

# Eradication of invasive aquatic species using carbon dioxide and liquid ammonia



**David Ward, Rylan Morton-Starner and Ben Vaage**

**Southwest Biological Science Center**

**Grand Canyon Monitoring and Research Center**

“It is unlikely that the present arsenal of approved piscicides would be effective for controlling nonnative fishes in the southwestern United States”



Integrated Management Techniques to Control Nonnative Fishes

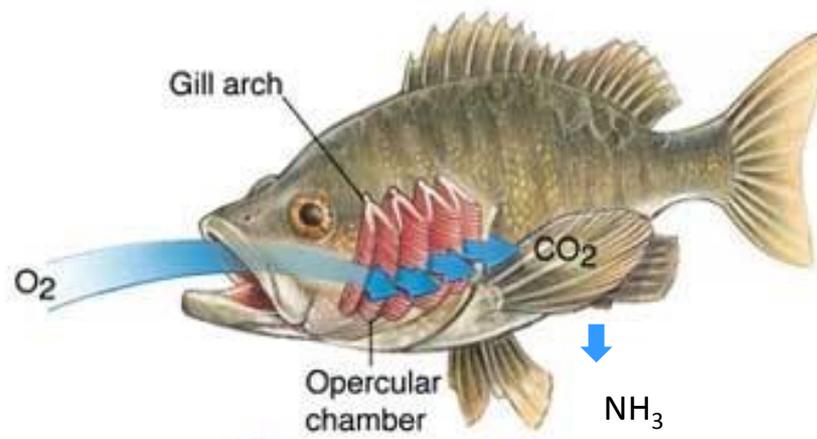


Completion Report  
Interagency Agreement Number: 01-AA-32-0040

Dawson and Kolar 2003

# Why CO<sub>2</sub> and Ammonia?

Carbon dioxide and ammonia are by-products of fish metabolism and are naturally present in the environment at low levels, yet are known to be toxic to most aquatic species





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To reach 200 ppm CO<sub>2</sub> in 1,000 gallons of water

You need - 1.5 kg baking soda and 0.5 gallons of acid



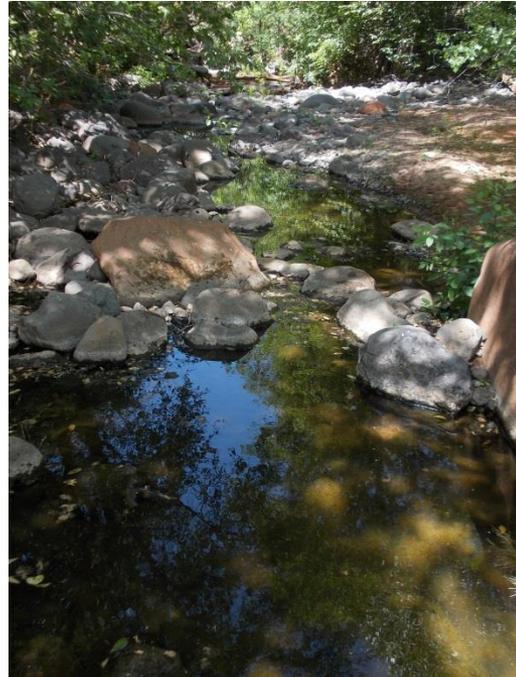
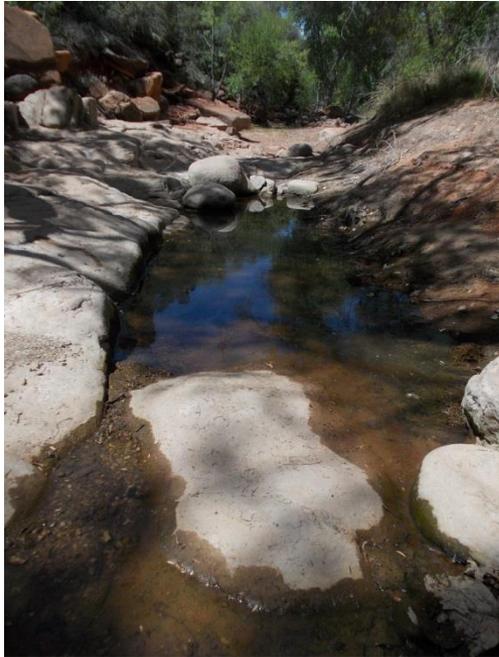
13 lb bag - \$7



2 gallons muriatic acid - \$16

= Treatment for 4,000 gallons

# Isolated pools near Verde River, June 2014



## Isolated pool near Verde River, June 2014



This video was removed, contact David Ward or it may be uploaded to YouTube

# Other Applications





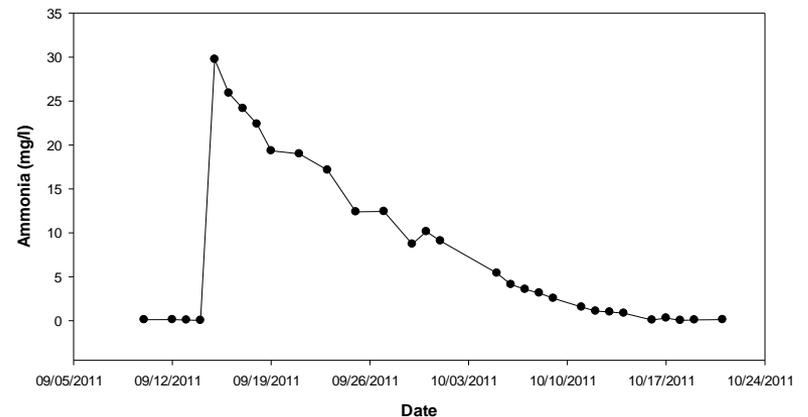
# Ammonia

- Waste product of aquatic organisms
- Naturally present in the environment
- Natural bacteria in the environment break it down

# Rocky Mountain Research Station, Flagstaff



Dosage of 0.5 ml ammonia (29%) per gallon of water



**Ward et al. 2013. An evaluation of Liquid Ammonia as a candidate Piscicide.**  
*North American Journal of Fisheries Management* 33: 400-405.

# Stock pond near flagstaff, AZ



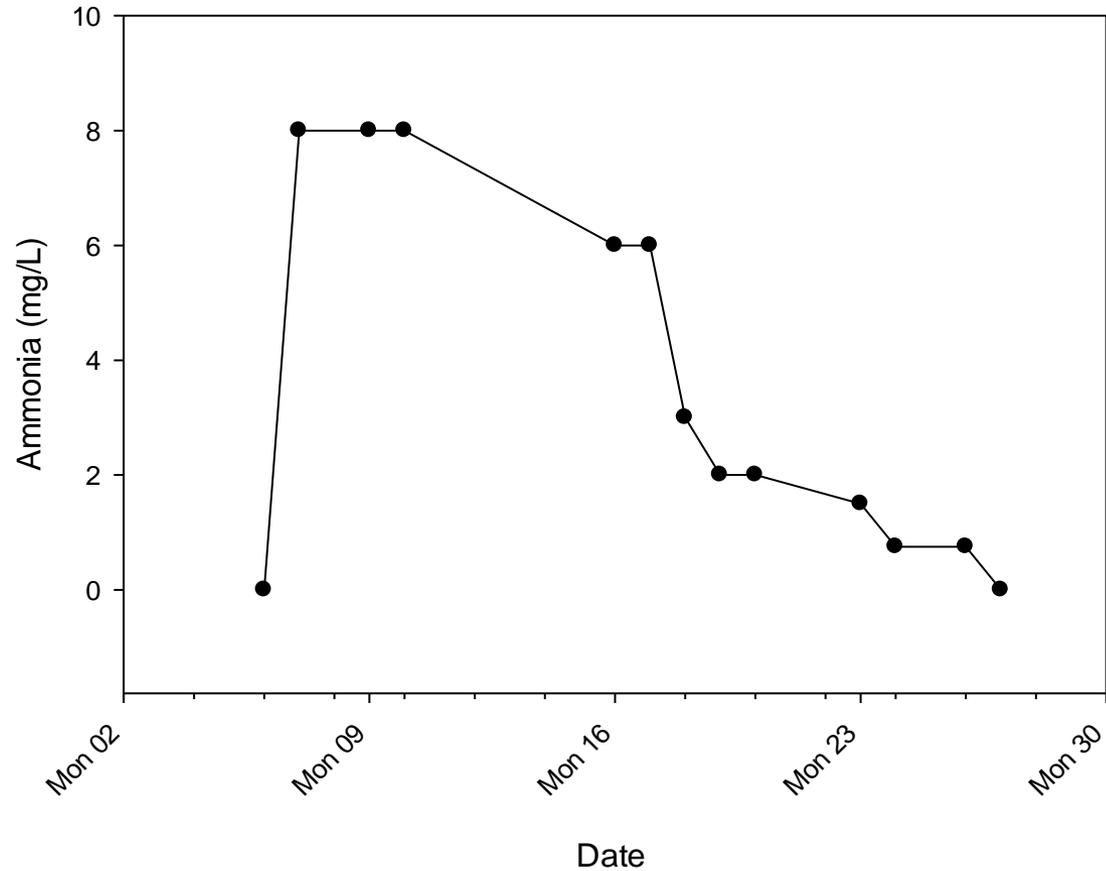
**750,000 Gallons  
(284,000 liters)**

**0.25** ml/gallon of water

30 gallons of ammonia



## Stock pond near flagstaff, AZ



Treated - June 6, 2014

4 baited hoopnets set on July 1, 2014 – no fish caught

4 baited hoopnets set again on July 31, 2014 – no fish caught

# Divide Tank, Tonto NF

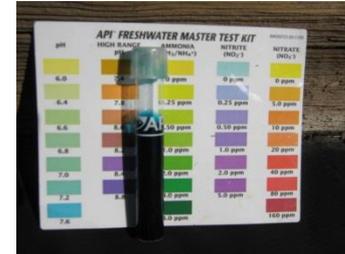


# Divide Tank, Ammonia Treatment



This video was removed, contact David Ward or it may be uploaded to YouTube

# Some crayfish still alive - pond is still toxic



Nov 4<sup>th</sup> – 7 live crayfish caught  
Nov 13<sup>th</sup> – 6 live crayfish caught  
Dec 30 – Pond frozen over

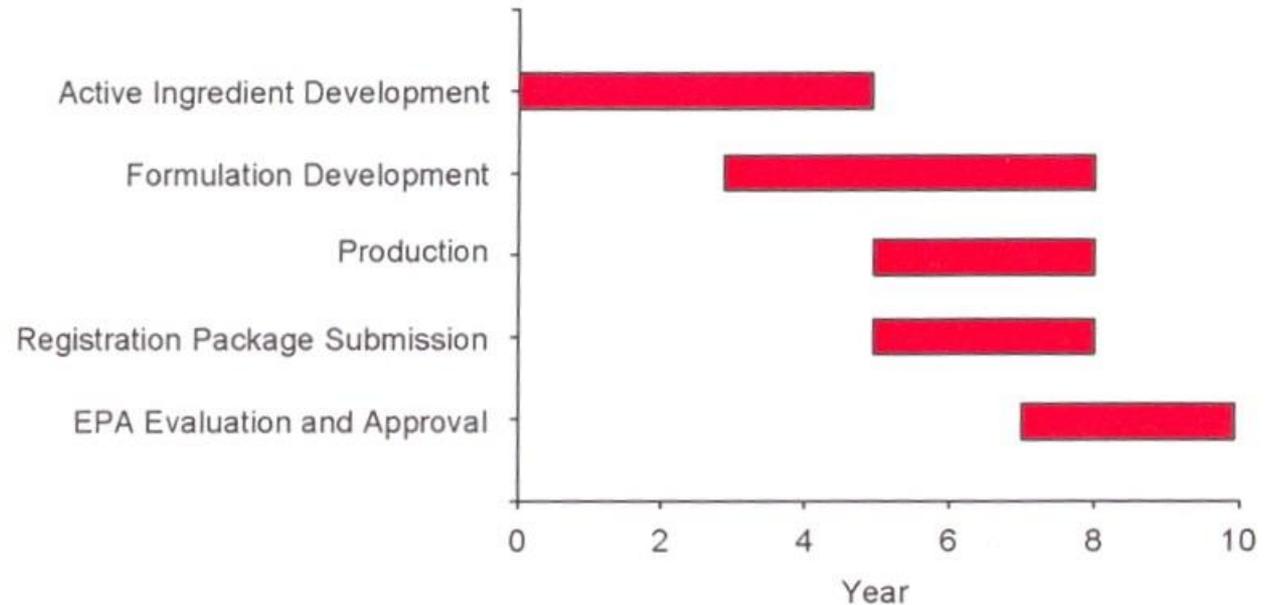
Ammonia and Nitrite still high



# Development of new Piscicides

Expanding EPA label requirements for new piscicides

- 8-10 years



- Costs \$7 – \$35 million

# Ammonia is already registered as a Pesticide – a huge advantage!

## PAN Pesticides Database - Chemical Toxicity Studies on Aquatic Organisms

### Toxicity Studies for Ammonia on Fish - Toxicology studies from the primary scientific literature on aquatic organisms

Use(s): Insecticide, Deer Repellent, Fungicide    Chem Class: Inorganic    U.S. EPA  
PC Code: 005302    CAS Number: 7664-41-7

## Ecotoxicity for Ammonia

### All Toxic Effects for Organism Group

<u>Organism Group</u>	<u>Effects Noted</u>
<a href="#">Amphibians</a>	Population
<a href="#">Annelida</a>	Mortality, Population
<a href="#">AquaticPlants</a>	Behavior, Mortality, Physiology
<a href="#">Crustaceans</a>	Accumulation, Behavior, Biochemistry, Development, Growth, Intoxication, Mortality, Physiology, Population
<a href="#">Echinoderms</a>	Development, Reproduction
<a href="#">Fish</a>	Accumulation, Behavior, Biochemistry, Enzyme(s), Feeding Behavior, Genetics, Growth, Histology, Immunological, Mortality, Physiology, Population
<a href="#">Insects</a>	Mortality, Population
<a href="#">Molluscs</a>	Behavior, Development, Growth, Intoxication, Mortality, Physiology, Population

# Avenue we are currently pursuing for authorization to use ammonia experimentally as a piscicide

**Arizona Department of Agriculture**

**Special Local Needs (SLN) Section 24(c) pesticide registration**

“SLN registrations play an important role in Arizona pest control. These Registrations allow a pesticide to be used for up to 5 years for purposes that are not permitted on the original label.”



# Conclusions

- **Carbon dioxide – Great tool!**
  - **Usefulness likely limited to smaller ponds**
- **Ammonia – Great for fish removal**
  - **100 % effective at 0.25 ml/gal**
  - **Inexpensive and easy to apply**
  - **Lower doses may also be effective**
  - **May not work for crayfish eradication!**

**Just need SLN pesticide registration for larger scale experimentation**