

Southern Nevada Quagga Mussel Meeting

Date: August 2, 2007 • Location: 1350 Richard Bunker Avenue, Henderson NV 89015

Action Items:

- ▶ Participants will send their quagga mussel monitoring protocols to Shawn Gerstenberger (shawn.gerstenberger@unlv.edu) to be reviewed, combined, and sent back out via e-mail for review.
- ▶ Submit educational materials (outreach) to Shawn Gerstenberger if you would like his group to distribute at Lake Mead while they are conducting surveys.
- ▶ Consider: How could another meeting or presentation by this group fit into 100th Meridian Initiative meeting in November?
- ▶ Next meeting: Thursday October 11, 2007 (same location)

Welcome and Introduction

Shawn Gerstenberger, University of Nevada, Las Vegas

Purpose of today's meeting as outlined in letter of invitation to meeting (see Appendix A):

- 1) To provide an opportunity for key entities/agencies to get together so that we can all see the quagga mussel monitoring issues that each is facing;
- 2) To get contact information for key personnel;
- 3) To identify major areas of overlap;
- 4) To move forward, as a group, with collective needs and issues in mind so we can collectively address them.

Agency Presentations

Kent Turner (National Park Service, Lake Mead National Recreation Area)

Members of the National Park Service and Southern Nevada Water Authority, and other agencies have been involved from the beginning as the core team for Lake Mead. It is time to get back together, share what we're finding, and learn about what other agencies/entities are doing. The National Park Service also has some long-term goals for the outcomes of these types of discussions as well. Lake Mead NRA has begun a Southern Nevada Public Lands Management Act (SNPLMA)-funded project with UNLV through cooperative agreement that includes the development of an interagency quagga mussel monitoring and research-needs report.

We are considering what we need to monitor and what we need to document. We have some baseline information, now we need to know what ecological responses are occurring and will occur due to quagga mussel infestation on Lakes Mead and Mohave. Other questions are: How will the impacts of the quagga mussel infestation affect Lake Mead users and downstream users? What is our long-term vision? How will long-term monitoring be done?

We can't work on quagga mussels in a vacuum; we need to consider the needs of others and those in California. One other need I'd like to discuss—towards the end of the day—is information sharing. How do we make sure information is available on a real-time basis?

Bryan Moore (National Park Service, Lake Mead National Recreation Area)

Provided a review of quagga mussel monitoring begun in January 2007 at Lake Mead NRA to date and provided a handout summarizing the methods and results.

Sampling locations: We believed the quagga mussels entered the Lake Mead on a boat, so we started monitoring marinas with dives. Local technical divers found mussels at 200 ft in the narrows between the basins. Quagga mussels are known survive at depths reaching 500 ft. We've installed eight transects: one on Lake Mohave and seven on Lake Mead. We installed three 15m transects at three different depths.

Because Lake Mead water levels are dropping, we have had to keep lowering our transects. Our initially installed transects were not easy to move; now we are using more moveable cinderblocks. We keep tweaking the sampling method according to the lowering water levels.

Results

20 ft (which was actually 5 ft): 288 – 1700 quagga mussels per square meter

40 ft (which was actually 25 ft): 556 – 1200 per square meter

50 ft (which was actually 45 ft): Thick density of mussels, one on top of another

So far, NPS has found the highest concentrations of quagga mussels at Callville Bay. Did the contaminated boat enter the lake at Callville Bay? That's a good assumption.

Artificial recruitment model: Basically, cinder blocks are cut in half horizontally, dropped to a set depth, and then brought to surface. We count the quagga mussels attached to the block, remove them, and drop the block back down.

We also have information from random collections and observations.

The problem with our 20ft transects is that they are being buried by rock slides.

BOR is doing plankton tows and conducting PCR analyses at three different sites; data will be presented later.

Portland Samplers: NPS did not detect mussels with Portland samplers until after quagga mussels were observed by other means. We haven't had luck with Portland Samplers, even modified ones. Wen Baldwin, an NPS volunteer that many of you know for his work in monitoring for zebra mussels is testing other substrates with which to attract quagga mussels.

The handout (see Appendix B) includes our datasheet. We would appreciate input about whether we should add anything or change anything Do we need to add or change anything to our datasheets? Please let us know.

Meeting Summary

The University of Texas at Arlington (UTA) is conducting quagga mussel thermal tolerance tests for the National Park Service. UTA is also conducting age-of-growth analyses for us. This is the first time quagga mussels have been found in warm water lakes; we don't know how these temperatures will affect breeding.

Public Interface: The NPS is conducting boat checks; people entering the park with boats are surveyed; a notice to boat owners is posted at all marinas; and staff at the launch ramps are making visitor contacts and showing boaters quagga mussel samples. Signs will be installed at roads coming into the park. The marina concessionaires have sent notices about mussels to all slip owners about how to properly decontaminate their boats and the location of approved wash facilities. All marinas have temporary wash facilities. There is a permanent wash facility installed at Callville Bay Marina. NPS is ordering three more permanent wash facilities.

We are working on the monitoring plan; but it is still in draft form.
E-mail Bryan if you want a copy.

Question:

What are the veliger densities in the plankton tows? That will be presented later.

Question:

How can you set up a stricter program? It seems that compliance is voluntary. Cutting off the source is very important to those outside of the Lakes Mead/Mohave area.

Response:

There are seven marinas operating; people can leave in the middle of the night. We do not have 24-hour surveillance or 24-hour fee stations.

It should also be noted that NPS outreach efforts includes informing people about the laws and that it's illegal to bring quagga mussels into California.

Comment:

Other bodies of water don't have inspections...what about them?

Comment:

Lake Powell conducts inspections.

Comment by Kent Turner: The NPS has an interdiction program; NPS authorities for *prevention* are much stronger to interdict anything suspect that comes into the park. We have the authority to stop, interdict, and impound any boat that's dirty, or has visible mussels on it. We've had discussions with our solicitors, who have determined that the best avenue is for us to work with concessionaires and their contractual relationships with boat owners.

Comments:

Water within 1,500 miles of here should all have their own program to watch for mussels.

Utah is moving ahead on the same scale as California.

Question:

How will UTA information be disseminated? Is there a method?

Kent: We have some thoughts on how to disseminate information, but I hope we can discuss information sharing later this afternoon. The 100th meridian group hopes that this information will be put on their Web site. We don't have it yet.

Jon Sjoberg (Nevada Department of Wildlife)

See PowerPoint File: ndow QM monitoring.ppt

PowerPoint covers:

- Quagga Mussel Monitoring Activities
- Current Mead/Mohave Activities
- Additional Capacity / Opportunities

Hatchery has been closed for disinfection. In September, it will perhaps run in a mussel positive environment. NDOW is looking at long-term ways to keep mussels out of the hatchery.

NDOW has not found mussels outside of Lakes Mead and Mohave to date. However, there is a backlog of plankton tows (from the central and northern part of the state) that have yet to be processed. These lakes have limited exposure; but risk of infestation is here from now on.

Stocking: NDOW transfers fish in a saline solution, which kills veligers before they are put into the receiving water body. Once veligers were discovered in Lake Mead, stock fish did not go out of Clark County. Potassium chloride / formaldehyde treatment protocol.

We need to know what we need to be doing and how to fine-tune our efforts to detect subtle changes. However, NDOW's focus is on the fish; it is not equipped or staffed to detect other changes in the system.

Tom Burke (Bureau of Reclamation)

A data handout (see Appendix C) was provided that describes veliger density/L for samples taken from Lakes Mead and Mohave since March 2007. BOR is interested in veliger densities as we move into the spawning season. No one knows how Mead and Mohave densities will compare to those of the Great Lakes, given the nature of the temperature differences.

BOR conducts 30 m vertical tows; (Hoover Dam sample is shallow 10 m).
Mohave is shallow; rarely getting below 7 m (mixing)

Meeting Summary

The most significant observation:

Going from March to May to July: we initially found from 10s to 100s of quagga mussels per L, whereas now there are greater than a 1000/L in Katherine's Landing. There's kind of a "bend in the road" in that area; it's deep but you get a good mix going from Katherine to Davis dam. Understand that an order of magnitude change has occurred.

Temperature Correspondence:

During July:

0-30 m / surface of Lake Mead = 29°C

30 m and deeper = 15- 18 °C

In March the lake is isothermal at 10 -11 °C

Quagga Mussels can live at depths below 30 m, we don't necessarily depend on surface temperatures in deep reservoirs.

Putting the numbers in perspective: In temperate lakes across the nation, you will typically find 50 (planktonic) organisms per L. If you have above 500/L, you're looking at eutrophic conditions. Typically in Lake Mead/Mohave a normal count is 50 – 100/L (at Lake Powell up to 200/L are found). Veliger counts add to the normal zooplankton counts.

We don't have a good database on larval and juvenile carp. What kind of adjustment will occur in the food chain? Maybe obligate planktivores will benefit? But we don't know. This is just monitoring data, a monthly sample done at the Denver office

BOR also takes hydrolab profiles each month (data is available).

In the spring, BOR used a large ROV to examine Hoover and Davis Dams and other structures down river. We will repeat during the isothermal period.

Dams are off budget; any work done with those is done internally by them. They feel they have instrumentation on the structures and are looking at monitoring smallest orifices. So far they have found no evidence of impact to firefighting or other equipment.

Parker Dam (completed in 1938): In 1994, BOR Cal McNabb initiated a program to suspend 6x6 square stamps (PVC squares suspended on a weighted line). These have been maintained. On June 20, (2007) the stamps were covered with very young ($1/16$ in.) as well as 50 more mature ($1/8$ to $1/4$ in.) mussels.

BOR is looking to get a smaller ROV that the dive team can deploy in smaller areas; it needs to be put into a case to be taken up and down the river.

Question:

Any plans to / should we use the ROV at Glen Canyon? No

Meeting Summary

Plans to look at historical plankton concentrations: Historical plankton data are out there. Earliest is a 1970s quantification thesis (University of Arizona, Tucson). Most work was done in the 1980s and 1990s. Denver office has been monitoring.

To distinguish between veligers and other plankton, cross-polarized light is used because crystalline calcite crystals light up under polarized light. Ostracods, however, are a source of false positives.

Observation: The County has noticed partial replacement of zooplankton veligers as of June. 40% of plankton concentration is now veligers (replacement).

How is this affecting fish on the Lower Colorado River? To most fish, this is a change in food type. How this change cascades through the food chain nobody knows.

Analysis has been deferred to regular monitoring. So far, system seems healthy. An important consideration, however, is that a lot is going on: drought, nutrient loading, and amount coming in...a lot going in. There are many changes happening to the river in addition to the quagga mussel invasion.

Individual zooplankton organisms vary in quantity from month to month. There can be tremendous seasonality among types of organisms, but the total amount of zooplankton is stable.

Comment by Kent Turner: Data for veliger monitoring is posted on 100th meridian Web site. The technical services center that is doing this monitoring is doing 24 sites around Lake Mead. Standard water quality parameters are studied on a monthly basis.

Jeremy Lustig and James Okazaki (City of Henderson)

The majority of City of Henderson water comes from SNWA. Basic Water Company provides all of City of Henderson's treatment water

James Okazaki described City of Henderson's combined effort with Basic Water Company.

We receive water from the Basic Management Company's two raw water reservoirs from the lake; these are tiny compared to those of SNWA. When quagga mussels were detected in the lake, we hired a consultant to do an investigative summary. BMI takes it's reservoirs down yearly for cleaning. This year we found quagga mussels in the open reservoir. We don't find growth in treatment plant because we pre-chlorinate. We will continue to take down the reservoir yearly. SNWA provides us with veliger capture information.

This facility is 6-7 miles from lake, so the veligers have traveled quite a distance.

Alan Simms / Jim La Bounty / Dave Johnson / Peggy Roeffer (Southern Nevada Water Authority)

See: SNWA August 2, 2007.ppt

Meeting Summary

PowerPoint covers:

- Monitoring
- Inspections
- Treatment
- Infrastructure
- Research Needs

Observation: As you move out toward open water, veliger concentrations increase.
Monitoring is done with concrete-backed boards 16x16 in.

Inspections: Equipment is inspected for signs of quagga mussel infestations.
We pre-chlorinate

Intake:

- 1) Alfred Merritt Smith
- 2) River Mountain facility

Intake 1 has a significantly smaller length

In January, where Intake 1 comes out of the rock face at 1,050 elevation we found a very low density of quagga mussels 15-20...at 1,000 elevation we found nothing. Nothing on intake screen

Intake 2 was clean as well.

On July 13, it was a different story. In lower lake, a considerable mass of mussels was found on top of each other on rock face. As we went down length of pipe from 1050-1000: larger mussels growing on top of each other to smaller (juvenile) mussels sporadically seen.

We have placed boards and cinderblock above and below intake point.

Whenever we pull out equipment, valves, etc., we look for quagga mussels.

We are just starting to see mussels attach in our raw water system. We scrape the sides, look what's in the net, and conduct visual observation.

Treatment:

- Chlorine, July 13 2007. A professor at the University of Buffalo showed that chlorine prevents attachment. That's what we want. We don't want veligers to attach. Prevention of attachment pre-treatment plant.

Infrastructure:

Preliminary Risk Analysis... "x's" represent where do we have potential for infestation?

Meeting Summary

Assess risk that we have. We are going to do this in a more formal way: Black and Beech (consultant) will provide a thorough, detailed approach.

Infrastructure

For IPS1, we can't feed chemicals out to point of intake.

At IPS 2, we can feed chemical out to point of intake.

Potassium permanganate? Would this be beneficial: Issues: manganese issue; discoloration of water if dose are off

Telephone comment:

Regarding chlorination, veligers can't close up; they don't have a shell. Once they are juveniles the sooner they have to open their shells.

Pulsed chlorination. Let veligers settle and grow for a week and then pump in chlorine for a week

UB – CT curves on veligers. A dose took multiple hours he was looking at older veligers that have a little bit of shells.

Do you have any studies that we can't look at? Yes, I'll do a literature search.

Adults can move and re-locate.

Good news: any mussel can go anaerobic for only 21-22 days.

Question:

Do you have interest in looking at changes in density of blue green algae?

When we pulsed with ozone 3-4 years ago, run time of filters increased dramatically. We've cut our dosages back. Filters are not run to maximum blockage; they are washed before that.

When we had blue-green algal blooms (limbia sp?), we had a lot more problems. It's a big, filamentous blue green algae. It provides a substrate. Ozonation fixed the problem.

We have seen a reduction of chlorine demand in raw water. This over the last couple of weeks.

Advanced planning of third intake: It is going to be 3-miles long. The difficulty will be in obtaining true raw water samples, if we add chemicals at the point of intake. If we pre-chlorinate before it gets to the plant, we won't be able to test raw water quality. We will need to put in a three-mile 4 inch line to obtain raw water. This line will need to be cleaned, which will be a challenge.

Steve Webber (Lake Las Vegas)

Lake Las Vegas used divers to see if quagga mussels had entered Lake Las Vegas.

Meeting Summary

Lake Las Vegas water bodies comprise the main reservoir plus 15 or 16 ponds associated with irrigation for golf course. Quagga mussels are found within the pond at the entry location at depth. We manually clean intakes which are completely encrusted month to month. Depth does not matter. All of the water in the resort passes through the main reservoir.

We have positioned different collection substrates at three sites down the center axis at 0, 5, and 20 meters. The coupons are made of wood, PVC, and aluminum. The wood coupons were first deployed last month. We have found a 1/16th of an inch on the 20m aluminum coupon.

Main issues: There are many miles of pipeline on a golf course. We have been consulting with the PGA. The PGA has been dealing with zebra mussels in Florida using potassium chloride treatment. Treat ponds with potassium... powder or liquid disbursement.

Question:

What do you expect to happen if you didn't do anything?

Response:

Within a year we'd expect major problems in the golf course system. Ecological problems in the reservoir would be no different than those expected for Lake Mead. All ponds at LLV are stocked with live fish such as koi. The original idea to solve this problem was to just chlorinate all the ponds. This is not feasible to maintain fish viability.

Note: Those who want to collect quagga mussels will need to get a permit from Jon Sjoberg, NDOW.

We also use water source heat pumps...but these are essentially closed systems...no quaggas have been found in those areas of Lake Las Vegas.

Larry Riley (Arizona Game and Fish)

Early on we participated in dive surveys at Lake Mead. However, our dive capabilities are limited so we have moved away from dive surveys. Now the focus is on substrate sampling and veliger sampling. Our partners include BOR Denver.

We are utilizing PCR technology; however, relatively few of these studies have been completed for us so far.

We have not observed adults outside of Havasu as yet; Havasu water is carried downstream to the Salt River Project.

Central Arizona project is connected with Salt River Project

Veligers are in canal system

Meeting Summary

Lake Pleasant: no adults according to dive surveys and substrate sampling. We expect them to be there in the future. However, Lake Pleasant fluctuates broadly by season.

Trend data: a long term data set that can be available.

Veliger sampling: we pump into a reservoir for collection. We use a small diaphragm pump. We clean equipment and tubes between each sampling to avoid false positives.

We are using the same signage as Lake Mead NRA: "Don't Move a Mussel" / "Stop Aquatic Hitchhikers"

We are concerned with movement of mussels by boaters. We have been doing some enforcement activity and have worked with other law enforcement organizations along the Colorado River (Maricopa County) – now these organizations are aware of the situation but it is not a high priority for them. We are working with some National Forests and Glen Canyon NRA. We are getting an idea of distribution. We have pulled samples at Lee's Ferry and did not find veligers there. We're also working with Grand Canyon National Park. We have taken samples at Diamond Creek.

We are working with boaters /operators.

A scientific permit is required to collect.

Question:

What about below imperial dam?

Veliger larvae are moving down stream, but no adults have been observed. It is yet to be determined whether they could establish (turbidity, salinity).

Comment:

PCR does not distinguish between live and dead veligers.

Craig Westenburg (U.S. Geologic Survey)

What I'm hearing is that there is a lot of monitoring going on. I work for water resources, which is co-located with biological resources. There are a number of people Western Ecological Resource Center (San Diego). However, we have no aquatic ecologist in our office. We study the hydrologic part...but we could have biologists available to study the biological effects.

See USGS Studies at Lake Mead.Monitoring.2Aug07.ppt

The PowerPoint presentation covered:

Water-quality station locations and testing parameters for:

- Lake Mead
- Muddy and Virgin Rivers
- Lower Colorado River

USGS operates these monitoring platforms in cooperation with SNWA and NPS. Also, all but one of the platforms are equipped with meteorological monitoring instrumentation. Platform data are posted close to real time (except those from the Virgin Basin; no communication at that site). Raw data is transmitted, processed, transferred to Carson City and posted to the Web site:

<http://nevada.usgs.gov/lmqw/#>

Bob Pitman (100th Meridian Initiative)

This conversation started in 1990s to prevent the spread of mussels into western states. These same conversations (monitoring, outreach, etc.) were had in the 80s and 90s in the Great Lakes area. The monitoring conducted at Lake Mead was a result of the 100th Meridian Initiative. How can we prevent contaminating other waters? Risk in Columbia River basin is enormous: A significant risk. We work in collaboration with others to reduce risk primarily through voluntary monitoring. One consideration is that we might want to close bodies of water entirely. Monitoring and early detection were the earliest components of the initiative. Substrate samplers did not work initially. Our outreach and messaging has been around for five years or more. It speaks to the message. It was developed by marketers. People recognize it now. The brand and tagline are available at: www.protectyourwaters.net. Anyone can use it. There are a few basic requirements of the marketing campaign.

Everyone is asked to share information with the 100th Meridian Initiative so that it can be shared with everyone else. The Web site consists of public access and restricted areas (password protected).

Watch cards were handed out. These cards provide a 24-hour hot line, which is in place for early detection. When someone calls the hotline with evidence of mussels, they will be assisted. This line is not for the general public, it is for those in a position to inspect contaminated boats; it provides assistance on what to do to prevent spread.

I ask that you share your monitoring information with us so that decision makers can have the latest information available.

Question:

Are you optimistic?

I think 100 years from now, there are still going to be uncontaminated waters. If you don't start now, when do you start? Why waste our time? There are some places we can protect if we look at pathways and strategically focus our efforts. There are three billboards in the Las Vegas area now. We ask that boaters do simple things to take responsibility and be in legal compliance. An analogy is speed limits; we have speed limits we abide by even without a patrol car next to us.

Comment: I have been getting feedback that the 100th Meridian Web site needs to be updated.

The Web site is fairly well updated but there are sections that are not updated as regularly as they could be. It is a quick central location. Dr. Dave Brenton and his graduate students are responsible for the Web site.

Rick DeLeon (Metropolitan Water District of Southern California)

When Metropolitan Water District of Southern California first heard the news of quagga invasion, they initiated a rapid response program (Fish and Game and FWS process). Phase I has been going on from February until now. Program was primarily aimed at controlling the spread, now we are initiating a longer-term program. Initially very we found a low density; now in June and July it's a different system. The Quagga Control Program went to board for funding; now it is going again for phase II funding.

See: Gene IPM-Quagga Mussels Control Program.ppt

PowerPoint covered:

- Invasive Mussels Rapid Response Plans
- CRW Adult Quagga Detections
- Quagga Mussel Control Program
- Phase I Detection and Coordination Activities
- Quagga Mussel Control Program Action
- Phase I. Mitigation Activities
- Phase I. Completed Activities
- Designing an Invasive Mussel Control Program
- Integrated Pest Management (IPM)
- Proper Identification of Mussels
- Understand Biology of Pest: Quagga/Zebra Mussel Life Cycle
- Monitor to Assess Pest Population
- Adult Mussel Inspections
- Microscopic Detection of Veligers (larval stage)
- Molecular Detection of Quagga Mussels
- Discriminating Between Quagga and Zebra Mussels
- Sizing the Problem
- Establish Action Thresholds
- Vulnerability Assessments
- Pyramid of Integrated Pest Management Tactics
- Examples of Control Measures by IPM Tactical Categories
- Interim Boating Actions
- Evaluate Results of a Control Program
- Next Phase of the Quagga Mussel Control Program

Comment:

It's not a good idea to chase an invasive species with another invasive species. Quagga mussels are concentrating contaminants. Diving ducks are now dying possibly from ingesting concentrated contaminants.

Mussel-sniffing Dog. Dogs can be trained to detect abalone and other organisms as well. Dogs can detect quaggas and possibly veligers on boats.

Break for Lunch

Denise A. Walther (US Fish and Wildlife Service, California)

- Underscored the importance of using 100th Meridian Web site as a one-stop location to disseminate information
- Passed around acrylic displays (\$40 – 50; Carolina Biological) of Quagga mussels
- Proposal has been accepted by Cal Fed to support quagga and zebra mussel outreach efforts

Question: Do you anticipate FWS getting additional funding? It will be late 2007/2008 before we know about funding.

Through 100th Meridian Initiative, a letter was sent to the Western Governor's Association concerning states coming to a unified response to quagga mussels across the West.

Question:

Why would there be USFWS interest more than by the USDA?

Comment:

FWS has a direct relationship with the aquatic nuisance species task force. USDA APHIS does collaborate on the ANS (Aquatic Nuisance Species) task force. Don't know why they don't have a broader presence...speculate because they are more focused on land-based plant and animal species.

Shawn Gerstenberger (University of Nevada Las Vegas)

Received funds in 2002 to conduct studies on Lakes Mead, Powell, and Havasu. We have received more funding to continue these efforts. If you have outreach materials, we would be happy to distribute them as we come into contact with the public when we do our surveying, as long as it's okay with NPS.

Contaminate monitoring, a long-standing interest. We have done toxicology studies on diving ducks at Overton with NDOW prior to the invasion of quagga mussels. So, we have baseline data on diving ducks.

We are working with Lake Las Vegas on their potassium chloride studies.

The departments of Biology and Engineering at UNLV could also assist and provide expertise.

Monica Swartz (Coachella Valley Water District)

Science advisor to other agencies. Put together a task force of technical folks to deal with the invasion as it would affect the Coachella valley. Canal from Imperial Dam. No native fish in the system whatsoever. Concrete-lined canal. All species were removed. No fishing, no recreation, no access. No natural water bodies are connected to it. It goes to fields and golf courses. No connectivity to natural systems. It serves as a good experimental system for looking at quagga mussel control. Given the quantity of the veligers that are coming down the pipe. Even if a measure is 99.9% effective, that's still too many veligers getting through...that would harm farmer's pipes. Looked at putting in as many barriers as possible. Decided on "hydrologic jumps" which create vortices that would rip veligers apart. There are multiple hydrologic jumps. Also looking at putting in a sharp gravel bed that would grind any mussels to bits.

We rely on triploid carp for grass control. So system can not be sterilized chemically. Our focus is not on monitoring. We assume there are plenty of them coming. Maintaining containment and control is the focus. Elevating levels of potassium that paralyze cilia of mussels and settlement and eventually causes suffocation without harming fish.

How would it affect crop? Many farmers already add potassium, so farmers would have to be informed so that could adjust how much they add.

All irrigation is on drip systems and pre-mixed with fertilizer. Each plant has its own drip. Each farmer is their own water chemist.

Mechanical, chemical, biological control. Excited about patented pseudomonas. We have no native mollusks...if you want to test anything in our system we would be thrilled. The canal is under the jurisdiction of the BOR but administered locally. This is a forward-thinking group that works with a variety of agencies.

Robert Powell (Imperial Irrigation District)

Largest user on the Colorado. Uses coupons suspended in All-American Canal monitoring. Our water system does not have too much depth to it. We've turned up Asian clam...but maybe quagga at our deepest spot which is right before the headwater.

General Discussion Section

What should we be monitoring for / where do we put our effort?

What would people in the mid-west do (looking back)?

That [above] question was asked in March...

You guys are a big experiment, you can base things based on what we know...a different system.

You have a year to get ready, plan your attack. The boating industry might have a different perspective. Monitoring becomes academic...what does that teach you? You guys are going to write the text book on this...but for our own good we've got to survive first.

The issues are do we need to work year round or can we work seasonally to cut cost? It is important to understand reproduction so we don't have to chlorinate year round. We need to monitor in terms of seasonality. We need to understand how long veligers remain in system. We don't know this. We have a whole suite of parameters (based on the literature on Eastern U.S. and European data). These parameters don't necessarily apply to Desert Southwest. How often do we need to scrape, do maintenance based on seasonality? We need to know, here, the rate of invasion / seasonality / remarkable observations / know what they are not doing, where they do not show up and use these as tools.

Sport fish / recreational aspects / boating

We're learning things all along. This year we had reproduction at 11 degrees C and experts assumed that these were last year's veligers that hung around.

We cannot assume that veligers / quagga mussels will respond in this system as they did in whatever system they came from. Don't anticipate that this species will react in a predictable manner. Everything that has moved to the Desert Southwest has loved it here.

Question: Has anybody seen any problems with flow in their system? Has it actually been a problem?

BMI water is used when perchlorate is removed from Las Vegas wash, water exchange. The guy that's the head of it asked if quagga mussels have clogged up the filter...flow is down (Kerr McGee) anecdotal story

You actually don't have to change much in flow to cause a cost. There will be an economic and ecological cost. Data suggests that we are very early on in the invasion and everything we see is still showing exponential expansion rate.

Question: In terms of veliger monitoring at Lakes Mead / Mohave – transects at depth. Are there gaps in looking for quagga mussels themselves?

Meeting Summary

With ROVs there needs to be a protocol. Benthic sampling...when, how, how often. We're concerned with water intakes (water company)

Lakewide: this is new in the invasion we need time to find out things...but we don't have time to do it because we have to worry about preserving our infrastructure now.

Does Arizona public service entities such as power plants (or others) use cooling water that would be affected? The thin pipes used for cooling would most definitely be at risk.

For those who are monitoring, is everyone going to publish to the 100th meridian? Is that still a good name? Susan Ellis w/ Fish and Game has committed to post to 100th meridian. A new map is created to see where monitoring is taking place and get metadata. Need to know quality of monitoring. Quantitative monitoring (plankton tows) vs. concrete slab counts.

Is Lake Mead the only body of water that has spawning population? It's safe to assume that wherever you have an adult population that spawning is going on.

Concentrations are highest in Lake Mohave...have they been sucked from Lake Mead into Mohave. Or is it a rookery? Havasu and Mohave are cranking. Why is this?...Temperature? Turbidity?

Different characteristics of different reservoirs...whole suite of questions we don't have answers to.

Below Parker Dam, we don't know what's happening at lower end of system in regard to reproduction and establishment. Evidence seems that there is less ability to establish in flowing water, but mussels find slack water and backwater even in areas of flowing water.

We have a surrogate: Corbicula. Its distribution could be used as a template. Where you have Corbicula, that is where you see quagga also, at a minimum. Maybe quagga mussel distribution is even broader. If a trash screen is in for only eight weeks and it's totally covered with fresh water sponge, what can that tell us about quagga?

In Coachella we have a protozoan that was first described in Tahiti.

In regard to when did the quagga mussel invasion start, where did it start, what is it doing? (speculation) I think that a contaminated houseboat came into Callville. Quagga mussels are thick on the canyon wall, and on the houseboats. Then they entered Sentinel, they are thick there. They aren't in Las Vegas Wash. So, the invasion started in Callville ... it's moving downstream and quagga mussels are settling where they like it best all the way to Havasu. Thick in Havasu...they like it there; but they are not that thick in Lake Mead.

The quagga mussel population is exploding now, and next year at this time and we will be more desperate...so, what do we do now?

Meeting Summary

Should we put more effort in Virgin River and Lake Mead? Yes, adults have been found on the west side of the Virgin River.

You can backtrack and look at its forward progression. This is the second of August. In January we were in ignorant bliss. Only seven months time has passed. In one generation, threadfin shad, were found all down through the system. This is the case with species that take a shotgun approach to reproduction.

Another example: Blue tilapia started in the Muddy River and then were found in Lake Mead in 1994. Catastrophic hypotheses were made on their affect on sport fish. We saw a blip...a boom and bust scenario. I wouldn't bank on it [a boom and bust scenario] with mussel species. (maybe not a good analogy)

We are not going to eradicate these organisms. In fact, in the artificial system of a pipe without biological control whatsoever, they have whole niche to themselves (in pipe)

Lose the word 'natural system'...we do not have a natural system. We built this lake for the human population with all kinds of different species. No. 1 thing to consider...do we continue to maintain this source for water use and power (one suite of monitoring)? We're stuck with the organisms. The ecological effects might not be germane to this issue.

From an infrastructure perspective, they are here in a density that will likely cause a problem.

There are ecological ramifications to the human use...anoxic / shells washing up / affecting drinking water supply.

There is a good overlap among activities that support wildlife and make Lake Mead a good source of drinking water as well.

Focus monitoring on what you want to accomplish. There are different things that you get out of monitoring. Physical, chemical, biological relationships...some monitoring isn't actually useful to water purveyors and power companies.

We want to know population numbers, # of organisms on structures. We need to standardize our monitoring (# per L). Using plates...we've got to standardize materials, size...so whoever is hanging structures out there we have data in common unit of measure. This is an area we do need to work on. Maybe 100th meridian could help us with this. Storing and sharing data...across the west. This may provide us some value.

Which agency is in charge that brings this to standardization vs. willy nilly?

Standards...forms...who is going to step up to the plate and provide this leadership. Sample, monitor, and grow – we need standards. There was an attempt to do this in 1994. Size, type, frequency of monitoring. This information is at the Denver Technical Resource Center.

Meeting Summary

We are not in a situation right now where we have standardization. Let's report on a common unit of measure so that we can start collecting with that intent. There is different affinity for different types of substrates.

There is a need for good data to make database decisions. Everyone wants it but we do not have it. How can we develop a monitoring plan that is consistent? How do we develop it? Who is going to do that? I think we (at this meeting) are going to do it. In a few short meetings, we can decide upon these protocols. Who is going to store and house these data? It would be beneficial if we put all our data in a common site...made database decisions. We have to push to get this. We need to use our data to make decisions.

Budgets: Looking two years out / appropriation cycles

100th meridian is already set up / contracts with UT Arlington to maintain it. A 100th meridian meeting is set for last week in November. So Denver and Las Vegas were brought up. There should be standardization but when you put up metadata you can tell if it meets your standards. This site also supports the ANS task force.

PVC samplers (standard protocols for monitoring for zebra mussels) (Illinois Natural History Survey) \$5

Back in the early 1990s, a study was funded by BOR. When zebra mussels hit the Great Lakes, everyone thought they could come west and wreak havoc. So we got funding and hired Cal McNabb and others. There were four FTEs that worked on zebra mussels for 5 years. Denver has all these reports. The group developed techniques. Because no zebra mussels were found, the line item was dropped. Charles Liston is in Kentucky now (one of the investigators)...we could mine all that old information and using it. A lot of tax payer money was spent on this work.

Should DOI take the lead role? In some regards, policy is ahead of the science. Best practices for people in this room are very different. East and west are different. East uses ground water whereas the west uses raw water.

California Science Advisory Panel Report...anticipating impact. Legislation is already set up in every state. This could be a bi-partisan issue that could bring many states / people together. If you could have a slug of money that came through 2008 that went to every state that went to best practices, methodology, etc. for invasive species...How do we bring this to attention to the scope and magnitude of this problem? What's the reaction to the California Science Advisory Report? There needs to be stakeholder input into a science advisory panel. Need a hybrid of ideas.

In California legislature, there is already a mechanism for Fish and Game to be given authority over bodies of water (where quagga mussels are found).

We need a quagga mussel management and control plan. Feasibility of eradication: we may not be able to eradicate quagga mussels from Lake Mead.

Meeting Summary

IPM (integrated pest management) approach is right on for control. Although we would love to put the genie back in the bottle, it's not possible. But, what is still needed is coordination among what everyone is doing on their own.

We need to pick quantitative values, which we could do today. Let's just agree on how we're going to approach our science.

Substrate: Aluminum & Concrete Backer Board

Veligers: numbers per L

Qualitative: Is there a certain type of sampler? In regard to in situ observations, native rock is native rock. Maybe in those cases, we could use photos and quantitatively measure.

This way we could look at each other's data without concern.

Afternoon Break:

10 minute break to talk about standards and protocols. Decide on them after the break.

NPS is going to have a meeting of agencies working on Lake Mead thru cooperative agreement w/ UNLV. Contact agencies on Lakes Mead and Mohave what they're doing and how work with water 2025 teams to develop a monitoring plan for Lakes Mead and Mohave.

Agree to get something going with people in this room. Maybe Shawn could get going on compilation (including below lake Mohave) would he facilitate that happening with people in this room.

They are also doing a literature search; post a compilation of what we know now with a draft-monitoring plan concerning lakes Mead and Mohave.

Need two protocols:

- 1) abundance monitoring
- 2) detection monitoring

Need to store and share data. Maybe put on 100th Meridian where folks from other basins can look at it.

Scientific validity and credibility are needed.

2008 (water quality interagency symposium) – if there were identifiable things that people suggested to complement or inform quagga mussel evaluations over time.

In the essence of time, better to stick with quagga mussels.

Meeting Summary

If people have standard protocols for veliger and mussel sampling, please send them in e-mails or by hard copy. It's just a matter of looking at them. (With names because they'll be part of joint task force.)

Standards Protocols for Monitoring and Sampling Zebra Mussels (J. Ellen Marsden) Biological Notes 138 April 1992 Illinois Natural History Survey

The above needs to be standardized into a publication that could be widespread.

Caution: Protocols tested in other places don't necessarily work here. Let's see what works here / examine our methodology. Before we forge ahead and endorse something that doesn't work here.

Leading up to this point and beyond...we don't want to discard data. Metadata helps describe what to expect from the observation. Some data maybe less comparable but doesn't make it unusable.

100th meridian is doing some mapping but it would be very valuable for inventory and occurrence work along the whole Colorado corridor. At last look you could zoom in on a region...but it wasn't complete.

With monitoring efforts...would you know if you were detecting zebra mussels or not. Is this incorporated into sampling? The PCR BOR is doing is for genus and species...cannot separate quagga from zebra. You can distinguish from using size and shape of shell. You can't distinguish for some individuals but you'll be able to distinguish some.

Peggy Roefer and Jim LaBounty have 2 publications coming out. Southwest Hydrology and Lakeline Magazine to let the general public know what's going on.

Are all the types of monitoring going on at Lake Mead going to catch changes in water quality? In some future discussion, let's make sure that we're going to catch impacts with the assessments we're doing.

Will UNLV's literature search going to be available to everyone? Yes, Sara Meuting (graduate student) is creating an excel spreadsheet of everything she finds dealing with quagga mussels and titles, within the spreadsheet, are linked to the publications.

As NPS starts this literature search process, the work is going to focus on what is important to Lakes Mead/Mohave. Kent asks participants to consider if this search should be broader. Shawn: We haven't done an exhaustive search; our search has been more focused on life history. How can we expand it? How can it be facilitated? Kent: What kind of workload are we talking about? A broader search may fall within the scope of the project...Shawn would have to let us know if he needs more resources to address topics such as impacts on water treatments systems and methods for controlling these impacts.

Meeting Summary

U.S. Army Corps of Engineers have done a literature database for zebra mussels. It is searchable by year, author, location.

Another whole subset of issues: Is there a role for the fish management team? Bringing together resource agencies to have them discuss ecologically based questions. Is that an appropriate forum in which to discuss long-term monitoring needs for ecology of the system? Issues separate from all the issues discussed today. A subpart of the discussion today that Kent would like to get to is ecology (benthic, change in zooplankton community, fishery trends). These are the issues that NDOW would like to discuss without tying up a bunch of busy people. Maybe a subcommittee / or other group can have discussions and bring back recommendations to the larger group.

One of the things we need to look for are weaknesses in quagga mussels that can be exploited. When we look at lower trophic levels, I encourage taking a close look at algae. Shift in algae has ramifications not only ecologically but also for taste.

Look at what changed in the Great Lakes; those are the markers. Great Lakes are very diverse (of course, all caveats apply).

How could another meeting or presentation fit into 100th meridian meeting in November?

Need to get started on Standardizing Protocols – more important than next meeting time.

Unit of measure is the most important thing.

In the example of striped bass, individuals had different definitions for length, different definitions of “net night”—resulting data was not comparable. We needed to define a net night in same units and measure fish in same units

Record size you use, depth, relative density, temperature, count everything within a pre-determined size, settle on a consistent matrix.

Action threshold might not be universal. Bring your data in standard units.

Agenda suggestions

- protocols
- updates
- communication (same thing we did today)
- literature search, what product you're going to end up with when you're all done.

Next meeting: Thursday October 11, same location.

Meeting adjourned at 4pm.

Meeting Summary

Appendix A:

From: Kathy Lauckner, UNLV HRC

Hello Everyone:

Just to confirm. The intent of this meeting is to address the Quagga Mussel monitoring issues of Lakes Mead and Mohave. Everyone listed below will have a chance to elaborate on their programs, issues, and successes regarding this issue. Those with programmatic responsibilities will present **in the order listed**. Shawn Gerstenberger will welcome everyone and be followed by Kent Turner and Bryan Moore to start things off. We expect to finish with everyone understanding where we are on the monitoring issue and how we might make program adjustments with the cooperation from all the agencies involved. Welcome to all and please do not hesitate to call my cell phone at 702-236-3013 if you have any problems getting to the meeting place.

Thank you. Kathy Lauckner

Amenities:

I visited the River Mountain Water Treatment Facility, thank you to Peggy Roefer for the tour. It is an excellent facility and I think we will all be very comfortable. The room is large, and the acoustics are good. There is computer equipment, with projection hard wired into the room so bring your presentation on a CD or USB drive. There will be water and / or coffee offered in the morning. Lunch is on your own and we'll have drinks available for the afternoon. There is a small cafeteria downstairs and vending machines that offer Pepsi products and snacks.

Directions to the Plant:

The treatment facility's largest cross streets are HORIZON DRIVE and BOULDER HIGHWAY, (There is a KMart on the corner). Horizon Drive on the east-side of Boulder Highway becomes Racetrack Drive. At Racetrack and Burkholder there is a Church of Latter Day Saints with a white steeple. Turn right at the church onto Burkholder. Continue up the hill towards the plant. At the stop sign make a right. Follow the perimeter of the plant (Richard Bunker Ave.) until you reach the guard gate (it will be on your left. Give your name to the guard and he will give you a visitor name tag. Proceed up the hill until it turns to the right. The first building you come to is the Laboratory Facility and the Chaparral Room (the meeting room is on the upper floor). Park in BUS parking right outside the building. You may enter the meeting room from the parking lot. There will be a sign on the door to welcome you in.

The Agenda:

The organizations represented for this Thursday's round table discussion are listed below. Agencies with programmatic responsibilities on Lakes Mead or Mohave will be invited to share information on the following:

- 1) current quagga mussel monitoring;
- 2) ongoing studies that could be tweaked;
- 3) capacity to participate in ecological monitoring

After the presentations, each organization will have the opportunity to discuss the issues of monitoring as they pertain to Lake Mead and Lake Mohave and the relevance to the Colorado River entities. As an organization, you may choose to have one speaker or present as a team. The intent is to review what each organization is doing regarding quagga mussel monitoring, any gaps that can be immediately addressed and then any long term monitoring issues that are before us. As the discussion moves along, we may also address:

Meeting Summary

- What you can offer to others
- Where you need assistance
- Areas of overlap where we can pool resources and maximize effort
- Approach to short-term data sharing
- How to shape a proposal for long-term monitoring

Again, we will begin the meeting promptly at 8:30 a.m.; break for lunch at 12 noon; reconvene at 1:30 p.m. and end the official meeting at 5:00 p.m.

Please do not hesitate to contact me if you have questions.

Presentations:

Kent Turner, Bryan Moore National Park Service, Lake Mead
Jon Sjoberg, Clyde Parke Nevada Department of Wildlife
Tom Burke U.S. Bureau of Reclamation
James Okazaki, Jeremy Lustig City of Henderson
Alan Sims Las Vegas Valley Water District
Peggy Roefer, Jim LaBounty, David Syzdek, Linda Blish,
Dave Johnson, Roger Buehrer Southern Nevada Water Authority
Steve Weber Lake Las Vegas Resort
Colen Watts Basic Water Company
Larry Riley, Marc Dahlberg Arizona Game and Fish Department
Bill Werner Arizona Department of Water Resources
Craig Westenburg U.S. Geological Survey
Ric DeLeon Metropolitan Water District of Southern California

Other Participants:

Bob Pitman Arizona - U.S. Fish and Wildlife Service
Denise A. Walther California - U.S. Fish and Wildlife Service
Shawn Gerstenberger, Craig Palmer,
Kathy Lauckner, Sara Muetting University of Nevada Las Vegas
Linda Drees, John Wullschleger National Park Service (via telephone conference)
Chuck O'Neill Cornell University (via telephone conference)
Monica Swartz Coachella Valley Water District.
Robert Powell Imperial Irrigation District

Appendix B:

Handout Provided by Bryan Moore

Overview

INITIAL RESPONSE

The National Park Service led a three-month interagency initial response effort focused on assessment, containment, treatment, and long-term management of the quagga mussel infestation in Lakes Mead and Mohave. This effort culminated in an Initial Response Plan. When no treatment or eradication methods were found to be feasible at this time, the efforts focused on containment of spread to other watersheds. The highlights of the initial response effort include:

- Interagency planning at the local level with close coordination with concurrent upstream and downstream planning efforts as well as significant input from the scientific community.
- Formation of the Lake Mead Interagency Core Team with representatives from each of the five agencies with direct management responsibilities in the Boulder - Basin of Lake Mead, including National Park Service (NPS), Bureau of Reclamation (BOR), Southern Nevada Water Authority (SNWA), Nevada Department of Wildlife (NDOW), Arizona Game and Fish Department (AGFD) and the U.S. Fish and Wildlife (USFWS) Willow Beach Fish Hatchery on Lake Mohave.
- The Core Team also established coordination and communication with the Upper Colorado Prevention Response Effort and the California Quagga Mussel Incident Management Team, as well as established a science advisory team.
- Increased emphasis on the pre-existing invasive aquatic species prevention and early detection program.
- Assessment and monitoring of adult and juvenile quagga mussel populations in Lakes Mead and Mohave.
- Containment strategy focused on mandatory cleaning upon entry and exit for all slipped and moored boats.
- New special use permit conditions for all water based activities to require cleaning of all participant watercraft upon entry and exit.
- Increased boat wash capacity at almost all concessioner-operated marinas, including the planned installation in 2007 of five permanent boat wash stations to be operated by concessioners
- Public messaging campaign - including signage, rack cards, displays, ramp staffing, and outreach to boat based businesses - to encourage come and go boaters to leave the lake with their watercraft clean, drained, and dry.

PRESENCE/ ABSENCE

- Dives were conducted at all marinas.
- Diving was expanded to areas between marinas and to remote sites.
- Maps of infested areas were created and made available to the public on the 100th meridian website.

-Assessment at depths greater than 100 feet using ROV.

TRANSECTS

- 8 Transects are installed. 7 on Mead and 1 on Mohave. Each transect consist of 3, 15 meter yellow polypropylene lines, one at 20' 40' and 60'.
- 2 Artificial Recruitment Modules (ARM's) are placed at each Transect in approximately 80' of water.
- Size Frequencies are record from rocks randomly collected on site.

LARVAL MONITORING (BOR)

- 8 sites
- plankton net pulls are analyzed using cross-polarized microscopy
- PCR - Microscopic detection is confirmed with polymerase chain reaction.

PASSIVE SAMPLERS

-Newly designed passive samplers have been installed at five marinas plus two undeveloped sites.

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- Age / growth analysis for established colonies.
- Thermal tolerances and habitat preferences.

BOATS

- ZM Prevention
- Entrance Stations stopping suspect boats and having boat owners fill out questionnaire.
- Inspections of incoming boats from mussel infested states.
- All slip renters received notification in the mail and signs were posted on all slip gates and dry storage gates informing boaters that it is unlawful to transport mussels and that their vessels are required to be cleaned upon exit.
- As a condition of slip rental agreements, all slipped and moored boats must be washed prior to entry and upon exit for transport outside of Lake Mead NRA.
- All marina concessioners have been instructed to immediately offer boat cleaning services using portable hot water pressure sprayers and five large boat wash facilities are being installed at marinas to facilitate this service.
- Free boat cleaning training courses were offered by the Park and all marina workers offering this service in the Park were required to attend training and follow the established guidelines.

DIVES

- Approximately 115 dives have been recorded

Appendix B:
 Handout Provided by Bryan Moore
 (continued)

Quadrats quagga mussels

Location _____ Date _____
 Diver _____ Partner _____
 Transect Circle one: **20ft** 40ft 60ft

Swim tape out 15 m, from left to right when facing shore.

#	Meter #	Depth ft	Count (# Mussels)	Quadrat Size (Circle One)	Substrate (% cobble, etc.)	Notes
1	0			1/4 or 1/16 M ²		
2	1.5			1/4 or 1/16 M ²		
3	3			1/4 or 1/16 M ²		
4	4.5			1/4 or 1/16 M ²		
5	6			1/4 or 1/16 M ²		
6	7.5			1/4 or 1/16 M ²		
7	9			1/4 or 1/16 M ²		
8	10.5			1/4 or 1/16 M ²		
9	12			1/4 or 1/16 M ²		
10	13.5			1/4 or 1/16 M ²		

Appendix C:
Handout Provided by Tom Burke

VELIGER LARVAE MONITORING - LAKE MEAD AND LAKE MOHAVE					
<i>(All numbers shown are individuals per liter)</i>					
Station/Date	March	April	May	June	July
Sandy Point (Inflow to Mead)	0.00	0.09	0.00	0.50	0.20
Echo Bay (Middle Overton Arm)	0.00	0.40	0.09	0.20	0.10
Temple Bar	0.10	0.20	0.60	0.70	0.20
Hoover Dam - deep	0.10	0.85	44.70	28.70	126.0
Hoover Dam - shallow	0.60	3.20	24.00	3.70	36.50
Willow Beach	0.60	0.90	11.70	35.90	28.00
Placer Cove	1.10	0.60	62.00	24.90	32.80
Cottonwood Cove	1.10	3.80	18.00	22.70	26.10
Katherine's Landing	n/a*	1.00	10.60	40.30	>462.1**
* not sampled ** Greater than 1000 veligers per mL are too numerous to count or TNTC					

Meeting Summary

Appendix D: List of Attendees

Name	Affiliation	Email
Linda Blish	SNWA	linda.blish@lvvwd.com
Roger Buehrer	SNWA	roger.buehrer@lvwd.com
Tom Burke	USBR	tburke@lc.usbr.gov
Mike Burrell	NDOW	mburrell@ndow.org
Phil Davis	SNWA	cresolve@aol.com
Rick DeLeon	MWD	
Shawn Gerstenberger	UNLV	Shawn.Gerstenberger@unlv.edu
Dave Johnson	SNWA	dave.johnson@snwa.com
Jim LaBounty	SNWA	jlabounty@snwa.com
Kathy Laucker	UNLV/ Harry Reid Center	Kathy.Laucker@unlv.edu
Jeremy Lustig	City of Henderson	jeremy.lustig@cityofhenderson.com
Christy Meza	SNWA	christy.mezger@lvvwd.com
Melissa Mezger	SNWA	melissa.mezger@lvvwd.com
Jennell M. Miller	UNLV/ Public Lands Institute	jennell.miller@unlv.edu
Bryan Moore	NPS	bryan_moore@nps.gov
Sara Mueting	UNLV	mueting@unlv.nevada.edu
James Okazaki	City of Henderson	james.okazaki@cityofhenderson.com
Craig Palmer	UNLV/ Harry Reid Center	craig.palmer@unlv.edu
Clyde Parke	NDOW	cparke@ndow.org
Bob Pitman	USFWS	bob_pitman@fws.gov
Robert Powell	Irrigation District	rjpowell@iid.com
David J. Rexing	SNWA	d.rexing@snwa.com
Larry Riley	AZ Game and Fish	lriley@azgfd.gov
Peggy Roefer	SNWA	peggy.roefer@snwa.com
Alan B. Sims	SNWA	alan.sims@lvvwd.com
Jon Sjöberg	NV Dept of Wildlife	sjoberg@endow.org
Monica Swartz	CVWD	mswartz@cvwd.org
David Syzdek	SNWA	david.syzdek@snwa.com
Kent Turner	NPS	kent_turner@nps.gov
Denise Walther	USFWS	denise_walther@fws.com
Steve Weber	LLV	
Bill Werner	AZ Dept. of Water Resources	bwerner@azwater.gov
Craig Westenburg	USGS	cwesten@lvvwd.com
Ron Zegers	SNWS	ron.zegers@lvvwd.org