Operational Guidelines for Cleaning Wildland Firefighting Equipment Exposed to Aquatic Invasive Species


quagga mussels


Parrotfeather and giant salvinia


New Zealand mudsnails


Didymo (fresh water diatom)

Sandee Dingman, Biologist
Lake Mead National Recreation Area

Outline

- Problem definition
  - Vectors
  - Pathways
- Solutions
  - Engineered solutions
  - Policy solutions
  - Chemical solutions
- Efficacy of chemical sanitation (Britton)
- Future directions
- Questions

Problem Definition

- Lots of wildland firefighting operations move lots of raw water around the landscape

Year	Fires	Acres
2008	78,979	5,292,468
2007	85,705	9,328,045
2006	96,385	9,873,745
2005	66,753	8,689,389
2004	65,461	8,097,880
2003	63,629	3,960,842
2002	73,457	7,184,712
2001	84,079	3,570,911
2000	92,250	7,393,493
1999	92,487	5,626,093
10-yr total	**799,185**	**69,017,578**

Trend is increasing due to

- climate change
  = more fires, bigger fires
- altered fire regimes
  = more intense, longer duration fires
- wildland urban interface
  = more suppression
- Increased reliance on aviation
  = more water moving

70 million acres burned in 800,000 fires in U.S.

Double Threat

- 1) Some aquatic invasive species pose a threat to the mechanical workings of firefighting equipment.

- 2) Contaminated equipment are vectors and moving contaminated water around the landscape are pathways for invasion, thus pose an ecological threat.

Many different types of vectors

Helicopters:

- Buckets
- Snorkels & internal tanks
- Portable tanks

Many different types of vectors

Fixed Wing Aircraft

- Air Tankers , used for retardant
- Single Engine Ag Tankers
- “Scooper” or “Duck”

Many different types of vectors

Fixed Wing Aircraft

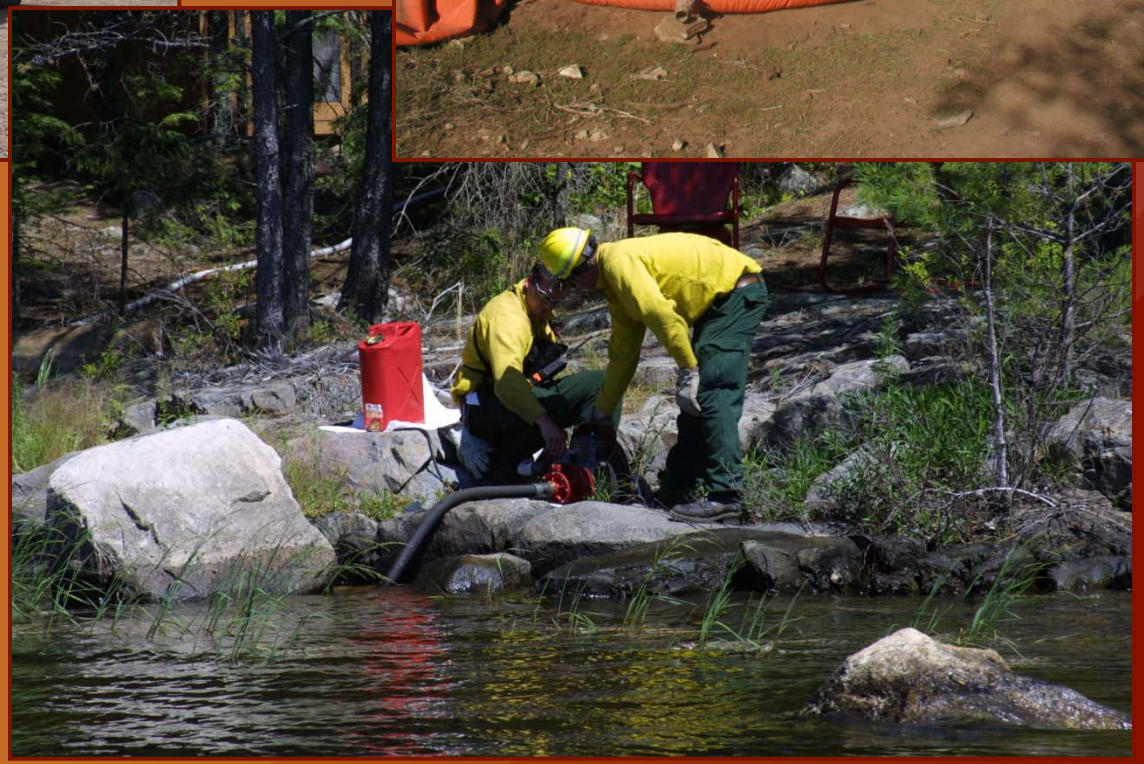
- Air Tankers , used for retardant
- Single Engine Ag Tankers
- “Scooper” or “Duck” – 1400 gallons

Bigger vectors….

On Lake Shasta, 2008

Mars Water Bomber in service since 2007 for firefighting in Canada and California
Each drop is 7200 gallons and covers an area of up to 4 acres (1.6 hectares)

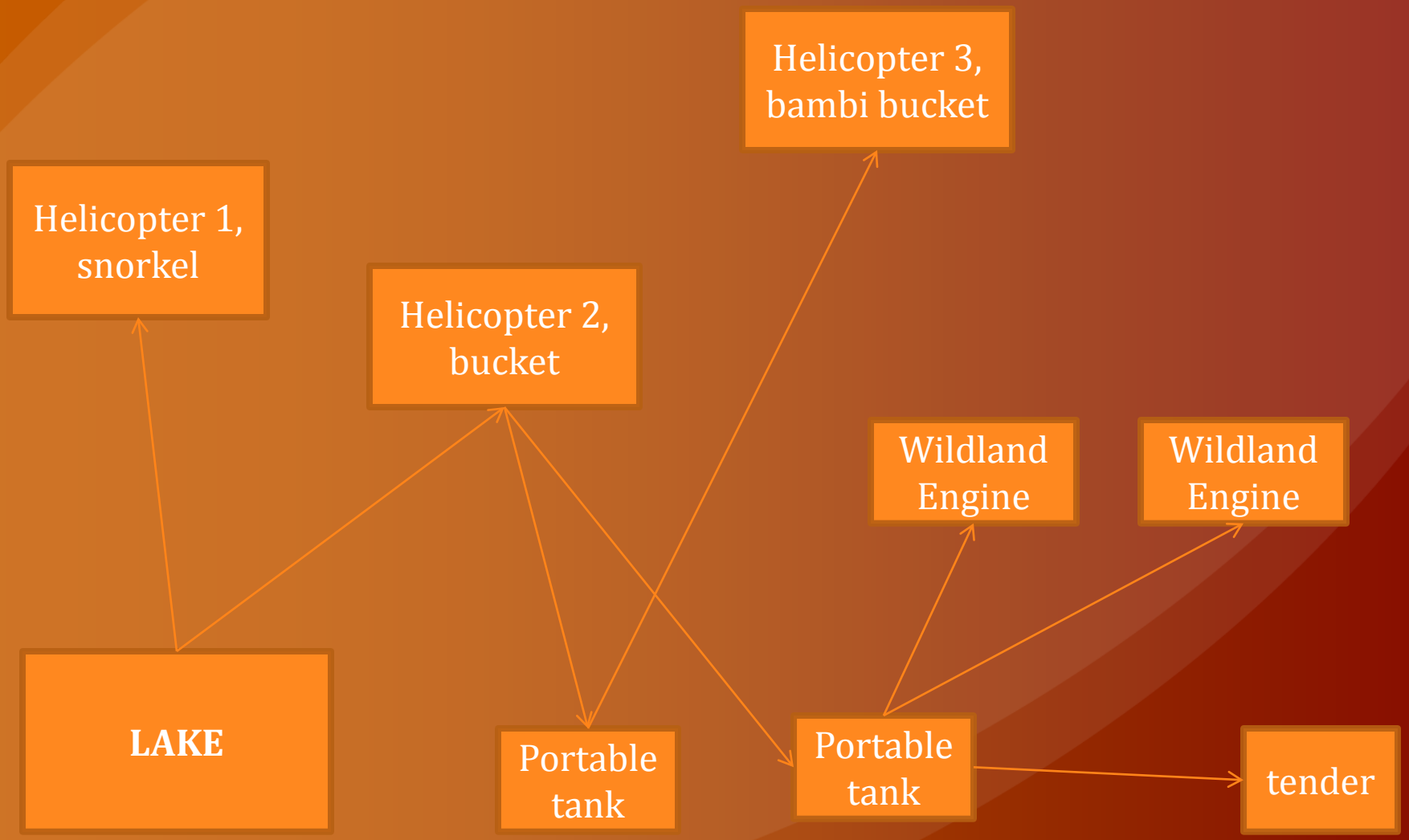
Many different types of vectors



Ground based

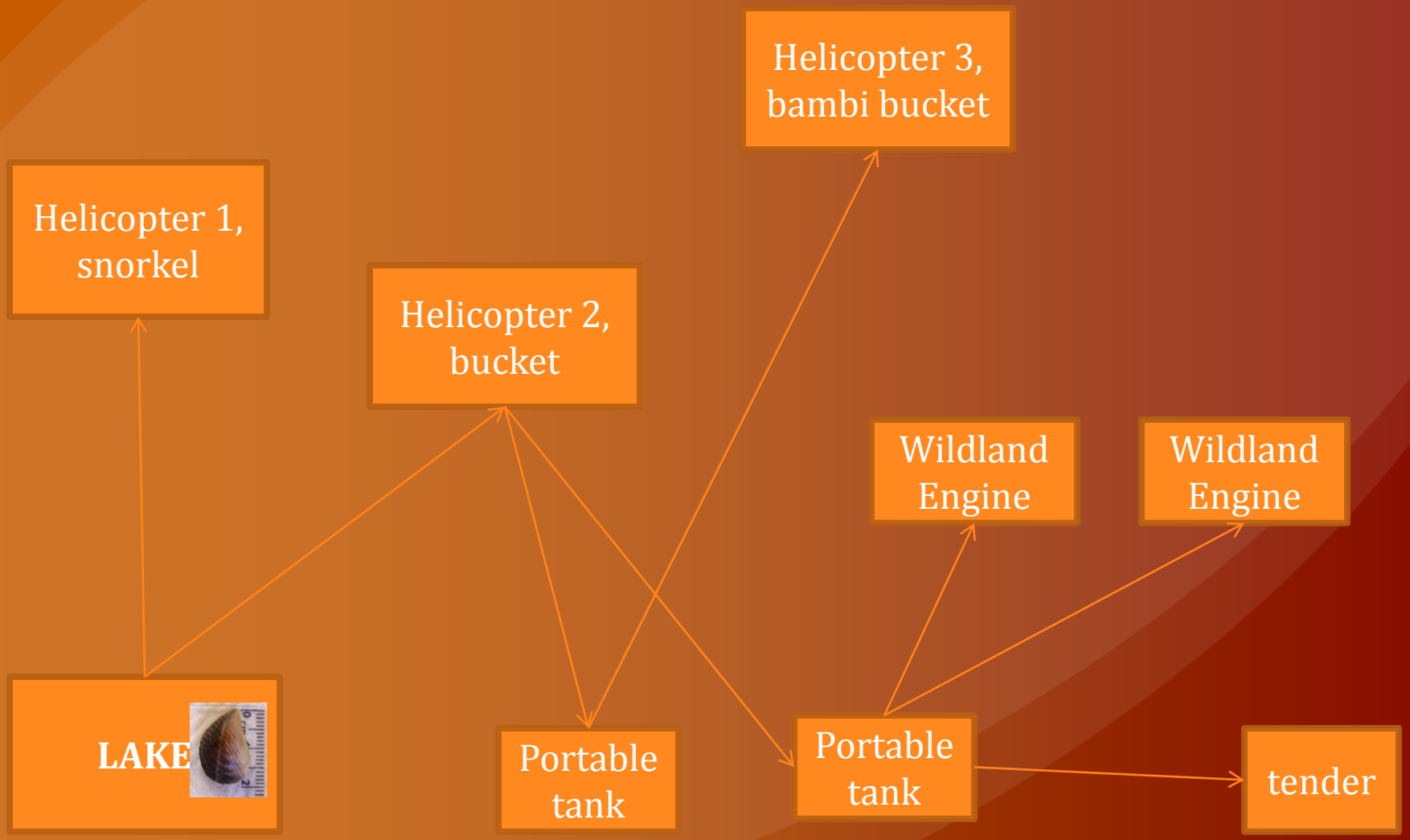
- Engines
- Portable tanks
- Water tenders
- Portable pumps/drafting

Complex Pathways



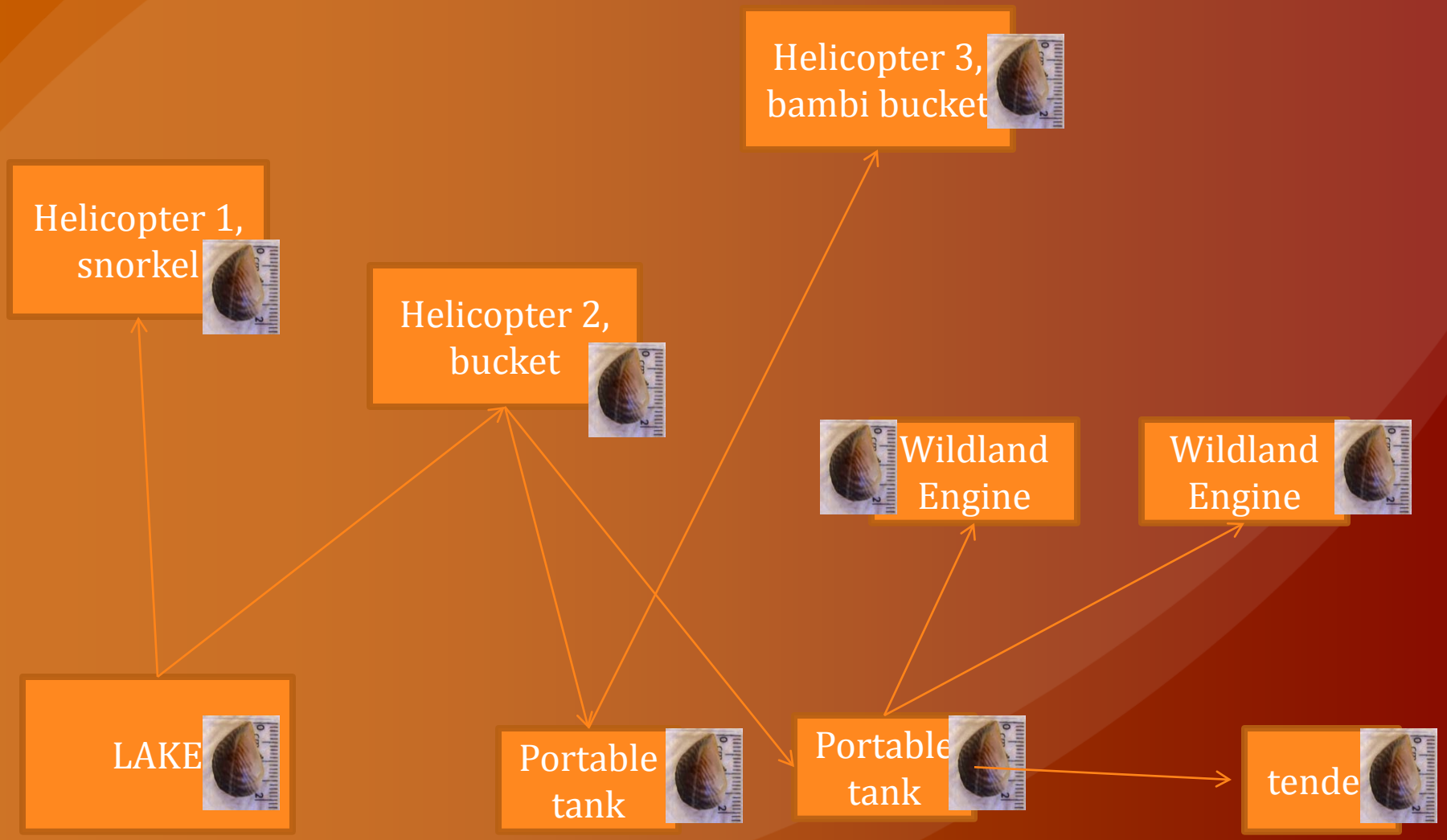
Complex Pathways

Starts with a single, pre-existing invasion in local waterbody that maybe known or unknown.



Complex Pathways

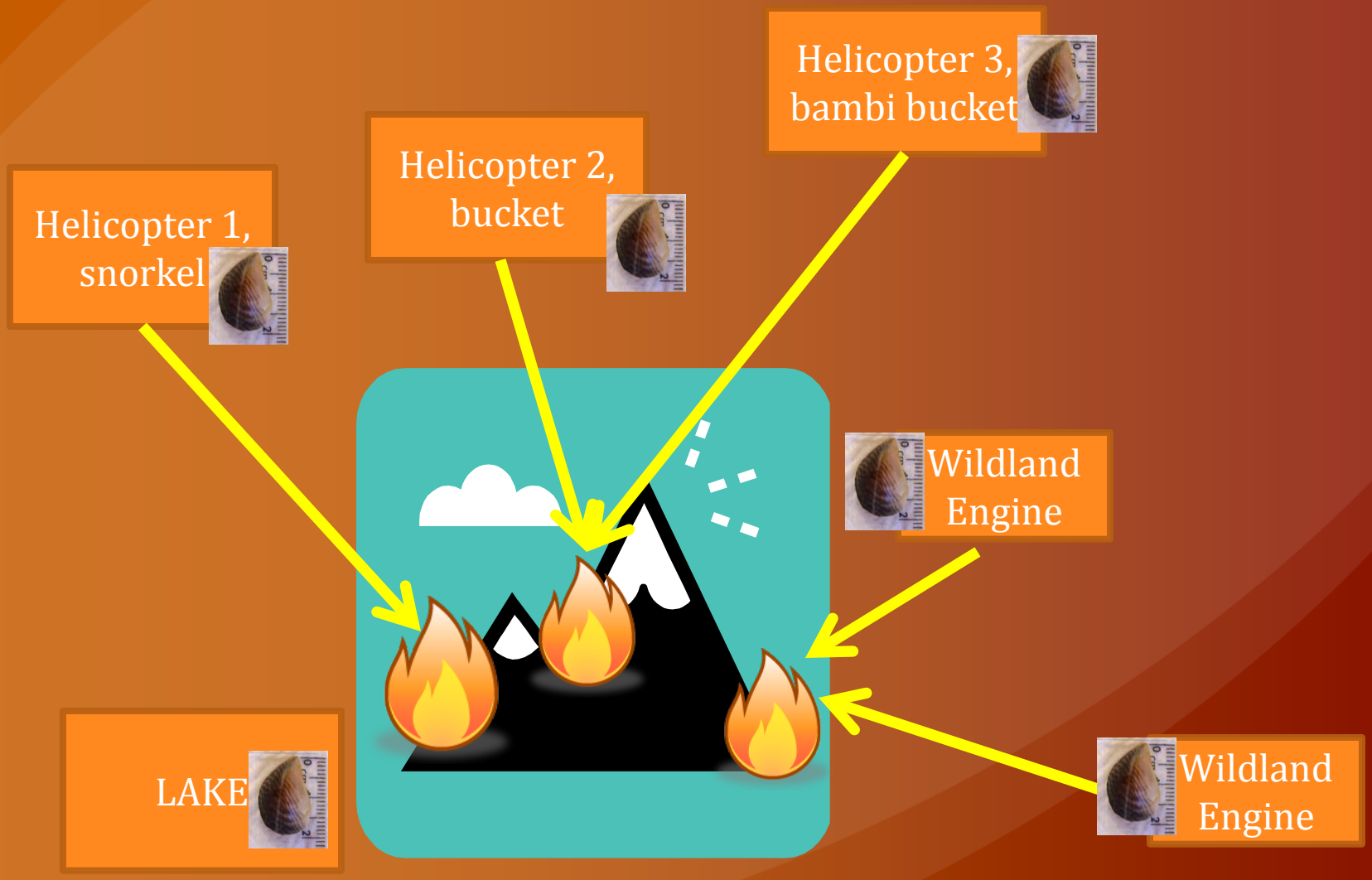
Equipment contaminated from single source



Complex Pathways

Complex Pathways

Contaminated equipment used for fire suppression



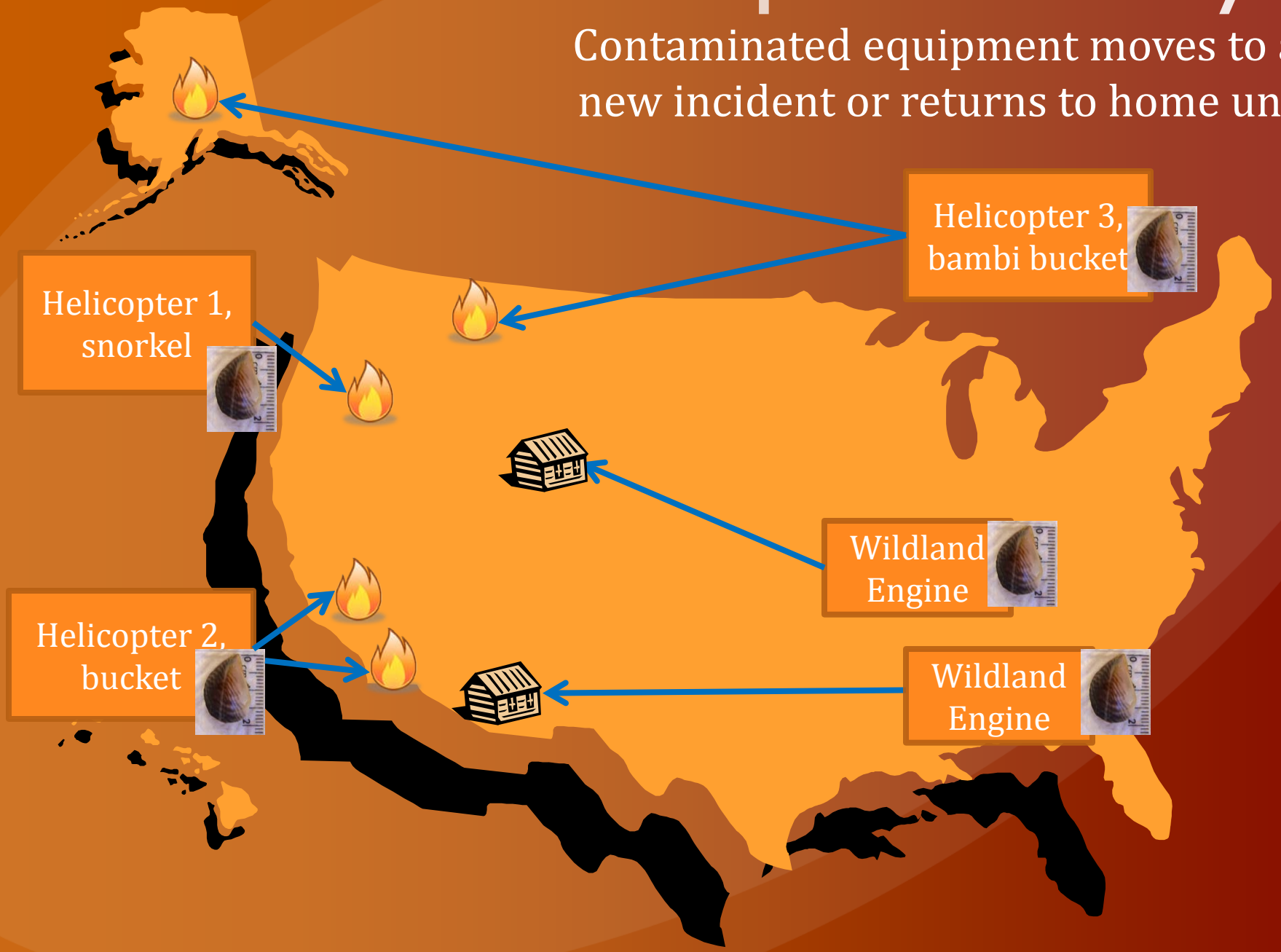
Complex Pathways

Fires out but now there are multiple invasions to new watersheds and waterbodies, including remote and isolated headwaters!

LAKE 

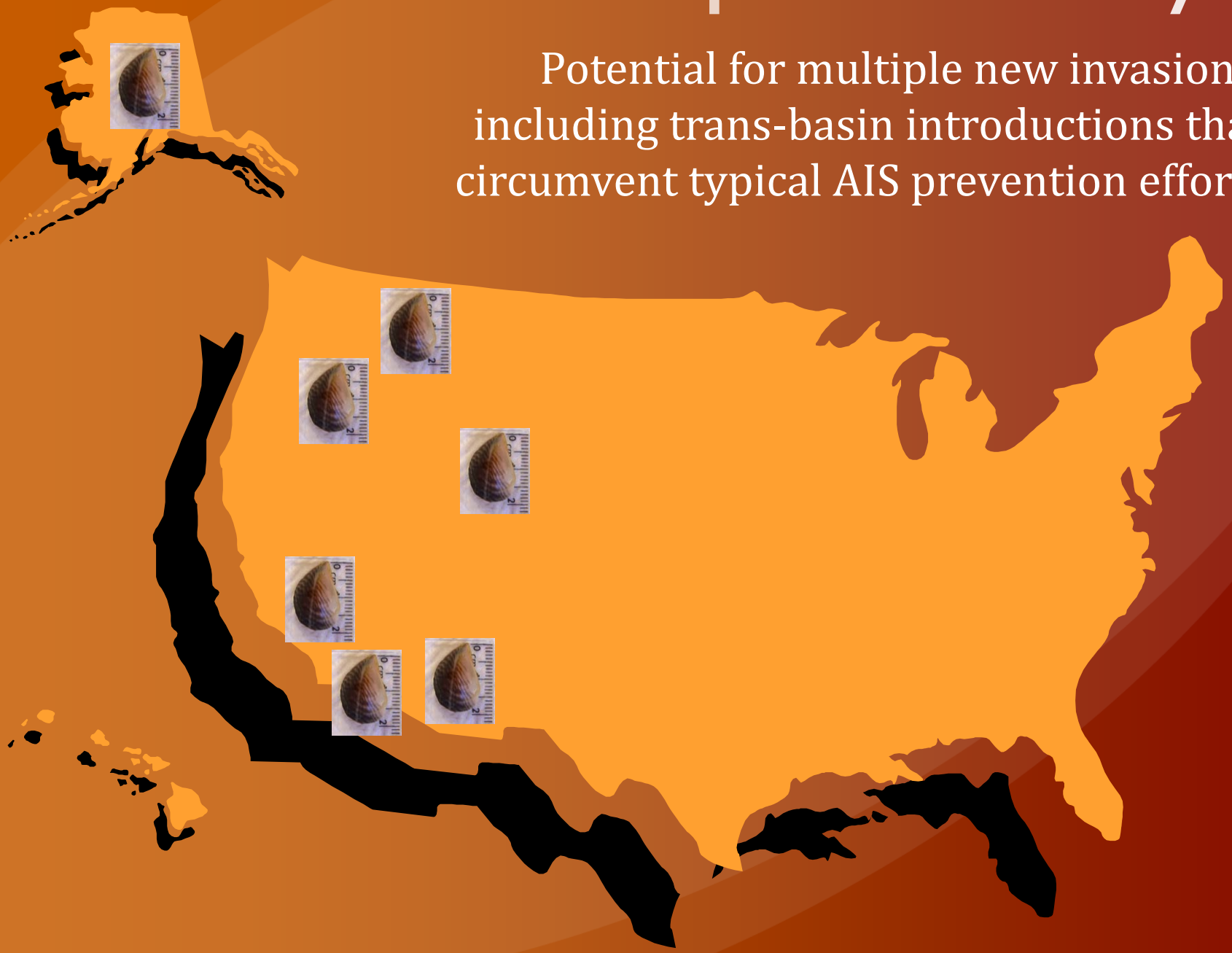
Complex Pathways

Contaminated equipment moves to a new incident or returns to home unit



Complex Pathways

Potential for multiple new invasions, including trans-basin introductions that circumvent typical AIS prevention efforts.



Example: Angora Fire

June 2007 in South Lake Tahoe, California

Fire burned 3100 acres, including 254 homes

2180 personnel assigned to the fire, including:

- 21 helicopters
- 56 engines
- 15 tenders
- multiple fixed wing

What to do?

- Equipment solutions
- Policy solutions
- Chemical solutions

Engineered Solutions

- Fish strainers (0.094 inch maximum mesh)
- Created by US Forest Service San Dimas Lab for protection of endangered fish and larvae

Hose-end fish strainer for drafting operations.

Light helicopter dipping from fish strainer with a 180-gallon Bambi Bucket.

Policy Solutions

- 2007: US Forest Service, Region 4, started internal guidelines (Tait et al.)
- 2008: Interagency working group with Southwest Geographic Coordinating Center produced Interagency Operational Guidelines and Technical Guide in 2008 (Smith et al.)
- 2010: AIS prevention included in the interagency Red Book

Chemical Solutions – pg 1

From Southwest Guidelines

- Any equipment that comes into contact with raw water should be sanitized. Drying alone may be effective in some situations depending upon equipment, temperature, and relative humidity. Consult the Resource Advisor (READ).

- In coordination with the READ, establish sanitation areas where there is no potential for runoff into stormdrains, waterways, or sensitive habitats.

- Remove all visible plant parts, soil and other materials from external surfaces of gear and equipment. If possible, powerwash all accessible surfaces with clean, hot water (≥140ºF ideally).

Chemical Solutions – pg 2

- **Set up a portable disinfection tank using a cleaning solution of quaternary ammonium compound, a common cleaning agents used in homes, swimming pools, and hospitals, and safe for gear and equipment when used at the recommended concentration. Two brands are readily available from GSA or local suppliers: Quat128® (by Waxie) or Sparquat 256® (by Spartan). Costs and effectiveness are comparable; both are labeled for use as fungicides/ virucides. Follow individual agency integrated pest management requirements, including pesticide use proposals.**

Volume of tap water	**Volume of *Quat128®* To make 5% solution**	**Volume of *Sparquat 256®* To make 3% solution**
100 mL water	4.63 mL	3.00 mL
1 gallon water	6.35 liquid oz.	4.12 liquid oz.
1 gallon water	12.7 tbsp	8.2 tbsp
1 gallon water	0.79 cups	0.51 cups
100 gallons water	4.96 gallons	3.22 gallons
1000 gallons water	49.6 gallons	32.2 gallons

Chemical Solutions – pg 3

- For engines and tenders, empty the tank then circulate the cleaning solution for 10 minutes. Float portable pumps in the disinfection tank and pump cleaning solution through for 10 minutes. Pump cleaning solution through hose then rinse with water. Discharge cleaning solution back into the disinfection tank for re-use.
- Where feasible dip gear or equipment (e.g. helicopter buckets) into the cleaning solution. Alternatively, put the cleaning solution in backpack spray pumps to clean portable tanks, helicopter buckets, and other equipment. The solution must be in contact with the surface being sanitized for at least 10 minutes and then rinsed with water.
- Under the direction of the READ, test cleaning solution daily according to the directions below. The cleaning solution can be used repeatedly for up to a week unless heavily muddied or diluted. If the concentration is too weak, dispose of the used solution properly and make a new solution.

Efficacy of Chemical Sanitation

Preliminary research conducted by Dr. David Britton, US Fish and Wildlife Service at Dr. Robert McMahon's Lab at University of Texas, Arlington.

Methods:

- Tested the survivability of 89 living veligers or pediveligers from Lake Mead

  n=26 as controls in dechlorinated tap water (control)

  n=63 in 3% Sparquat 256® solution

- Submerged for either 5 or 10 minutes in either Sparquat solution or dechlorinated tap water , checked for survivors

- Removed to fresh dechlorinated tap water for one hour, checked for survivors

Efficacy of Chemical Sanitation

Results:

- All veligers survived exposure to the control fluid (dechlorinated tap water)
- 33 of 34 veligers were alive immediately after 5 minutes exposure
- 10 of 29 veligers were alive immediately after 10 minutes exposure
- 3 of 34 veligers were still alive 60 minute after 5 minutes exposure
- 0 of 29 veligers were still alive 60 minutes after 10 minutes exposure

Efficacy of Chemical Sanitation

Discussion

- 10 minutes exposure to 3% Sparquat 256 ® is sufficient to kill quagga veligers, but kill is not immediate
- 5 minutes is unacceptable for effective treatment
- Need more research with larger sample sizes for a rigorous survival analysis
  - Variables of interest: ambient temperature, veliger age/stage, contact time, chemical concentration, different quaternary ammoniums

Future Outlook

- Continue to incorporate aquatic invasive species awareness and prevention protocol in firefighter training, pre-season meetings for Incident Management Teams, etc.

- Dr. Britton plans to continue efficacy testing with quaternary ammonium compounds on quagga mussels this spring/summer at different concentrations, contact times, and temperatures.

- US Forest Service funded a FY11 proposal research the disinfectant qualities of foam and retardant in killing quagga/zebra mussel larvae, New Zealand mudsnails, whirling disease, and didymo.

Acknowledgements

- David K. Britton, acting Regional Aquatic Invasive Species Coordinator, Region 2, US Fish and Wildlife Service, for his efficacy testing
- Emily Austin and Jessie Rinella, Lake Mead NRA, for collecting larvae samples for efficacy testing
- Brenda Smith, Arizona Ecological Services Office, US Fish and Wildlife Service for chairing the Southwest Working Group
- Cynthia Tait, Regional Aquatic Ecologist, Region 4, US Forest Service for continued work on the AIS-fire issue
- Tina Boehle (National Interagency Fire Center), David Eaker (Zion NP), and Michelle Fidler (Saguaro NP) for fire aviation photos

QUESTIONS?

Sandee Dingman
702-298-1070
sandee_dingman@nps.gov