The following is a list of the presentations at the New Zealand Mud Snail conference in Bozeman, MT. on August 16th and 17th. The comments in blue are from my notes, including this opening paragraph. Some of the issues that consistently arose were:

1. We still need more information
2. We still have not found an effective and efficient eradication technique
3. We need a consistent message for the public
4. Early detection of potential new populations is of utmost imporatance incontrolling spread (where will they show up next?)
5. We need to get the management and control plan to ANS this year

Abstracts and Comments:

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 downstream from Flaming Gorge Dam. Since then the snail has spread throughout northern Utah. We will present data on their current distribution. We also evaluated if juvenile rainbow trout could assimilate nutrients or use energy from New Zealand mud snails was via experimental additions and movement of the stable isotopes N15 and C13 through several trophic levels and evaluation of changes in fish weight over time. Trout fed NZMSs gained significantly less weight and absorbed less of a stable isotope tracer then those fed a native amphipod food source, *Hyalella azteca*. On average, fish fed NZMSs lost 0.2% of their initial body weight per day over three 100 day feeding trials.

Notes: Distribution maps were shown and NZMS have spread through northern Utah but the focus of this presentation was whether fish digest and get nutrients from NZMS. Fish do very poorly when all they have to eat are NZMS. They can digest them, however, and in trout stomachs they found on average 15% of NZMS empty (digested), 42% dead, and 43% alive. The fish that eat NZMS are: 75% brown trout, 20% rainbow trout and 5% mountain whitefish. Future research question: NZMS do not seem to be interacting with other invertebrates in this system- maybe they are eating something different?

Survival of New Zealand Mudsnails (*Potamopyrgus antipodarum*) in the Gastrointestinal Tract of Rainbow Trout (*Oncorhynchus mykiss*)

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Fish stocking and transfers from hatcheries may accelerate the spread and introduction of the New Zealand mudsnails, as the snail has been reported to survive passage through the gastrointestinal tract of trout. We are examining in detail the survival and passage of NZMSs in three regions of the gastrointestinal tract of rainbow trout (*Oncorhynchus mykiss*). Six snails were force fed to each of 40 individual trout, which were held in eight aquaria. Fish were sampled at five time intervals following feeding to determine the number of snails alive and dead in the stomach, anterior intestine, and posterior intestine. We found alive snails in all gastrointestinal tract regions. Studies include evaluation of the effects of fish, fish size, snail size, fish feeding regimes, and amount of snails force-fed on survival and transit time of ingested snails. This research will pose a potential depuration strategy to reduce the risk of transferring snails during fish stocking.

Notes: The risk of moving NZMS around via fish stocking is high because of the snails ability to stay alive through the trouts digestive system.
Future research needs: Need to find a way to cleanse the systems of trout for safer stocking.

Assessing winter populations of New Zealand Mudsnails (*Potamopyrgus antipodarum*) in Silver Creek Drainage, Blaine County, Idaho and Riley Creek Drainage, Gooding County, Idaho

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New Zealand mudsnails *Potamopyrgus antipodarum*, have been observed in some reaches of Silver Creek, Blaine County, Idaho. Previous surveys for New Zealand mudsnails in the drainage have identified two areas of infestation with very little expansion: Loving and Butte Creek downstream of IDFG's Haypsur Hatchery and Silver Creek proper near the Nature Conservancy's Silver Creek Preserve Visitor Center. In December 2004 and January 2005, we began collecting samples of New Zealand mudsnails to assess seasonal changes in the population both in the Silver Creek drainage and in Riley Creek, Gooding County, Idaho. In addition to assessing the densities of NZMS in the streams, we are also assessing the size class distribution and reproductive potential between winter and summer. Winter densities ranged from 12 to 32,000 snails/m^2 in Loving Creek and from 460 to 450,000 snails/m^2 in Riley Creek. Snails <3.0 mm in shell length were particularly abundant in Riley Creek, while snails were fairly evenly distributed in all size classes in Loving Creek. It appears that the densities of New Zealand mudsnails in Loving Creek are extensively lower than densities in Riley Creek. This difference may well be attributable to length of time since introduction into each stream, and that the Loving Creek population is still in its lag phase of invasion. However, given that the snail has been present in the Silver Creek drainage since at least 2001 and its prolific reproductive potential in other streams, it would seems likely that it would have proceeded beyond the lag phase and become invasive by this point.

Notes: NZMS don't seem to be expanding much in Silver Creek. Common belief that Silver Creek stream temperatures are relatively constant throughout the year is debated and it seems to be the variation in temperature throughout the year that may be controlling NZMS numbers. The threat at Silver Creek may be that the large number of users are taking the snail with them other places.
Further research: Continuation of this research to monitor NZMS numbers and test temperature regime hypothesis.

Preliminary survey for NZMS in California: range delineation and field observations

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In North America the New Zealand mudsnail (*Potamopyrgus antipodarum*, NZMS) wasfirst discovered in the middle Snake River, Idaho in the mid-1980's and has rapidly spread throughout the western U.S. There is much concern about the impacts that NZMS may have on native species, fisheries and freshwater ecosystems in California.
Since 2000, New Zealand mudsnails have been confirmed to be present in six waterways in California. There have been varying efforts regarding the delineation of NZMS populations in each of these systems. Between 2000-2004, populations have been identified in the Owens River, Hot Creek, just downstream of the Hot Creek Hatchery, Lower Putah Creek in a mile-long stretch, in the Lower Mokelumne River; in a five mile stretch above Woodbridge dam, in the Lower Calaveras River; Mormon Slough within an eleven mile stretch, and in the Napa River; near its outlet into north San Francisco Bay.
The U.S. Fish and Wildlife Service Stockton Fish and Wildlife Office (STFWO) has been working with partners to monitor the ongoing spread of NZMS from initial confirmed locations in California as well as beginning to delineate existing populations in California waterways. The results of NZMS population delineations in California will be presented as well as other observations from specific sites.
Anyone that thinks they have found a new population of NZMS in California or Nevada is urged to contact David Bergendorf (USFWS) (david_bergendorf@fws.gov), (209) 946-6400 x 342 or call (toll-free) 1-888-321-8913.

Notes: This research focused on densities and distributions.

Native vs. Invasive Mollusks in Hells Canyon, Snake River, USA

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Little is known about native and invasive mollusks in Hells Canyon (HC) of the Snake River, USA. Therefore, in September and October 2004, we sampled > 150 miles of reservoir, tributaries, and main stem of Snake River, Hells Canyon, using ponar grab, suction dredge, hand-picked cobbles, kick-net, snorkeling, and SCUBA. Results of our study include: >15 mollusk taxa found, a probable new species of hydrobiid, *Taylorconcha* sp. throughout the canyon, the invasive *Potamopyrgus antipodarum* and *Corbicula fluminea* were the most abundant mollusks in system, native unionids virtually absent, and the new *Taylorconcha* species and *P. antipodarum* had significant niche overlap suggesting potential co-existence. The latter finding will be discussed in more detail.

Notes: Different kinds of grazers may be able to co-exist with NZMS- diggers, grazers, and plowers, etc.

Studies of NZMS biocontrol: an update

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We have been investigating a trematode parasite from New Zealand as a potential biocontrol agent. We are mainly interested in the specificity and effectiveness of this parasite. Here we present the results of two experiments that demonstrate specificity for the lineage of parasites selected as an agent. We also present an analysis of the phylogenetic relationships of the parasite. Both studies could have ruled out the potential for this parasite, but have not. A discussion of the further importance of specificity testing is provided.

Notes: The NZMS in the U.S. is one sinlge geonotype (all clonal populations and the same genetic makeup) and this mean biocontrols may be a feasible option. The approach of this research: 1.) Assess the Pest, 2.) Look at its native enemies, 3.) evaluate its enemies…are they safe? Would they work here? , And 4.) Should we implement?
There are 14 species of parasites that control NZMS in their native habitat. One in particular singles out the U.S. clone. This parasite (Microphallus sp.) uses waterfowl as a carrier.
Further research: We need to understand whether this parasite could harm waterfowl populations or other species. In addition, we need to understand whether this would work over a long period of time and whether it would infect other snails. Benefits vs. costs?

Hazard Analysis and Critical Control Point (HACCP) Planning; developing a protocol for preventing the spread of New Zealand mudsnails, *Potamopyrgus antipodarum*, by field researchers in Oregon

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The invasive New Zealand mudsnail, *Potamopyrgus antipodarum*, has become well established in the waters of ten western states and is rapidly expanding its range. In the state of Oregon, mudsnails have been found in two major river systems and two coastal lakes. Dispersal of *P. antipodarum* is often considered to be unintentionally facilitated by anglers and recreational water users transporting snails in contaminated gear. However, mudsnails may also be spread by field research personnel. In 2004, while researchers continued to seek an effective chemical disinfectant to sterilize waders and sampling gear, teams of field research personnel required practical, on the ground, control methods. For many field teams, 24-48 hour desiccation times are untenable, freezers and dryers are not available, and large quantities of chlorine bleach are impractical. By applying Hazard Analysis and Critical Control Point (HACCP) planning to document the risks of invasive species contamination, a series of protocols was devised for use in the field. These HACCP protocols were tested by field crews working for the Oregon Department of Environmental Quality and the US Forest Service during the summer 2004 sampling season. In future field seasons field protocols will be updated and will incorporate lessons learned in 2004 and 2005 about the practicality of the initial HACCP plan and, where appropriate, will reflect new developments in disinfection technology.

Notes: By applying HACCP planning to invasive species they identified areas of potential risk and developed protorcol for combating the risk.

Controlling the Spread of New Zealand Mud Snails on Wading Gear

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Unintentional transport of New Zealand mud snails on fishing gear and equipment, notably wading gear, is likely one of the primary vectors spreading mud snails among water bodies in the western United States. A phased approach study identified several chemicals and cleaning methods that could easily be used in the field to efficaciously remove snails from wading gear with minimal corrosiveness to the gear.

New Zealand mud snails were exposed in laboratory tests to solutions of benzethonium chloride, chlorine bleach, Formula 409® Disinfectant, Pine-Sol®, ammonia, grapefruit seed extract, isopropyl alcohol, potassium permanganate, and copper sulfate. Except for grapefruit seed extract, potassium permanganate and isopropyl alcohol, these materials all killed mud snails within five minutes. Wading gear was repeatedly exposed to bleach, copper sulfate, Pine-Sol®, benzethonium chloride, and Formula 409® Disinfectant for prolonged periods. Solutions of bleach and Pine-Sol® structurally damaged the wading gear. Solutions of copper sulfate (252 mg/L Cu), 1,940 mg/L benzethonium chloride, and 50% Formula 409® Disinfectant had minimal effects on wading gear integrity. Wading gear was completely submersed or put in a dry-sack with the cleaning solutions and shaken in field trials. The results of these trials indicate that copper sulfate (252 mg/L Cu), benzethonium chloride (1,940 mg/L) and Formula 409® Disinfectant (50% dilution) solutions under field conditions can prevent the spread of New Zealand mud snails on wading gear. In separate trials, copper sulfate solution (252 mg/L Cu), and 50% Formula 409® Disinfectant were sprayed on wading gear. The copper sulfate solution killed 100% of the snails; however the Formula 409® Disinfectant (50% dilution) solution did not.

Notes: These researchers were not willing to recommend any of the about chemicals for killing the snails because of the risk of defining them as pesticides. Many people were concerned about the logistics and cost of having any of the above options for people to clean their gear (50% solution of 409, dry bags, etc.). Many people were concerned about dumping or spilling 409 close to water sources. Most people in the field working with the public opted for using cleaning stations with vinegar or soap as an educational tool and to remove large clumps of debris. One concern raised with the methods in this study was that they required removal of gear. Many boaters and fishermen to do not remove their gear and almost none remove the insoles from their boots (under which many mud snails get trapped).

Development of a Device to Monitor New Zealand Mudsnails in Deep Water and Water Conveyance Systems.

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The highly invasive New Zealand Mudsnail, *Potamopyrgus antipodarum*, can quickly establish populations in a variety of habitats. Within months of the discovery of the snail infestation in Putah Creek, Yolo County, California, the exotic mollusks had colonized riffles, runs, pools, sand bars, macrophyte beds, and aquatic moss fields. Within those habitats the snails grazed on anything left in the creek including bottles, cans, paper bags, bricks, and socks. That observation led to the development of a trapping device to monitor the snails in a variety of habitats, their downstream spread, and their eventual entry into the Putah South Canal. With funding from the U.S. Bureau of Reclamation several trap designs were tested and mass produced. The most effective and durable design is currently being used in the Putah South Canal to monitor the movement of *P. antipodarum*. This PowerPoint presentation will focus on the lessons learned in

Putah Creek, the design of the Putah Trap, and the efforts to monitor *P. antipodarum* in Putah South Canal.

To stock or not to stock: Managing the risk of

New Zealand mudsnail introductions by a National Fish Hatchery

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In the fall of 2002, New Zealand mudsnails (NZMS), *Potamopyrgus antipodarum*, were discovered in several springs that supply the Hagerman National Fish Hatchery (NFH) in Idaho. Concerned with the hatchery's potential to spread NZMS through fish stocking operations, the U.S. Fish and Wildlife Service (Service) conducted a risk assessment. Given the life history and physical tolerances of NZMS, introduction vectors from hatcheries include contaminated gear, contaminated stocking water, and snails ingested by stocked fish prior to transfer. The Service determined that hatchery fish releases presented a likely risk of NZMS introduction if: (1) within the last 12 months, there is evidence of at least one NZMS (dead or alive) associated with water used in rearing or transport of subject fish, inside facilities that indicate availability for consumption by subject fish, or inside subject fish, and; (2) NZMS have not yet been found in the watershed of the tributary where the hatchery release is to occur. Using these criteria, the Service determined that stocking activities for several tributaries in the Snake River watershed could lead to NZMS spread. Additional variables, including other introduction pathways and habitat suitability, were evaluated relative to this assessment to develop risk management guidelines for Hagerman NFH. These guidelines provide for continued stocking in some tributaries and cessation of stocking in others. This effort revealed the need for further research on NZMS biology and control options and emphasized the need to develop a coordinated risk management strategy among all agencies operating contaminated hatcheries.

<u>Notes:</u> Stocking is to risky to continue as presently implemented.
Recommendations:

- consistent policies at fish hatcheries.
- Adoption of national NZMS plan
- Further evaluation of risks and impacts
- Developmemt of effective control techniques
- Completion of HACCPs at hatcheries