

Eradication of invasive aquatic species using carbon dioxide and liquid ammonia



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“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

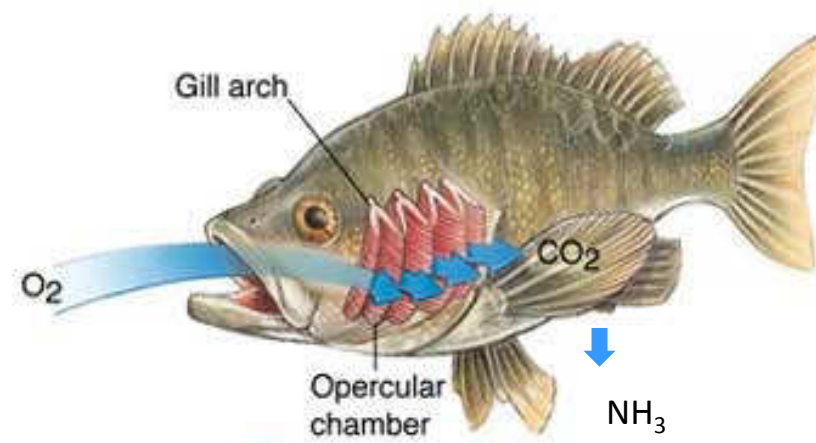


Completion Report
Interagency Agreement Number: 01-AA-32-0040

Dawson and Kolar 2003

Why CO₂ 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 CO₂ in 1,000 gallons of water

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



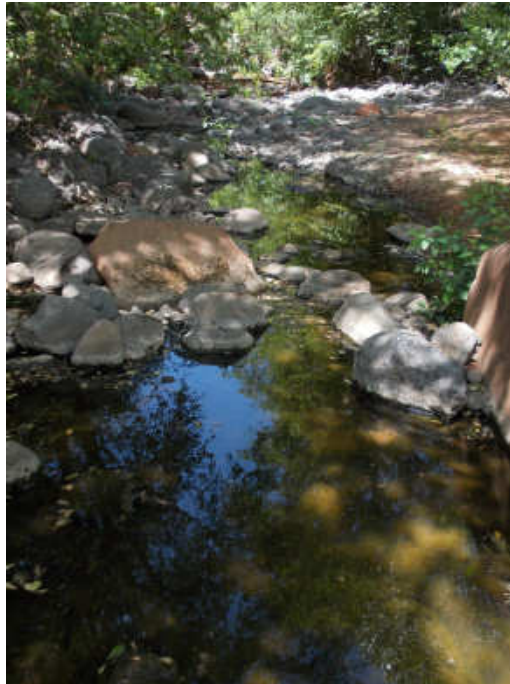
13 lb bag - \$7



2 gallons muriatic acid - \$16

= Treatment for 4,000 gallons

Isolated pools near Verde River, June 2014



Isolated pool near Verde River, June 2014



Other Applications





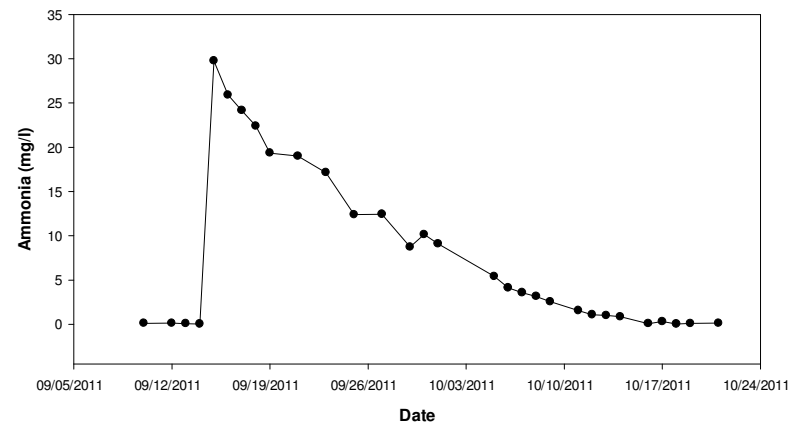
Ammonia

- 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



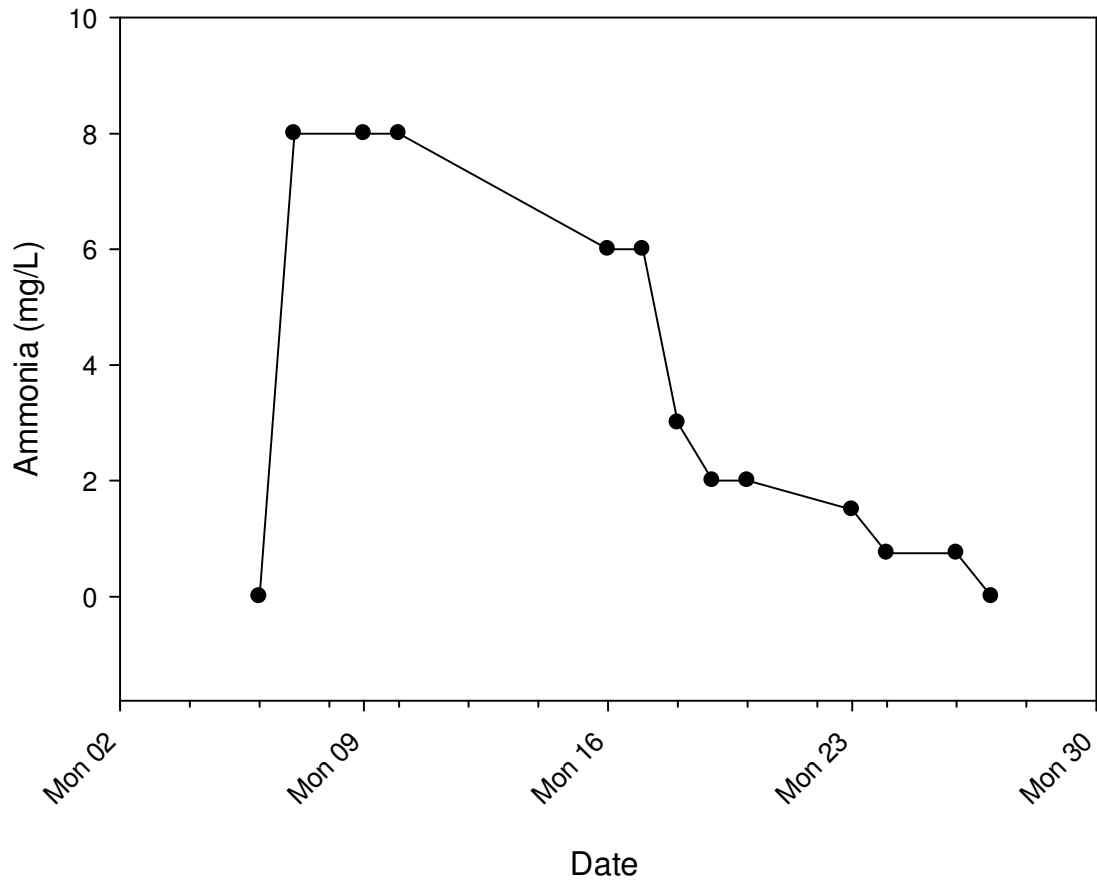
**750,000 Gallons
(284,000 liters)**

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



Some crayfish still alive - pond is still toxic



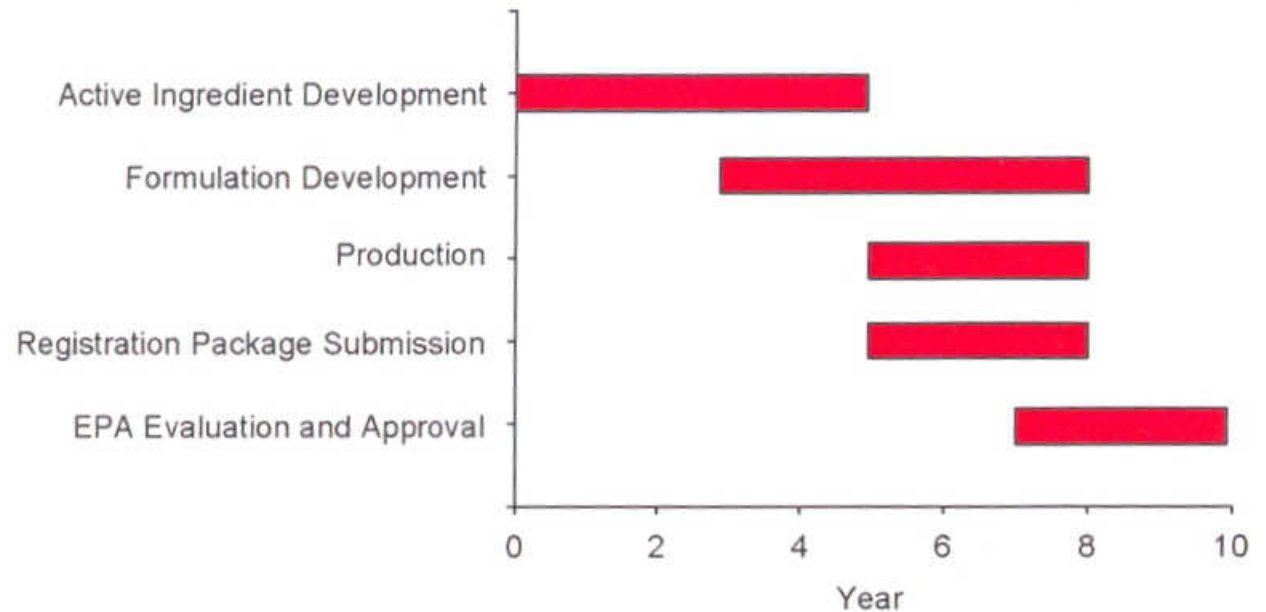
Nov 4th – 7 live crayfish caught
Nov 13th – 6 live crayfish caught
Dec 30 – Pond frozen over
Ammonia and Nitrite still high



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>
Amphibians	Population
Annelida	Mortality, Population
AquaticPlants	Behavior, Mortality, Physiology
Crustaceans	Accumulation, Behavior, Biochemistry, Development, Growth, Intoxication, Mortality, Physiology, Population
Echinoderms	Development, Reproduction
Fish	Accumulation, Behavior, Biochemistry, Enzyme(s), Feeding Behavior, Genetics, Growth, Histology, Immunological, Mortality, Physiology, Population
Insects	Mortality, Population
Molluscs	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