Potamopyrgus antipodarum (Gray, 1843) at Capitol Lake, Olympia, Washington: Surveys, Containment, and Control of the Introduction

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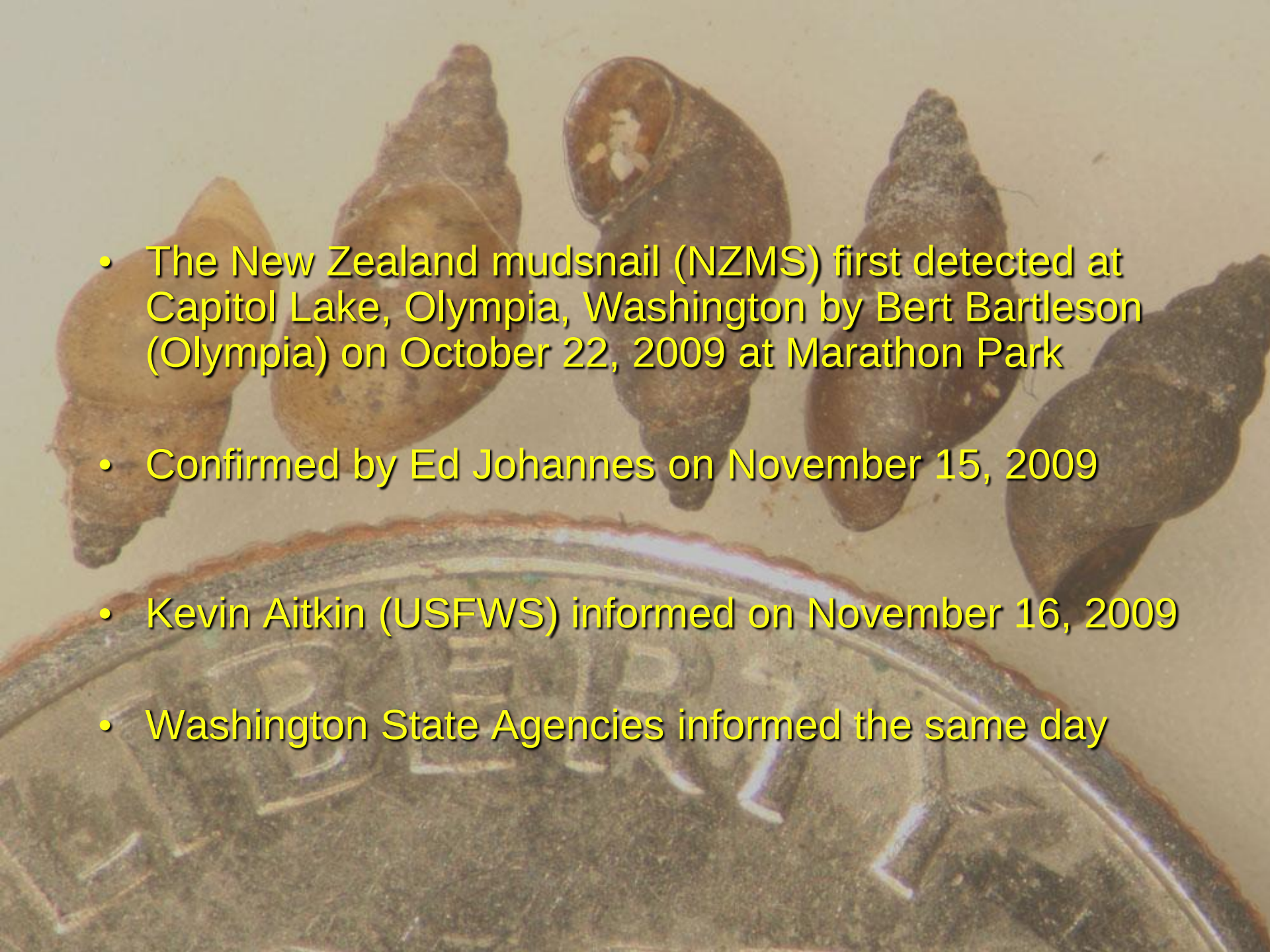
Photo: WDFW



- The New Zealand mudsnail (NZMS) first detected at Capitol Lake, Olympia, Washington by Bert Bartleson (Olympia) on October 22, 2009 at Marathon Park
- Confirmed by Ed Johannes on November 15, 2009
- Kevin Aitkin (USFWS) informed on November 16, 2009
- Washington State Agencies informed the same day

Capitol Lake Response Committee

- WA Department of General Administration (GA)
- WA Department of Fish & Wildlife (WDFW)
- WA Department of Ecology (WDOE)
- WA Invasive Species Council
- WA Department of Natural Resources (WSDNR)

- US Fish & Wildlife Service (USFWS)

- City of Olympia

Capitol Lake

- Shallow manmade lake created in 1951 by damming the estuary of the Deschutes River
- 3 km long and covers about 105 hectares
- Two tributaries flow into the lake (Percival Creek and the Deschutes River)
- Managed by WA Department of General Administration

★ =site where NZMS was first found in 2009

Capitol Lake Introductions

At least 12 introduced species present in 2009

Three are freshwater mollusks found post 1996 when refilling of Capitol Lake with salt water after draw downs ceased (Herrera, 1996, 2004; Johannes, 2010).

Mollusks	Year Found
Corbicula fluminea (Asian clam)	2003
Potamopyrgus antipodarum (New Zealand mudsnail)	2009
Radix auricularia (Big-ear Radix)	2003

Mammal

Myocaster coypus (Nutria)

Amphibian

Rana catesbeiana (American bullfrog)

Fishes

Ameirus nebulosus (brown bullhead)
Cyprinus carpio (common carp)
Micropterus dolomieu (smallmouth bass)
Micropterus salmoides (largemouth bass)
Perca flavescens (yellow perch)

Plants

Lythrum salicaria (purple loosestrife)
Myriophyllum spicatum (Eurasian watermilfoil)

Capitol Lake Native Mollusks

At least 6 species present in 2009

All found post 1996 when refilling of Capitol Lake with salt water after draw downs ceased. Since the 2011 salt water back-flush, the status of these species in Capitol Lake is unknown.

Mollusks	Year Found
Gastropods	
**Gyraulus*	2003
º*Juga silicula* (glass juga)	2009
**Physella*	2003
**Stagnicola*	2003
Bivalves	
º*Anodonta oregonensis* (oregon floater)	2009
+*Sphaeriidae*	1996

+=Herrera (1996)
*=Herrera (2004)
º=Johannes (2010)

Photo: WDFW

Photo: Stong & Frest, 2007

Containment

- GA closes access & boat ramps to Capitol Lake on November 24, 2009
- GA installs 15 warning signs
- WDFW informs the press on November 24, 2009
- GA informs WA State Highway Patrol
- GA partially fences Capitol Lake in early 2010

Photo: WDFW

Fencing and sign 2010

Photo: GA

Control

- 1st drawdown. GA lowers Capitol Lake on December 9, 2009 for freeze study on NZMS. About 98% mortality at exposed sites
- 2nd drawdown. GA lowers Capitol Lake on February 26, 2010 for saltwater back-flush study. Gates closed then opened during extreme high tide on March 1st and lake filled with saltwater. About 12% mortality
- 3rd drawdown. GA lowers Capitol Lake on February 23, 2011 during a cold snap. Not effective due to snow covering exposed lake bottom

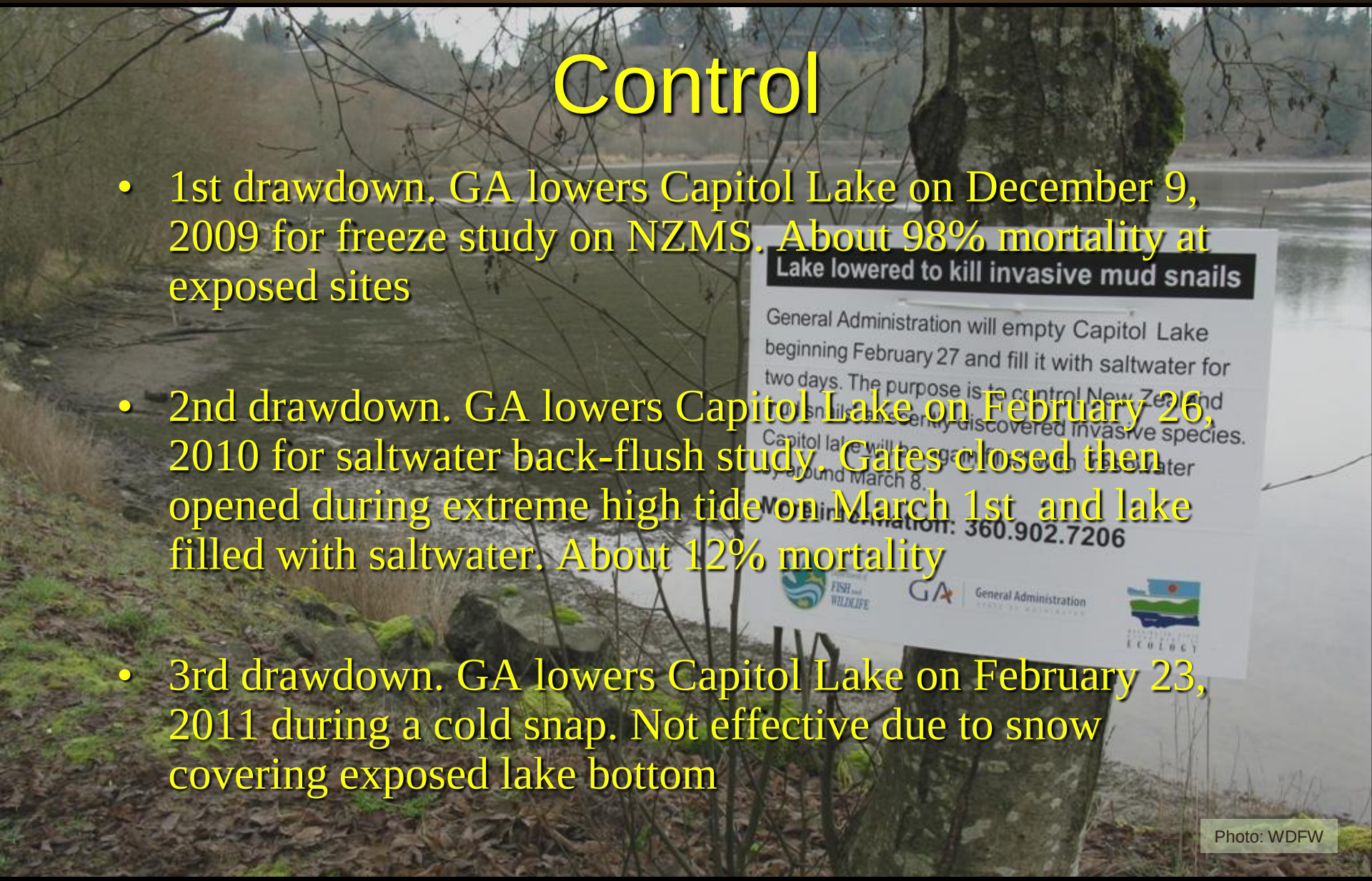
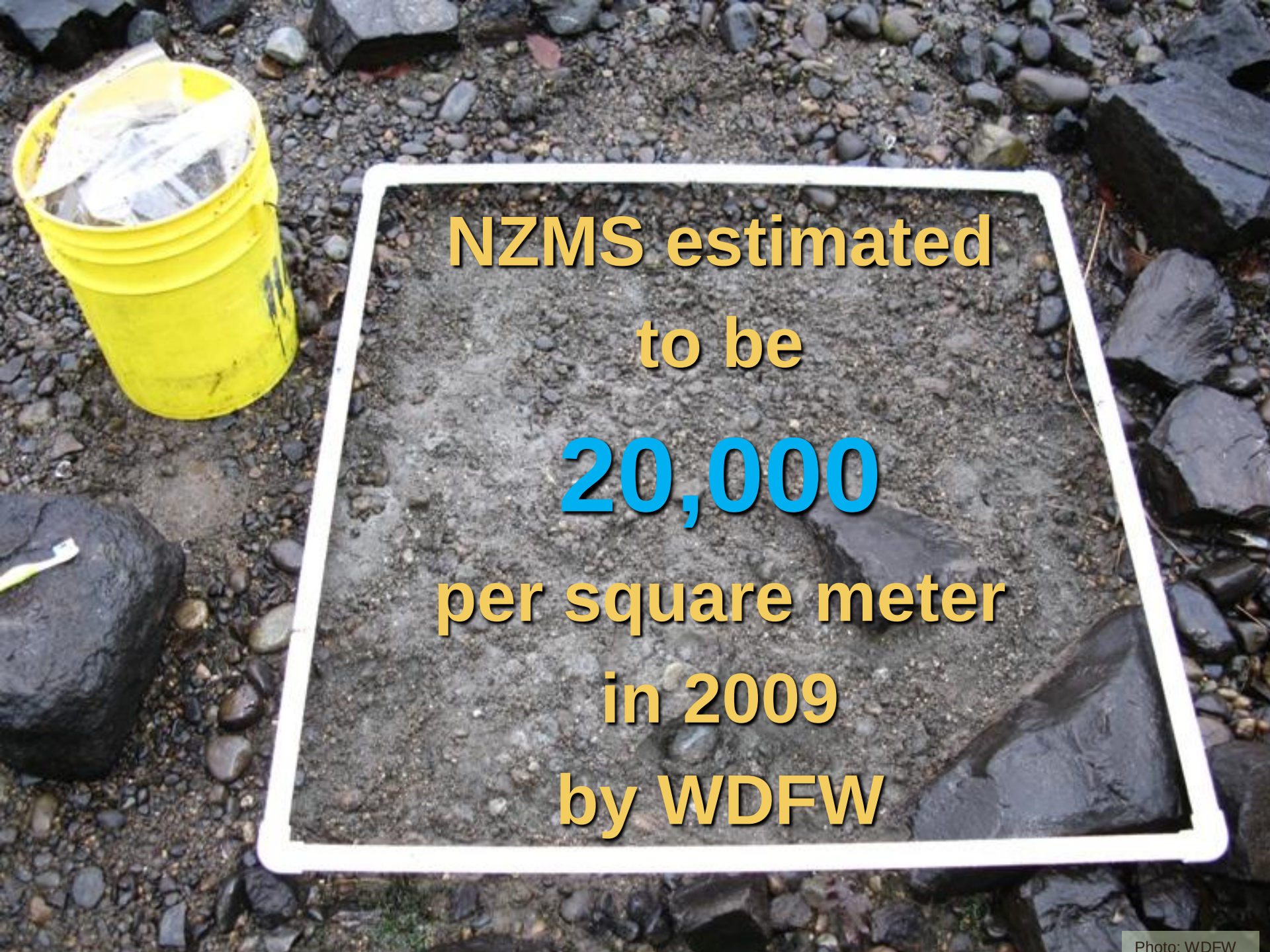


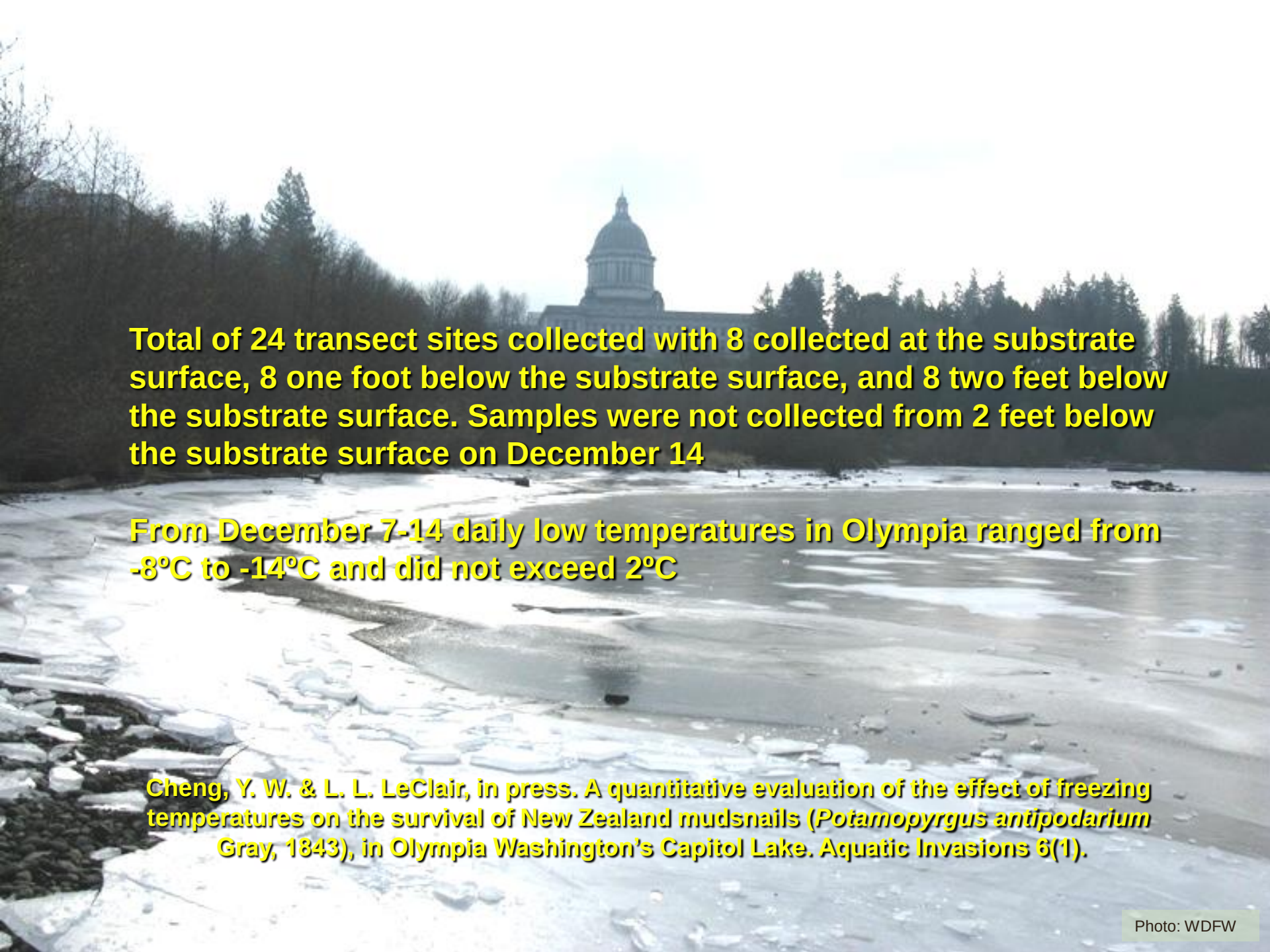
Photo: WDFW


NZMS estimated
to be
20,000
per square meter
in 2009
by WDFW
Photo: WDFW

Freeze Effectiveness Study 2009
1st drawdown

December 9 - drawdown
December 10 – Sample 1
December 11 – Sample 2
December 14 – Sample 3

Photo: WDFW



Total of 24 transect sites collected with 8 collected at the substrate surface, 8 one foot below the substrate surface, and 8 two feet below the substrate surface. Samples were not collected from 2 feet below the substrate surface on December 14

From December 7-14 daily low temperatures in Olympia ranged from -8ºC to -14ºC and did not exceed 2ºC

Cheng, Y. W. & L. L. LeClair, in press. A quantitative evaluation of the effect of freezing temperatures on the survival of New Zealand mudsnails (*Potamopyrgus antipodarium* Gray, 1843), in Olympia Washington's Capitol Lake. Aquatic Invasions 6(1).

Photo: WDFW

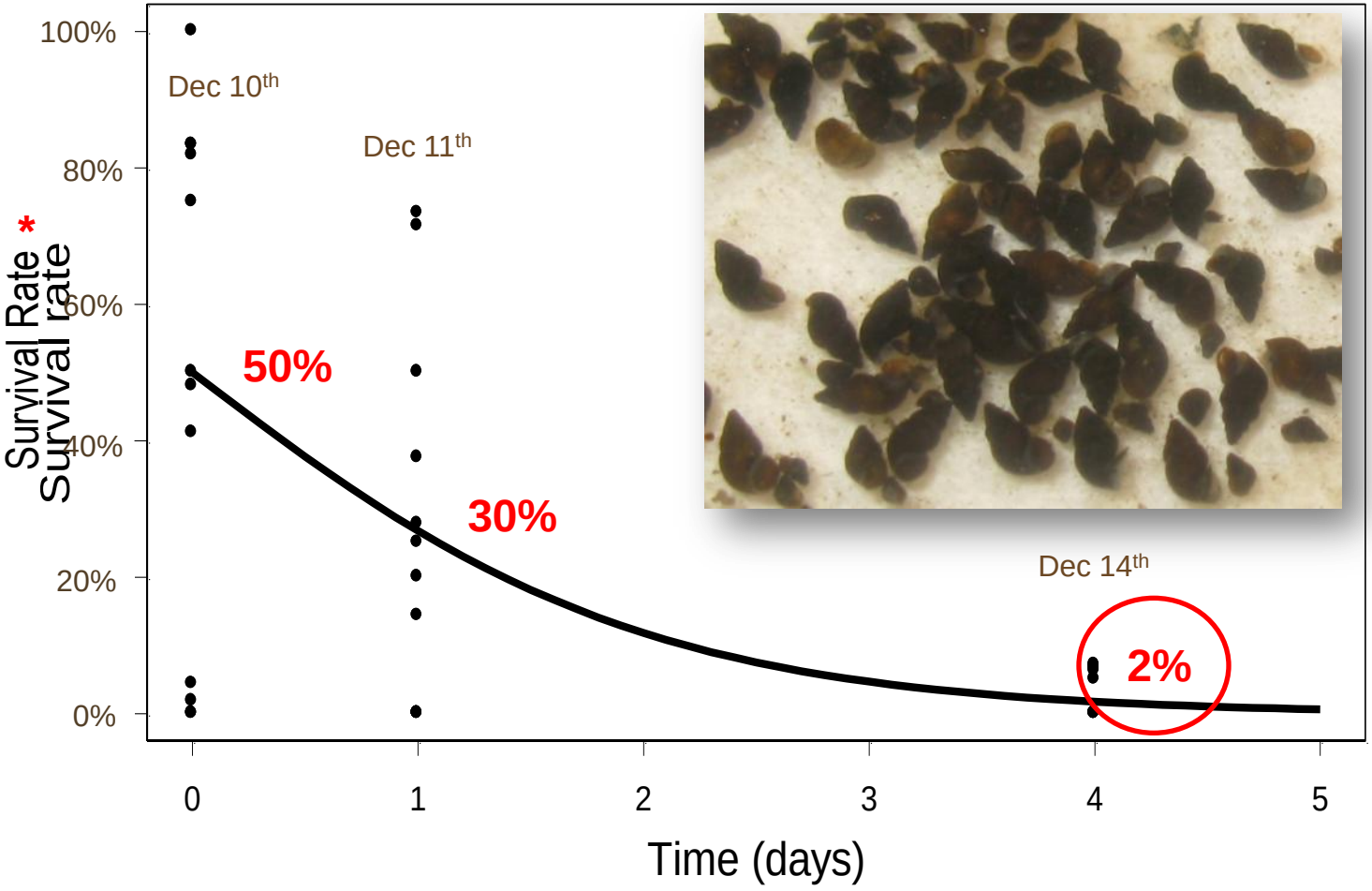
Lab

- Samples allowed to sit 24 hrs. to reach room temperature
- Samples processed using stainless steel sieves with 0.425 mm openings. Brass sieves not used due to toxicity to mollusks
- NZMS examined under binocular dissecting microscope to determine the following 3 conditions:
  1) live
     a) crawling
     b) emerged out of shell
     c) closed operculum moved
     d) moved when disturbed
  2) recent dead
     a) body present
     b) operculum present (does not move when prodded)
     c) empty shell (periostracum intact)
  3) long dead (empty shell)*
     a) periostracum corroded
     b) no periostracum present

*=shells in this condition were not included in the statistical analysis

Freeze Effectiveness Results

Counted only live and recent dead

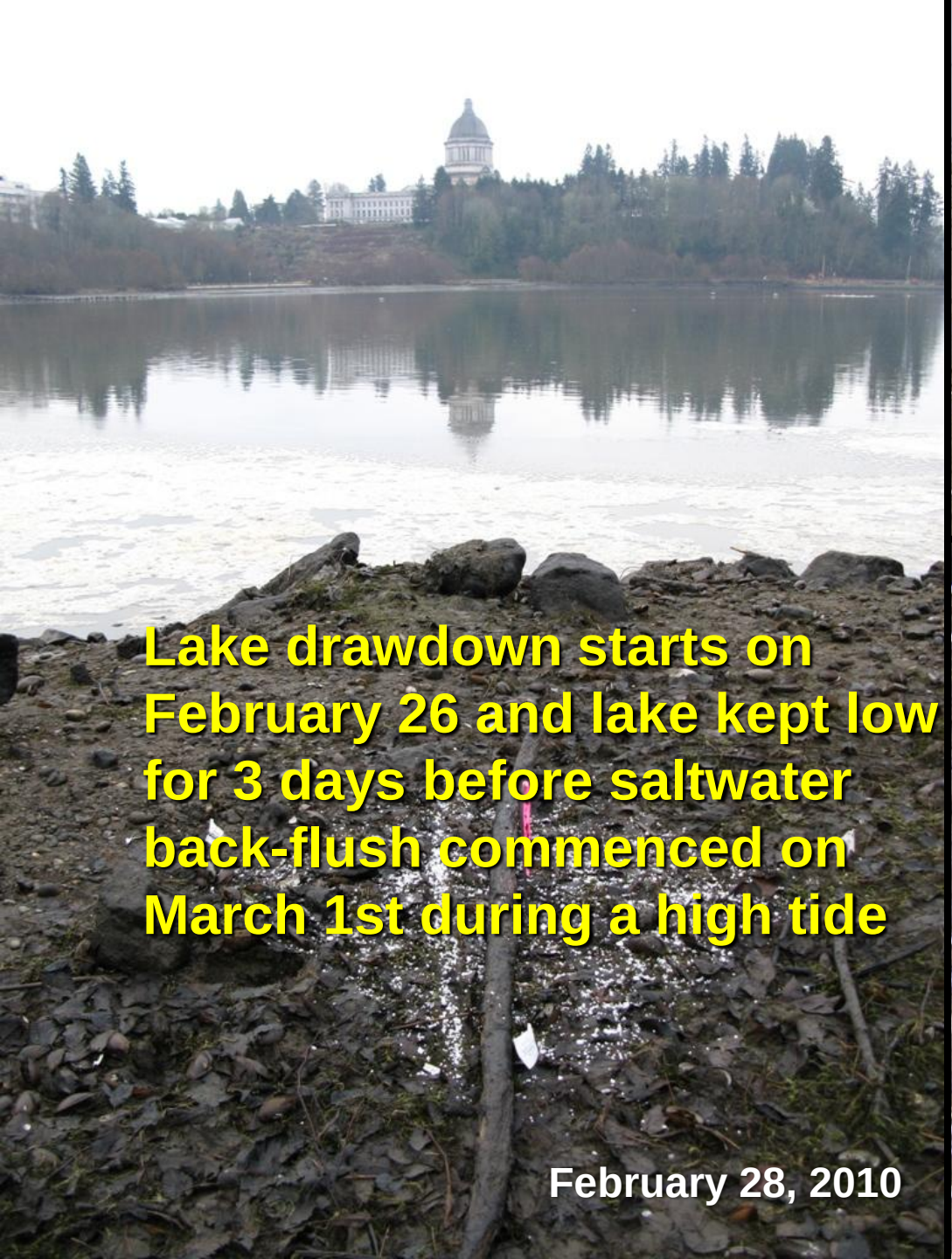


*Only representative of study sites with no ice cover

Graph: WDFW

Saltwater Back-Flush Study 2010
2nd drawdown

The Olympian November, 2010


Lake drawdown starts on February 26 and lake kept low for 3 days before saltwater back-flush commenced on March 1st during a high tide
February 28, 2010


1 kg Salt per square meter


Photos: WDFW

26 Total Sites chosen before back-flush commenced

- **14 north shore sites near dam**
- **4 on the south shore at Marathon Park**
- **8 additional sites with salt added (4 each at north and south shores)**

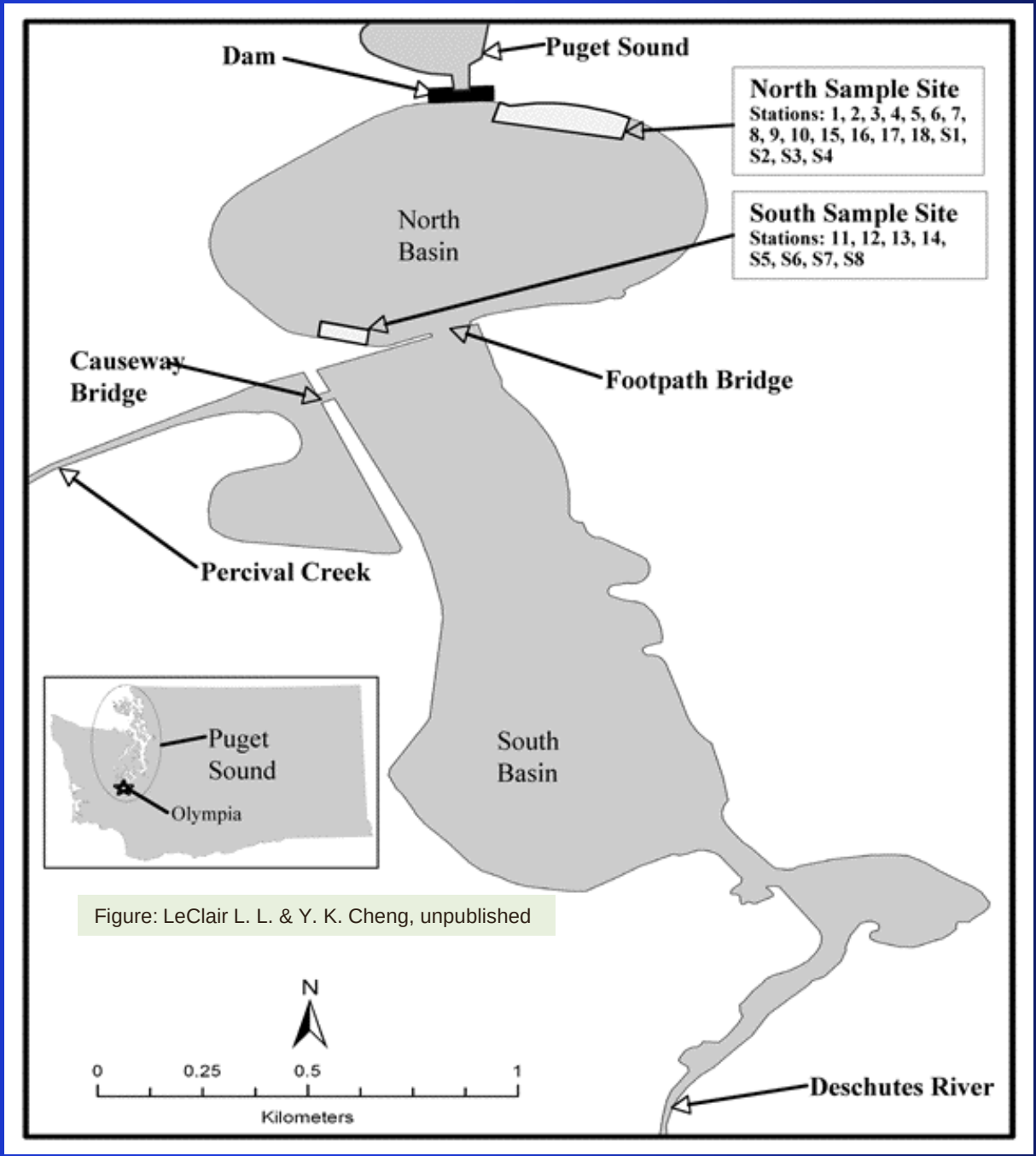


Figure: LeClair L. L. & Y. K. Cheng, unpublished

Saltwater Back-flush Starts

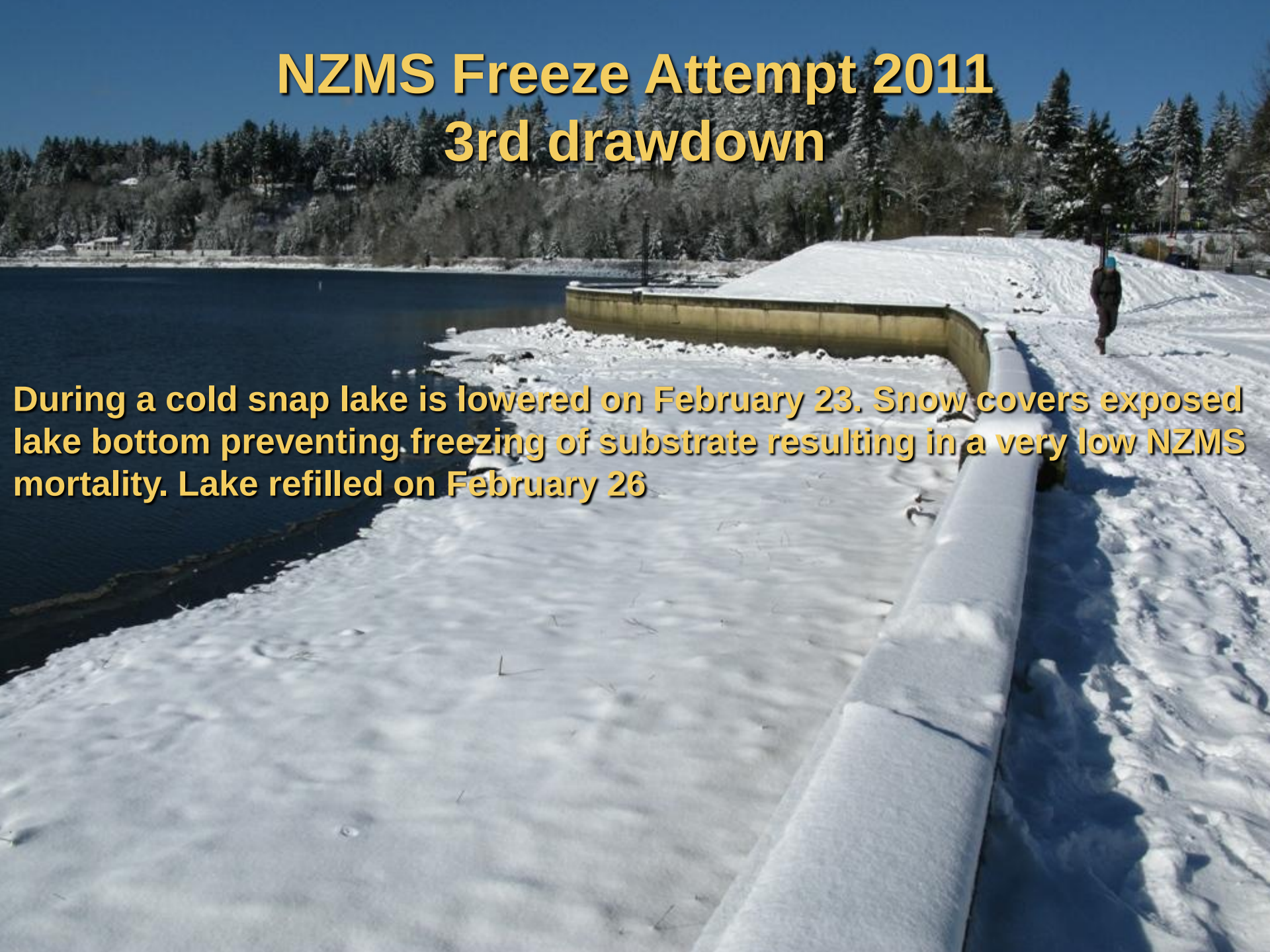
March 1, 2010

Photos: WDFW

- Measurement of Puget Sound near dam registered 28.7 ppt
- Salinity at at the two sample areas registered 10.5-12.4 ppt near surface and 24.8 ppt and 22.8 ppt near bottom
- 12% mortality at untreated sites and 18% mortality at salted sites

Photo: WDFW

NZMS Freeze Attempt 2011
3rd drawdown



During a cold snap lake is lowered on February 23. Snow covers exposed lake bottom preventing freezing of substrate resulting in a very low NZMS mortality. Lake refilled on February 26

Surveys

2009

- Nov. 17 Will Morris (WDFW) collects snail sample from Marathon Park
- Nov. 19 WDFW surveyed outflow of Black Lake Ditch, the mouth of Percival Creek, and more areas of Capitol Lake
- Nov. 20 WDFW surveys Tumwater Falls hatchery pens. WDFW used waders to conduct additional surveys of the outflow of Black Lake Ditch and mouth of Percival Creek
- Nov. 23 WDFW surveyed more of Capitol Lake using waders
- Nov. 24 WDFW continued surveying Captitol Lake using waders. Also surveyed outflow of Black Lake Ditch and Percival Creek from mouth to 0.75 mi. upstream using divers
- Dec. 3 Allen Pleus (WDFW) surveyed 3 sites on the Deschutes River
- Dec. 9 WDFW surveyed 5 sites on Percival Creek

2010

- Between Aug. 9 to Sept. 11 Edward Johannes (Deixis Consultants) surveyed drainages within a 5-mile radius of Capitol Lake for Washington Invasive Species Council

http://www.invasivespecies.wa.gov/documents/newzealandmudsnailsurvey.pdf

Photo: Bert Bartleson

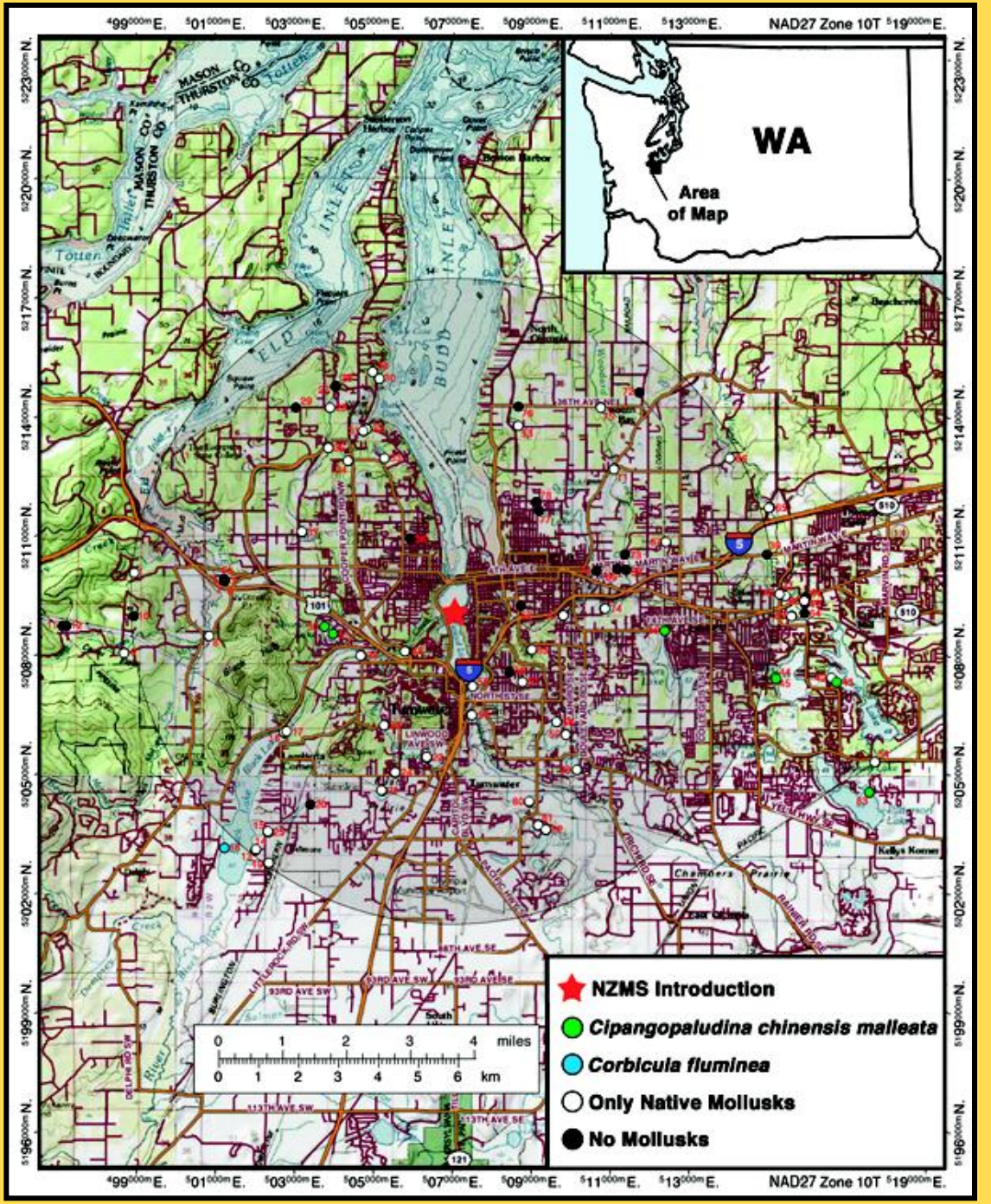
NZMS Survey

August/September 2010

- Survey for NZMS was conducted within a 5-mile radius of Capitol Lake by Deixis Consultants
- Eighty-five sites sampled
  15 lakes, 3 marshes, 4 ponds, 3 springs, 1 river and 22 creeks and tributaries
- No NZMS were found outside of Capitol Lake
- Two introduced species were found only in lakes
- *Cipangopaludina* not reported previously from the area

Cipangopaludina chinensis malleata

Corbicula fluminea



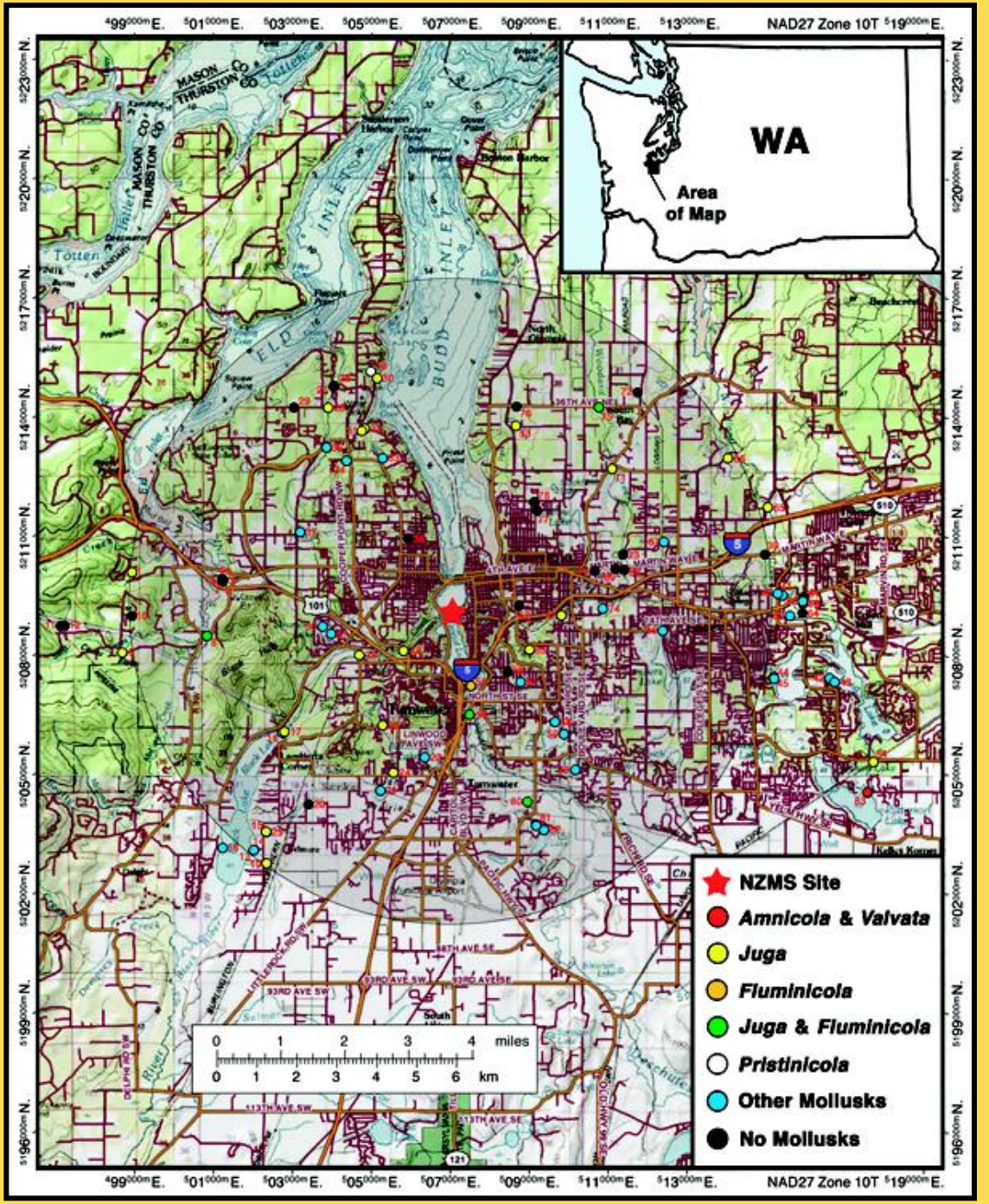
NZMS Survey

August/September 2010

- Survey for NZMS within a 5-mile radius of Capitol Lake resulted in the first detailed freshwater mollusk survey of the region and their status
- Total of 12 native gastropods and at least 7 native bivalves were found beyond Capitol Lake
- Two rare gastropod species were found in Pattison Lake

Amnicola n. sp. 1

Valvata n. sp.



MOLLUSK FAUNA WITHIN 5-MILE RADIUS OF CAPITOL LAKE

GASTROPODS (13)

Valvata n. sp.
**Cipangopaludina chinensis malleata*
Amnicola n. sp. 1
Pristinicola hemphilli
Fluminicola n. sp.
Juga silicula
Fossaria (*F.*) *modicella*
Physella (*P.*) *gyrina*
Gyraulus (*T.*) *parvus*
Menetus (*M.*) *callioglyptus*
Planorbella (*P.*) *subcrenatum*
Ferrissia californica
Oxyloma sp.

BIVALVES (7)

Sphaerium patella
Musculium raymondi
Musculium securis
Pisidium (*C.*) *casertanum*
Pisidium (*C.*) *variabile*
Pisidium (*N.*) *insigne*
**Corbicula fluminea*

*=introduced species

Next Steps

- Work toward total eradication of the NZMS in Capitol Lake
- Continue surveys of Capitol Lake and surrounding drainages

Acknowledgements

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