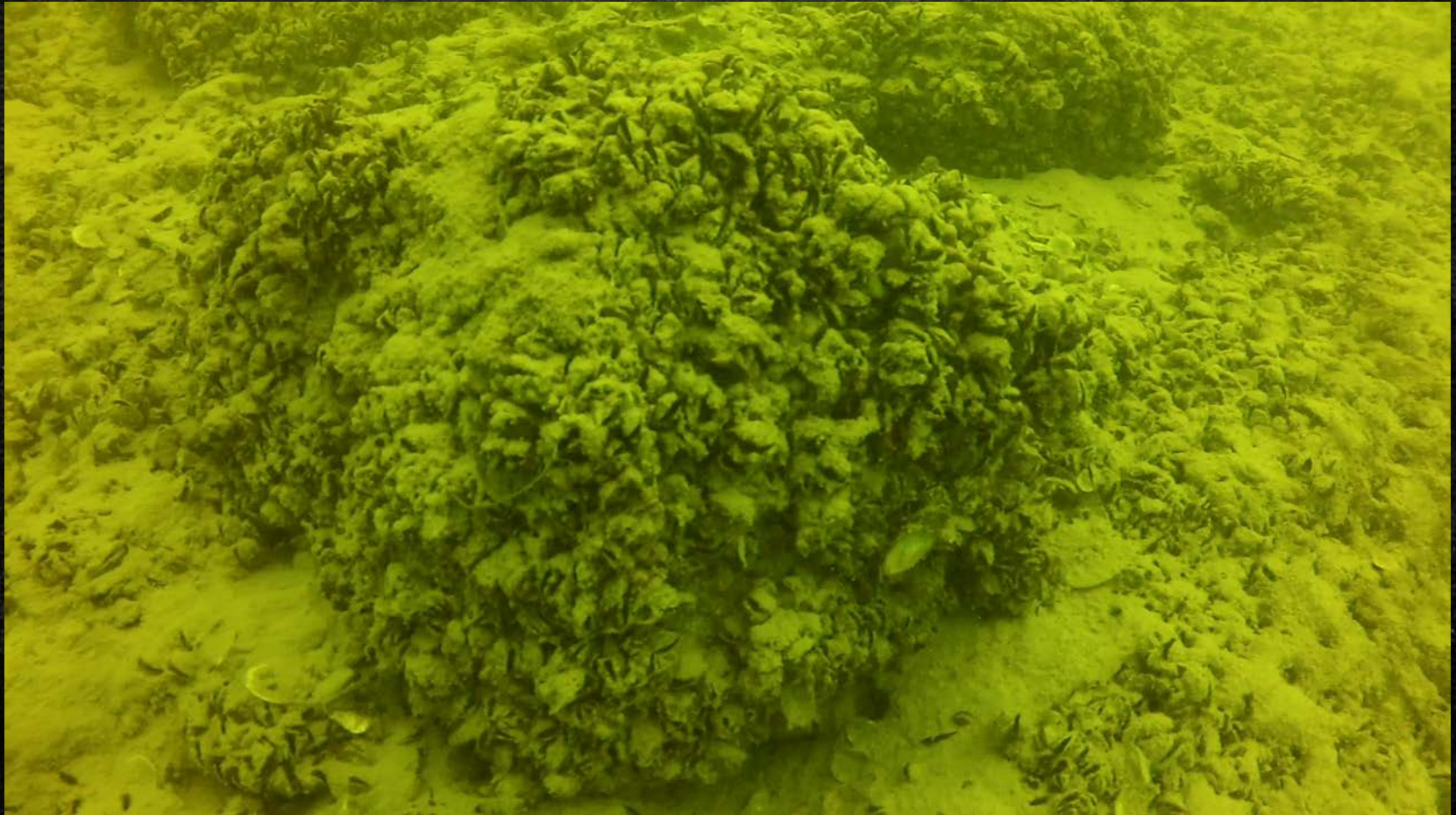
550,000 net tested

Quaggas are tested in
USEPA Hard Water
Solution for 90 days then
autoclaved and disposed.

Conditions Changed, Quagga Has Not !

- Lake Havasu water temperatures are high.
 - Summer 2017 29c / 85f to depth of 25m / 75f
 - Quagga gets lethargic and stressed
 - Do not last long above 22c / 72f
 - Large die off in summer
- Size of quagga has remained consistent
- Quaggas are healthier in colder waters
- Have not become resistant to Zequanox

Pseudofeces is matter added to the lake increasing turbidity.



Summary

- Quaggas have adapted to the Colorado river.
 - Remain compliant with chemical and non chemical eradication solutions in closed systems.
 - Cycling through species mortality stages.
 - Have affected water visibility and plankton growth.
- Direct observation provides reliable data for understanding the ongoing problem of invasive species.

References

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