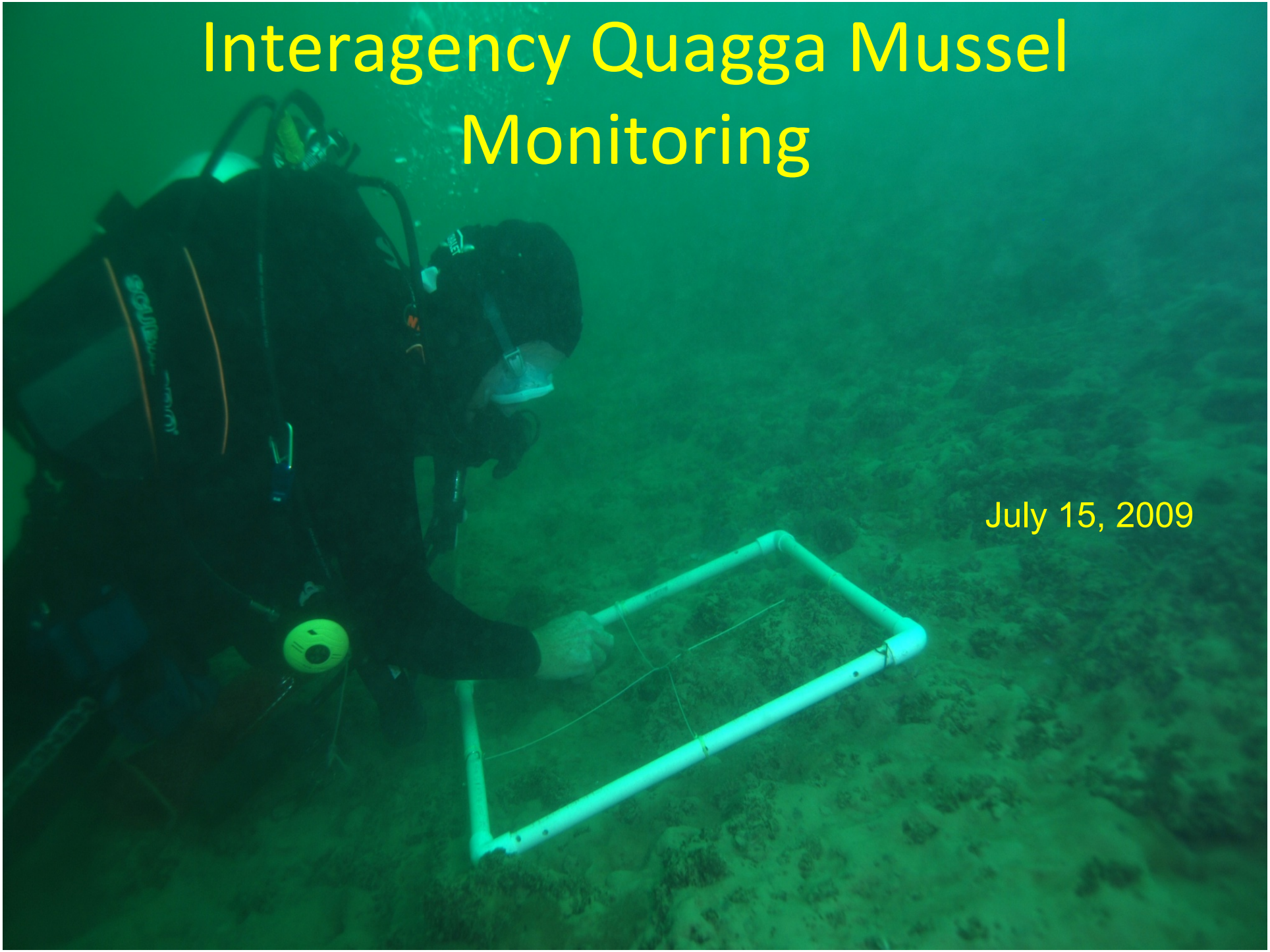
Interagency Quagga Mussel Monitoring



July 15, 2009

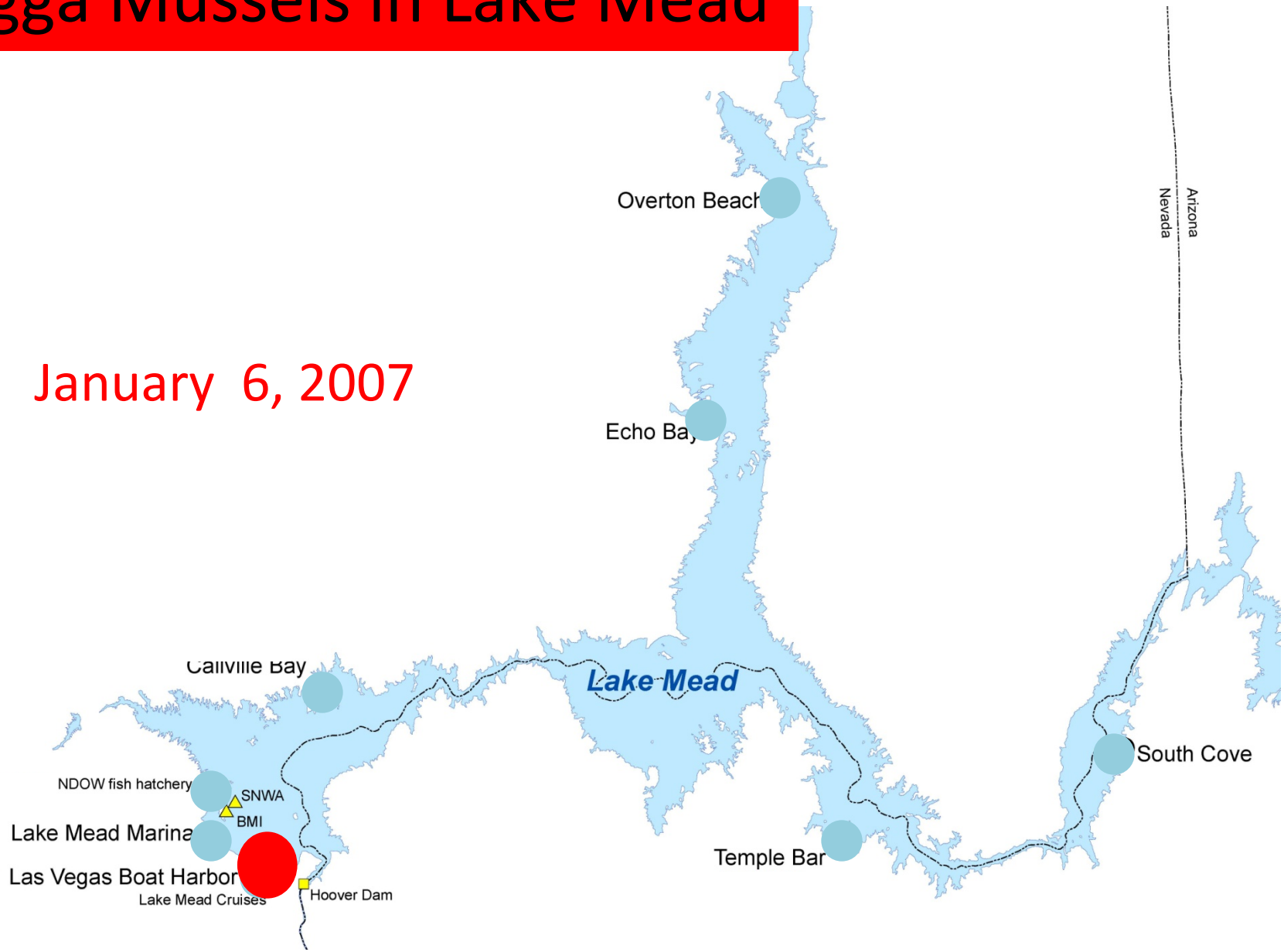
Interagency Monitoring Action Plan (I-MAP): Quagga Mussels in Lake Mead

1. Introduction: I-MAP Background
2. I-MAP members and monitoring program;
3. Update on monitoring life history of quagga mussels in Lake Mead;
4. Update on monitoring effects of quagga mussels on water quality and biota;
5. Update on boat inspection and cleaning.

1. Introduction: I-MAP Background

Quagga Mussels in Lake Mead

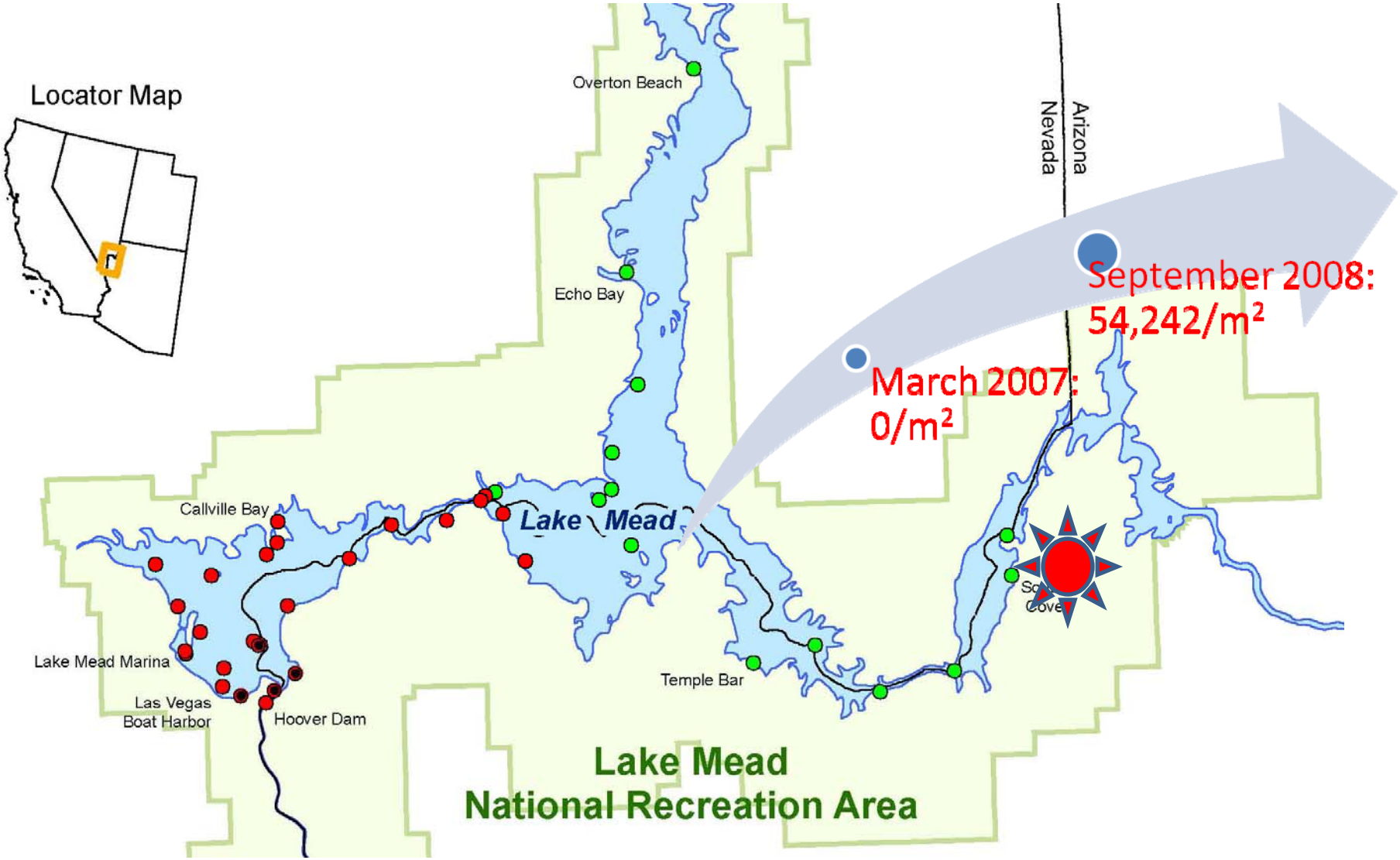
January 6, 2007



March 8, 2007

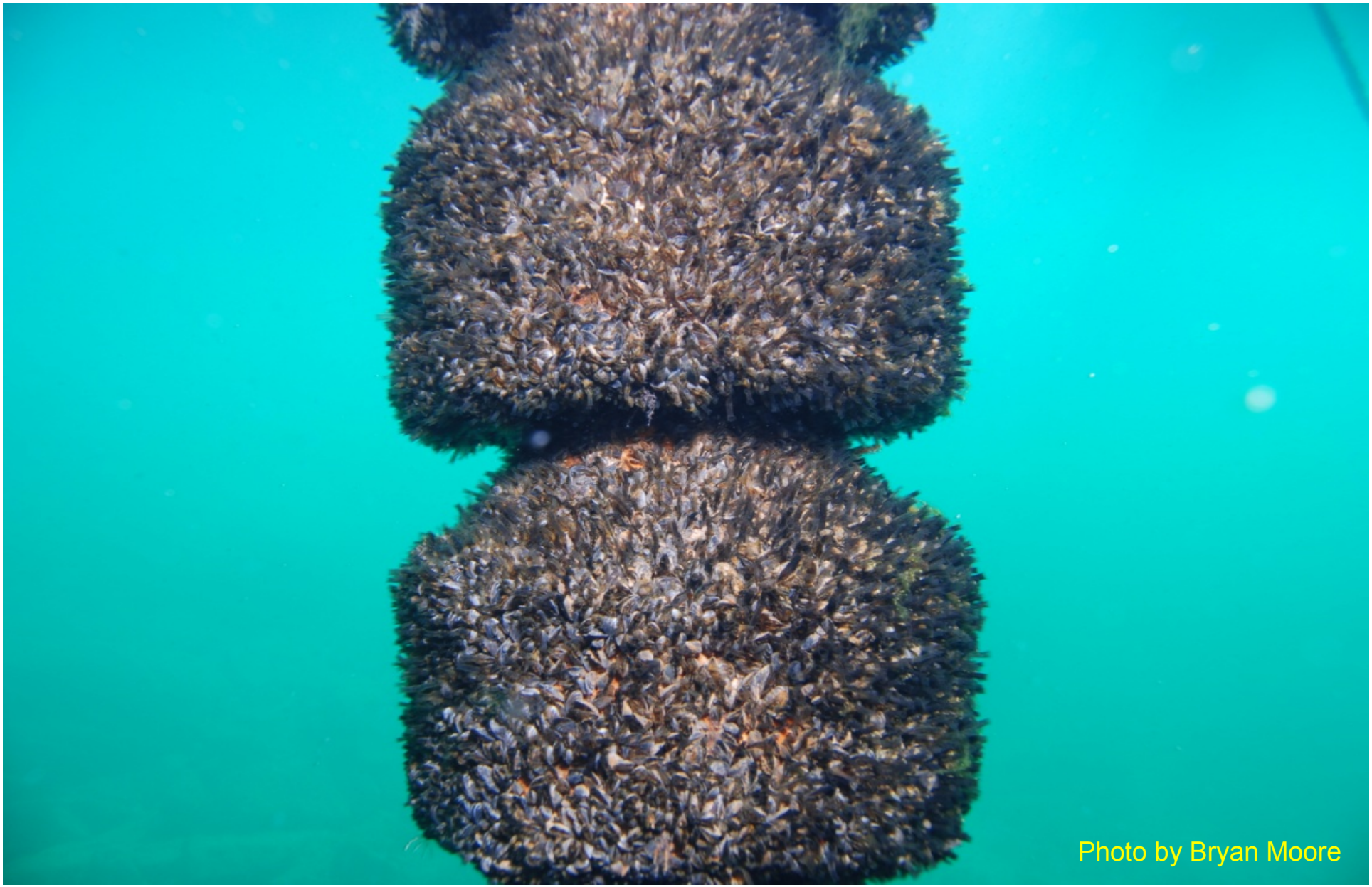
Locator Map
Overton Beach
Echo Bay
Arizona
Nevada
Callville Bay
Lake Mead
South Cove
Lake Mead Marina
Las Vegas Boat Harbor
Hoover Dam
Temple Bar
Lake Mead National Recreation Area

Quagga mussel spread quickly



SNWA Water Intake

NPS Water Intake



Hoover Dam: Penstocks

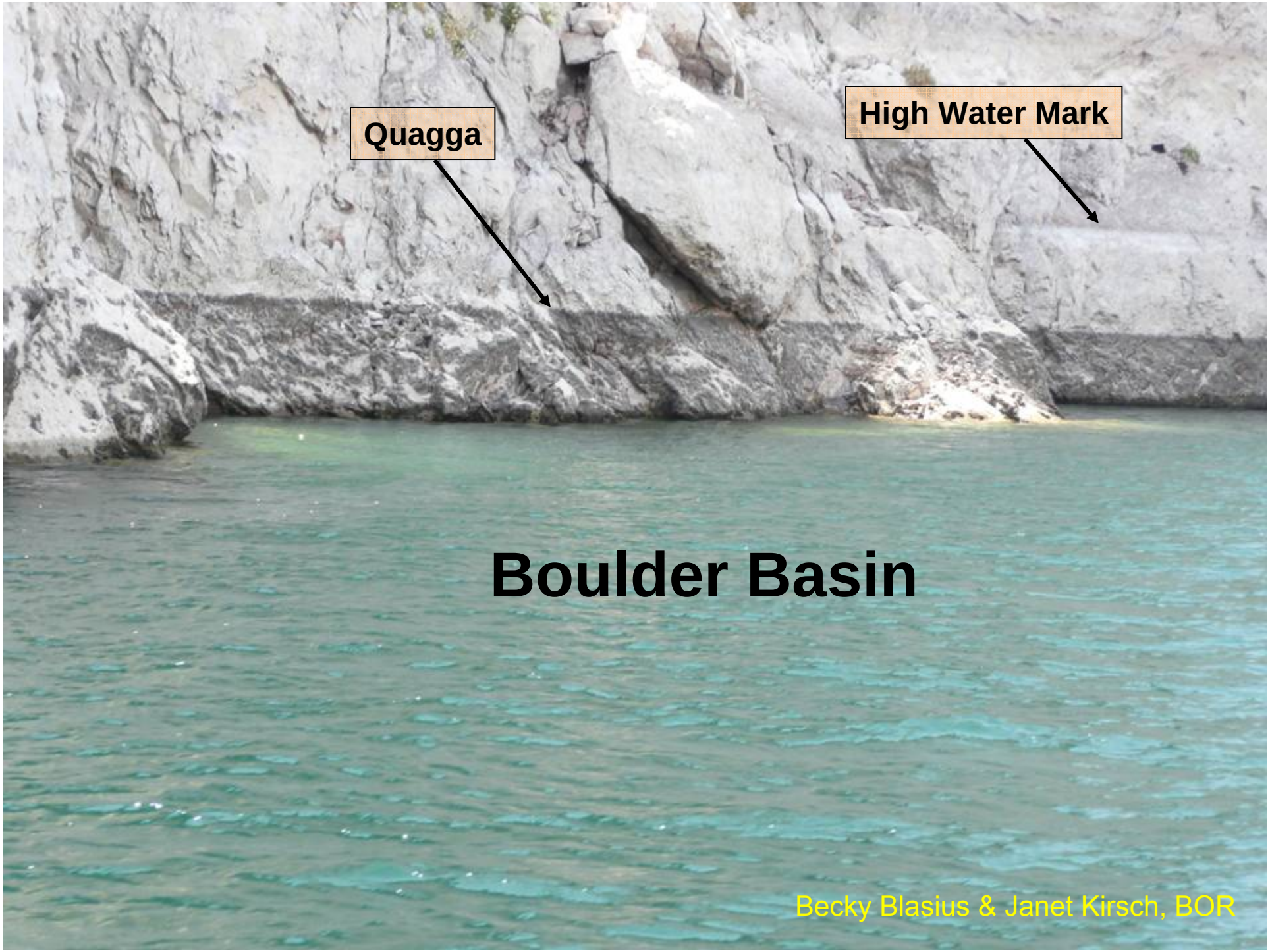
Mussel bed at the bottom

Propeller

Sandal in Lake Mead

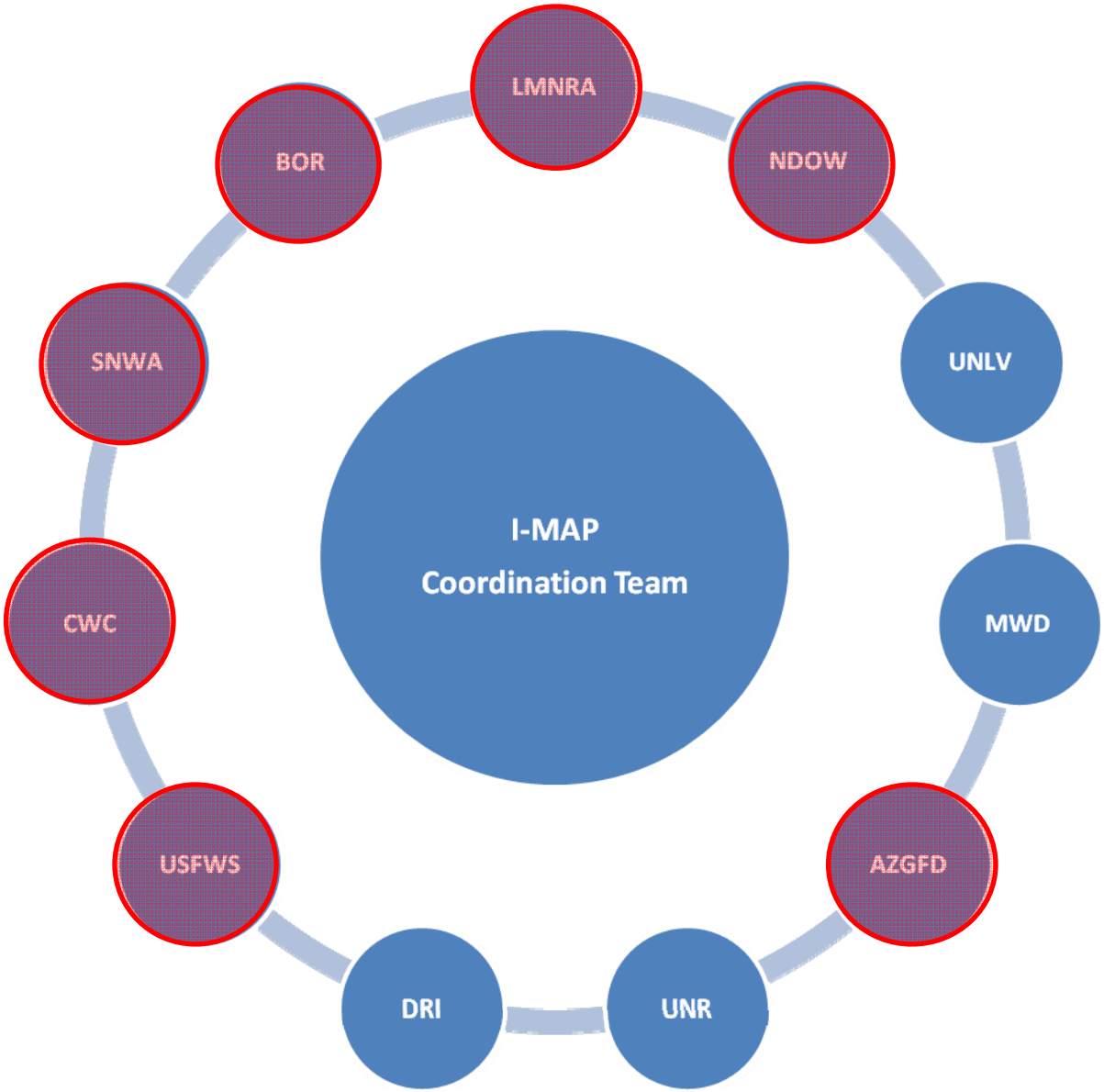
David Wong

Colorado River Inflow
Becky Blasius & Janet Kirsch, BOR


Quagga
High Water Mark
Boulder Basin
Becky Blasius & Janet Kirsch, BOR

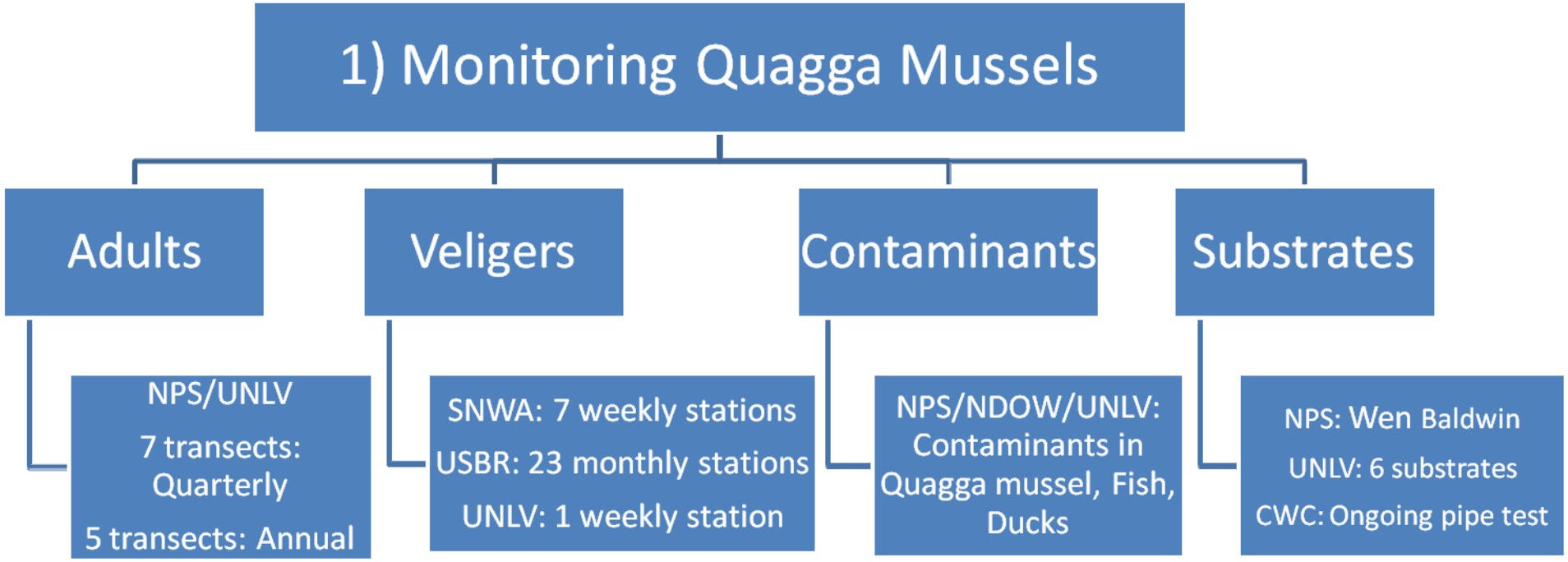
Becky Blasius & Janet Kirsch, BOR

2. I-MAP Interagency Members:



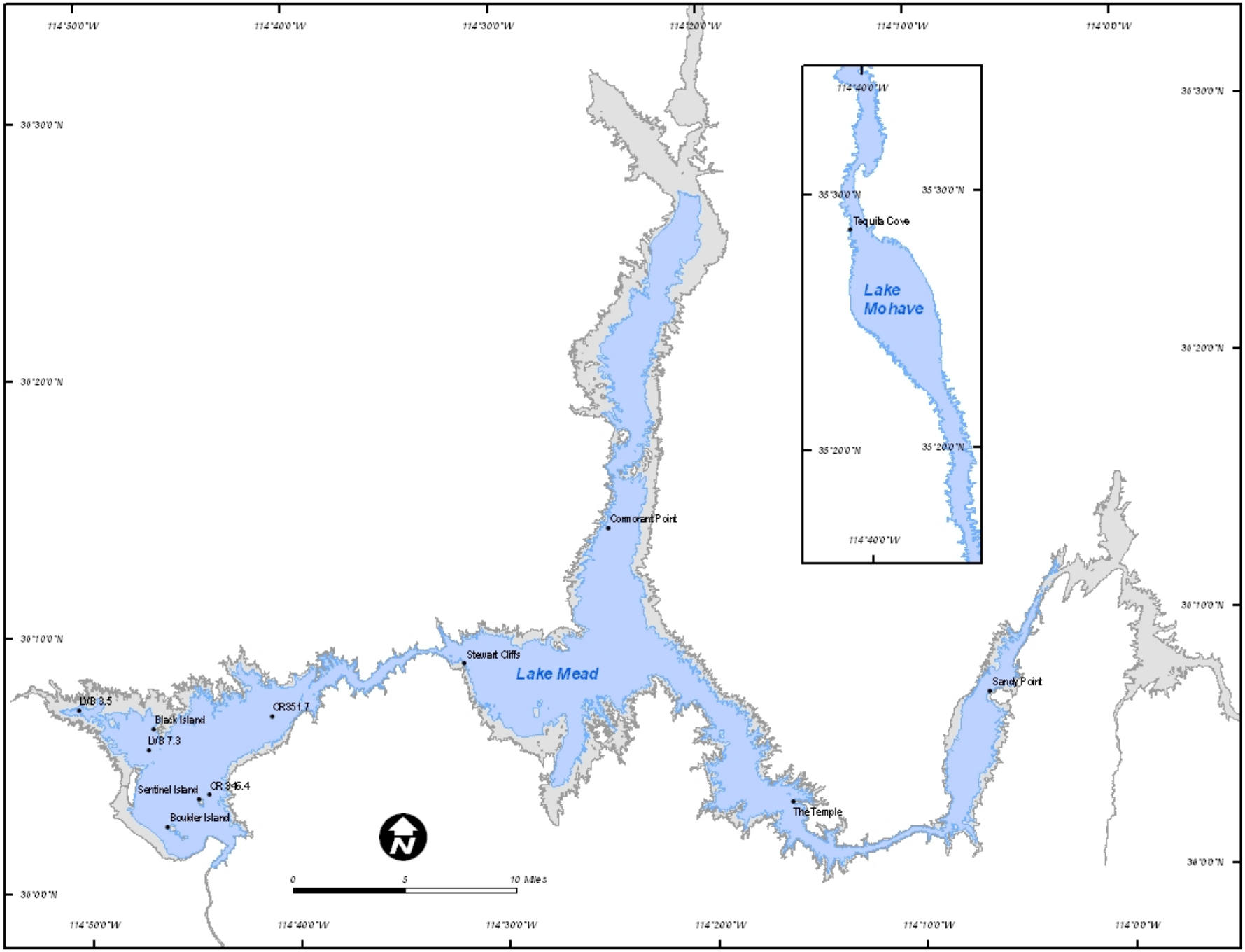
What does I-MAP monitor?

Monitoring	Participant Agencies
1. Quagga Mussels (adults, juveniles, and veligers)	NPS/USBR/SNWA/CWC/UNLV/NDOW
2. Water Quality	USBR/SNWA/CWC/NPS/USGS
3. Fish and Invertebrates	NPS/NDOW/UNLV/UNR
4. Infrastructure Maintenance and Public Education	NPS/NDOW/SNWA/USBR/UNLV

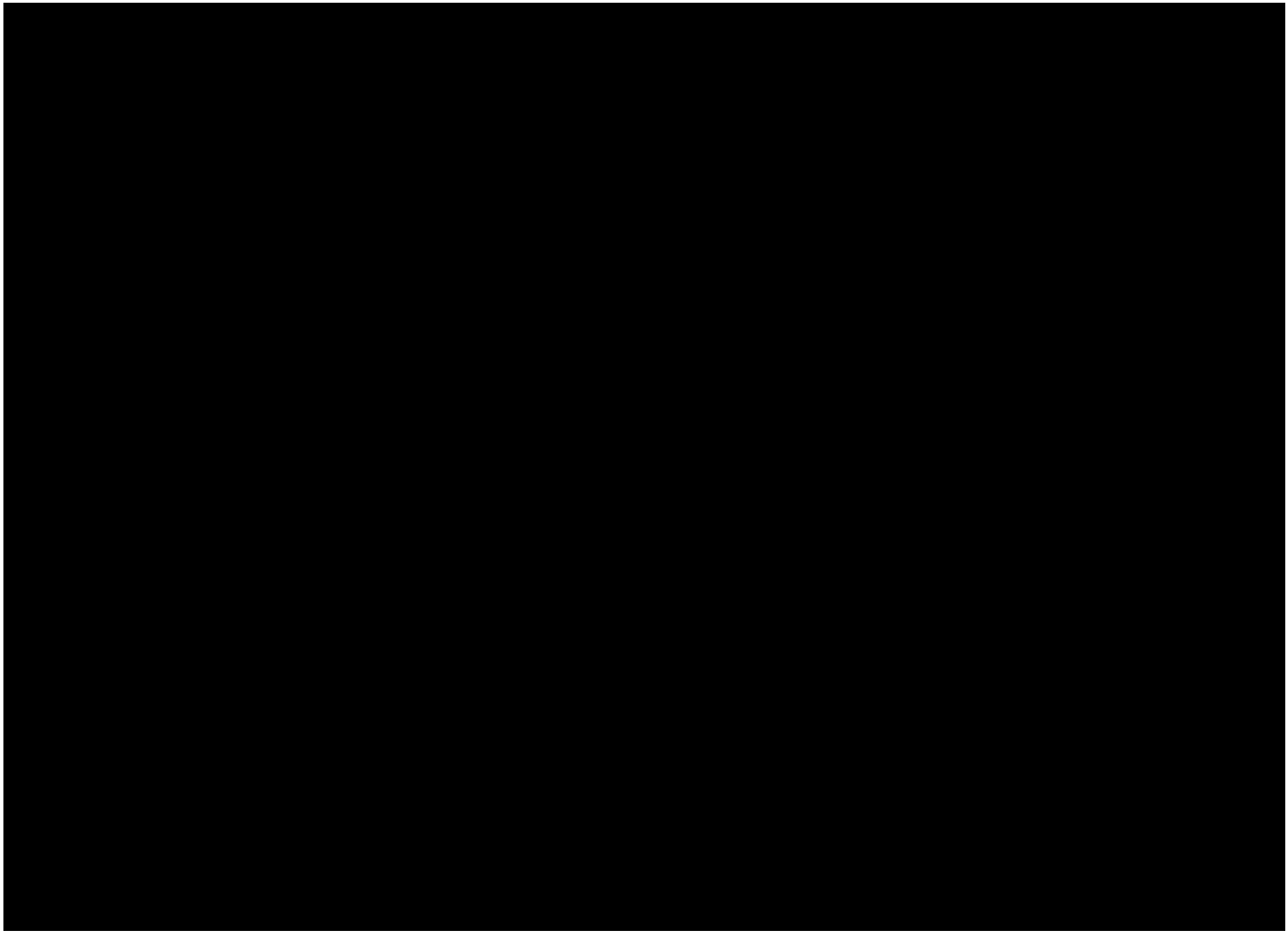

1) Monitoring Quagga Mussels
Adults
NPS/UNLV
7 transects: Quarterly
5 transects: Annual
Veligers
SNWA: 7 weekly stations
USBR: 23 monthly stations
UNLV: 1 weekly station
Contaminants
NPS/NDOW/UNLV: Contaminants in Quagga mussel, Fish, Ducks
Substrates
NPS: Wen Baldwin
UNLV: 6 substrates
CWC: Ongoing pipe test

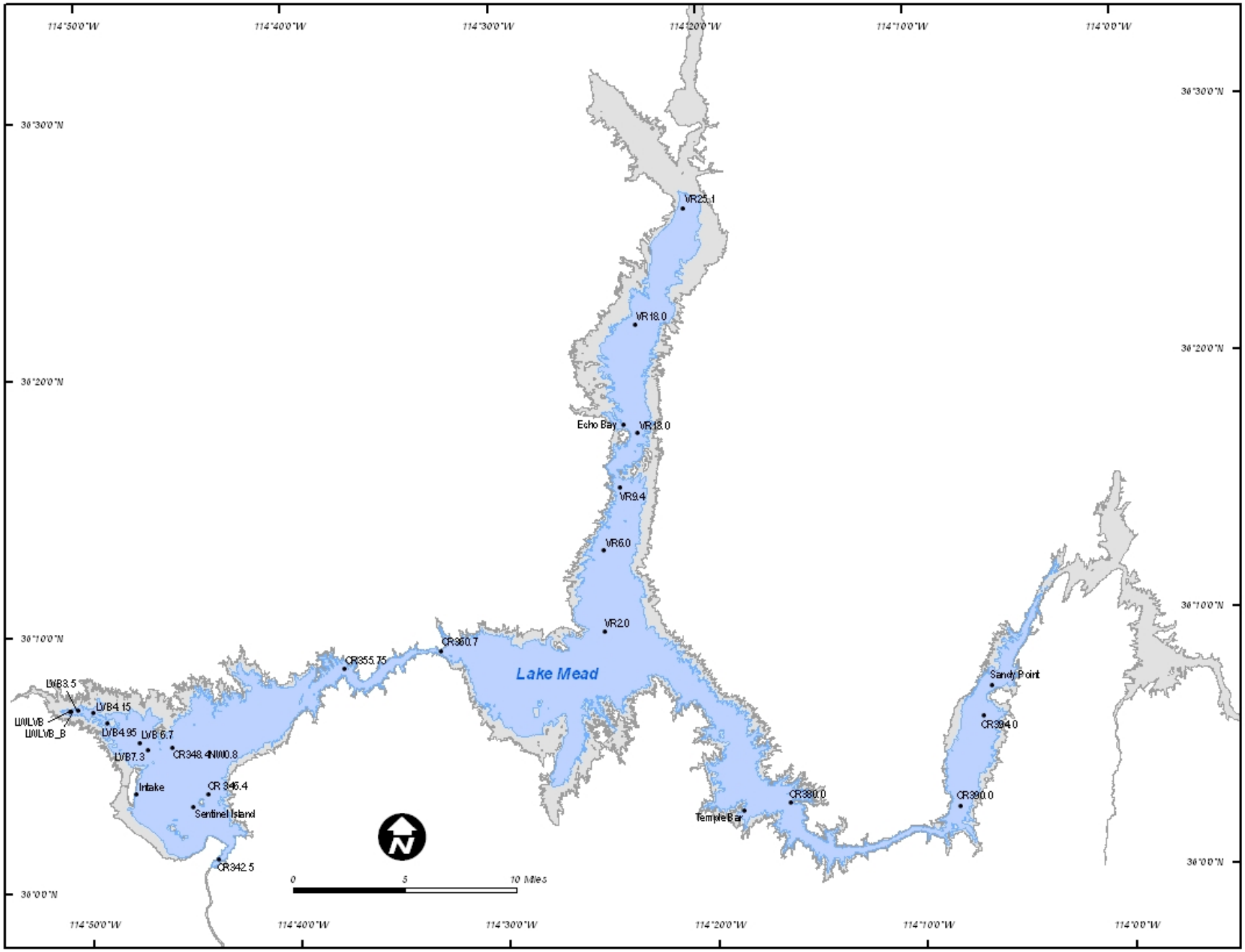
Sampling location and frequency of adult and juvenile quagga mussels in Lake Mead

Transect	Station Name	Latitude	Longitude	Substrate	Sampling	Frequency
1	CR 346.4	36° 03' 42" N	114° 44' 21" W	Soft	Grab	Quarterly
2	LVB 7.3	36° 05' 29" N	114° 47' 15" W	Soft	Grab	Quarterly
3	LVB 3.5	36° 07' 05" N	114° 50' 30" W	Soft	Grab	Quarterly
4	CR351.7	36° 06' 42" N	114° 41' 14" W	Soft	Grab	Quarterly
5	Sentinel Island	36° 03' 34" N	114° 44' 48" W	Hard	Diving	Quarterly
6	Black Island	36° 06' 18" N	114° 46' 56" W	Hard	Diving	Quarterly
7	Boulder Island	36° 02' 30" N	114° 46' 20" W	Hard	Diving	Quarterly
8	Stewart Cliffs	36° 05' 09" N	114° 19' 10" W	Hard	Diving	Annual
9	Cormorant Point	36° 08' 14" N	114° 14' 53" W	Hard	Diving	Annual
10	The Temple	36° 01' 43" N	114° 09' 46" W	Hard	Diving	Annual
11	Sandy Point	36° 06' 58" N	114° 06' 41" W	Hard	Diving	Annual
12	Tequila Cove	35° 17' 08" N	114° 24' 26" W	Hard	Diving	Annual


114°50'0"W
114°40'0"W
114°30'0"W
114°20'0"W
114°10'0"W
114°0'0"W
36°30'0"N
36°20'0"N
36°10'0"N
36°0'0"N
Lake Mohave
Tequila Cove
35°30'0"N
35°20'0"N
Cormorant Point
Stewart Cliffs
Lake Mead
Sandy Point
The Temple
LVB 8.5
Black Island
LVB 7.3
CR351.7
Sentinel Island
CR 346.4
Boulder Island
0
5
10 Miles

Quagga mussel velgiers monitoring stations in Lake Mead




114°50'0"W
114°40'0"W
114°30'0"W
114°20'0"W
114°10'0"W
114°0'0"W
36°30'0"N
36°20'0"N
36°10'0"N
36°0'0"N
VR25.1
VR18.0
Echo Bay
VR13.0
VR9.4
VR6.0
VR2.0
Lake Mead
CR360.7
CR355.75
LVB3.5
LVB4.15
LVB/LVB
LVB/LVB_B
LVB4.95
LVB 6.7
LVB7.3
CR348.4
NW0.8
Intake
CR 346.4
Sentinel Island
CR342.5
Temple Bar
CR380.0
Sandy Point
CR394.0
CR390.0
0
5
10 Miles
N

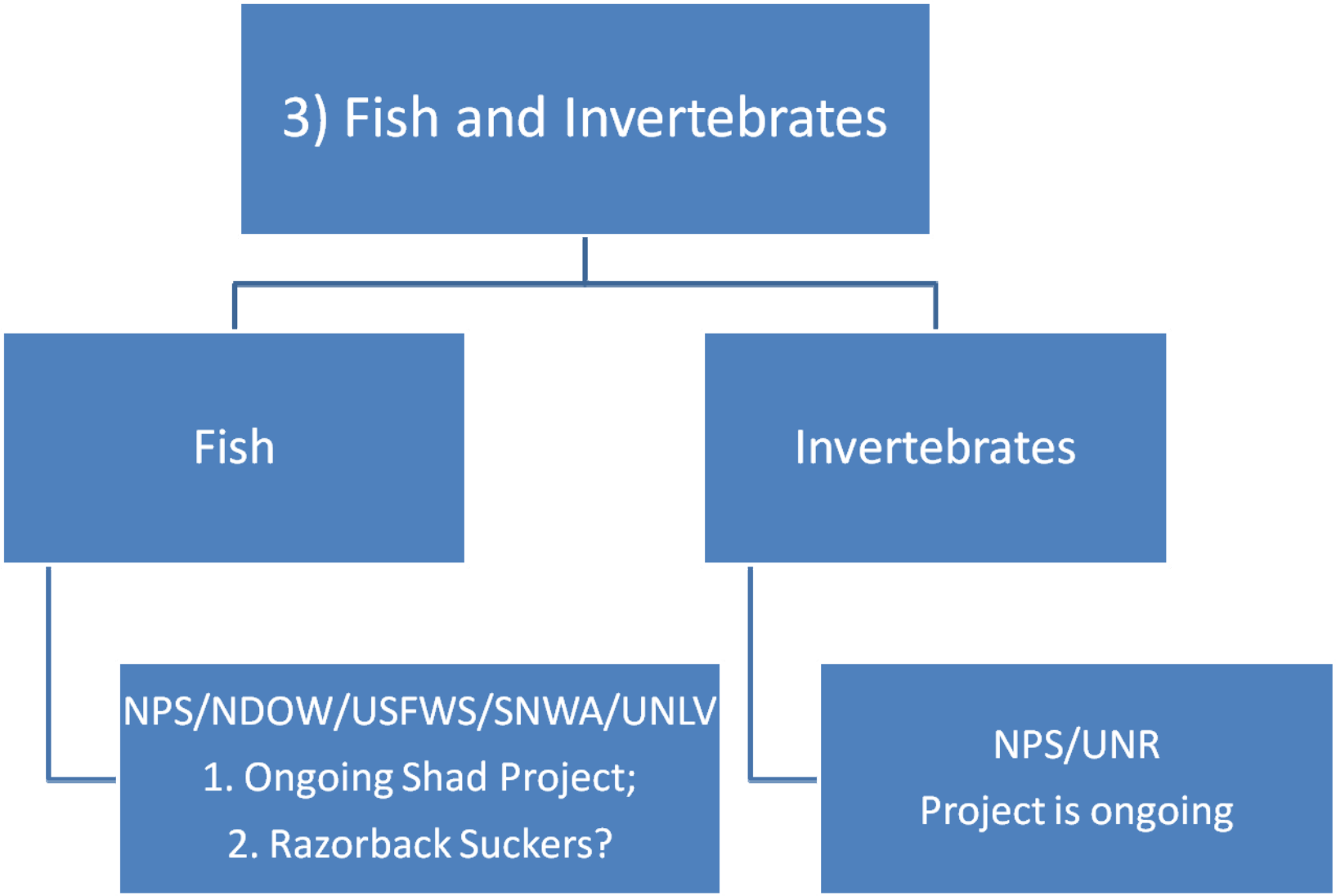
2) Water Quality Monitoring

SNWA: 15 permanent stations

CWC: 5 BBAMP stations

BOR: 7 Permanent stations

- Chl-*a*
- Secchi
- Phosphorus
- Nitrogen
- TOC
- DO
- Phytoplankton
- Zooplankton


3) Fish and Invertebrates
Fish
Invertebrates
NPS/NDOW/USFWS/SNWA/UNLV
1. Ongoing Shad Project;
2. Razorback Suckers?
NPS/UNR
Project is ongoing

4) Infrastructure Maintenance and Public Education

NPS

1. Boat Inspection
2. Boat Cleaning
3. Disinfection Training
4. Public Education

SNWA

1. Intake monitoring
2. Intake cleaning

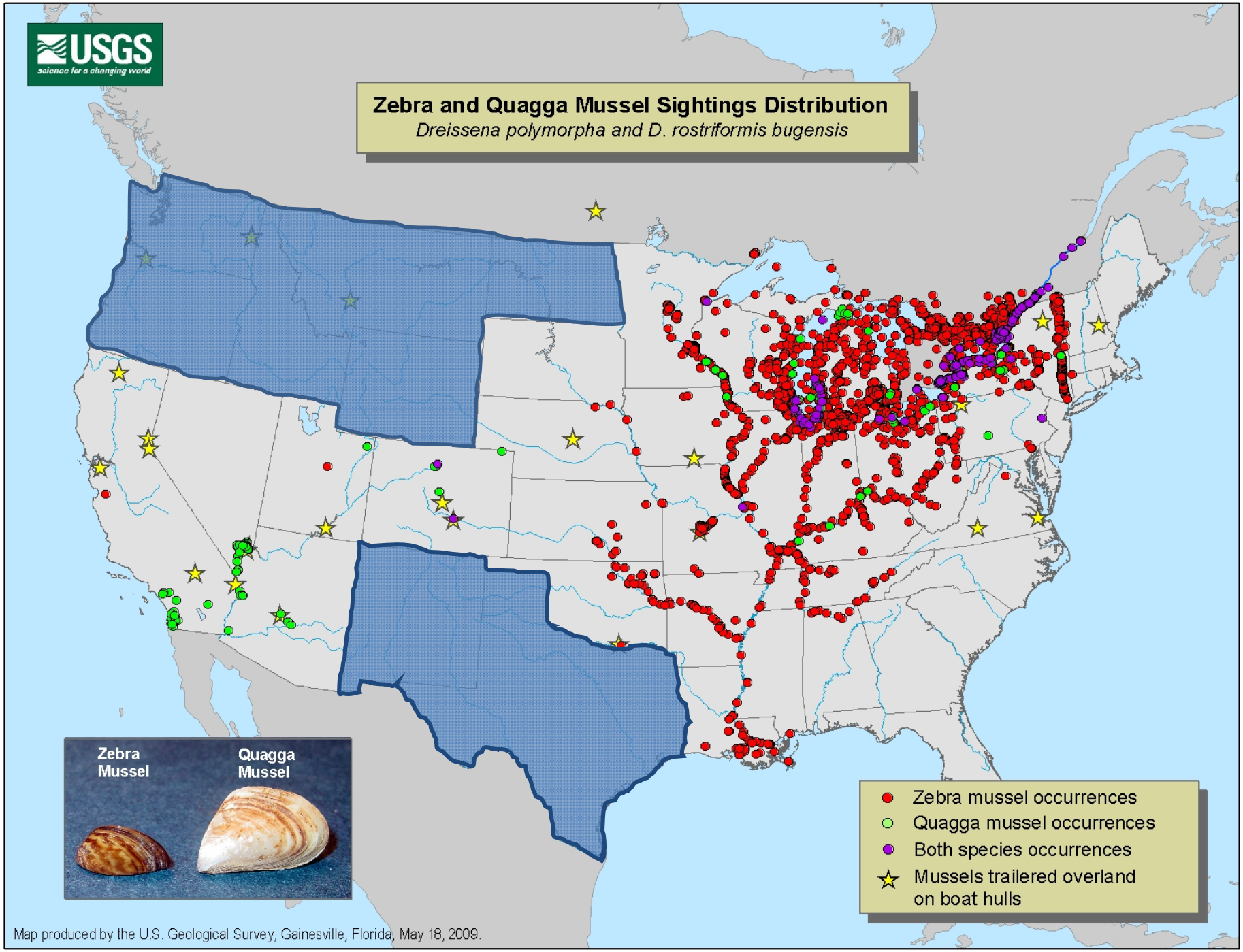
USBR

1. Dam maintenance
2. Coating study
3. UV and Filtration
4. *Pseudomonas fluorescens*

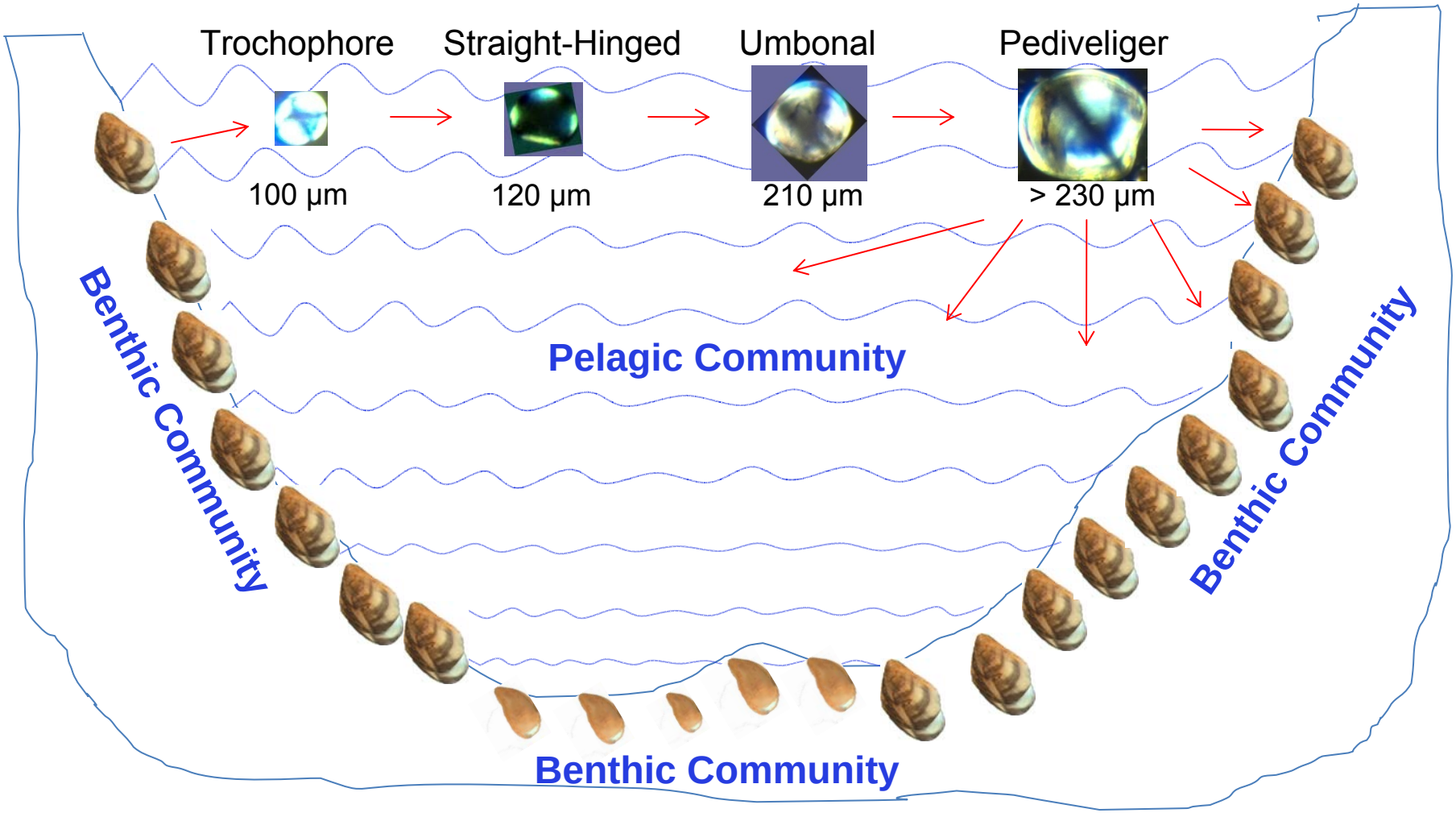
UNLV

1. Boat Survey

3. Update on Monitoring
Life history of Quagga Mussels


USGS
science for a changing world
Zebra and Quagga Mussel Sightings Distribution
Dreissena polymorpha and D. rostriformis bugensis
Zebra Mussel
Quagga Mussel
Zebra mussel occurrences
Quagga mussel occurrences
Both species occurrences
Mussels trailered overland on boat hulls
Map produced by the U.S. Geological Survey, Gainesville, Florida, May 18, 2009.

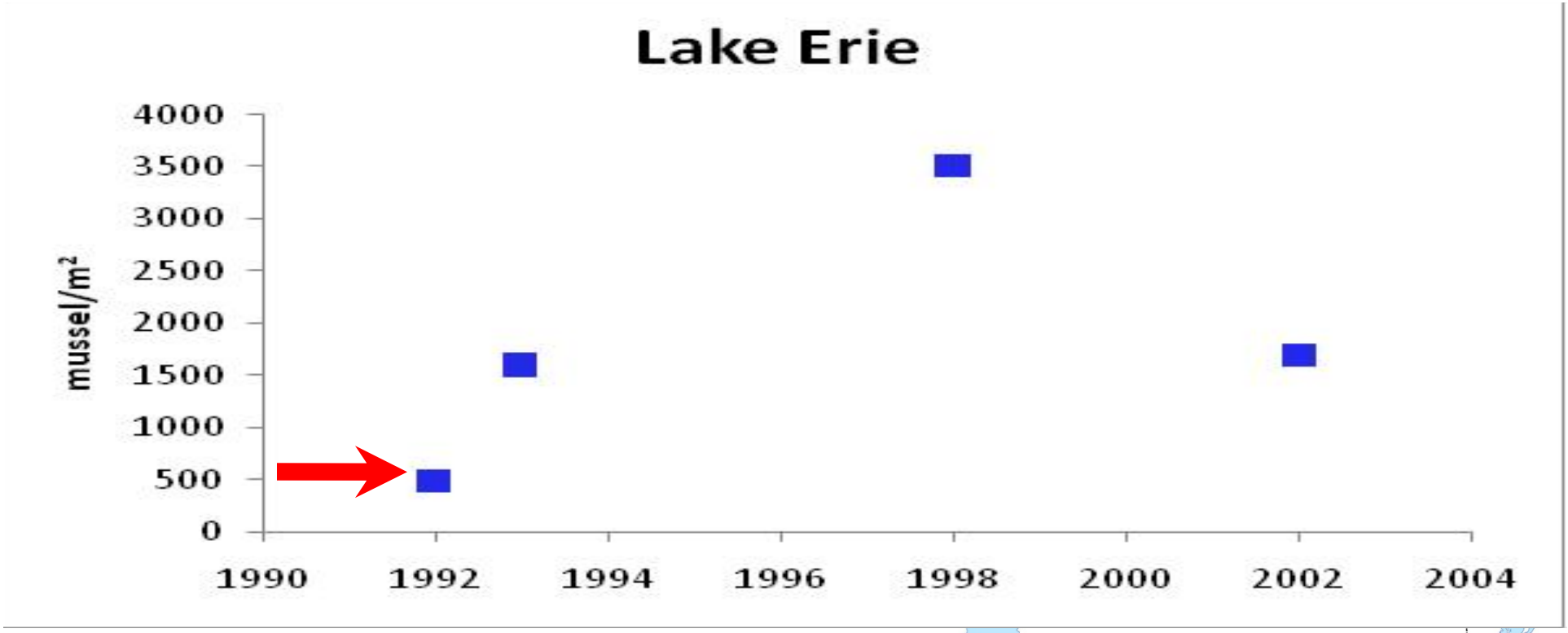
Quagga Mussel Life History



How many mussels: Boulder Basin

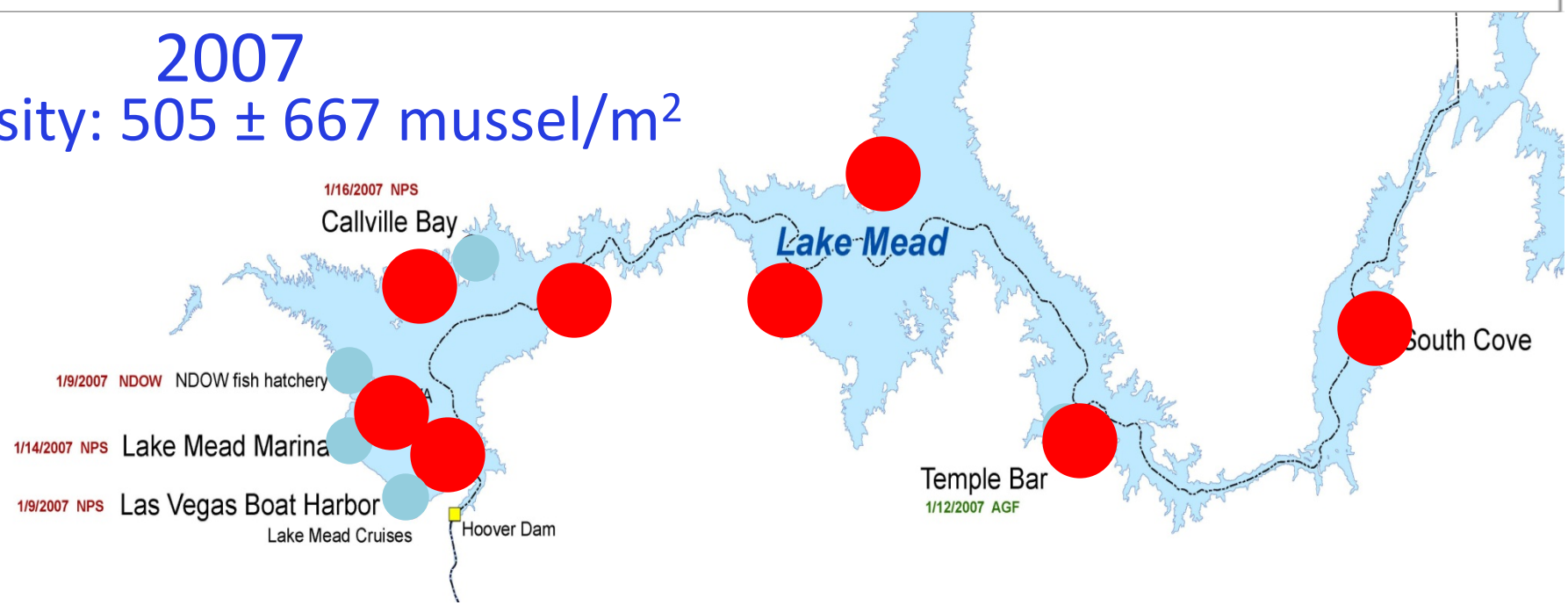
Mussels	Boulder Basin	2007	2008
Adults & Juveniles [1]	Soft substrates (Muddy/Sandy Areas)	4,418,810,840	409,205,220,131
	Hard substrates (Rocky Areas)	43,379,740,389	2,507,071,900,221
	Sub-total	47,798,551,229	2,916,277,120,353
Veligers[2]	Water	38,539,940,581,229	26,511,374,631,303

1. National Park Service Survey data
2. US Bureau of Reclamation

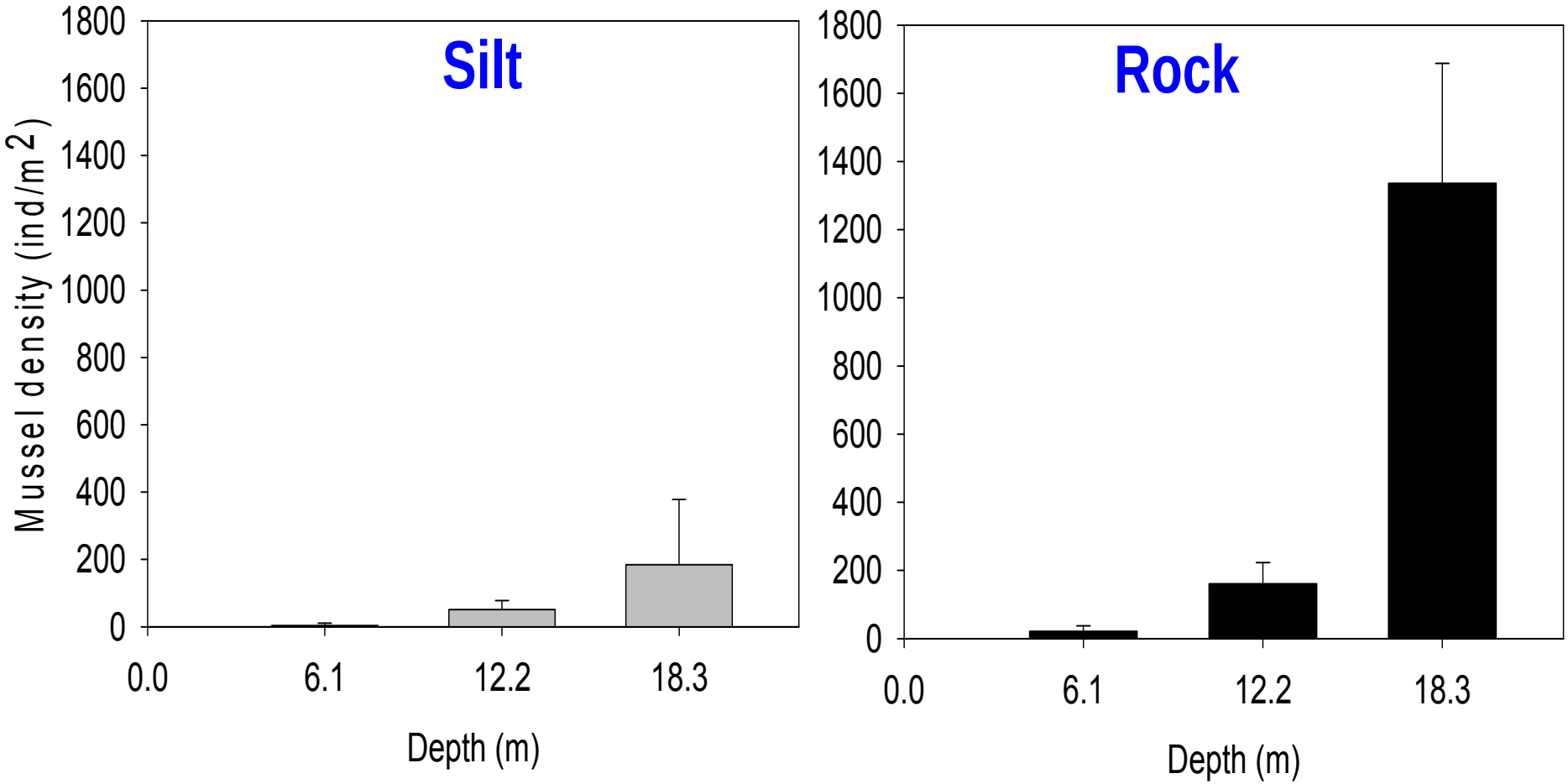


2007

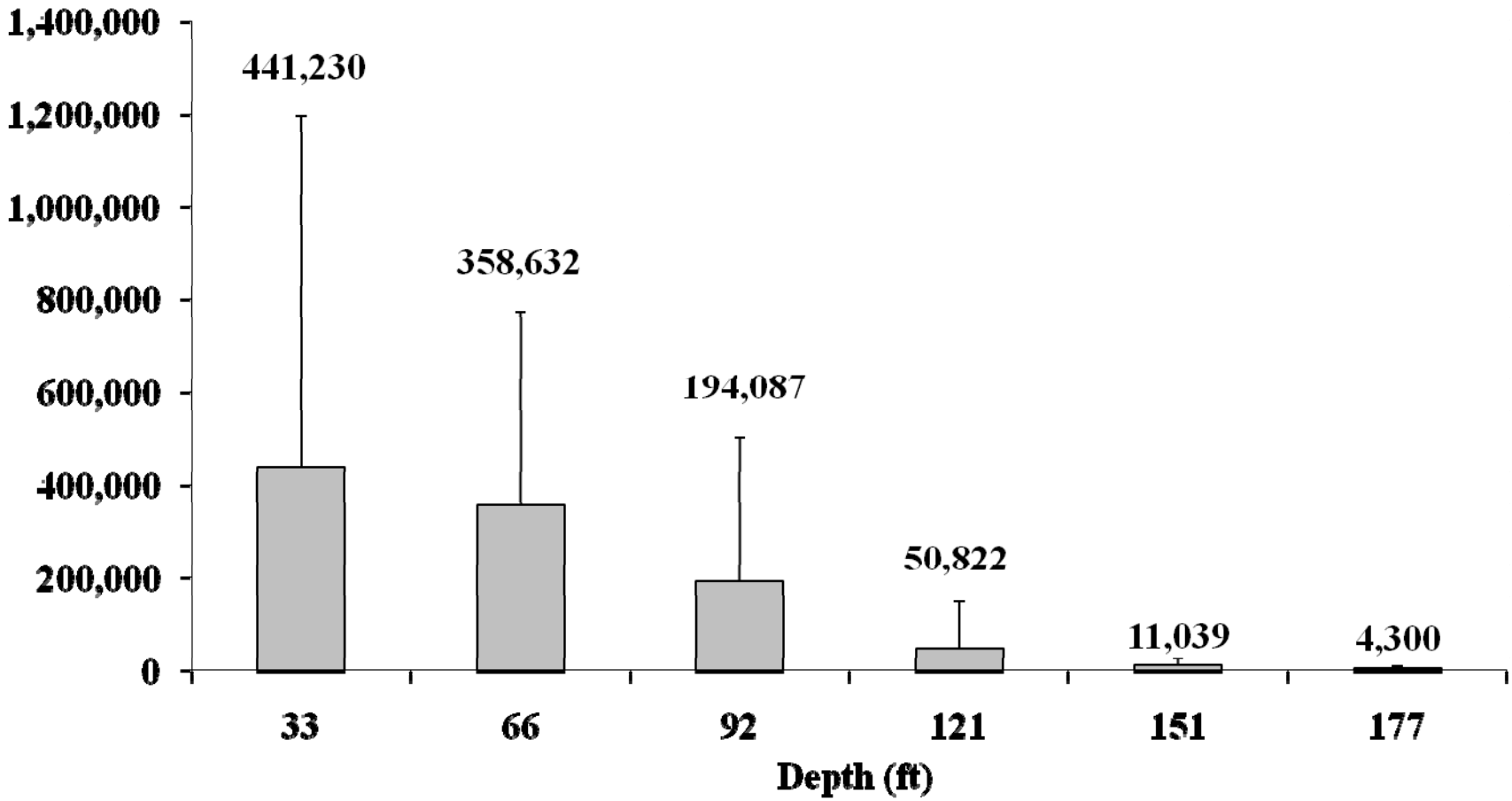
Density: 505 ± 667 mussel/m²



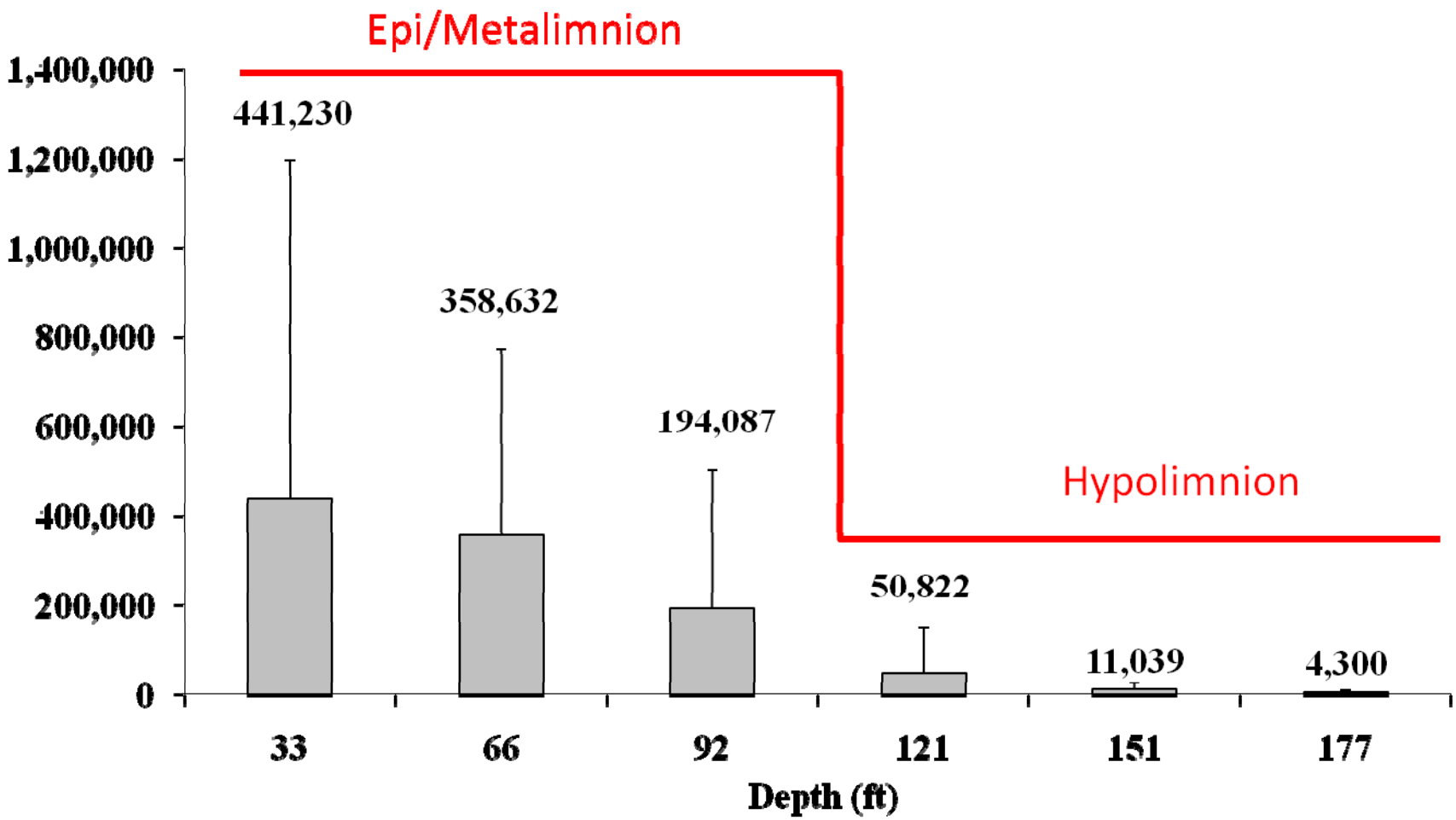
Quagga Mussels on Different Substrates



Quaggas at Different Depths



Quaggas at Different Depths

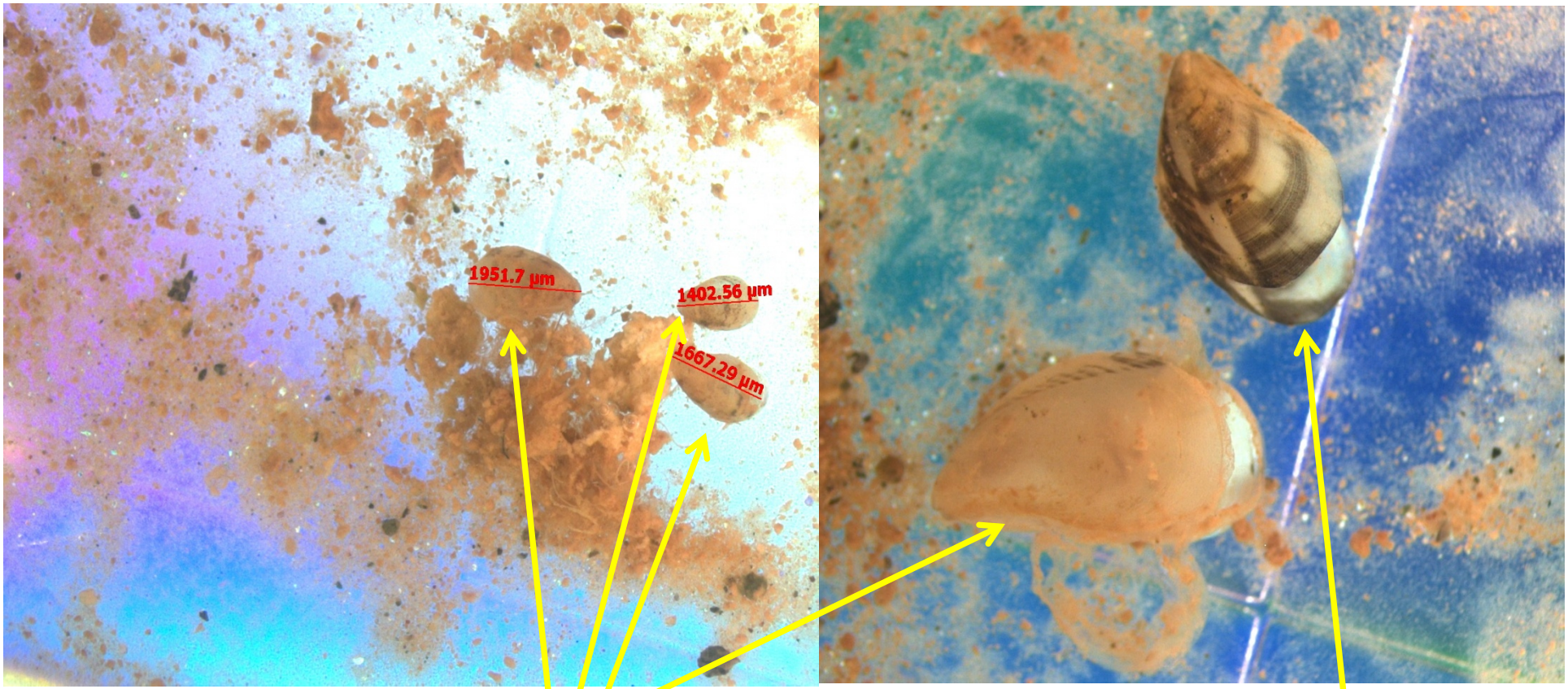


Quagga mussels found in the deepest area: Narrows between Boulder Basin and Virgina Basin

(Wong & Moore)

10 X

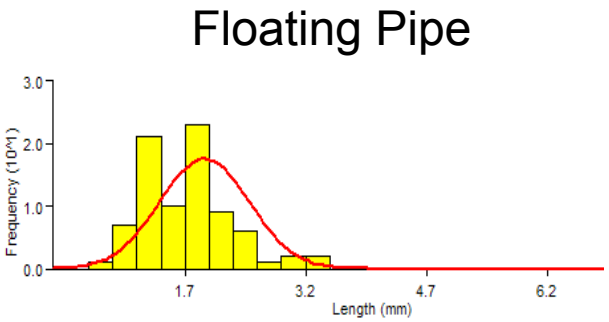
80 X

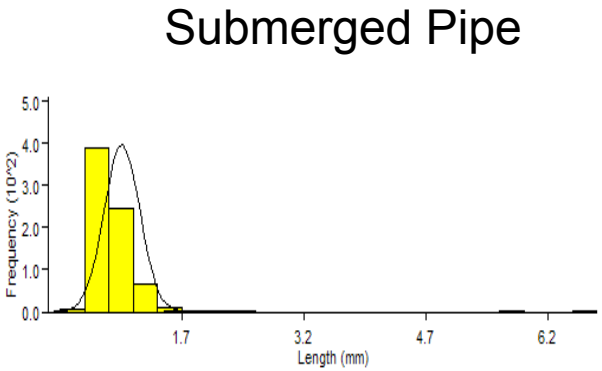


355 ft

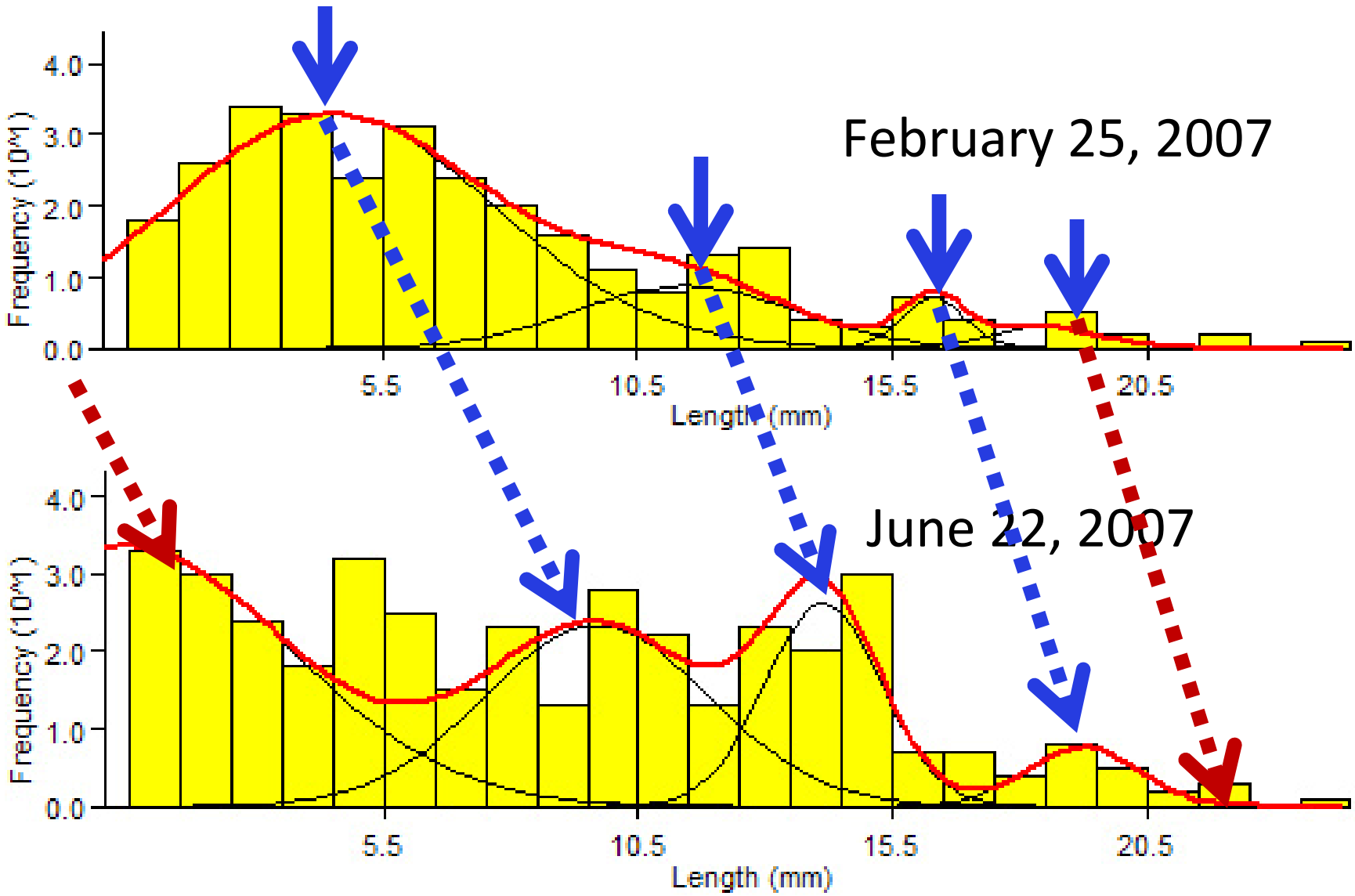
50 ft

Quagga Mussel Size: CWC In Situ Pipe Test

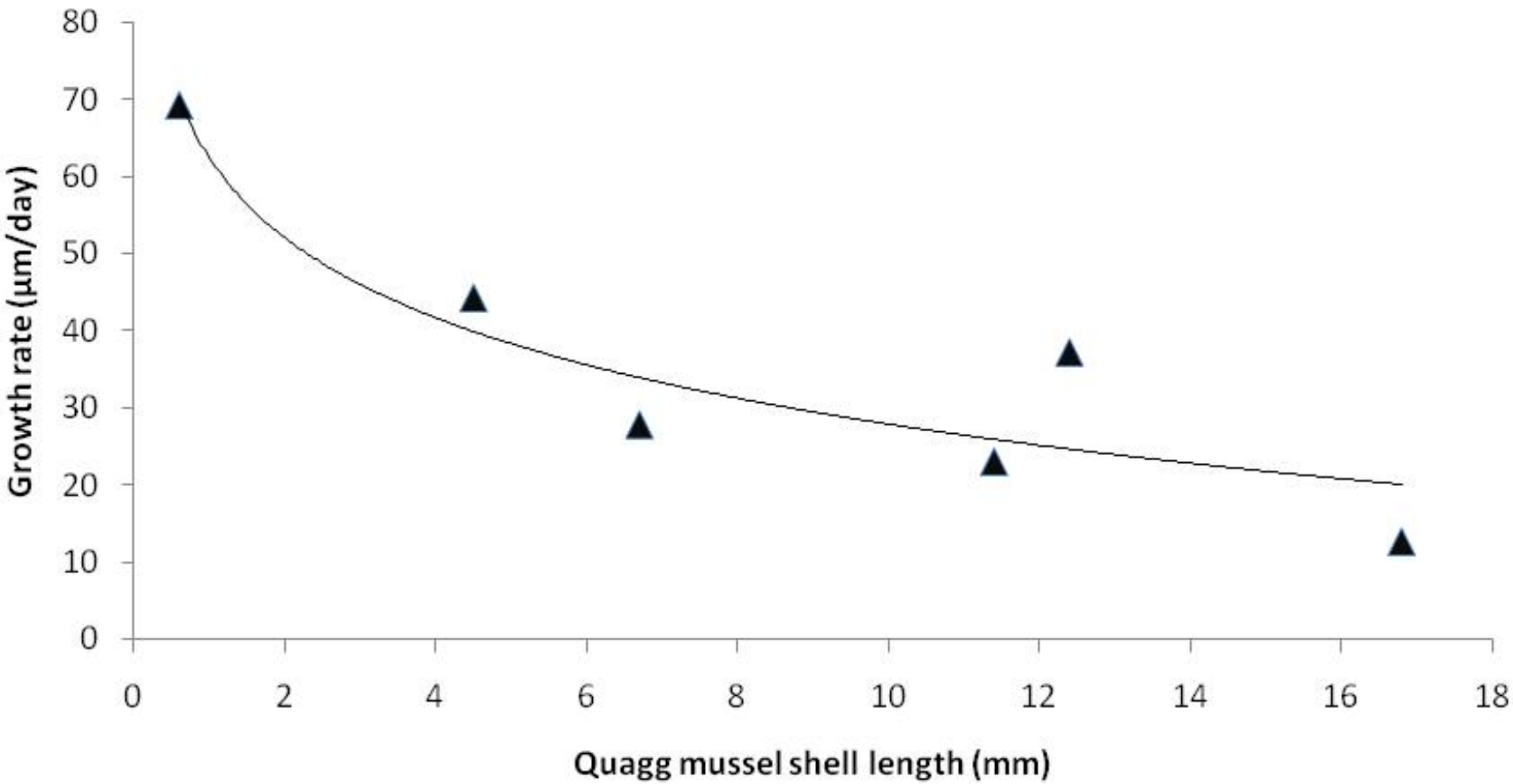




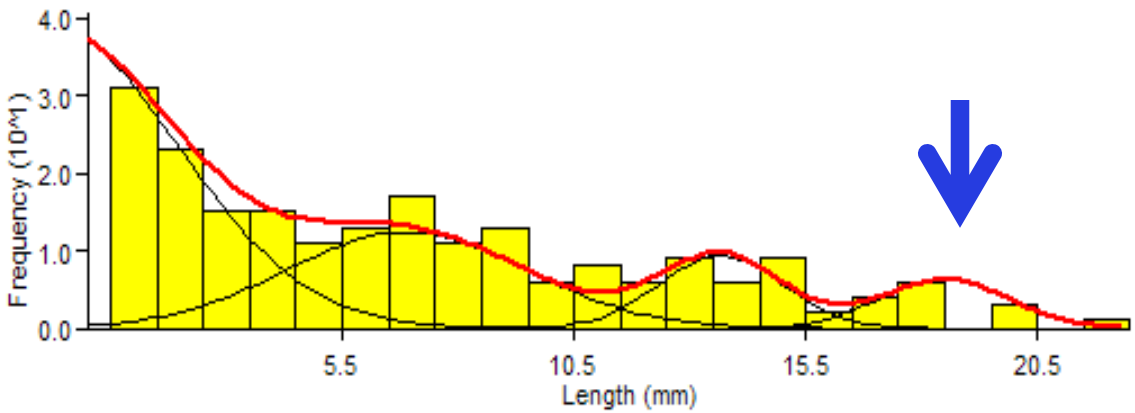
Indian Canyon: Length Frequency



Growth


80
70
60
50
40
30
20
10
0
Growth rate (µm/day)
0
2
4
6
8
10
12
14
16
18
Quagg mussel shell length (mm)

Earliest Population Length Record in Lake Mead: Sentinel Island

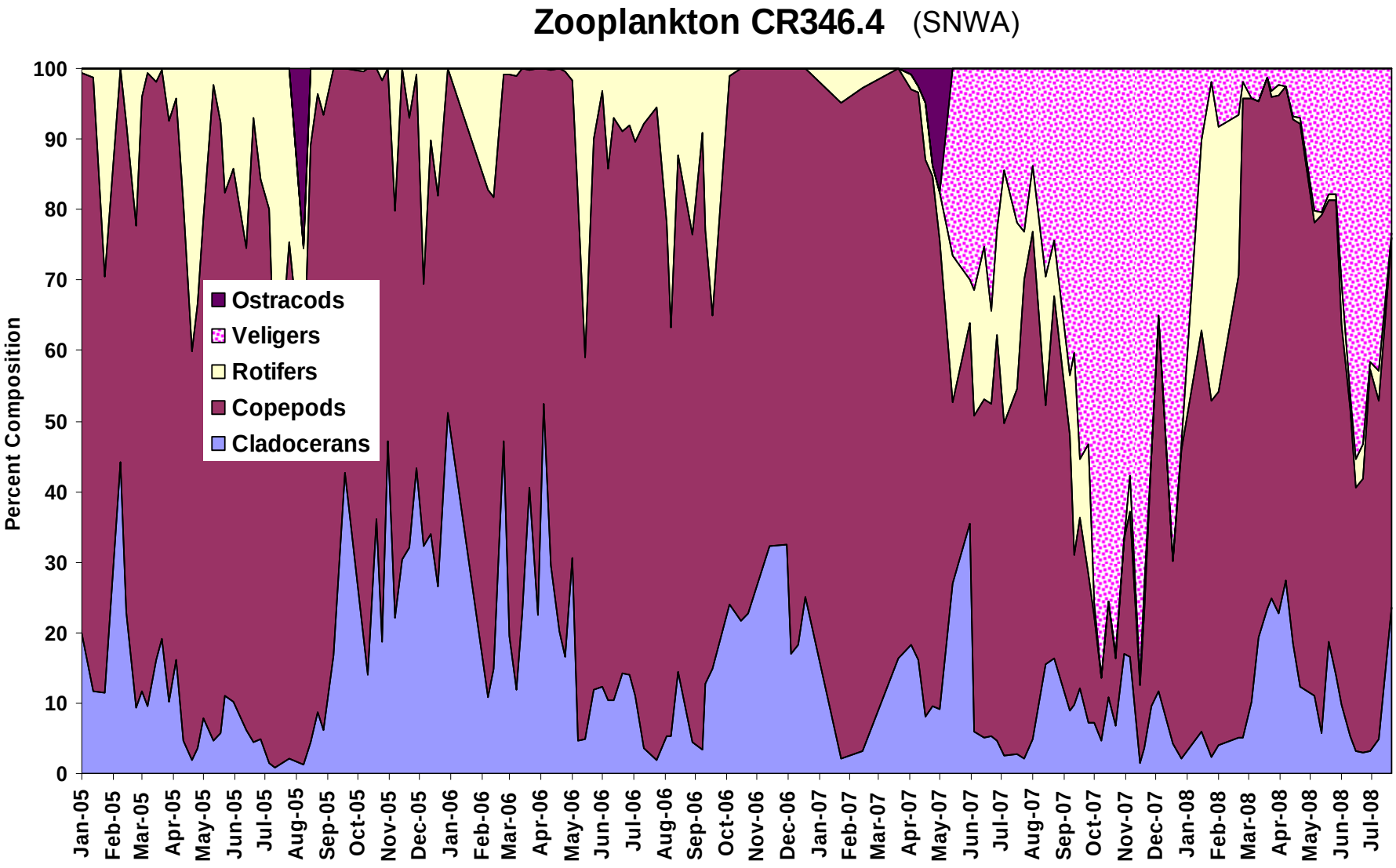


Shell Length:
18.4 mm
Date: February 25, 2007

? <<<

First Cohort: August 21, 2005

Veligers


Zooplankton CR346.4 (SNWA)
Percent Composition
100
90
80
70
60
50
40
30
20
10
0
Ostracods
Veligers
Rotifers
Copepods
Cladocerans
Jan-05
Feb-05
Mar-05
Apr-05
May-05
Jun-05
Jul-05
Aug-05
Sep-05
Oct-05
Nov-05
Dec-05
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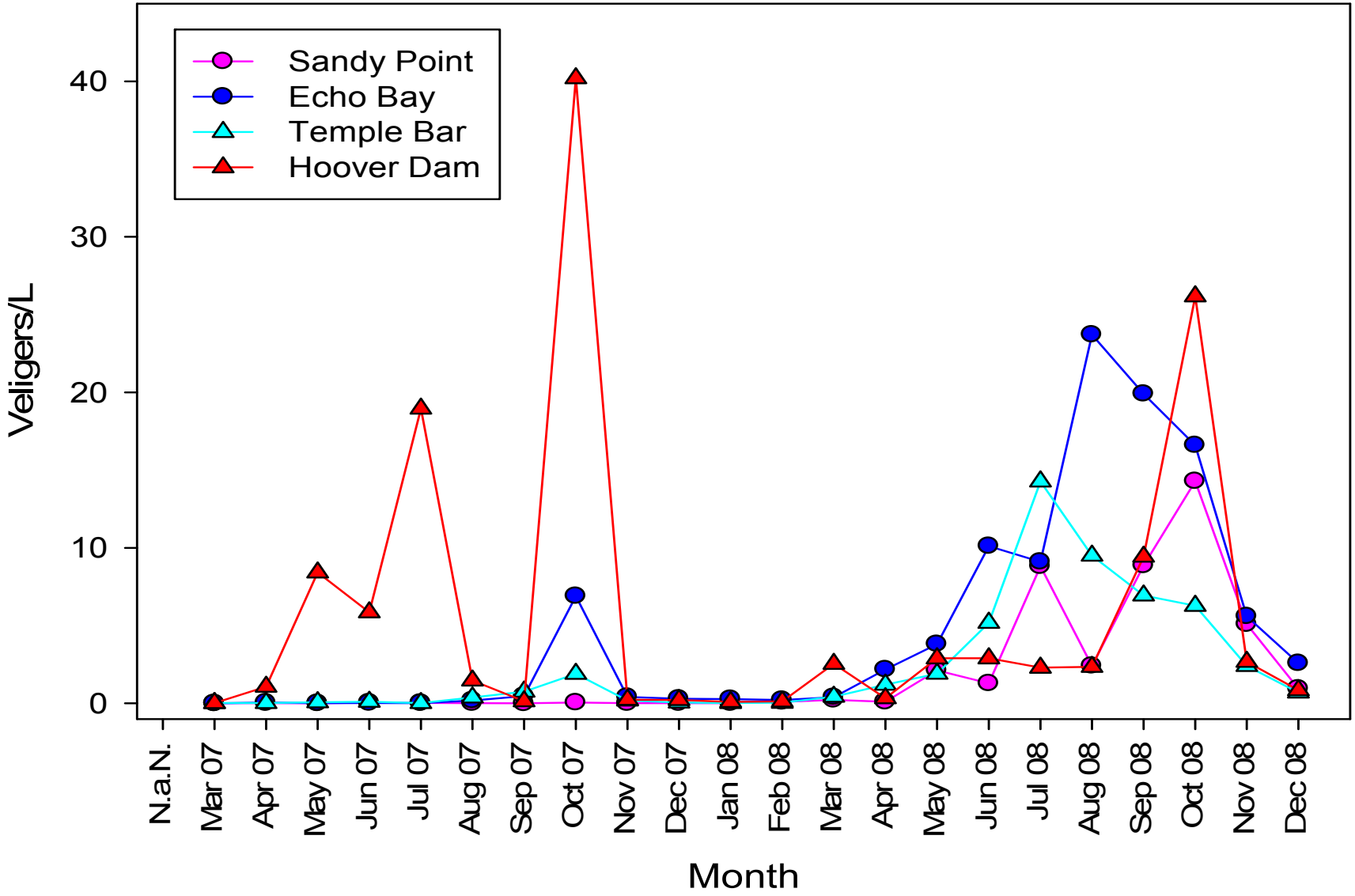
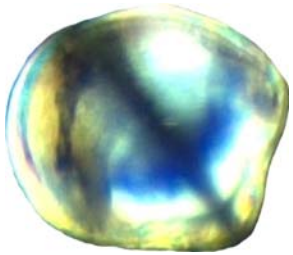
Apr-08
May-08
Jun-08
Jul-08

Veligers (USBR)



Sizes of Quagga Mussels

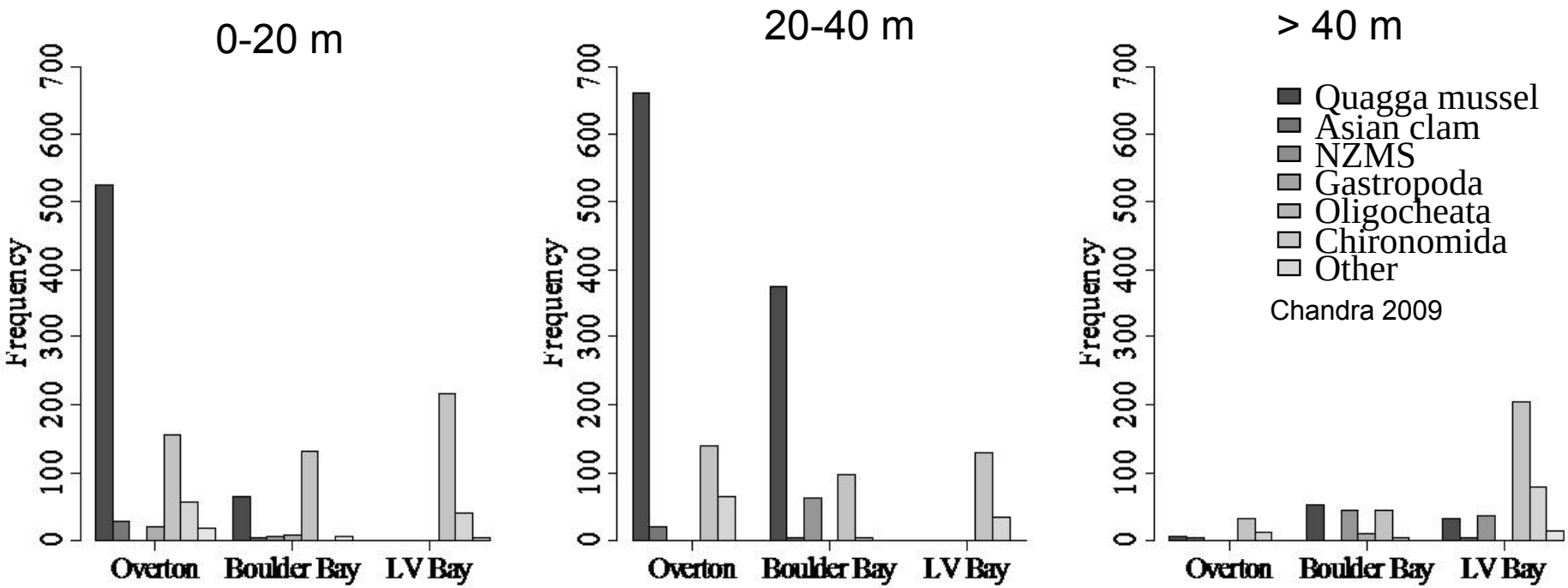


Largest : 355.6 µm
Smallest : 77.8 µm

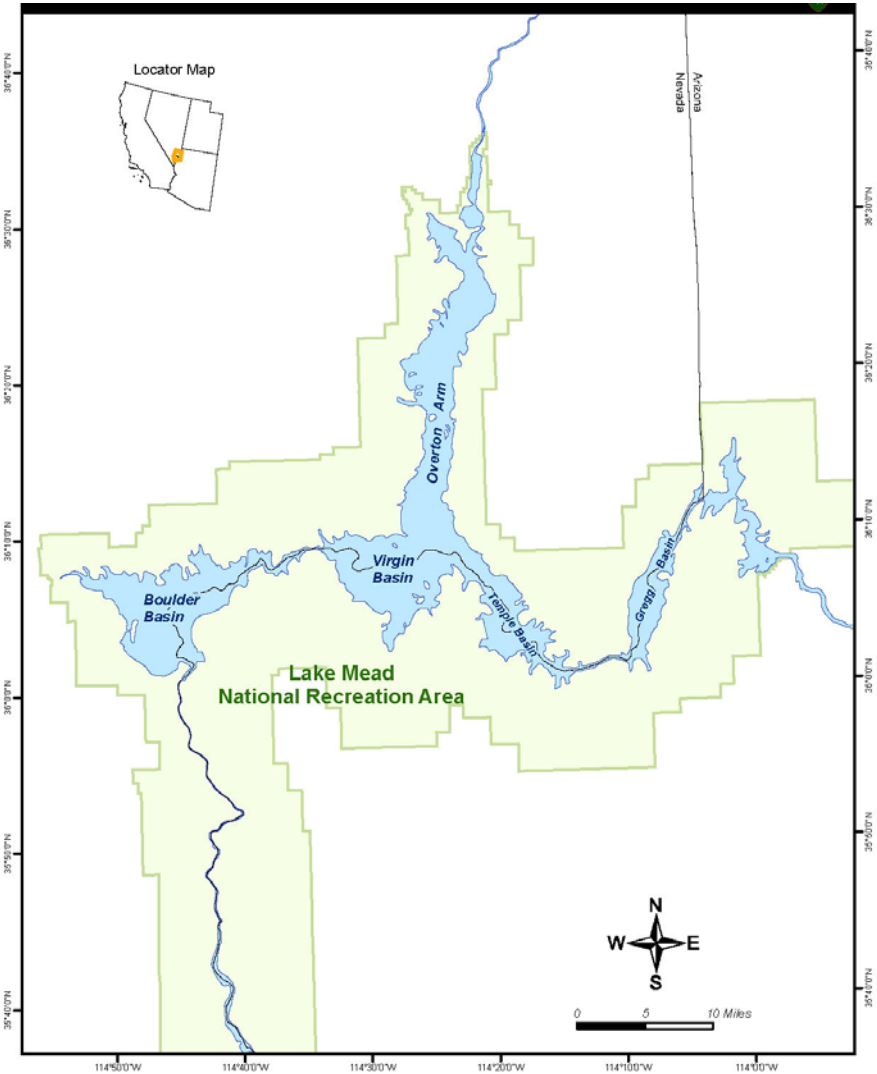
Largest (mm): 28.7 mm
Smallest (mm): 0.21 mm

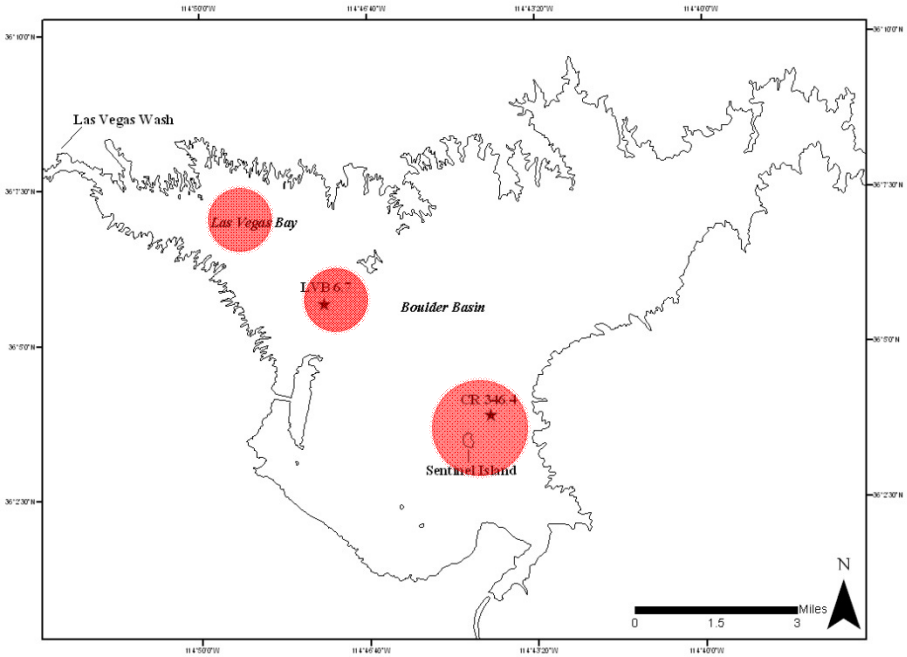
4. Effects on Biological Communities and Water Quality

Lake Benthic Community

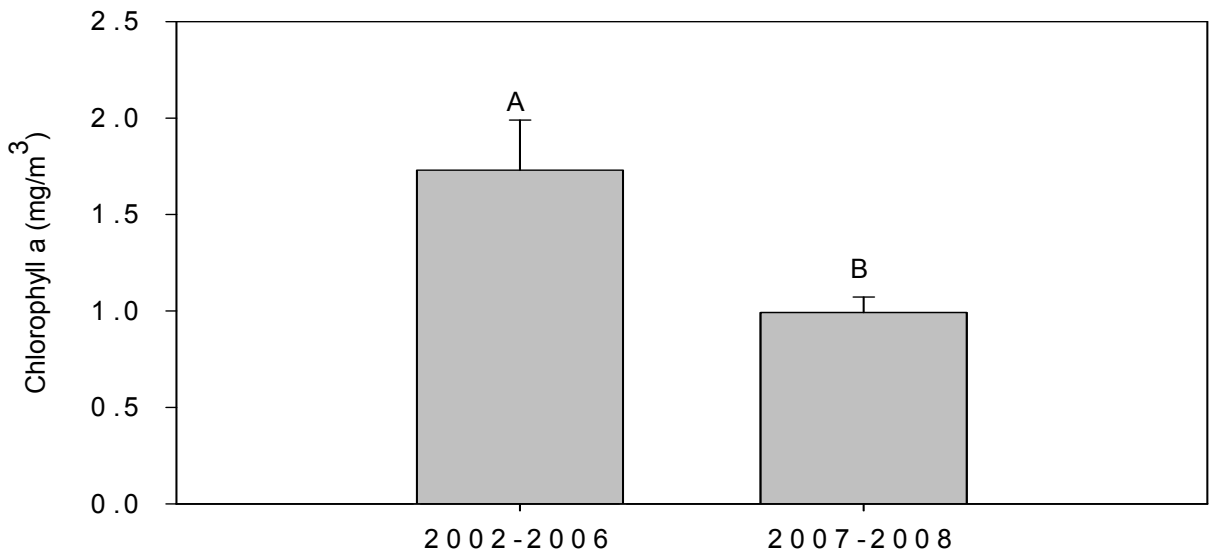


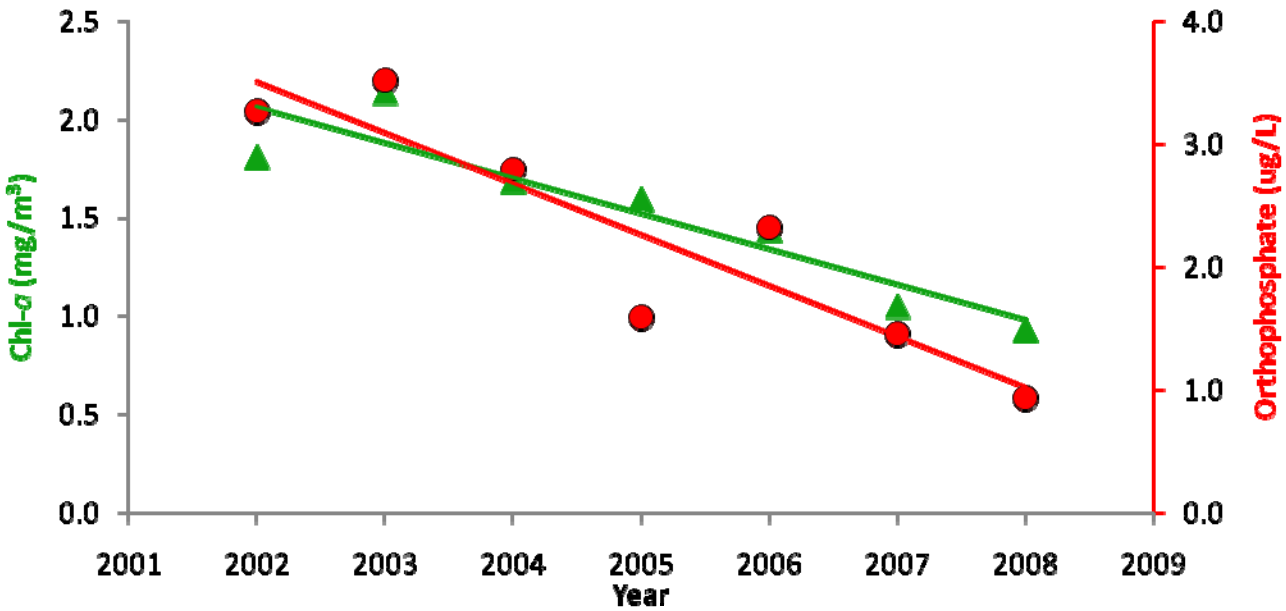
Lakewide impact





Open Water (CR 346.4): Chlorophyll *a*





Open Water Quality and Biota

Water Clarity	No Change
Nutrient Concentration (TP, OP, Ammonia)	No Change
TOC	No Change with marginally increase in the epilimnion (P = 0.04)
Dissolved Oxygen	+ Marginally (Eplimnion, P = 0.051; Metalimnion, P = 0.041; Hypolimnion, P = 0.047)
Zooplankton	No Change
Shad larval population	No Change

Quagga Mussels and Health

1. **Organic (PAHs and PCBs) and inorganic contaminants can be accumulated in the tissues of quagga mussels.**
2. **These contaminants could be transferred to higher predators through the food chain.**
3. **The contaminants in quagga mussel tissue need to be continuously monitored.**
4. **Quagga mussel can favor the growth of some cyanobacteria which can produce neurotoxins, hepatotoxins, cytotoxins, and endotoxins.**

5. Boat Inspection and Cleaning

GHO-SERIES

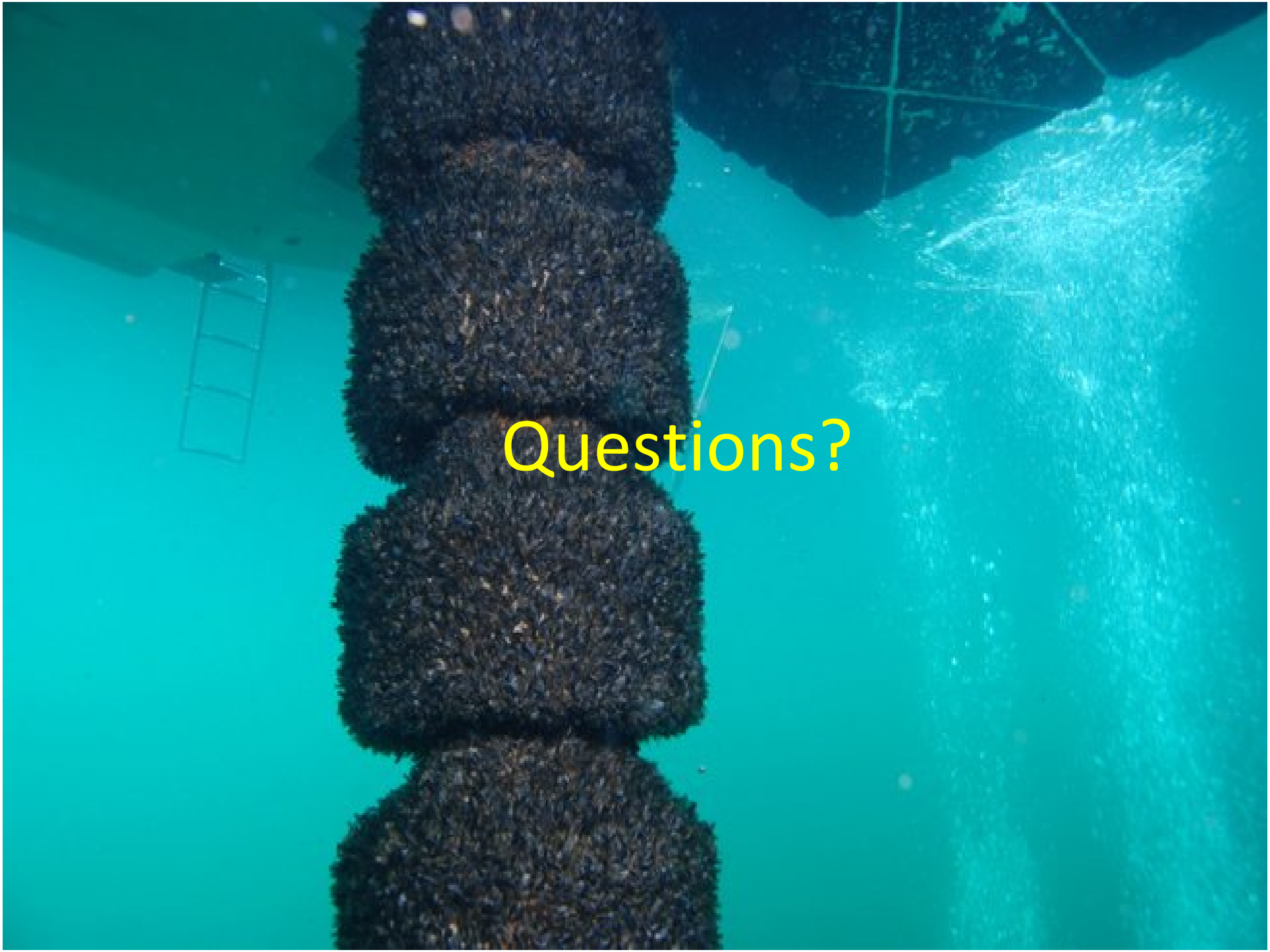
HE
HYDRO
HYDROPAD

mercruiser
mercruiser

E DOIN'

8 sessions
14 states
25 agencies
9 marina operations
104 graduates

107 Decontaminations


Questions?