

# New Zealand Mudsnail in the Western USA and its Impacts on Water Quality



David C. Richards  
EcoAnalysts Inc.  
Center for Aquatic Studies  
Bozeman, Montana



*Potamopyrgus antipodarum* (Gray)



New Zealand mudsnail

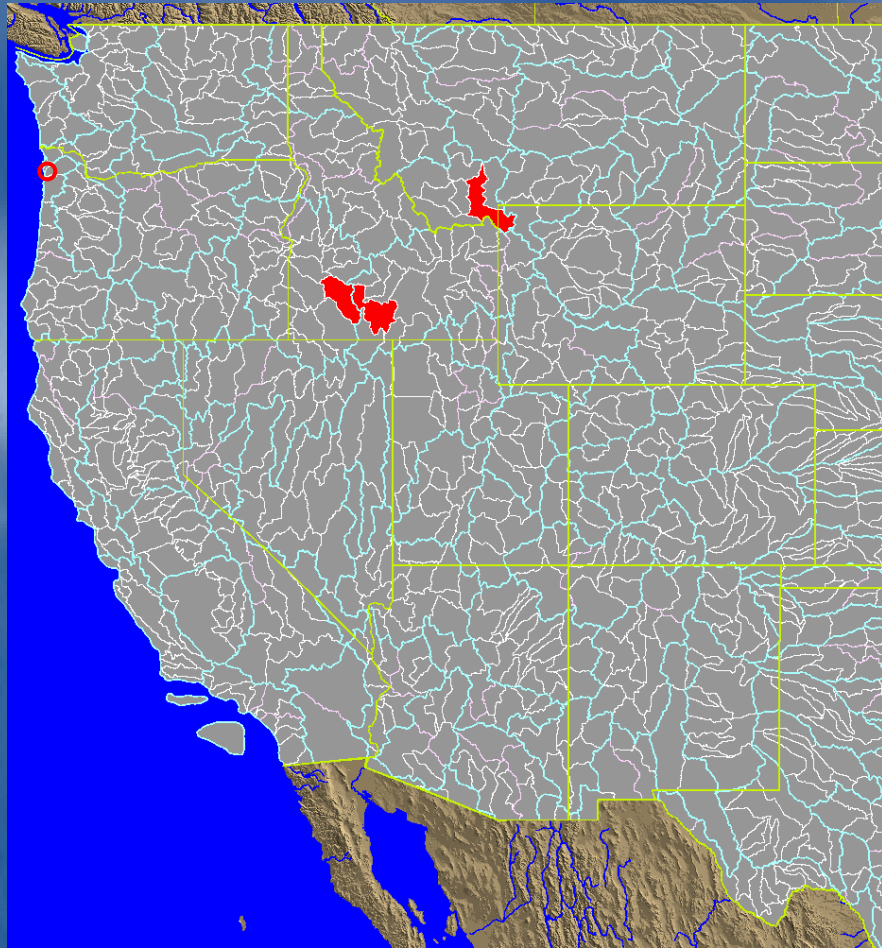
# What Makes This Snail So Successful?

- 1) Parthenogenic (clonal), live-bearer, high reproductive potential
- 2) Operculum
- 3) Small size (max 5 mm)
- 4) Tolerates many aquatic environments
- 5) Probably didn't bring any of its enemies (parasites or pathogens) with it

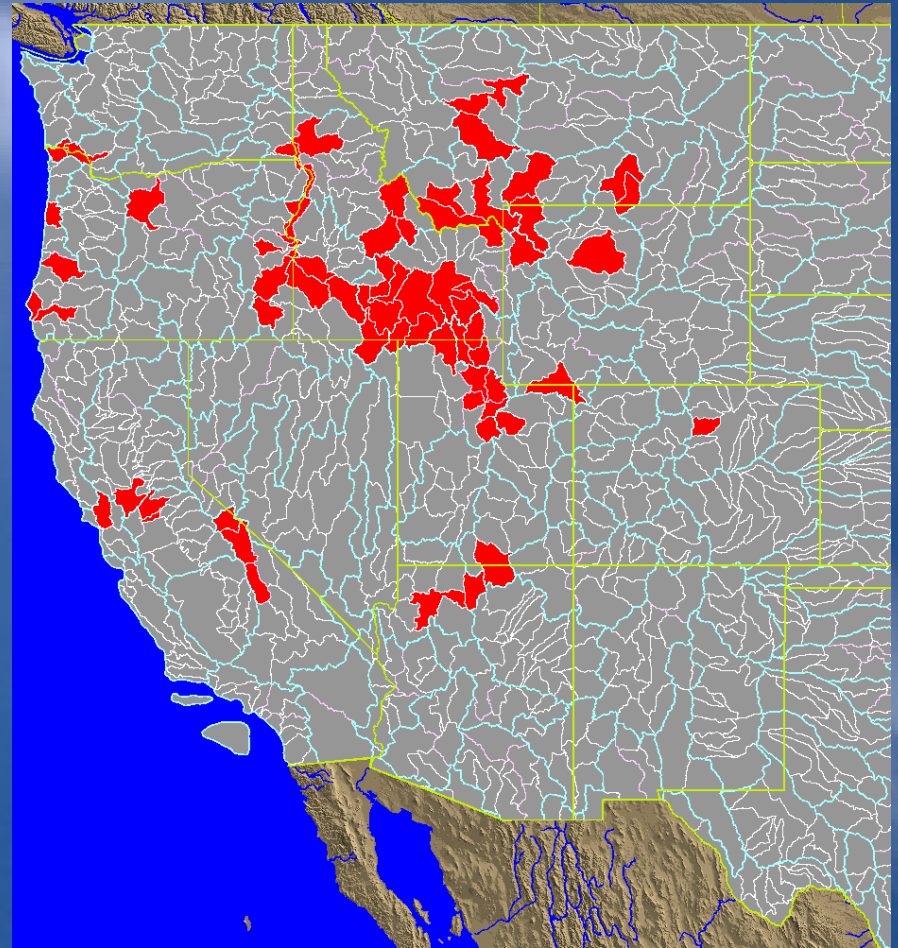
- Native of New Zealand
- Common throughout Europe/Asia and Australia
- First reported in Snake River near Thousand Springs @1985
- Probably one of the most widespread species on the planet

# Rapid spread

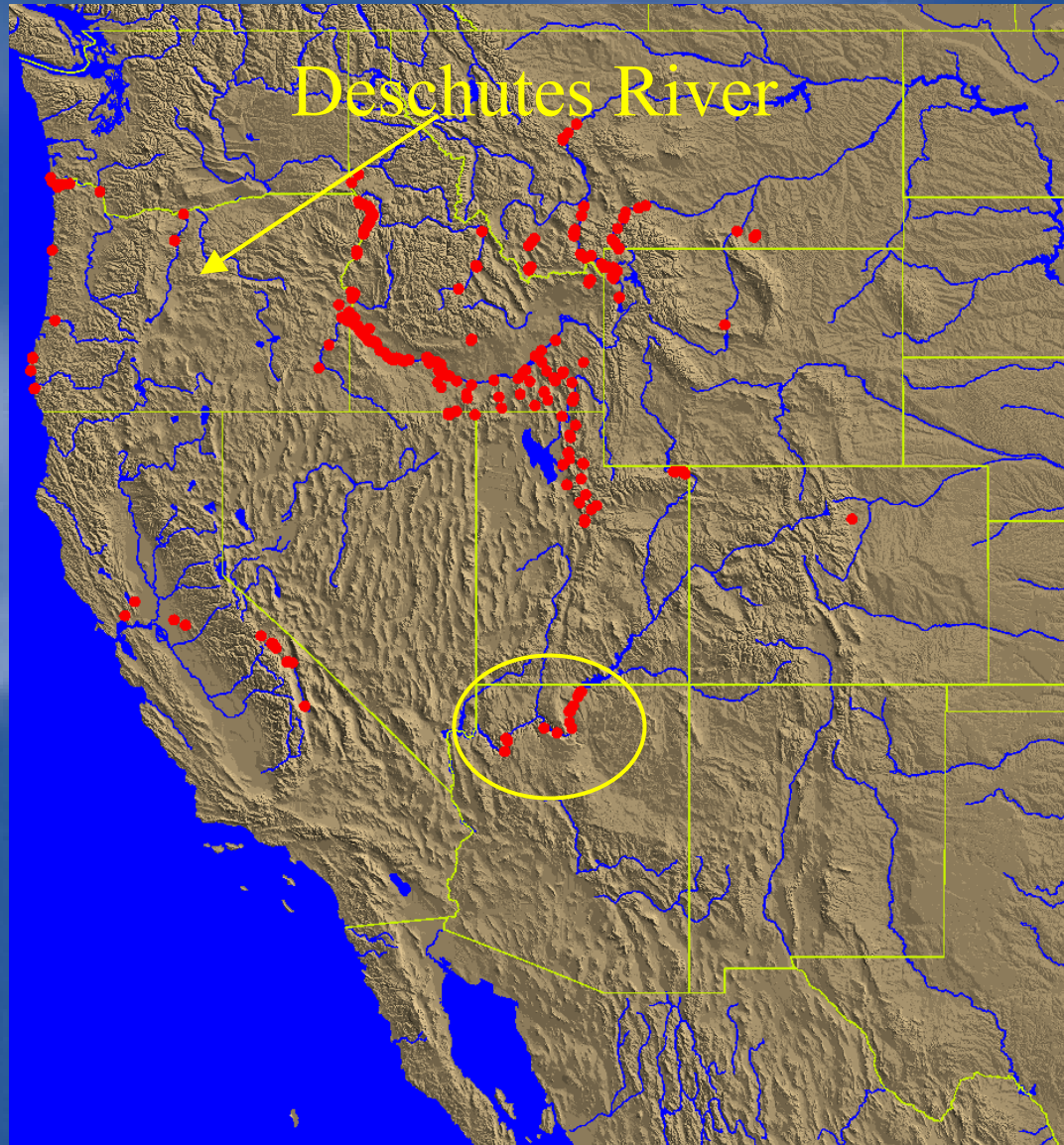
1995



2005



# Reported locations (October 2005)

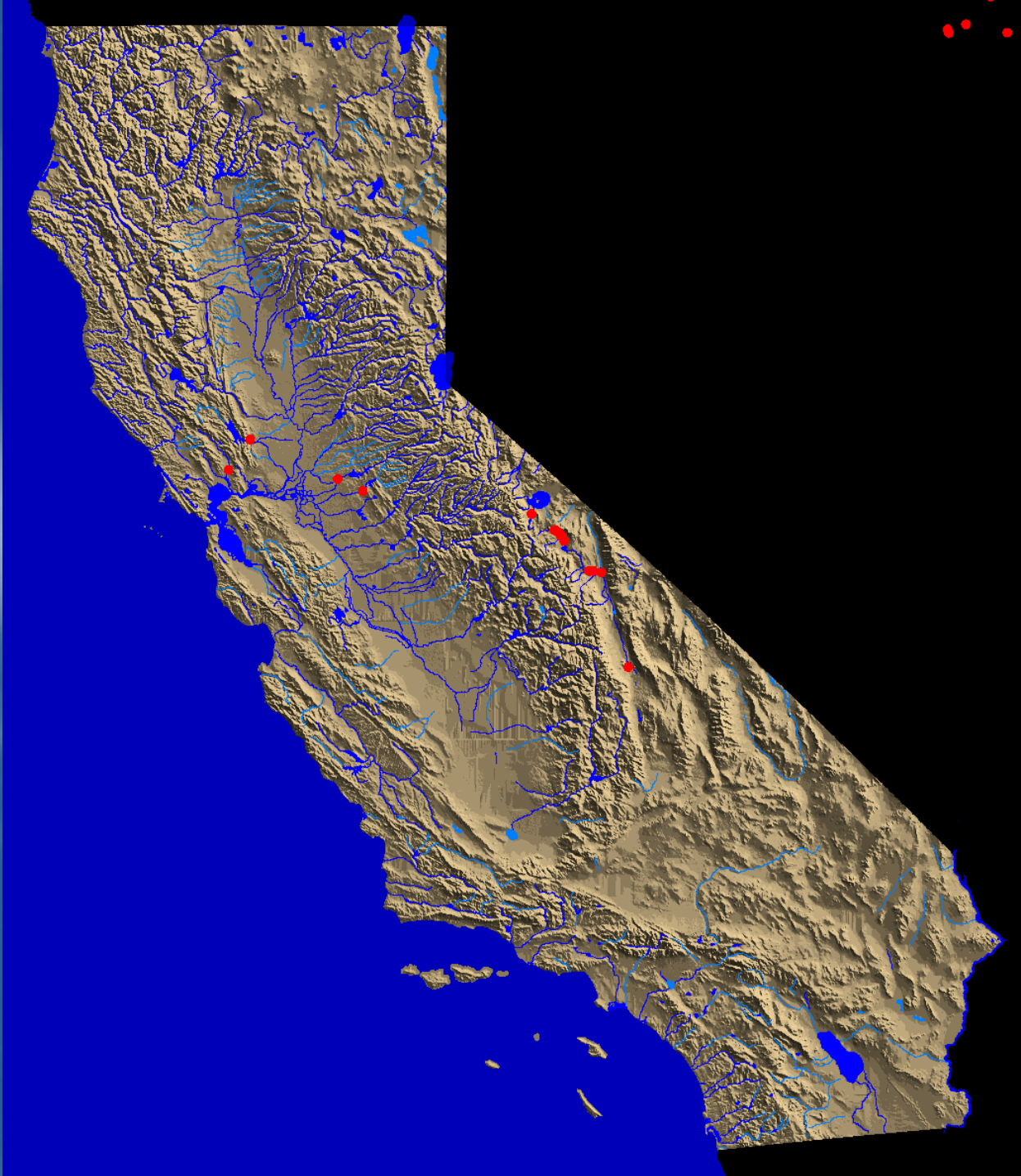


# Colorado River, Grand Canyon, June 2002









Live NZMS

Notice operculum

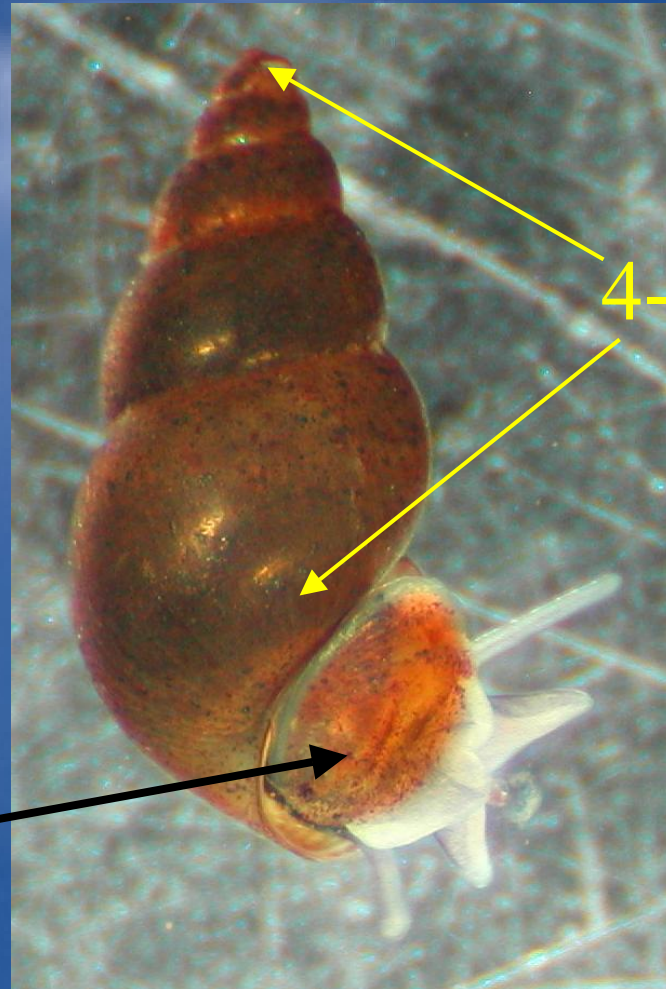


Photo: Dan Gustafson

With Carina

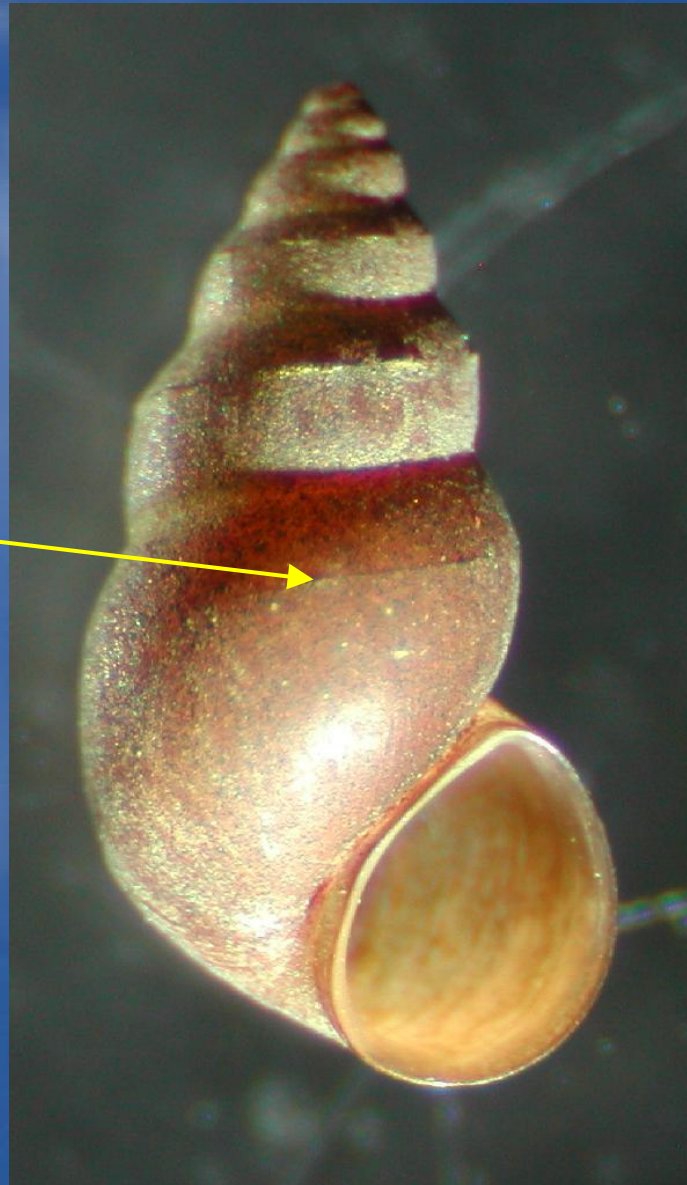


Photo  
Dan Gustafson

## NZMS with ornamentation



NZMS could be confused  
with *Pyrgophorus coronatus*

Typical adult NMS  
from western USA

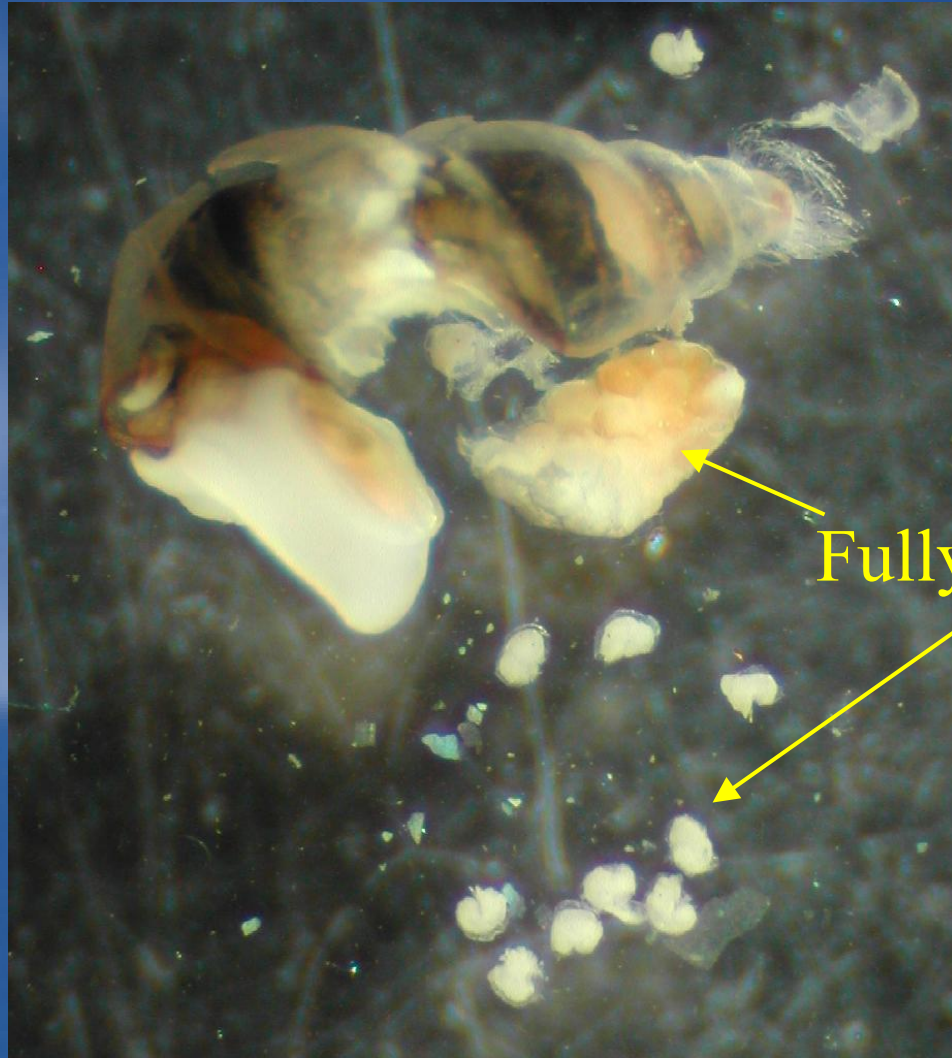


New improved version

♀ with neonates (embryos)

Photo: Dan Gustafson





Fully formed young



## Uncommon Male NZMS

Photo Dan Gustafson



# Life History and Population Dynamics

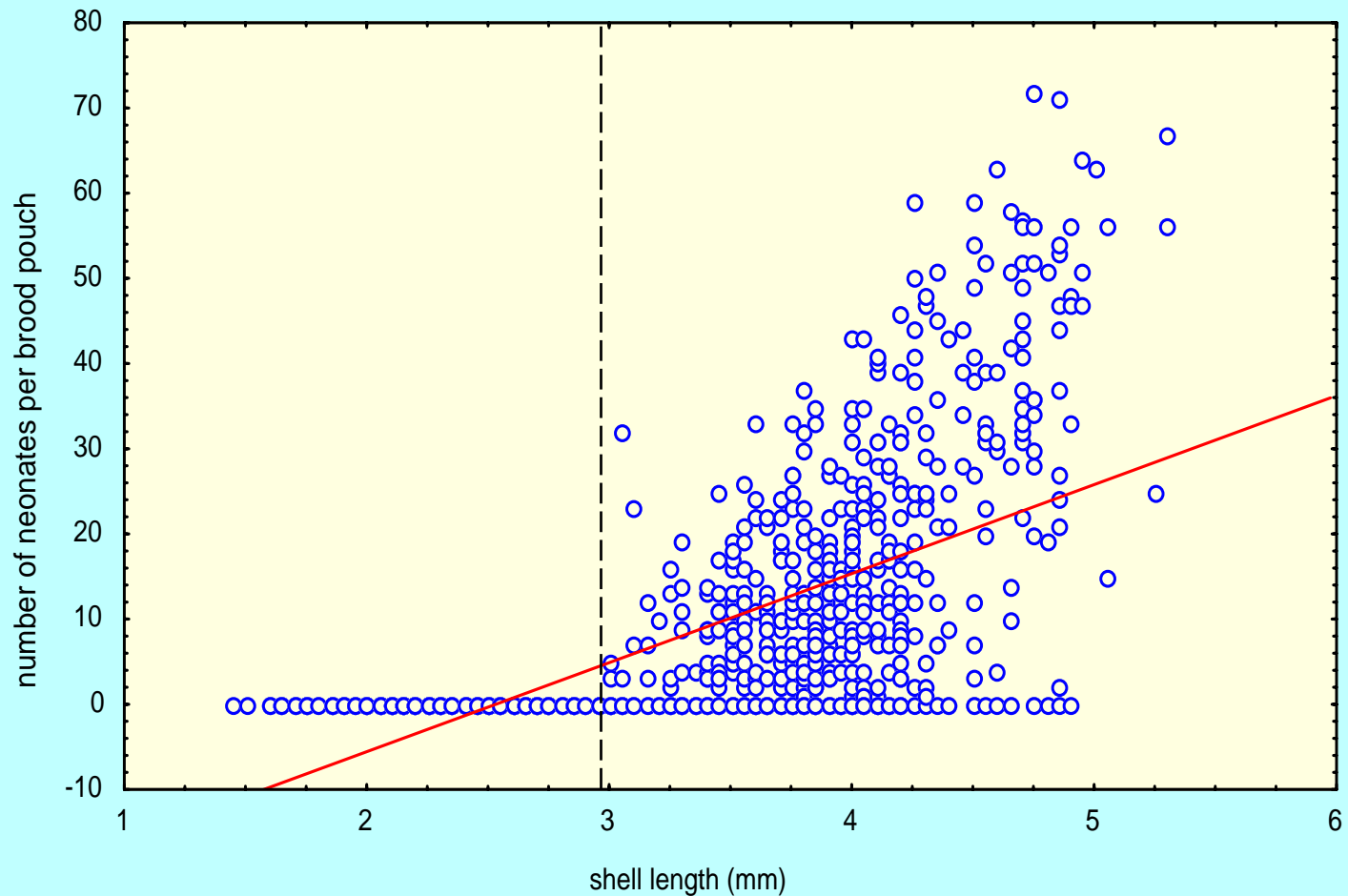


photophobic

% on top **night** = **73** (95% CI; 68, 78)

% on top **day** = **4** (95% CI; 3, 6)

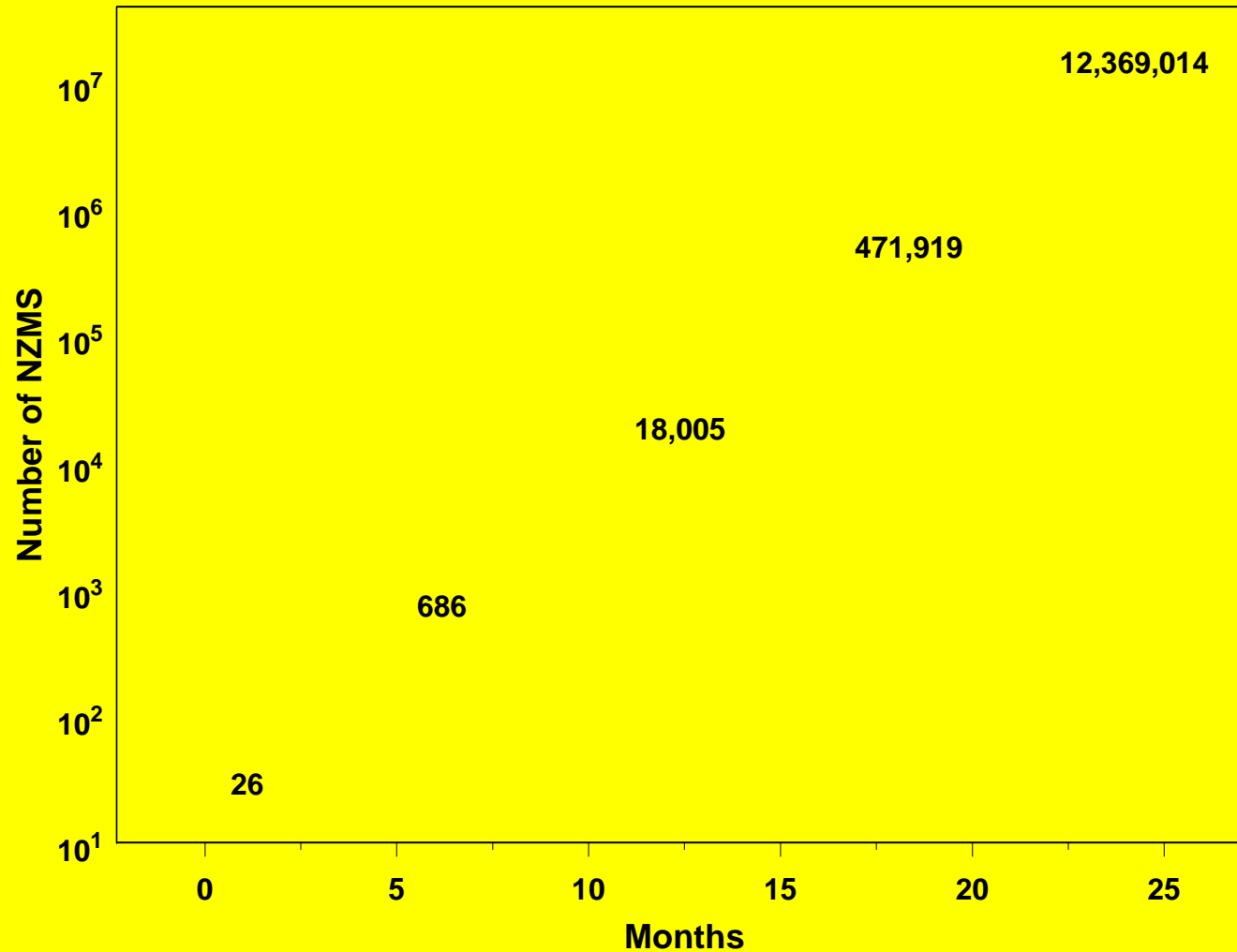
# Embryos/brood pouch vs. shell length



$R^2 = 0.41$ ,  $p = 0.00$ ,  $N = 902$

# Population explosion

26 offspring/adult/6 months



# DENSITIES

- Densities in Snake River drainage: 100,000/m<sup>2</sup> to 300,000/m<sup>2</sup>
- Madison River > 300,000/m<sup>2</sup>
- Polecat Creek (GTNP) est. **750,000/m<sup>2</sup>**
- Lake Zurich > 800,000/m<sup>2</sup>
- This means the bottom of a river or lake can be nothing but Snails, snails and more snails!



Outlet Banbury Springs, Snake River,  
southern Idaho



Snake River

Bob Hall, University of Wyoming,  
1 million/m<sup>2</sup>



Photo by D. L. Gustafson,  
Montana State University



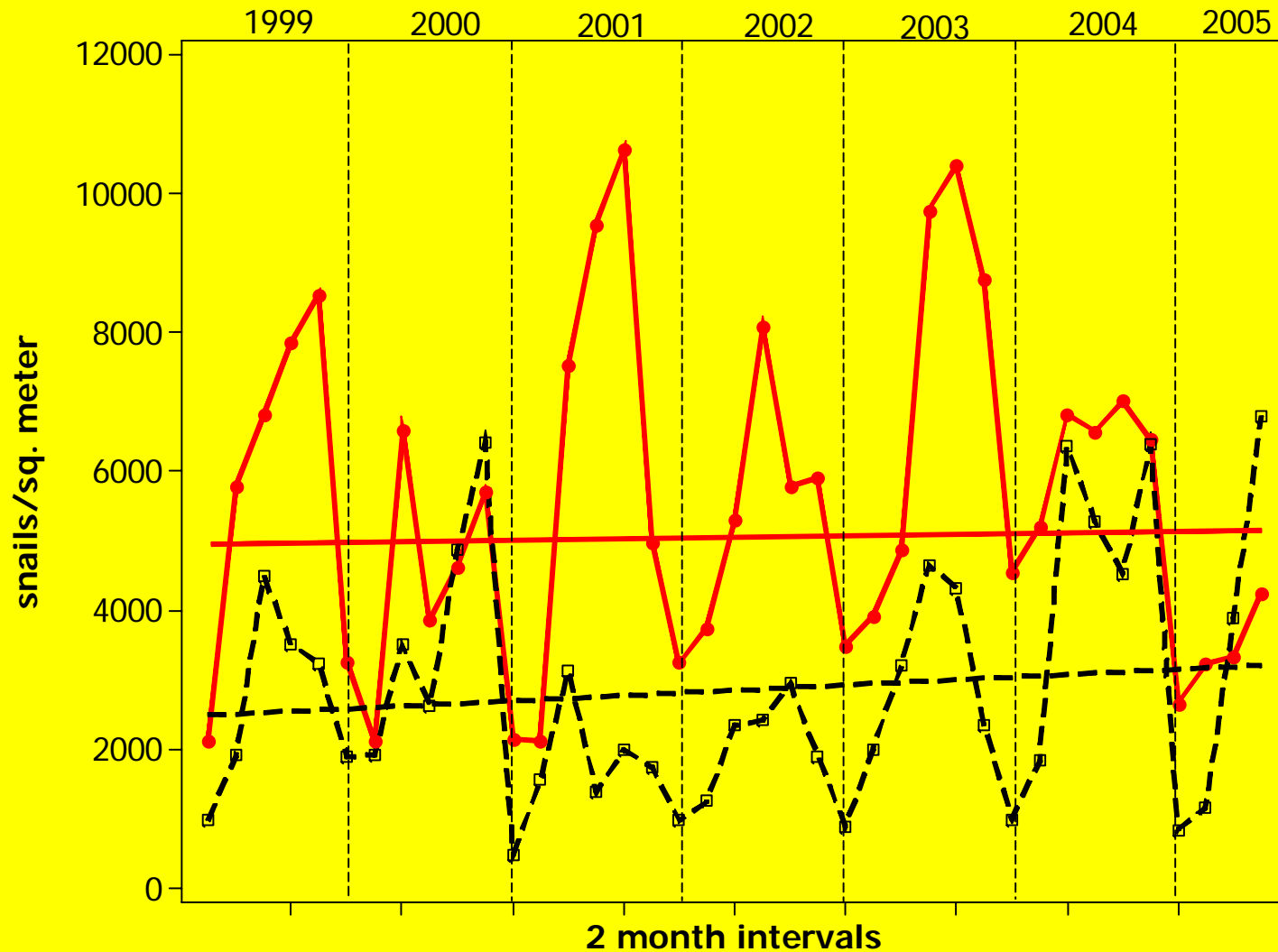
## Seasonal and yearly fluctuations



Outlet of Banbury Springs  
Snake River, Idaho



# Time series analysis



# NZMS and Water Quality

“...to maintain and improve  
the physical, chemical, and  
**biological integrity** of our  
nations waters”

CWA 1974

Just what does biological integrity mean?



NZMS are Biological Pollution

# Impacts



Threatened snail



# Competition with natives (Richards 2004)

Developed competition coefficients

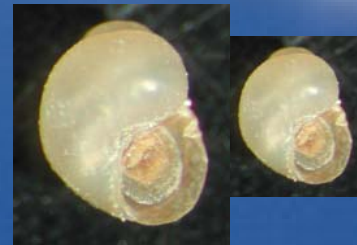
Growth rates

$$a_{ij} = 1.52 (1.22, 1.83)$$



NZMS

=



Bliss Rapids snail  
(threatened)



Mark Vinson's  
NZMS as trout food study

# RBT given essentially unlimited food & space over 3 months

On average:

Fish fed scuds gained about 1% of their body  
weight per day

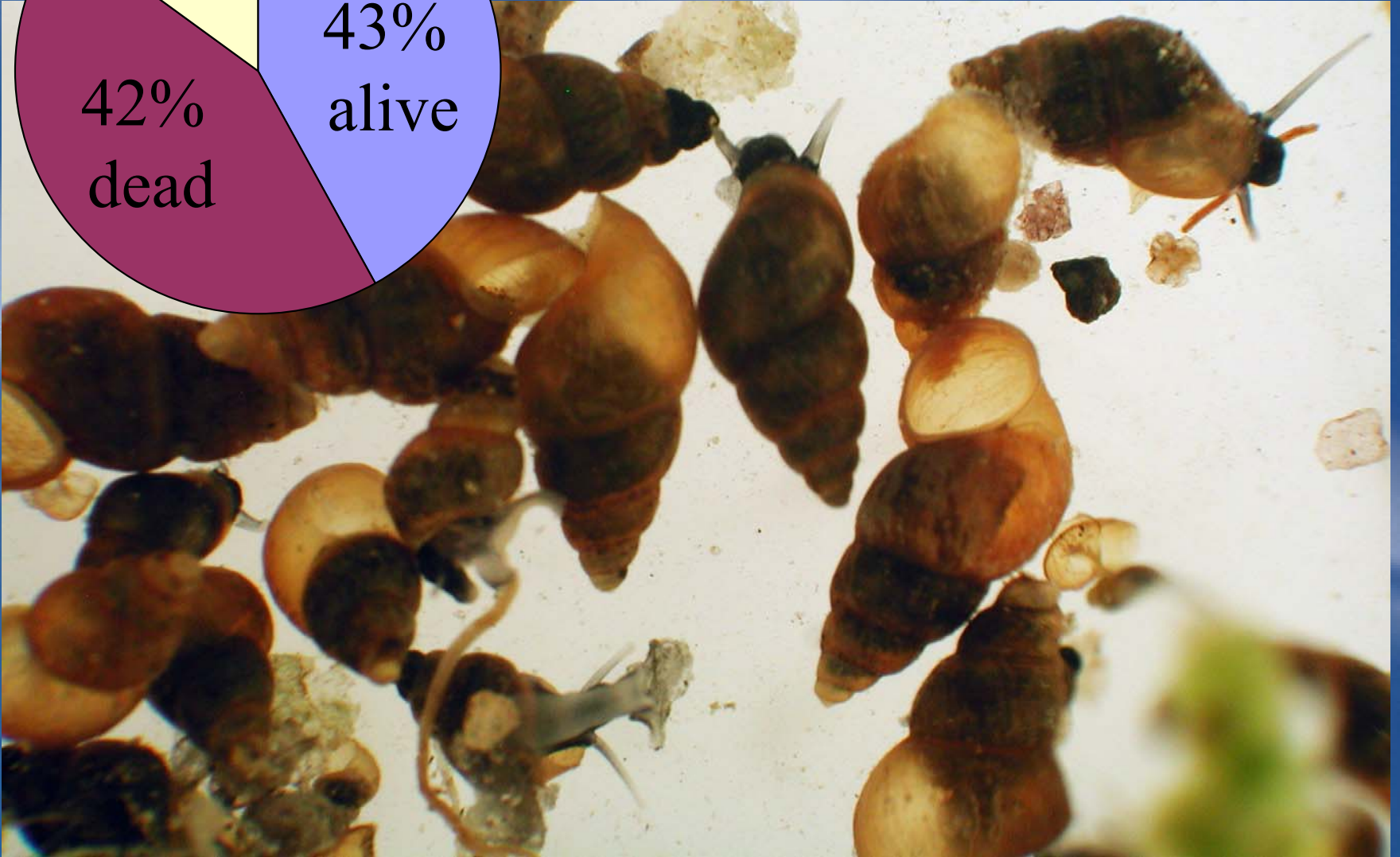
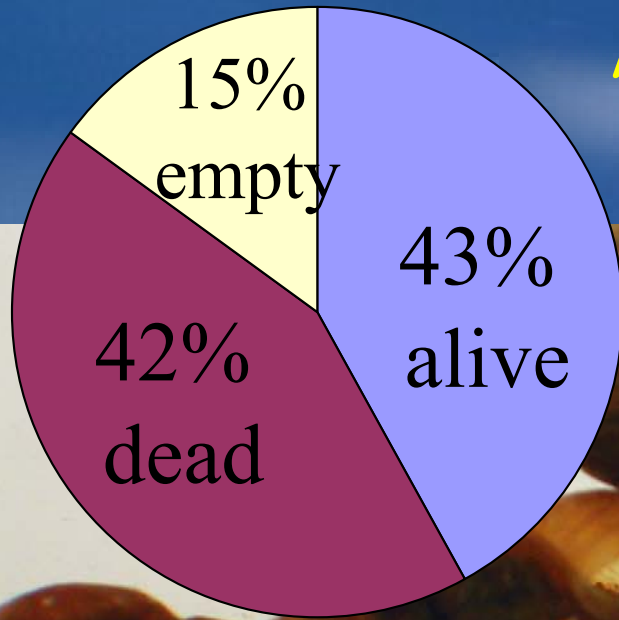


Fish fed NZMS lost 0.2% of their body weight  
per day





*Fate of 914 snails passing through  
the trout's digestive tract*





COBBLESTONE FISHING ACCESS SITE

**CLOSED**  
**UNTIL FURTHER NOTICE**  
**NO ADMITTANCE**

DUE TO DISCOVERY OF NEW ZEALAND MUD SNAIL  
IN DARLINTON SPRING CREEK, YOUR COOPERATION  
IS NEEDED TO PREVENT FURTHER SPREAD OF THIS  
AQUATIC NUISANCE ORGANISM.



Montana Department of Fish, Wildlife & Parks  
PURSUANT TO MCA 87-1-303

Summary of Hall et al.  
*Front Ecol Environ* 2003; 1(8): 407–411

- NZMS dominated flows of N and C in Polecat Creek
- **Almost all of primary production in Polecat Creek GTNP goes through NZMS**

## Hall et al. 2003 continued:

- Impacts similar to zebra mussel invasions: one organism that achieves high biomass can dominate fluxes;
  - Zebra mussels can filter the entire water column in 1–4 days (Strayer 1999),
  - Analogous to NZMS consuming nearly all primary production

## Hall et al. 2003 continued:

- NZMS probably altered ecosystem functions of storage and fluxes of N.
- Community-level impacts beyond direct interactions: altered ecosystem functioning at the base of the food web

## NZMS impacts (i.e. biological pollution) are:

- Can compete with native invertebrates
- Poor food source for trout
- Can drastically alter ecosystem functioning
- Has as much impact on water quality as single point or non-point sources

# RBP Water Quality Metrics

- Few or no protocols with 'Invasive metric  
or
- On a '0 -10' scale for some metrics: give NZMS a **10**

# Prognosis

- NZMS well established throughout western USA
- Can have major impacts on water quality
- Removal from streams at this time not an option
- Hatcheries need to make sure they don't spread it
- Goes for river biologists as well
- Education and clean gear
- **Opportunity lost over 20 years ago**
- For now.... Learn to live with it.



New Zealand Mudsnail  
Web site

[www2.montana.edu/nzms](http://www2.montana.edu/nzms)