

# **FINAL REPORT**

(January 20, 2003)

## **Emergency Delineation of New Zealand Mud Snail Population in Putah Creek, Yolo Co., California**

**Ken W. Davis**

*Aquatic Biologist*

*Wildlife Survey & Photo Service*

*2443 Fair Oaks Blvd. # 209*

*Sacramento, CA 95825*

### **Background**

In late October, a new population of New Zealand Mud snails was discovered in Putah Creek, Yolo County, California at Fishing Access # 3. This was the first confirmed population of the highly-invasive NZMS west of the Owens River in the Owens Valley in Eastern California. The NZMS population in Putah Creek initially appeared to be localized at the Fishing Access # 3 site. Before considering any control or eradication action, Putah Creek had to be surveyed to delineate the NZMS population. The results of that Emergency Delineation Survey form the basis of this report.

### **Objectives**

1. To determine the upstream and downstream range of the NZMS population.
2. To learn more about the type of water conditions, substrate, flow regime, solar conditions and other information that might assist in locating those areas where the NZMS can successfully colonize.

### **Methods**

Information about NZMS populations is wanting. While a formal delineation protocol did not exist, David Richards (Montana State University) offered a technique he had used in Montana. Using David Richards suggestions, I intensified the range and scope of the survey and presented it to the Putah Creek Stakeholders for review and comment. With minor changes suggested by David Bergendorf (USF&WS), approval for the California Department of Fish & Game, and funding from the U.S. Bureau of Reclamation, we decided to proceed. Erin Williams (USF&WS) offered the assistance of David Bergendorf and Roger Buttermore to accomplish the delineation. Making minor changes in the protocol, we started the survey on December 1, 2003. A draft of the protocol is available in this document.

### **Results**

The NZMS population (prior to the storm events in late December 2003) appears to be restricted to an area approximately two tenths of a mile downstream from Fishing Access # 3 (Site L on the Delineation Map) and upstream approximately seven tenths of a mile from Fishing Access # 3. See the Delineation Map on Page 5 of this document. Unfortunately,

we did not receive the expected level of cooperation from local fly fishing enthusiasts who continued to fish in the infested area.

Offering scanty scientific and empirical evidence, I believe individual snails were spread (mainly upstream) by fishermen. For example, at site M (Fishing Access # 2) we found one suspect snail in a population of hundreds of native snails. I returned to that site on two subsequent days and resurveyed the site. I did not find any suspect snails after looking at thousands of native snails. During the emergency delineation, David Bergendorf found at least one NZMS in the folds of his lace-up boots after surveying an NZMS infested area. That snail was found due to the rigorous physical examination performed on our equipment after surveying every site. I do not feel that most fishermen perform that level of examination before moving within the same water course. After the "Fishing Alert" signs were posted on November 16, 2003, it was common to see 15-20 individuals fishing in the area from Fishing Access # 3 to the Monticello Dam.

### **Observations**

#### Habitat Preferences:

While the Emergency Delineation was the primary objective of the project, we learned highly valuable information about the habitat preferences of the NZMS during the delineation. Consistent with existing data, the snail appears to thrive in slow-moving water while attached to variety of substrates that includes aquatic macrophytes, rocks, sand, wood, beer bottles, paper bags, and various textiles. The NZMS appeared to thrive in a variety of solar conditions including full sun and total shade.

#### Macrophytes:

While further examination is prudent, it appears that NZMS do not favor any of the aquatic macrophytes (*Myriophyllum spicatum*, *Potamogeton sp.*, *Elodea sp.*) available in Putah Creek. The *Potamogeton sp.* appears to have more leaf surface for grazing, yet in areas infested with NZMS, the snails are commonly found on all aquatic macrophytes examined.

#### Snails out of the creek bed:

We also learned that NZMS can survive for an unknown period of time if left stranded by high water events. Due to reports by Erin Williams (USF&WS) and James Navicky (DF&G) that NZMS were found in mud and under leaves away from flowing water course, I surveyed several transects perpendicular to the water course at Fishing Access #3. Live snails were found under leaves on damp mud and sand, as far as twenty-six (26) feet from flowing water on elevated benches within the same water course. Site pictures are available on Page 18 (Report 755-22L-1). Because the sand bench is in shade, it is feasible that the leaf and detritus covered area can stay sufficiently damp to support individual NZMS for an extended period of time. Note that the survey area at the site is several feet above the current water level (50 CSF), it is not in wetlands external to the Putah Creek drainage as reported in the press. High water (500-1000 CSF) events have demonstrated to my satisfaction that the area in question is indeed within the normal water course and not wetlands external to Putah Creek.

### **Recommendations**

There is a desire for more information and data necessary for the appropriate management of the NZMS in Putah Creek and elsewhere. While the University of California at Davis (P. Moyle and R. Grossberg) have agreed to assist with select long-term studies, they are unavailable for the short term except for reviewing protocols. The following is information needed currently for management considerations.

1. To track the movement of the snail population. (Proposal to USBR)
2. Invertebrate species and community composition in the creek to determine any future impact on salmonid populations above (trout) and below (salmon) the Solano Diversion Dam. (Proposal to SCWA)

Submitted 1/20/04

Ken W. Davis  
Aquatic Biologist  
Wildlife Survey & Photo Service

Information listed below is a partial compilation of the information on the individual survey report sheets. The **Site Label** refers to the site as shown on the Putah Creek Map (next page). The **File No.** is the Site Report Number and the file number used for voucher specimens and site photographs.

Site Label	File No.	Site	Latitude			Longitude			NZMS
A	736-22A	Winters City Limits	38	31.0	19.3	121	57.0	51.8	NEG
B	771-22B	Stan Mertz Property	38	30.0	19.7	121	59	8.2	NEG
BA	772-22BA	Tony Morales Property	38	29.0	57.0	121	59	48.7	NEG
C	735-22C	Below Diversion Dam	38	29.0	39.0	122	0.0	11.0	NEG
D	765-22D	Lake Solano	38	29.0	31.0	122	0.0	32.0	NEG
E	766-22E	Lake Solano (Bridge)	38	29.0	36.0	122	1.0	40.0	NEG
EE	769-22EE	Lake Solano (Bridge)	38	29.0	35.0	122	1.0	41.0	NEG
F	769-22F	Lake Solano (S. Isl.)	38	30.0	13.0	122	2.0	27.0	NEG
G	No Sample	Lake Solano (N. Isl.)	Visual reported by J. Navicky						NEG
H	737-22H	Fishing Access # 5	38	30.0	24.9	122	2.0	35.2	NEG
I	738-22I	Fishing Access # 5	38	30.0	27.6	122	2.0	38.8	NEG
J	739-22J	Fishing Access # 4	38	30.0	40.0	122	2.0	56.0	NEG
JA	741-22JA	Gravel Bar off Hyw 128	38	30.0	56.4	122	3.0	18.2	POS
K	740-22K	Bend DS from #3	38	31.0	1.1	122	3.0	23.0	POS
L-1	755-22L-1	DS from L	38	31.0	2.0	122	03	29	POS
L	749-22L	<b>Fishing Access # 3</b>	38	31.0	0.0	122	3.0	32.0	POS
LA	747-22LA	US from L	38	30.0	56.8	122	3.0	41.8	POS
LB	748-22LB	Upstream from LA	38	30.0	55.7	122	3.0	54.0	POS
LC	750-22LC	Upstream from LB	38	30.0	54.9	122	3.0	55.0	POS
LD	751-22LD	Upstream from LC	38	30.0	52.6	122	4.0	3.2	POS
LE	752-22LE	Upstream from LD	38	30.0	52.2	122	4.0	3.4	POS
LF	753-22LF	Upstream from LE	38	30.0	51.2	122	4.0	14.5	NEG
LF2	757-22LF2	Second check of same area as LF - Middle channel							NEG
LF3	760-22LF3	Third check of same area as LF - North channel							NEG
M	746-22M	Fishing Access # 2	38	30.0	49.9	122	4.0	21.2	NEG
M2	756-22M2	Second check of same area as Site M							NEG
M3	759-22M3	Third check of same area as Site M							NEG
N	745-22N	Fishing Access # 1	38	30.0	51.2	122	4.0	48.7	NEG
O	744-22O	Under Solano Bridge	38	30.0	48.4	122	5.0	42.9	NEG
P	743-22P	Below Monticello Dam	38	30.0	45.6	122	5.0	50.1	NEG
END									



# Wildlife Survey & Photo Service



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Putah Creek, Yolo County, CA  
FINAL MAP - Emergency NZMS Delineation  
Effective 12/23/2003  
Prepared by: Ken W. Davis, Aquatic Biologist

Fishing Access # 3 = L

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Lake Solano

Diversion Dam

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NZMS Negative

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NZMS Positive





**Wildlife Survey & Photo Service**

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Collection No: **736-22A**

**Site:** Putah Creek

**Survey Date:** 12/02/03

**Subsite Name:** Area immediately below the Percolation Dam.

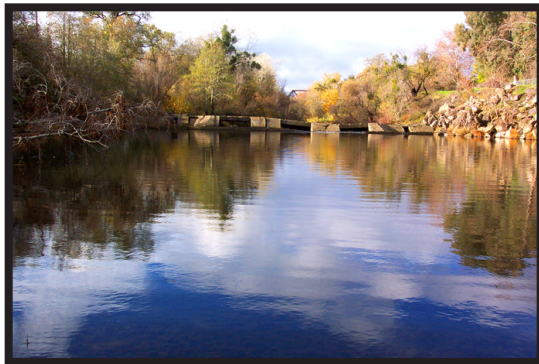
(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **NEGATIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek, Yolo County, California.

**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 736-22A-02

Facing upstream Percolation Dam



File No: 736-22K-04

Facing downstream

**Site Description:** Multihabitat area below Percolation Dam. Site adjacent to the City of Winters

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail is available.)

**Nearest Road:** Pleasants Valley Rd. **Nearest City:** Winters, CA **County:** Solano

**GPS:** N 38° 31' 19.3" W 121° 57' 51.8" **Elevation:**

**Water Temp:** 54°F **pH:** 8.1 **Depth:** 1-4 ft **MPS:** .1 to 0.5 m/sec.

**Habitat Description:** Creek in full sun. Typical inland riparian species: Oaks, Alder, black walnut, willow, blackberry, and significant populations of *Arundo*. Creek characterized by slow, weedy ponded area that narrows into flat run. No riffles at this site. North side of creek supports a residential area.

**Aquatic Macrophytes:** *Elodea* sp., *Potamogeton* sp., *Myriophyllum*

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
David Bergendorf, USF&WS Invasive Species, (209) 946-6400 x 342  
Roger Buttermore, USF&WS Invasive Species



**Site:** Putah Creek

**Survey Date:** 1/14/04

**Subsite Name:** Private access - Stan Mertz Property - Accompanied by R. Marovich.  
(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **NEGATIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek, Yolo County, California.

**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 771-22B-555

Facing upstream



File No: 771-22B-55

Facing downstream

**Site Description:** Site main channel of Putah with cut banks, pools, and riffles. Pools on side of main channel were ideal for NZMS. Area with multiple flood channels.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail is available.)

**Nearest Road:** Pleasants Valley Rd. **Nearest City:** Winters, CA **County:** Solano

**GPS:** N 38° 30' 19.7" W 121° 59' 08.2" **Elevation:**

**Water Temp:** 52°F **pH:** 8.1 **Depth:** 1-4+ ft **MPS:** not recorded

**Habitat Description:** Creek in full sun. Access by bank to main channel is limited by thick willow groves, blackberries, and flood debris. Riparian vegetation dominated by willows and alders.

**Aquatic Macrophytes:** *Myriophyllum* sp.

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
Accompanied by Richard Marovich, Putah Streamkeeper

**Voucher Specimen:** Negative for NZMS. Voucher specimens photographed.





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Collection No: **772-22BA**

**Site:** Putah Creek

**Survey Date:** 1/14/04

**Subsite Name:** Private access - **Tony Morales Property** - Accompanied by R. Marovich.  
(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **NEGATIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek, Yolo County, California.

**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 771-22B-555

Facing upstream



File No: 771-22B-55

Facing upstream

**Site Description:** Main channel deeply cut, with several flood channels on south side. Main channel alternates between riffles, pools, and runs. Salmon redds in area.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail is available.)

**Nearest Road:** Pleasants Valley Rd. **Nearest City:** Winters, CA **County:** Solano

**GPS:** N 38° 29' 57.0"

W 121° 59' 48.7"

**Elevation:**

**Water Temp:** 52°F

**pH:** 8.1

**Depth:** .5 - 3+ ft

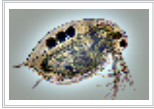
**MPS:** not recorded

**Habitat Description:** Creek mostly in full sun. Access by bank to main channel is limited by deeply cut banks. Banks covered with oaks, willows and blackberries. Many areas dominated by *Arundo*.

**Aquatic Macrophytes:** none seen in survey.

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537

**Voucher Specimen:** Negative for NZMS. Voucher specimens photographed. One dead Chinook salmon found on site. Salmon photographed.



**Site:** PUTAH CREEK

**Survey Date:** 12/05/03

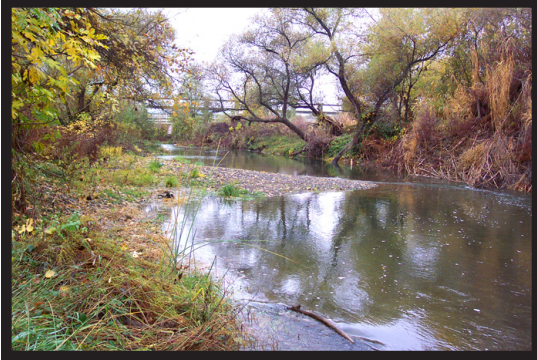
**Subsite Name:** Creek immediately below Diversion Dam  
(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **NEGATIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek.

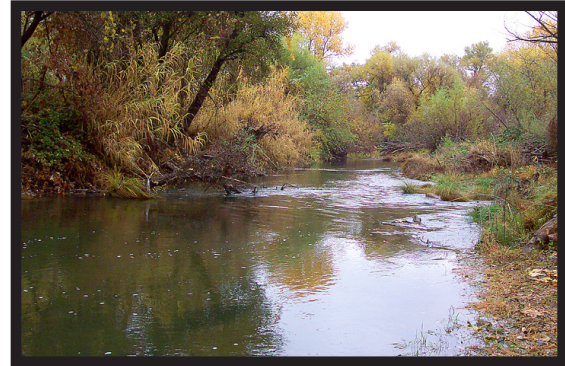
**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 740-22C-77

Facing upstream



File No: 740-22C-67

Facing downstream

**Site Description:** Creek 100 meters below Diversion Dam. Mainly runs and pools. Riffles likely with lower water levels. Easy access by short trail from Pleasant's Valley Road. Some use likely by fishermen. Deep bank on Yolo County side.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail will be available.)

**Nearest Road:** Highway 128

**Nearest City:** Winters, CA

**County:** Solano

**GPS:** N 38° 29' 39.0"

W 122° 00' 11"

**Elevation:** 126 feet

**Water Temp:** 56°F

**pH:** 8.0

**Depth:** 1-3 ft.

**MPS:** No recorded

**Habitat Description:** Creek in full sun. Typical inland riparian species: Oaks, Alder, black walnut, willow, blackberry. Invasive species: Arundo. Downstream characterized by deeply cut banks.

**Aquatic Macrophytes:** *Elodea* sp.; *Potamogeton* sp.; *Myriophyllum* sp.

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
David Bergendorf, USF&WS Invasive Species, (209) 946-6400 x 342

**Voucher Specimen:** Delivered to CDF&G (Doug Post) on 12/3/03



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Collection No: **765-22D**

**Site:** Putah Creek (Lake Solano)

**Survey Date:** 12/22/03

**Subsite Name:** Area immediately above (upstream) from Diversion Dam.  
(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **NEGATIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek, Yolo County, California.

**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 765-22D-66

Looking toward Diversion Dam

**Site Description:** Lake Solano formed by Putah Creek Diversion Dam. Rather shallow, weedy lake.

**Survey Protocol:** Six areas surveyed along bank with "D" net and/or tow net. Tow net was dragged at several levels through weed beds. Contents placed in white tubs and allowed to sit for ten minutes. Contents observed and surveyed for suspect snails.

**Nearest Road:** Pleasants Valley Rd. **Nearest City:** Winters, CA **County:** Solano

**GPS:** N 38° 29' 31" W 122° 00' 32 " **Elevation:**

**Water Temp:** 56°F **pH:** 8.1 **Depth:** 6-7 ft **MPS:**

**Habitat Description:** Shallow lake with significant populations of aquatic vegetation.

**Aquatic Macrophytes:** *Elodea sp.*, *Potamogeton sp.*, *Myriophyllum*

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537

**Voucher Specimen:** Negative for New Zealand Mud Snail.





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Collection No: **766-22E**

**Site:** Putah Creek (Lake Solano)

**Survey Date:** 12/22/03

**Subsite Name:** Area immediately below the Pleasants Valley Bridge.

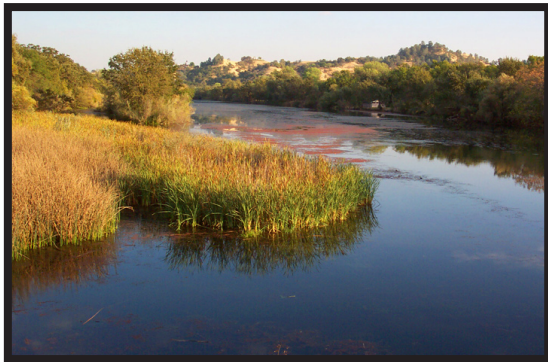
(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **NEGATIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek, Yolo County, California.

**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 766-22E-23

Looking south from bridge



File No: 766-22E-08

Looking south from bridge

**Site Description:** Lake Solano.

**Survey Protocol:** Six areas surveyed along bank with "D" net and/or tow net. Tow net was dragged at several levels through weed beds. Contents placed in white tubs and allowed to sit for ten minutes. Contents observed and surveyed for suspect snails.

**Nearest Road:** Pleasants Valley Rd. **Nearest City:** Winters, CA **County:** Yolo

**GPS:** N 38° 29' 36" W 122° 01' 40" **Elevation:**

**Water Temp:** 57°F **pH:** 8.1 **Depth:** 5+ ft **MPS:** not recored

**Habitat Description:** Shallow lake with significant populations of aquatic vegetation

**Aquatic Macrophytes:** *Elodea* sp., *Potamogeton* sp., *Myriophyllum* sp.

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537

**Voucher Specimen:** Negative for New Zealand Mud Snail.




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**Collection No: 769-22F**
**Site:** Putah Creek (Lake Solano)

**Survey Date:** 12/23/03

**Subsite Name:** Area in Lake Solano at "entrance" of Putah Creek.

(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **NEGATIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek, Yolo County, California.

**Client:** U.S. Bureau of Reclamation:

**Order No.** 04PG242858


File No: 769-22F-666

Facing upstream X survey site

**Site Description:** Lake Solano.

**Survey Protocol:** Six areas surveyed along bank with "D" net and/or tow net. Tow net was dragged at several levels through weed beds. Contents placed in white tubs and allowed to sit for ten minutes. Contents observed and surveyed for suspect snails.

**Nearest Road:** Highway 128    **Nearest City:** Winters, CA    **County:** Yolo

**GPS:** N 38° 30' 13"

W 122° 02' 27"

**Elevation:**
**Water Temp:** 56°F

**pH:** 8.0

**Depth:** 1-6 ft

**MPS:**
**Habitat Description:** Shallow lake with significant populations of aquatic vegetation

**Aquatic Macrophytes:** *Elodea* sp., *Potamogeton* sp., *Myriophyllum*
**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537

**Voucher Specimen:** - Negative for New Zealand Mud Snail.



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Collection No: **737-22H**

**Site:** PUTAH CREEK

**Survey Date:** 12/04/03

**Subsite Name:** Fishing Access # 5 - Downstream trail

(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** NEGATIVE - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population

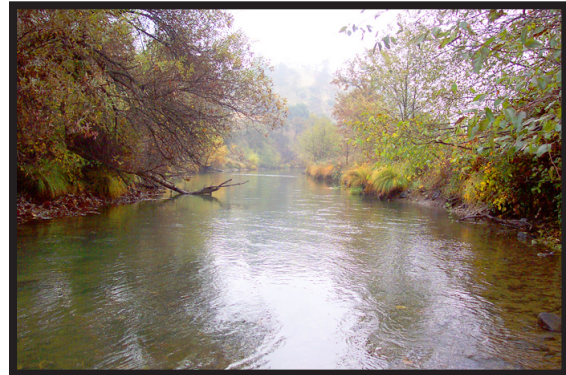
**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 737-22H-59

Facing upstream



File No: 737-22H-90

Facing downstream

**Site Description:** Wide riffles, pools and runs. Banks typically deep cut. Easy access by short trail from Highway 128. Used frequently by fishermen.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail is available.)

**Nearest Road:** Highway 128

**Nearest City:** Winters, CA

**County:** Yolo

**GPS:** N 38° 30' 24.9"

W 122° 02' 35.2 "

**Elevation:** 154 feet

**Water Temp:** 55°F

**pH:** 8.2

**Depth:** 4in - 3 ft.

**MPS:** .41 / .67 / 12.7

**Habitat Description:** Creek in full sun with riparian overhang. Typical inland riparian species: Oaks, Alder, black walnut, willow, blackberry and *Equisetum*. This appears to be the transition area between Putah Creek and Lake Solano.

**Aquatic Macrophytes:** None

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
David Bergendorf, USF&WS Invasive Species, (209) 946-6400 x 342  
James Navicky, DF&G Environmental Scientist

**Voucher Specimen:** Given to DF&G biologist James Navicky on 12/05/03 for examination by Doug Post - DF&G Aquatic Bioassessment Laboratory. Negative for NZMS


**Site:** PUTAH CREEK

**Survey Date:** 12/04/03

**Subsite Name:** Fishing Access # 5 - Upstream trail

(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** NEGATIVE - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

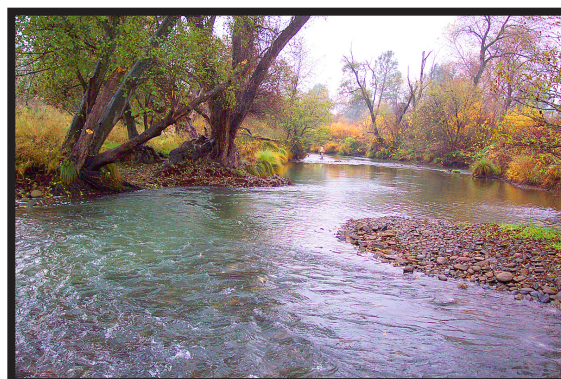
**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population

**Client:** U.S. Bureau of Reclamation:

**Order No.** 04PG242858


File No: 738-221-134

Facing upstream



File No: 738-221-03

Facing downstream

**Site Description:** Narrow riffles, pools and runs. Several channels at Site I. Shallow riffles with copious periphyton. Banks downstream deep cut. Easy access by short trail from Highway 128. Area used daily by fishermen.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail is available.)

**Nearest Road:** Highway 128

**Nearest City:** Winters, CA

**County:** Yolo

**GPS:** N 38° 30' 27.6"

W 122° 02' 38.8 "

**Elevation:** 132 feet

**Water Temp:** 55°F

**pH:** 8.1

**Depth:** 4in - 3 ft.

**MPS:** .2 / .73 / 1.0

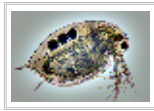
**Habitat Description:** Creek in full sun to total shade. Typical inland riparian species: Oaks, Alder, black walnut, willow, blackberry. Several channels with fast, medium, and slow riffles. Undercut pools.

**Aquatic Macrophytes:** None

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
 David Bergendorf, USF&WS Invasive Species, (209) 946-6400 x 342  
 James Navicky, DF&G Environmental Scientist

**Voucher Specimen:** Given to DF&G biologist James Navicky on 12/05/03 for examination by Doug Post - DF&G Aquatic Bioassessment Laboratory. Negative for NZMS





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Collection No: **739-22J**

**Site:** PUTAH CREEK

**Survey Date:** 12/04/03

**Subsite Name:** Fishing Access # 4 - Upstream trail

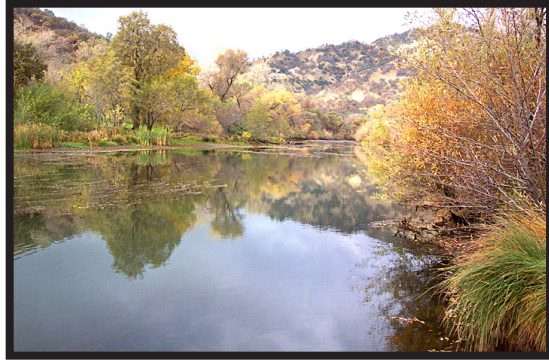
(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** NEGATIVE - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population

**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 737-22H-59

Facing upstream



File No: 737-22H-90

Facing downstream

**Site Description:** Wide slow, weedy section. Deep mud along banks. No wading. Banks typically deep cut. Easy access by short trail from Highway 128. Area used frequently by fishermen.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail is available.)

**Nearest Road:** Highway 128

**Nearest City:** Winters, CA

**County:** Yolo

**GPS:** N 38° 30' 40"

W 122° 02' 56.0 "

**Elevation:**

**Water Temp:** 55°F

**pH:** 8.2

**Depth:** 4in - 3 ft.

**MPS:** .07 / 0.11

**Habitat Description:** Creek in full sun with riparian overhang. Typical inland riparian species: Oaks, Alder, black walnut, willow, blackberry and *Equisetum*. This appears to be the transition area between Putah Creek and Lake Solano.

**Aquatic Macrophytes:** *Elodea sp.*; *Myriophyllum sp.*; *Potamogeton sp* (x2)

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
David Bergendorf, USF&WS Invasive Species, (209) 946-6400 x 342  
James Navicky, DF&G Environmental Scientist

**Voucher Specimen:** Given to DF&G biologist James Navicky on 12/05/03 for examination by Doug Post - DF&G Aquatic Bioassessment Laboratory. Negative for NZMS



**Site Name:** PUTAH CREEK

**Survey Date:** 12/05/03

**Results:** POSITIVE - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

NOTE: To date, this is the farthest downstream site from Fishing Access # 3 where we have found NZMS. Only a few snails were found in the middle tub. Downstream Site J was negative for NZMS.

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek.

**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 741-22-JA-127

Facing upstream



File No: 741-22-JA-120

Facing upstream

**Site Description:** Slow moving, flat water. Fishing access area with mud / cobble peninsula that effectively reduces the width of the creek by one-half.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail will be available.)

**Nearest Road:** Highway 128      **Nearest City:** Winters, CA      **County:** Yolo

**GPS:** N 38° 30' 56.4"      W 122° 03' 18.2"      **Elevation:** 155 feet

**Water Temp:** 57°F      **pH:** 8.1      **Depth:** ?      **MPS:** .26 / .14 / 0.05

**Habitat Description:** Creek in full sun with riparian overhang. Typical inland riparian species: Alder, black walnut, willow, blackberry.

**Aquatic Macrophytes:** *Elodea* sp.; *Potamogeton* sp.

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
David Bergendorf, USF&WS Invasive Species, (209) 946-6400 x 342

**Voucher Specimen:** Given to DF&G biologist James Navicky on 12/05/03 for confirmation by Doug Post - DF&G Aquatic Bioassessment Laboratory.




**Site Name:** PUTAH CREEK

**Survey Date:** 12/05/03

**Results:** POSITIVE - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

NOTE: This site has a significant population of New Zealand Mud Snails. It is approximately .18 miles from Fishing Access # 3. We found NZMS at this site and then backed up to Site JA to locate the transition area for the NZMS population. Site JA is between Site J and Site K. Site J was negative for NZMS.

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek.

**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 741-22-K-680

Facing downstream



File No: 741-22-K-888

Facing upstream

**Site Description:** Slow moving, flat water. Low flows reveal rocky area. Easy access by short trail from Highway 128. Used frequently by fishermen.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail will be available.)

**Nearest Road:** Highway 128

**Nearest City:** Winters, CA

**County:** Yolo

**GPS:** N 38° 31' 01.1"

W 122° 03' 23 "

**Elevation:** 156 feet

**Water Temp:** 56°F

**pH:** 8.0

**Depth:** ?

**MPS:** .2 to 0.11

**Habitat Description:** Creek in full sun with riparian overhang. Typical inland riparian species: Oaks, Alder, black walnut, willow, blackberry. Upstream characterized by deeply cut banks.

**Aquatic Macrophytes:** *Elodea* sp.; *Potamogeton* sp.

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
David Bergendorf, USF&WS Invasive Species, (209) 946-6400 x 342

**Voucher Specimen:** Given to DF&G biologist James Navicky on 12/05/03 for confirmation by Doug Post - DF&G Aquatic Bioassessment Laboratory.


**Site Name:** PUTAH CREEK

**Survey Date:** 12/17/03

**Results:** POSITIVE - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

NOTE: This site is approximately 100 yards downstream from the access point for Fishing Access # three. NZMS were reported at this site (by DF&G biologist) under leaves twenty feet from the creek. I was asked by several agencies (SCWA) to check for the presence of NZMS at various distances from the creek.

**Purpose of Survey:** To qualify the presence of NZMS under leaves away from the flowing water.

**Client:** U.S. Bureau of Reclamation:

**Order No.** 04PG242858


File No: 755-22-L1-06

Facing downstream



File No: 775-22L1-01

Facing downstream

**Site Description:** The site in question is a sand bench 3-4 feet above a secondary channel of Putah Creek.

**Survey Protocol:** Three transects were selected to reach three sites of the creek bed that were reported to support small numbers of NZMS under leaf material. A measuring tape was laid along the transect and five areas were selected to look for the presence of NZMS. At each of these five areas, a 12 x 14 inch section of the leaf material was placed in one of the white tubs shown in images above. Each tub was then filled with clean tap water from a plastic one-gallon jug. The leaf material was allowed to sit for ten minutes and then searched for NZMS.

**Nearest Road:** Highway 128

**Nearest City:** Winters, CA

**County:** Yolo

**GPS:** N 38° 31' 02"

W 122° 03' 29 "

**Elevation:** 155 feet

**Water Temp:**
**pH:**
**Depth:**
**MPS:**

**Habitat Description:** Creek bed in shade. Typical riparian species: Oaks, Alder, willows.

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537

**Results:**

Three feet	(10 live NZMS)
Six feet	(zero NZMS)
Eight feet	(2 live NZMS)
Fourteen feet	(9 live NZMS)
Twenty six feet	(2 dead NZMS and 1 live NZMS)





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Collection No: **749-22L**

**Site Name:** PUTAH CREEK

**Survey Date:** 12/15/03

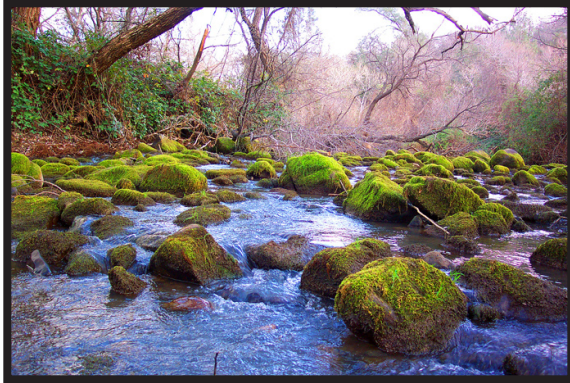
**Results:** POSITIVE - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

NOTE: This is Fishing Access # 3, the original site in Putah Creek for NZMS.

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek.

**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 754-22L-09

Facing upstream



File No: 754-22L77

Facing upstream

**Site Description:** Slow moving, boulder strewn pocket water in total shade. Easy access by short trail from Highway 128. Used frequently by fishermen.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail will be available.)

**Nearest Road:** Highway 128

**Nearest City:** Winters, CA

**County:** Yolo

**GPS:** N 38° 31' 00.0"

W 122° 03' 32"

**Elevation:**

**Water Temp:** 54°F

**pH:** 8.1

**Depth:** 2- 5 ft

**MPS:** not recorded

**Habitat Description:** Creek in total shade from riparian overhang. Typical inland riparian species: Oaks, Alder, black walnut, willow, blackberry. Boulders covered with aquatic moss.

**Aquatic Macrophytes:** *Potamogeton* sp.

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537

**Voucher Specimen:** Provided to DF&G


**Site Name:** PUTAH CREEK

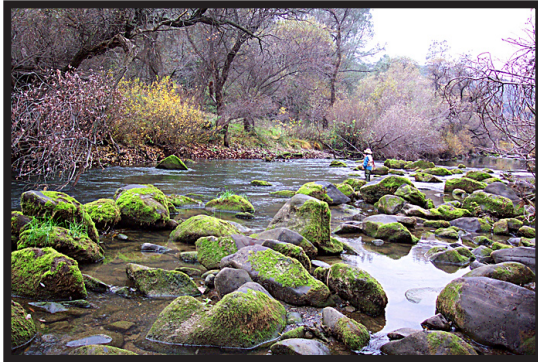
**Survey Date:** 12/10/03

**Results:** POSITIVE - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

*Note: This area has a significant NZMS population. The snails are highly visible on boulders, leaves, and sand banks. This is a popular fishing area.*

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek.

**Client:** U.S. Bureau of Reclamation:

**Order No.** 04PG242858


File No: 747-22LA-88

Facing upstream



File No: 747-22LA-39

Facing downstream

**Site Description:** Slow moving, pocket water. Easy access by short trail from Highway 128. Used frequently by fishermen.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail will be available.)

**Nearest Road:** Highway 128

**Nearest City:** Winters, CA

**County:** Yolo

**GPS:** N 38° 30' 56.8"

W 122° 03' 41.8 "

**Elevation:** 156 feet

**Water Temp:** 54°F

**pH:** 8.1

**Depth:** 2- 5 ft

**MPS:** 0.1 / 0.14 / 0.14

**Habitat Description:** Creek in full sun with riparian overhang. Typical inland riparian species: Oaks, Alder, black walnut, willow, blackberry. Large moss-covered boulders characterize the creek in this area.

**Aquatic Macrophytes:** *Elodea* sp.; *Potamogeton* sp.

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
David Bergendorf, USF&WS Invasive Species, (209) 946-6400 x 342

**Voucher Specimen:** None taken





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Collection No: **748-22LB**

**Site:** Putah Creek

**Survey Date:** 12/10/03

**Subsite Name:** Fishing access via short trail from Highway 128

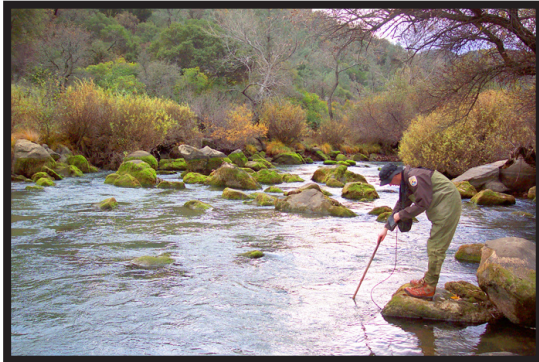
(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **POSITIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek, Yolo County, California.

**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



Facing upstream



Facing downstream

**Site Description:** Deep, pocket water with large boulders.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail is available.)

**Nearest Road:** Pleasants Valley Rd. **Nearest City:** Winters, CA **County:** Yolo

**GPS:** N 38° 30' 55.7" W 122° 03' 54.0" **Elevation:**

**Water Temp:** 54°F **pH:** 8.0 **Depth:** 1- 6+ ft **MPS:** .16 / 0.01m/sec.

**Habitat Description:** Creek in full sun. Creek characterized by slow, large boulders with areas supporting large populations of aquatic plants.

**Aquatic Macrophytes:** *Potamogeton* sp. (x2)

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
David Bergendorf, USF&WS Invasive Species, (209) 946-6400 x 342

**Voucher Specimen:** Delivered to James Navicky - Positive for NZMS.

**Site:** Putah Creek**Survey Date:** 12/14/03**Subsite Name:** Fishing access area adjacent to Highway 128

(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **POSITIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek, Yolo County, California.**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



No Upstream Photo

Facing upstream



Facing downstream

File No: 736-22K-04

**Site Description:** Flat, slow, weedy water below a series of riffles.**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail is available.)**Nearest Road:** Pleasants Valley Rd. **Nearest City:** Winters, CA **County:** Yolo**GPS:** N 38° 30' 52.2" W 122° 04' 03.4 "**Elevation:****Water Temp:** 54°F **pH:** 8.0 **Depth:** 1-4 ft **MPS:** .1 to 0.5 m/sec.**Habitat Description:** Creek in full sun. Typical inland riparian species: Oaks, Alder, black walnut, willow, blackberry, and significant populations of *Arundo*. Creek characterized by slow, weedy ponded area that narrows into flat run. No riffles at this site. North side of creek supports a residential area.**Aquatic Macrophytes:** *Elodea sp.*, *Potamogeton sp.*, *Myriophyllum sp.***Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537**Voucher Specimen:** Delivered to James Navicky, DF&G Environmental scientist.



**Wildlife Survey & Photo Service**

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Collection No: **753-22LF**

**Site:** Putah Creek

**Survey Date:** 12/14/03

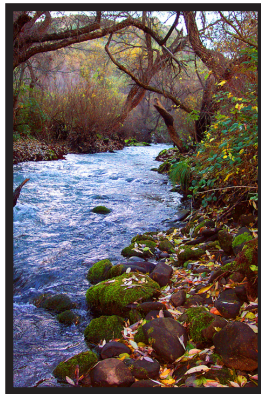
**Subsite Name:** Popular fishing area - Survey three times - 18 stations  
(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **NEGATIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek, Yolo County, California.

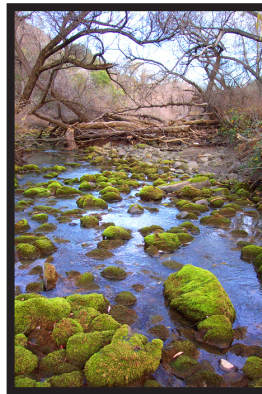
**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



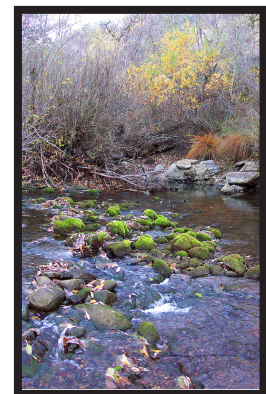
File No: 753-22LF-460

South run



File No: 753-22LF-333

Middle run



File No: 753-22LF-66

North run

**Site Description:** Area where three runs (channels) come together to form a large, slow, weedy section. Middle and north runs are ideal for NZMS colonization.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail is available.)

**Nearest Road:** Pleasants Valley Rd. **Nearest City:** Winters, CA **County:** Yolo

**GPS:** N 38° 30' 51.2" W 122° 04' 14.5" **Elevation:**

**Water Temp:** 54°F **pH:** **Depth:** 1-4 ft **MPS:**

**Habitat Description:** Three channels of creek converge. All runs in full shade. South run too fast for NZMS colonization. Middle run ideal for NZMS and very similar to Fishing Access #3. North run is shallow (2-9 inches), muddy, and pooled.

**Aquatic Macrophytes:** *Elodea sp.*, *Potamogeton sp.*, *Myriophyllum*

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537

**Voucher Specimen:** Delivered to James Navicky, DF&G Environmental scientist. Negative for NZMS. Area surveyed three separate times.




**Site:** Putah Creek

**Survey Date:** 12/02/03 / 12/23/03 / 1/4/04

**Subsite Name:** Fishing Access # 2. Site checked three separate times (18 tubs).  
(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **NEGATIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek, Yolo County, California.

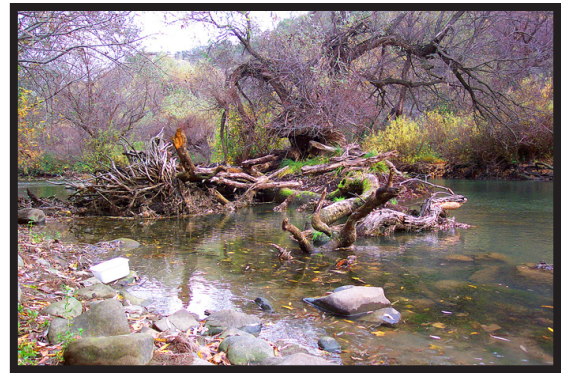
**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 746-22M-44

Facing upstream



File No: 746-22M-21

Facing downstream

**Site Description:** Creek with two fishing access points. Numerous boulders and downed trees along bank.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail is available.)

**Nearest Road:** Pleasants Valley Rd. **Nearest City:** Winters, CA **County:** Yolo

**GPS:** N 38° 30' 49.9" W 122° 04' 21.2 " **Elevation:**

**Water Temp:** 54°F **pH:** 8.2 **Depth:** 1-3 ft **MPS:** .09 / .26 / .29 m/sec.

**Habitat Description:** Creek in full sun. Typical inland riparian species: Oaks, Alder, black walnut, willow, and. blackberries. Creek characterized by slow, boulder strewn stretch with numerous logs, dead trees in the water, and aquatic vegetation.

**Aquatic Macrophytes:** *Elodea* sp., *Potamogeton* sp., *Myriophyllum*

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
David Bergendorf, USF&WS Invasive Species, (209) 946-6400 x 342

**Voucher Specimen:** Delivered to James Navicky, DF&G Environmental scientist.



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Collection No: **744-220**

**Site:** Putah Creek

**Survey Date:** 12/10/03

**Subsite Name:** Area under Highway 128 bridge over Putah Creek

(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **NEGATIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

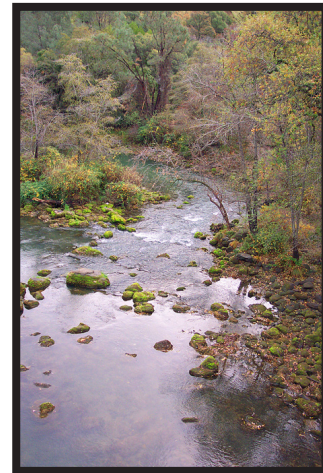
**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek, Yolo County, California.

**Client:** U.S. Bureau of Reclamation:



File No: 744-220-889

Facing upstream



File No: 744-220-35

Facing downstream

**Site Description:** Area characterized by slow, boulder strewn, flat water. Area below bridge is a very popular fishing site.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail is available.)

**Nearest Road:** Pleasants Valley Rd. **Nearest City:** Winters, CA **County:** Solano

**GPS:** N 38° 30' 48.4" W 122° 05' 42.9" **Elevation:**  
**Water Temp:** 54°F **pH:** 7.8 **Depth:** 1-4 ft **MPS:** .08 / .43 / .51 m/sec.

**Habitat Description:** Creek in full sun. Typical inland riparian species: Oaks, Alder, black walnut, willow, blackberry, and wild grape. Creek characterized by slow, flat water, with numerous moss-covered boulders. North side with deep mud and copious numbers of aquatic macrophytes.

**Aquatic Macrophytes:** *Elodea* sp., *Potamogeton* sp. (X2), *Myriophyllum*

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
 David Bergendorf, USF&WS Invasive Species, (209) 946-6400 x 342  
 Bernie Weston, volunteer

**Voucher Specimen:** Delivered to James Navicky - Negative for NZMS.





**Site:** Putah Creek

**Survey Date:** 12/10/03

**Subsite Name:** Area immediately below Monticello Dam.

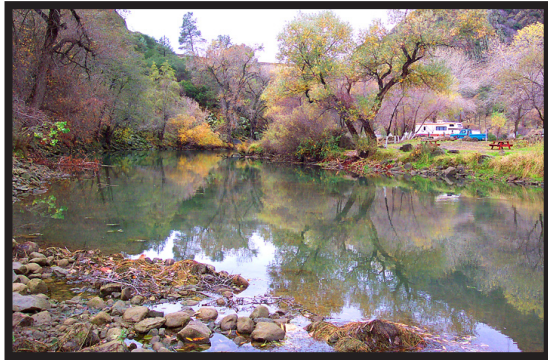
(NOTE: Area surveyed contains habitats that typically support NZMS colonization.)

**Results:** **NEGATIVE** - New Zealand Mud Snail, *Potamopyrgus antipodum* (Gray 1843)

**Purpose of Survey:** Emergency delineation of the New Zealand Mud Snail population in Putah Creek, Yolo County, California.

**Client:** U.S. Bureau of Reclamation:

Order No. 04PG242858



File No: 743-22P-01

Facing upstream



File No: 743-22P-07

Upstream from Bridge

**Site Description:** Area a few hundred yards below Monticello Dam. Campground on north side of creek. Cold Creek enters Putah from south side at this site.

**Survey Protocol:** From the center of the site, 6 white tubs (three upstream and three downstream) were spread approximately 25 feet apart. Each habitat type, including aquatic vegetation, between the tubs was sampled either with a 500 micron mesh dip net and / or by hand. The results were placed in the respective tubs and then inspected for the presence of NZMS. Snails having an operculum were collected with plastic pipettes and kept as a composite sample in water. (Note: Protocol in more detail is available.)

**Nearest Road:** Highway 128

**Nearest City:** Winters, CA **County:** Solano

**GPS:** N 38° 30' 45.6"

W 122° 05' 50.1"

**Elevation:**

**Water Temp:** 55°F **pH:** 8.2 **Depth:** 1-4 ft **MPS:** .1 to 0.22 m/sec.

**Habitat Description:** Creek in full sun. Riparian species include oaks, cottonwood, and willows. Creek characterized by slow, weedy, flat area with numerous weed beds. No riffles at this site.

**Aquatic Macrophytes:** *Elodea* sp., *Potamogeton* sp., *Myriophyllum* sp.

**Survey by:** Ken W. Davis, Wildlife Survey & Photo Service, (916) 747- 8537  
David Bergendorf, USF&WS Invasive Species, (209) 946-6400 x 342

**Voucher Specimen:** Delivered to James Navicky - Negative for NZMS.

# **Emergency Delineation of New Zealand Mudsnaills in Putah Creek, CA.**

December 22, 2003

## Draft of methods by:

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## **Background**

On October 30, 2003 Ken Davis found what appeared to be a population of New Zealand Mudsnaills (NZMS) [*Potamopyrgus antipodarum*] in Putah Creek, CA. The snail population was found at fishing site #3, while Ken was conducting a routine macroinvertebrate survey. The suspected sighting of this invasive mudsnail was rapidly reported to the California Department of Fish and Game (CDFG) and several other agencies. The CDFG Aquatic Bioassessment Laboratory confirmed identification of the snails as *Potamopyrgus antipodarum* on November 4, 2003.

Putah Creek runs from Lake Berryessa in the west through the towns of Winters and Davis California. The south fork of Putah creek passes through the Yolo bypass wildlife area and eventually connects to the Sacramento River Deep Water Shipping Channel. Through this connection, organisms living in Putah creek could passively spread into the Sacramento River - San Joaquin River Delta.

Putah creek is a popular fly fishing destination, with trophy populations of brown trout (*Salmo trutta*) and rainbow trout/steelhead (*Oncorhynchus mykiss*). Brown trout are known to be an introduced species, while steelhead are thought to be an endemic species to Putah Creek. Due to the dense vegetation surrounding Putah creek, fly fishers must wade into the stream to effectively cast their lines. The use of such wading gear has been suggested by several authors as a likely vector for the spread of the NZMS to new waterways. Through this vector NZMS could pass to virtually any waterways within the area.

By November 25, 2003 Ken Davis had received a contract from the U.S. Bureau of Reclamation to conduct an emergency delineation of the NZMS population in Putah Creek to determine the extent of their current spread. The Stockton Fish and Wildlife Office Aquatic Nuisance Species (ANS) program offered to assist with the delineation.

## **Methods**

The emergency delineation began on December 1, 2003 and continued through December

12, 2003. The objective of the delineation was to determine the extent of the NZMS population spread in Putah Creek. While the method described below is adequate for detecting NZMS populations this delineation method is probably not adequate to detect individual NZMS that may be present in relatively low numbers. The basic delineation protocol was suggested by David Richards of Montana State University.

### **Selection of sampling sites**

Sites in Putah Creek were sampled from the eastern edge of Lake Berryessa to the Putah Diversion Dam, seven and one-half miles downstream from Fishing Access #3. Primary sampling sites were selected based on fishing access (FA) sites. If snails were found at fishing access sites then additional samples were taken to determine if NZMS populations were present between access sites.

### **Transect sampling**

Once a sampling site was decided upon, the researchers would pace out a 150 ft. transect along the stream edge. Six 12" by 10" tubs were placed evenly along the transect so that the distance was approximately 25 ft. between each tub.

Once a transect had been laid out a single researcher would wade out into the stream 25 ft. downstream from the first tub. The researcher then began to sample the stream with a D frame kick net with a 10" by 12" head. The net used was a 500 micron mesh. The researcher then began to wade upstream using the net to sample a variety of potential habitats across the stream including submerged vegetation and inorganic substrate. Researchers would sample as far from the edge of the stream as was possible to safely wade to. For substrates composed of larger cobbles, the researchers would jostle the rocks with the net frame in an attempt to dislodge any NZMS that might be feeding on the underside of large substrate, with the open net held downstream. This sampling procedure continued upstream until the researcher reached a point parallel to a tub. When the researcher was parallel with a tub the contents of the net were emptied into the bucket. The researcher then resumed sampling upstream until reaching the next bucket and repeating the process. This procedure continued until the 150 ft. transect was completed.

The bucket contents were then allowed to settle for at least 20 minutes. This procedure permitted sediment to clear and also allowed researchers to take advantage of NZMS behavior to aid in identification. Once placed in a tub NZMS quickly begin to move up the sides of the container unlike most endemic snails. Another distinctive behavior is that if touched NZMS will immediately drop off from surfaces. In no active NZMS were found each collection was carefully searched for an additional 10-30 minutes, depending on the amount of debris in the sample.

When species that appeared morphologically similar to mudsnails were found in samples they were placed into a jar containing tap water. Some samples had few or no mollusks of any species in them, in which case a sample of whatever was available was retained as a sample. Samples from all six tubs, comprising a transect, were combined into a single jar to represent the aggregate 150 ft. transect.

After a transect was sampled all researchers returned to their vehicles to conduct decontamination of gear. Even if a researcher did not actually wade in the water,

decontamination of gear was still conducted. This procedure was conducted to assure that NZMS residing in puddles or damp leaf litter were eliminated before the researchers moved to a new sampling site.

Supplemental surveys using a trawl net pulled behind a kayak are planned to sample deep sites that could not be safely sampled by researchers wearing waders.

### **Decontamination of gear**

Gear was decontaminated using a methodology combining physical removal and chemical treatment. This treatment is not without risks and should not be recommended for anyone that does not have the time or diligence to adequately perform this method. After each site gear was sprayed with Clorox formula 409, which has been recommended for treatment of gear by the National NZMS Research and Monitoring Team (Richards 2001). All gear was then thoroughly scrubbed with a stiff bristled brush to remove all large NZMS from boots, waders and buckets. All gear was visually inspected to assure the removal of adult NZMS was affective. It was assumed that the caustic 409 spray would mortally wound any thin shelled, young NZMS that were not visible or removed by the brushing. After spraying and brushing, all gear was rinsed with tap water.

After completion of that days survey(s) all gear was treated as above, bagged, and soaked in 130 degree (F) water until the water cooled to approximately 110 degrees (F). The equipment was allowed to dry in the sun if possible

### **Collection of data**

A record sheet was kept by the researchers for every survey site, whether positive or negative for NZMS. The data included site name, collection number, habitat description, GPS information, water temperature, pH, flow in meters per second, and other site and location descriptors. Site photographs (upstream and downstream) were taken using a digital camera. Digital photographs were filed using the site collection number.

### **Analysis of snail samples**

All samples, in jars containing tap water, were sent to the CDFG Aquatic Bioassessment Laboratory for analysis. All samples were labeled with the Site Collection Number, the site name, the date and the Collector's name. When snails were found that were morphologically similar to NZMS then the U.S. Fish and Wildlife Service Aquatic Nuisance Species program retained a voucher specimen in a 10% solution of ethyl alcohol.

### **References**

Richards, David C. 2001. Research and Monitoring Team. In: Chavez Writing and Editing, July 9 and 10, 2001. In: New Zealand Mudsail in the Western USA: Minutes of the First Annual Conference. Cheever Hall, Montana State University, Bozeman, Montana.