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ABSTRACTS

Effects of *Potamopyrgus antipodarum* on density and biomass of macroinvertebrates in Darlinton Ditch, Montana State University

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Introduced populations of *Potamopyrgus antipodarum* in the Madison River drainage commonly reach 300,000 m^{-2}. Consequently, the snail could compete with native macroinvertebrates for periphyton food resources through exploitation or for space on rock surfaces through interference. We examined the effects of *P. antipodarum* on periphyton biomass and macroinvertebrate densities and biomass in Darlinton Ditch in the Madison River drainage. We sampled periphyton and macroinvertebrates from cobbles in downstream, invaded reaches and upstream, noninvaded reaches within a 50m section of stream during November 2000 and June 2001. Densities and biomass of *P. antipodarum* met experimental design criteria by having significantly higher densities and biomass in snail-positive reaches than in snail-negative reaches. Periphyton biomass was significantly lower in snail-positive reaches in November but not in June, suggesting that grazing by *P. antipodarum* decreases the availability of periphyton for other grazers. Analysis of macroinvertebrates included total density, total biomass and density/biomass by functional feeding group. Macroinvertebrates were assigned to the following functional feeding groups: scrapers, collector-gatherers, scraper/collector-gatherers, collector filterers, piercers and predators. Total density, excluding *P. antipodarum*, was significantly lower in snail-positive than snail-negative reaches. Similarly, total biomass per m^2, excluding *P. antipodarum*, was significantly higher in snail negative reaches than snail-positive reaches in November, but there was no difference in June. Mean densities of scraper/collector-gatherers, collector-gatherers, and collector filterers were significantly lower in snail-positive reaches than snail-negative reaches in November but not in June. Biomass per m^2 of scrapers and piercers was significantly higher in snail-negative reaches in November but exhibited the opposite pattern in June. Additionally, scraper/collector-gatherer and collector-gatherer biomass per m^2 was significantly higher in snail-negative than snail-positive reaches in November, but these groups showed no differences between snail treatments in June. These results indicate that *P. antipodarum* depresses periphyton biomass, as well as macroinvertebrate densities and biomasses. Consequently, *P. antipodarum* can exclude other grazers through competition either for food or for space.

Bioassay results of Bayluscide against New Zealand mudsnails

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New Zealand mudsnails (NZMS) (*Potomopyrgus antipodarum*) are documented in Darlinton Ditch along the lower Madison River near Three Forks Montana. Darlinton Ditch is an irrigation ditch, transporting water from the Madison River to nearby fields, and eventually to the adjacent Gallatin drainage. The ditch also captures spring water, so base flow in the absence of irrigation water is about 6 cfs. Montana Fish, Wildlife, & Parks maintains the Cobblestone Fishing Access Site, which provides public access to both Darlinton Ditch and the Madison River. A significant brown trout fishery has developed in Darlinton Ditch. To eliminate the threat NZMS pose to the aquatic biota and fishery of Darlinton Ditch, and to prevent their transportation to the adjacent Madison River, MFWP proposed to use the molluscicide Bayluscide to eradicate NZMS from Darlinton Ditch. Bioassay results show Bayluscide will kill NZMS, with 48 exposure units the minimum necessary for 100 percent mortality. Potassium permanganate will significantly neutralize Bayluscide, but the necessary exposure time is 24-48 hours. Bioassays also showed potassium permanganate by itself killed 100 percent of test NZMS at a 24-hour exposure of 40 ppm followed by 72 hours in fresh water.

Multiple worldwide invasion pathways of a freshwater snail: The revenge of New Zealand

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The success of an invader may be determined by its genetic diversity, which should be enhanced if populations are founded by multiple invasions of different origin. I tracked the invasion pathways of a New Zealand endemic freshwater snail *Potamopyrgus antipodarum* to determine their origin and diversity worldwide. In New Zealand, this species is dioecious but females are either obligately sexual or clonal. Invasive populations (UK, Europe, Australia, Tasmania, Japan, and USA) are clonal, and often dominate benthic habitats. Individual introduced populations could result from single invasions, or multiple sequential invasions; the origins may be either New Zealand populations or introduced populations via steppingstone pathways. Snails were sampled from 19 introduced populations from the 6 major regions. These were compared to numerous sexual and clonal populations from New Zealand's North and South Islands. Source-recipient relationships were traced using similarities in alleles or multilocus genotypes based on allozymes. This analysis shows that, in the UK and Europe, three distinct multilocus allozyme genotypes represent separate invasions from New Zealand, which concords with their distinct ecological ranges (UK rivers, Danish estuaries, and freshwaters elsewhere). In the USA, Lake Ontario (NY) is inhabited by the European freshwater clone, implying a steppingstone pathway. A different clone occurs across 4 disparate invasion areas in the western USA (ID, MT, OR, CA); it matches a genotype from Australia. Samples from Tasmania and Japan were monoclonal, and similar to North Island populations. Only Australian populations were comprised of diverse sets of clones. Thus, most individual introduced populations of *Potamopyrgus* have a single origin, and lack genetic diversity

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3 Ecological Studies of *P. antipodarum*

Steven Lysne

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Boise State University

We investigated aspects of the ecology of the exotic freshwater snail *Potamopyrgus antipodarum* in three controlled laboratory experiments between June 2001 and August 2002. A recent invader to Western North America, the New Zealand mudsnail (*P. antipodarum*) has been extensively studied in its native New Zealand as well as throughout Europe where it has been known as *P. jenkinsii* for nearly 100 years . However, the ecology of the exotic mudsnail in Western North America has been of interest since its discovery in 1987 in the middle-Snake River of south-central Idaho. The prolific reproductive capabilities and rapid spread of the recent invader are of concern to resource managers, particularly with regard to the effect on native aquatic organisms and system processes. We studied the ecology of *P. antipodarum* in three laboratory experiments: 1) *P. antipodarum* substrate preference, 2) Potential competitive interactions between *P. antipodarum* and the native *Valvata utahensis*, and 3) Prey choice of native crayfish (*Pacifasticus* spp.) on snail prey from the mid-Snake River in Idaho. Results from experiments # 1 and 2 are incomplete. Results from one choice predation experiments show crayfish prey on *P. antipodarum* and *V. utahensis*, but not *Pyrgulopsis idahoensis*. In two choice predation experiments, crayfish preyed on V. utahensis more often but results were not significant.

Tracking the New Zealand mud snail, *Potamopyrgus antipodarum* in the Upper Owens River Watershed

Gwen K. Noda
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I am documenting the distribution and abundance of the New Zealand mud snail in the Upper Owens River Watershed and recording the changes in snail density in 2002. First, I am looking at the presence or absence of the snails in the tributaries of Crowley Lake throughout the year. Second, I am taking macroinvertebrate density counts seven times (once per month from
May through November) this year in nine locations, which vary in observed snail densities. I have only observed the New Zealand mud snails to be in the main stem of the Owens River, with the exception of seeing them in Hot Creek where it meets the main stem of the Owens River. The leading edge is on private property owned by Howard Arcularius and the Inaja Land Company. The macroinvertebrate densities are still being tallied at this time.

Update of New Zealand mudsnail monitoring in the Madison River, Montana

Frank Pickett

PP&L
Butte, Montana

Frank Pickett, biologist for PP & L, will summarize and update PP & L information and findings on New Zealand mudsnails in the Madison River drainage.

New Zealand Mudsnail Control Team Development

Robert Pitman

USFWS
Albuquerque, NM

Introduction and latest findings on competition studies between *Potamopyrgus antipodarum* and the threatened Bliss Rapids Snail, *Taylorconcha serpenticola*

David Richards

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I will introduce all of the presenters attending the New Zealand mudsnail in the Western USA Conference 2002 and outline the meeting scheldule. I will also present our most recent results from a competition field experiment between *P. antipodarum* and *T. serpenticola*. In this experiment, *P. antipodarum* and *T. serpenticola* were stocked at seven densities in replicated test chambers with limited food resources at both the outlet and inlet of Banbury Springs, southern Idaho, in Spring 2002. Growth rates of both species were measured after one month to determine effects of intra and interspecific competition. Preliminary analysis shows that *P. antipodarum* has a greater competitive effect on *T. serpenticola* than did *T. serpenticola* on *P. antipodarum*, at both study sites. Both species growth rates were also affected by intraspecific competition. Competition coefficients between the species are currently being calculated and should be available for this presentation. Effects of both snails species on periphyton abundance and diversity are being evaluated but will not be available at this time.

Interactions between invasive and endemic freshwater snails: algal stimulation and relaxed competition

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The density and per capita interaction strength of invasive species determine their impact on native biota. The New Zealand mudsnail, *Potamopyrgus antipodarum*, an invasive in the western US rivers, attains densities of 550,000 individuals/m^2 within the Greater Yellowstone Ecosystem, where it is the dominant benthic macroinvertebrate in several rivers. However, their impact as grazing herbivores on the community is unknown. In one river, *Potamopyrgus* coexists with the narrowly endemic, grazing

snail, *Pyrgulopsis robusta*, which may be affected by resource competition with *Potamopyrgus*. We estimated the interaction strengths of *Potamopyrgus* and *Pyrgulopsis* on algal food resources, and the impact of intra- and interspecific competition on snail growth using in-stream cages. To examine intraspecific competition, cages were stocked with a fixed biomass of one species (target), along with conspecifics at 1x, 4x, and 8x the biomass of the targets. To examine interspecific competition, cages were stocked with a fixed biomass of the target species, and the other species at 1x, 4x, and 8x of the target. Shell length of a subset of target snails was measured weekly for growth rates. Each cage was stocked with rocks, and periphyton samples were collected from the rocks to estimate algal biomass. Surprisingly, algal biomass increased with increasing densities of snails, regardless of species composition. Concordantly, the growth of *Potamopyrgus* increased with increasing snail density. The growth of *Pyrgulopsis* remained the same across all densities under both intra- and interspecific competition. These results suggest that grazing stimulated algal growth, perhaps due to local nutrient enrichment, which minimized the effects of resource competition.

Alien macroinvertebrates in the Colorado River through Grand Canyon.

Joseph Shannon, Emma Benenati, Allen Haden, and Heidi Kloppel

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Glen Canyon Dam has created an autochthonous, artificial aquatic community dominated by alien taxa in the Colorado River through Glen Canyon National Recreation Area and Grand Canyon National Park. Three factors have created a depauperate and alien macroinvertebrate assemblage: 1) clear and cool stenothermic releases (10?C), 2) highly variable discharge (142-226 m3/s/d), and 3) seasonal turbidity. The macroinvertebrate assemblage is dominated by diatom grazing nearctic diptera, an introduced amphipod (Gammarus lacustris), several snail species, and oligochaetes. The New Zealand mudsnail (NZMS) arrival in August 1995 (mis-identified until 2002) corresponded with unprecedented changes in the phytobenthos of the Colorado River. In spring 1995 Lake Powell filled for the second time in its 30-year history which was followed by decreased nutrient levels, high discharges (500-650 m3/s), and increased river channel area for benthic colonization. Consequently, the dominant and keystone algal, Cladophora glomerata, was replaced by less nutrient dependent filamentous algae with an increase in snail densities. Cobble bar snail density from 1991-1995 comprised <1% of total macroinvertebrate numbers (340/m2; ± 87sd; n=151) for the entire study site. From 1996 - 2001 snail density increased from 5% to 99%. However, non-snail macroinvertebrates also increased 6.3 times over pre-1996 data (2146/m2; ± 980 sd; n=142). Factors affecting NZMS distribution that will be discussed include potential adaptive management implementation of ecological restoration flows and thermal modification of Glen Canyon Dam for preservation of the listed humpback chub.

Update of the New Zealand mudsnail distribution, abundance, and ecology in the Snake River, Idaho

Dianne Cazier Shinn

Idaho Power Company

Boise, Idaho

Dianne Cazier Shinn will provide information and update of Idaho Power Company's research on New Zealand mudsnails in the Snake River, Idaho

Proliferation of the New Zealand mud snail, *Potamopyrgus antipodarum*; preliminary results of the Lower Columbia River Aquatic Nonindigenous Species Survey

Mark Sytsma[1], Robyn Draheim[1], Jeff Cordell[2] and John Chapman[3]

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The Lower Columbia River Aquatic Nonindigenous Species Survey, an ongoing two-year survey to characterize nonnative species in the lower Columbia River from Bonneville Dam to the Pacific Ocean, will serve as a baseline for evaluating the rate of species introductions to the river, aid the US Coast Guard in evaluating the efficacy of ballast water management, and contribute important new information to ongoing regional aquatic nonindigenous species studies. Our preliminary first year results include several previously unreported species and large proliferations of the nonnative New Zealand mud snail Potamopyrgus antipodarum. During the course of our lower Columbia River survey, the first of its kind to focus on documenting aquatic nonindigenous species in the river, we discovered a small number of mud snails near Kalama, WA, over 50 miles farther upstream from previously noted populations in and around Astoria, OR. In addition, the New Zealand mud snail has spread throughout the Columbia River Estuary, where in some locations it is a significant fraction of the substratum. Further research will be necessary to fully document the distribution of mud snails in the lower Columbia River. We hope to continue to contribute to regional nonindigenous species issues as our survey progresses.

New Zealand mud snail investigations in Utah

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The New Zealand mud snail (NZMS), *Potamopyrgus antipodarum* (Gastropoda: Hydrobiidae) was first collected in Utah in September 2001 in the Green River 43 km downstream from Flaming Gorge Dam in northeastern Utah. As of August 2002, NZMS populations in the Green River had spread throughout the first 50 km of the river downstream from the
dam. Since April 2002 we have collected NZMS near Salt Lake City and in Cache County near Logan. In 2003 we will begin a statewide NZMS survey. We intend to focus our initial collection efforts at trout hatcheries, spring creeks, and regulated rivers.

Mudsnails and Public Education

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As New Zealand Mudsnails have expanded their range in Western North America fisheries managers and other aquatic scientists have quickly become alarmed about their possible impacts. Recognizing that prevention is the only effective way to control the spread of this invader, these scientists have developed protocols to avoid transport. Unfortunately, any attempt to control the spread of the organism will fail unless the entire population of resource users adopts and practices prevention. This presentation will focus on the strategies needed to effectively mount a public education campaign designed to enlist the greatest number of people in the effort to control spread.

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(monoclonal), but are apparently successful.

Tour of The New Zealand Mudsnail in the Western USA Web Page: mapping capabilities

Daniel L. Gustsfson

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Montana State University, Bozeman, MT

This will be a live demonstration on the world wide web of "The New Zealand Mudsnail in the Western USA Web Page" hosted by the Department of Ecology, Montana State University. NZMS mapping capabilities and potential uses will be highlighted.

Invasive New Zealand mud snails dominate secondary production in 3 geothermal rivers.

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Invasive New Zealand mud snails (*Potamopyrgus antipodarum*) have invaded geothermal rivers of Yellowstone National Park, and are have extremely high densities, however we do not know the degree to which they altered energy flow among invertebrate assemblages in these rivers. To this end we measured secondary production of mud snails and native invertebrates in 3 streams: Gibbon River, Firehole River, and Polecat Creek, which is located in the JDR Parkway. In the Firehole we calculated production in 2 habitats: armored riffles and in vegetated depositional zones. We collected samples monthly from each stream, and we estimated abundance, biomass and secondary production for each taxon, For mud snails, estimated production by measuring in situ growth rates. Mud snail production was extremely high, 160 g/m2 in Polecat Creek , which is one of the highest values ever reported for a stream invertebrate. In all streams mud snails were the most productive taxon and constituted about 60-92% of total productivity. Native invertebrate production was low in all streams, suggesting that snails are sequestering a large fraction of the available energy and nutrients for invertebrate production.

(Horror) Tales from Hawaii: biological invasions, impacts, and management blunders

David Hopper

USFWS
Boise, Idaho

TITLE

Billie Kerans

Department of Ecology