AMMONIA:
ROAD TO REGISTRATION

BUREAU OF RECLAMATION

NAU

USGS
science for a changing world

MARKING L.L. ET. AL(1992)

EVALUATION OF TOXICANTS FOR THE CONTROL OF CARP AND OTHER NUISANCE FISHES

Table 1. Chemicals used by fishery managers prior to 1970 regulatory restrictions.

1. ammonia
2. antimycin (Fintrol)
3. Aqualin
4. Bayluscide (Bayer 73)
5. calcium carbide
6. chlorine
7. copper sulfate
8. croton seed powder
9. Dichlorvos
10. Dibrom-malathion
11. endrin
12. Guthion
13. ichthyothercol (cunambi)
16. phosphamidon
17. polychlorpinene
18. rotenone
19. saponins
20. sodium cyanide
21. sodium hydroxide
22. sodium pentachlorophenate
23. sodium sulfite
24. Squoxin
25. Lampricide TFM
26. Thanite
27. Thiodan
28. tobacco waste

DIVIDE TANK

- CRAYFISH ARE HARD TO KILL BUT IT CAN BE DONE
- SEASONAL CONDITIONS A FACTOR
- HIGHER DOSE THAN FISH AND LONGER DURATION
- FOLLOWING YEAR FOUND YOUNG OF YEAR

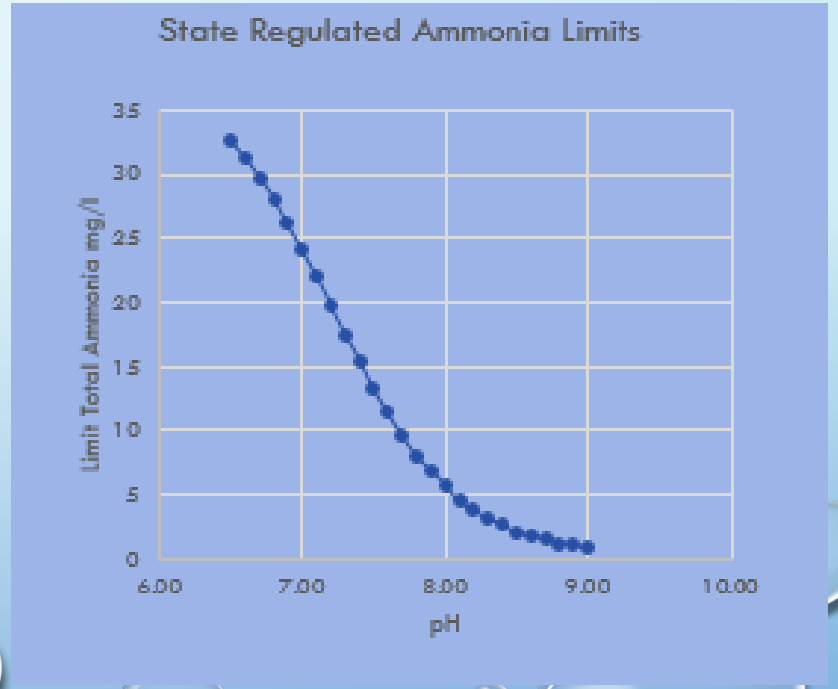
LEES FERRY SLOUGH

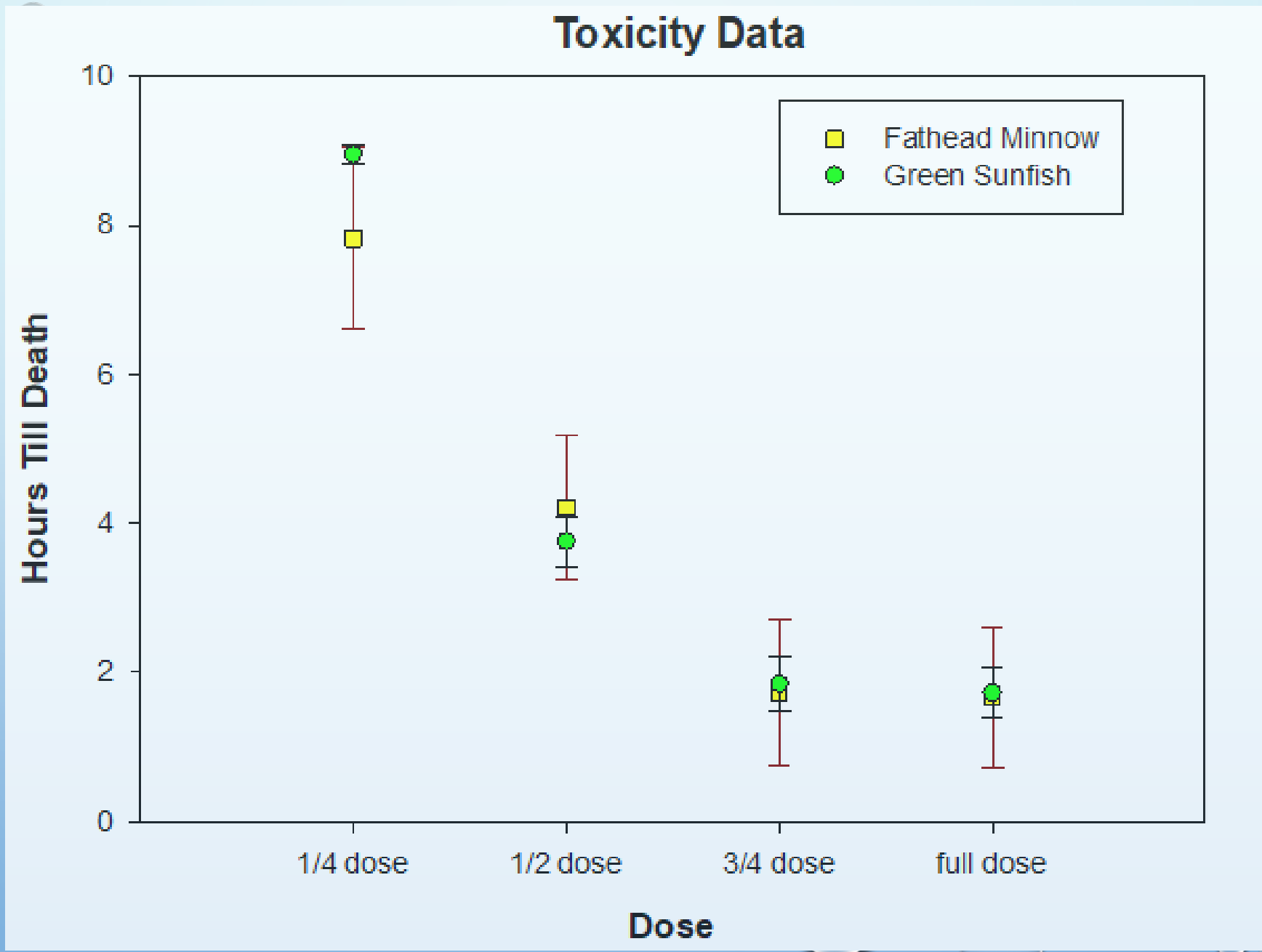
- TREATED WITH ROTENONE IN 2015
- TREATED WITH LIQUID AMMONIA IN 2016
- COVERED WITH BLACK PLASTIC IN 2017
- TREATED WITH POWDERED AMMONIA IN 2017

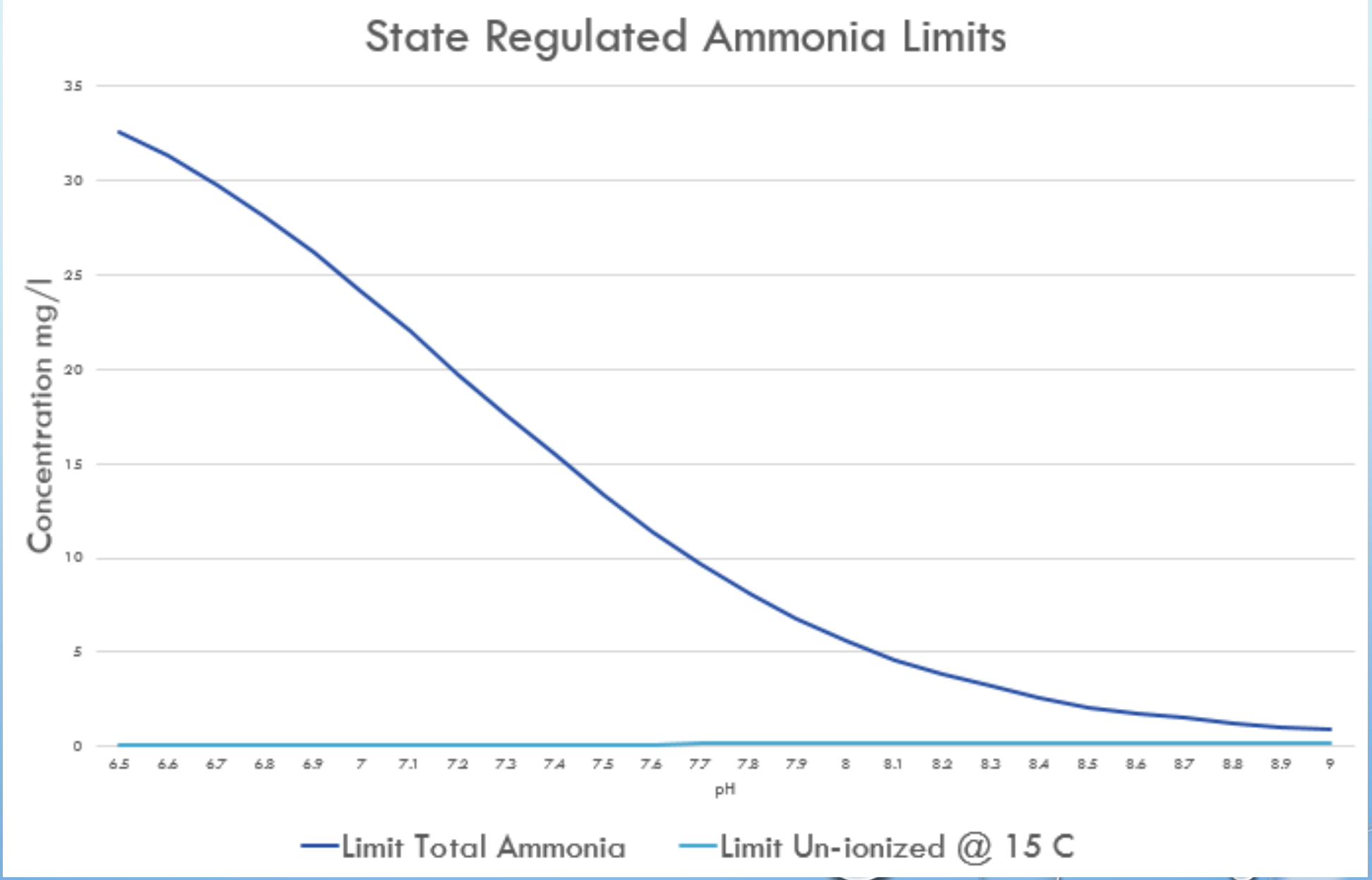
TOXICITY TRIALS 11/19

- 24 HOURS
- 8 AQUARIA
- 4 DOSES (100% 75% 50% 25% OF PRESCRIBED NH3)

  *=PARTS SODIUM CARBONATE AND SODIUM SULFITE
- 3 DIFFERENT SPECIES
- MEASURING EFFECTIVENESS AT LOW DOSES

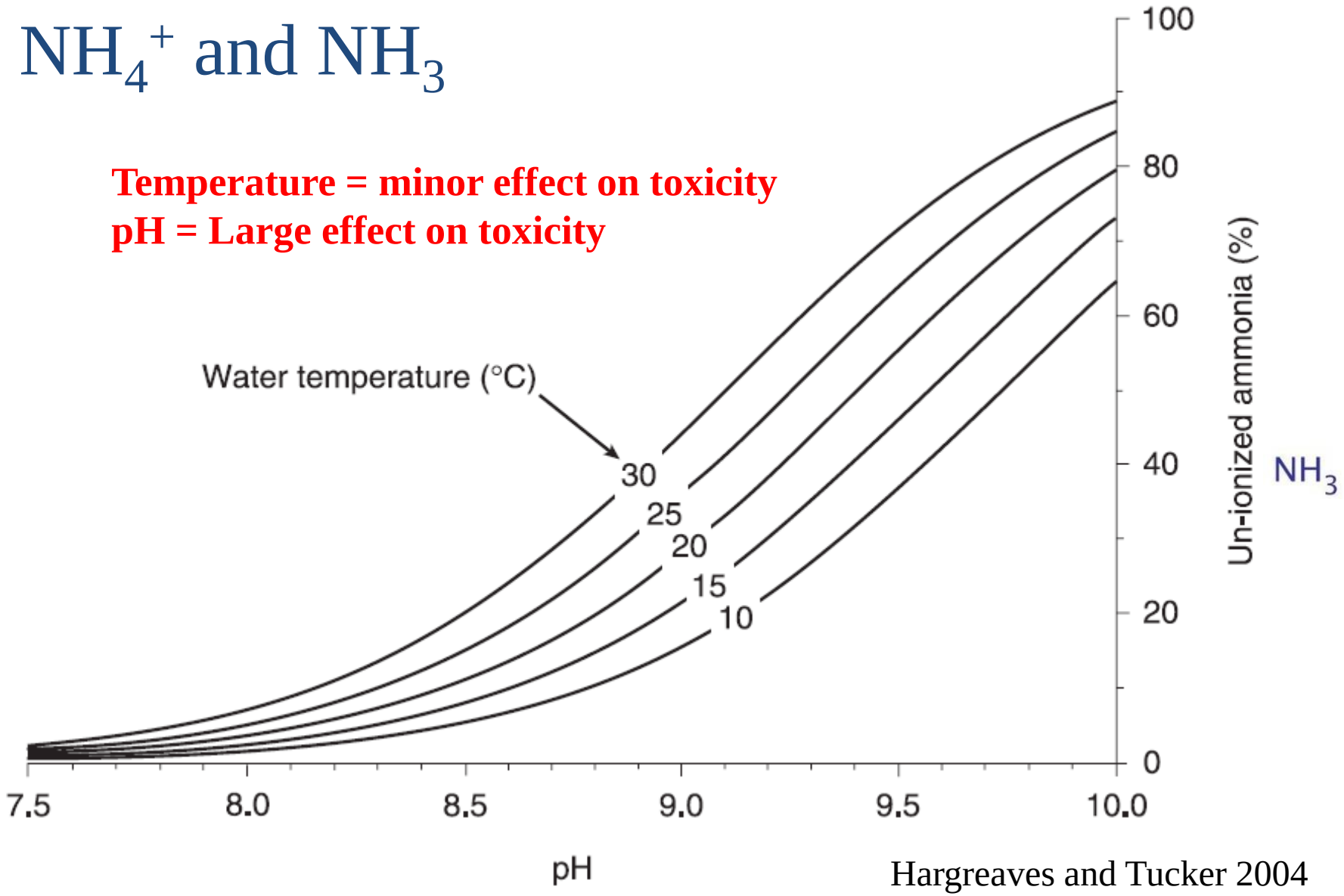



Toxicity Data
Fathead Minnow
Green Sunfish
Hours Till Death
10
8
6
4
2
0
1/4 dose
1/2 dose
3/4 dose
full dose
Dose


State Regulated Ammonia Limits
Concentration mg/l
35
30
25
20
15
10
5
0
6.5
6.6
6.7
6.8
6.9
7
7.1
7.2
7.3
7.4
7.5
7.6
7.7
7.8
7.9
8
8.1
8.2
8.3
8.4
8.5
8.6
8.7
8.8
8.9
9
pH
Limit Total Ammonia
Limit Un-ionized @ 15 C

NH_4^+ and NH_3

Temperature = minor effect on toxicity
pH = Large effect on toxicity

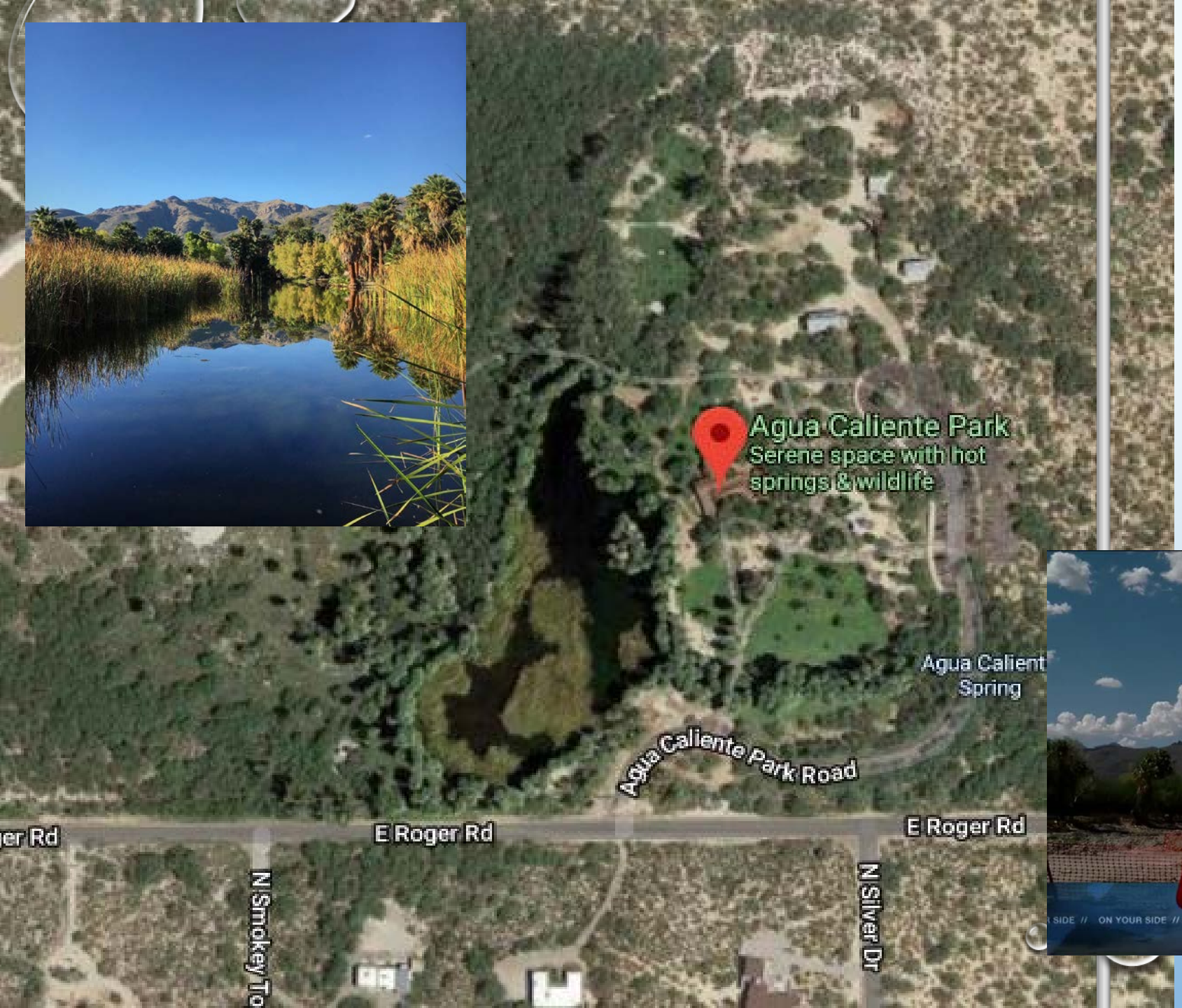


Hargreaves and Tucker 2004

Beal Lake Inlet
Legend
Topock Marsh
Beal Inlet - Topock Side 0.48 Acres
Beal Inlet - Beal Side 0.46 Acres
Google Earth
© 2018 Google
N
2000 ft

AGUA CALIENTE PARK

- CONSTRUCTION HAS PRESENTED A RESTORATION OPPORTUNITY
- MANAGEMENT EXPRESSED A DESIRE TO CREATE NATIVE FISH PONDS



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I5 GSF

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Year	Author	High Range Testec	Low Range Tested	NH3/NH4+,	LC50 value	time (hour:	pH (mean	species	TL (mm)	size(g)	Dissolved	temp.	nat. vs. lab	time in captivi	formulatior	Hardness (mg/L) as (	TDS
44	1984	McCormick			NH3-N	9	96	8.7	GSF		0.0625		22	lab	egg-44d			
45	1984	McCormick			NH3-N	10	72	8.7	GSF		0.0625		22	lab	egg-44d			
46	1984	McCormick			NH3-N	10	48	8.7	GSF		0.0625		22	lab	egg-44d			
47	1984	McCormick			NH3-N	9	24	8.7	GSF		0.0625		22	lab	egg-44d			
48	1984	McCormick			NH3-N	9	12	8.7	GSF		0.0625		22	lab	egg-44d			
49	1984	McCormick			NH3-N	9	6	8.7	GSF		0.0625		22	lab	egg-44d			
50	1984	McCormick			NH3-N	10	3	8.7	GSF		0.0625		22	lab	egg-44d			
51	1973	Jude				0.61	96	7.8	GSF				12.3	lab				
52	1983	Harader			NH4+	0.36	24	7.59-7.9	Chinook Salmon	51		8.8-9.2	11.7	lab			33	
53	1983	Harader			NH4+	0.87	24	6.99-7.26	Chinook Salmon	38		9.5-9.8	11.7	lab			1010	
54	1983	Harader			NH4+	2.19	24	8.38-8.67	Chinook Salmon	46		9.1-9.6	11.7	lab				
55	2002	Meyer			NH3	0.56	24	9.5	Lost R. Suckers	19	0.041	6.5	22.3	lab			51	
56	2002	Meyer			NH3	0.51	48	9.5	Lost R. Suckers	19	0.041	6.5	22.3	lab			51	
57	2002	Meyer			NH3	1.02	24	9.5	Lost R. Suckers	34	0.33	6.5	22.3	lab			51	
58	2002	Meyer			NH3	0.92	48	9.5	Lost R. Suckers	34	0.33	6.5	22.3	lab			51	
59	1996	Ashe			NH3	0.67	96	6.7	White Bass		finger		19.7	lab			5	
60	1993	Oppenborn			NH3	1.01	96	8.3	Striped Bass		*		21	lab			220	
61	1993	Oppenborn			NH3	0.64	96	8.3	Hybrid Striped Bass		*		21	lab			220	
62	1982	Szumski			NH3													
63	1978	Thurston	15.5	55.5	NH3-N	43.6	96	7.8	Salmo Fry		1	8.6	13.1	lab			199	
64	1978	Thurston	12.5	52.5	NH3-N	37.8	96	7.8	Salmo Fry		1	8.4	12.8	lab			199	
65	1978	Thurston	18.7	66.5	NH3-N	36.7	96	7.8	Salmo Fry		3	8.2	12.4	lab			199	
66	1978	Thurston	21.4	65.9	NH3-N	32.4	96	7.8	Salmo Fry		3	8.3	12.2	lab			199	
67	1978	Thurston	0.74	0.86	NH3	0.8	96	7.8	Salmo Fry		1	8.6	13.1	lab			199	
68	1978	Thurston	0.62	0.7	NH3	0.66	96	7.8	Salmo Fry		1	8.4	12.8	lab			199	
69	1978	Thurston	0.56	0.69	NH3	0.62	96	7.8	Salmo Fry		3	8.2	12.4	lab			199	
70	1978	Thurston	0.47	0.59	NH3	0.52	96	7.8	Salmo Fry		3	8.3	12.2	lab			199	
71	1981	Ruffier			NH3-N			7.6						lab	7d	NH4HCO3	340	22.7
72	2003	Fuller			NH3-N	5.86	96	8.5	Gila Trout	125	21					NH4CL		
73	2003	Fuller			NH3	0.47	96	8.5	Gila Trout	125	21							

Acute Chronic
90%
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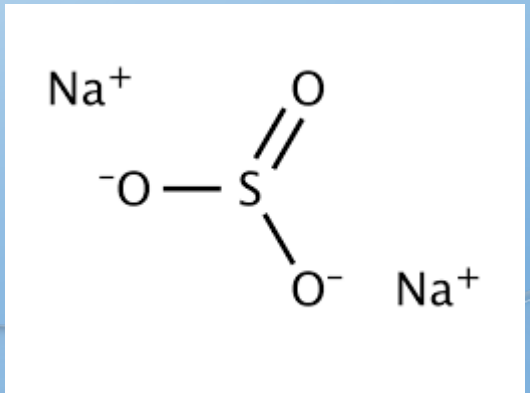
12/4/2019

SODIUM SULFITE

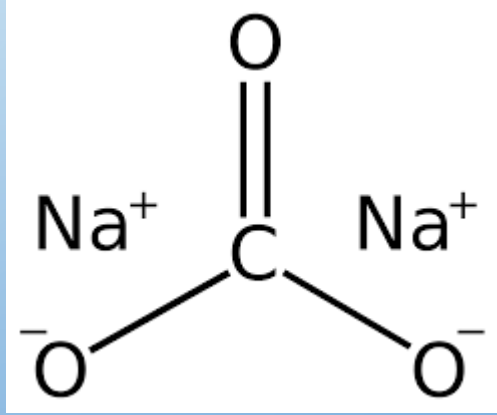
- CO_3^{-2} (AQ)+ H_2O → HCO_3^-(AQ) + OH^-(AQ)
- USED TO PREVENT DISCOLORATION OF DRIED FRUIT AND MEAT
- MOST COMMON OXYGEN SCAVENGER
- CAUSES FISH TO RESPIRE FASTER AND ALLOWS US TO USE LESS AMMONIA
- LESS AMMONIA = FASTER CLEAN-UP

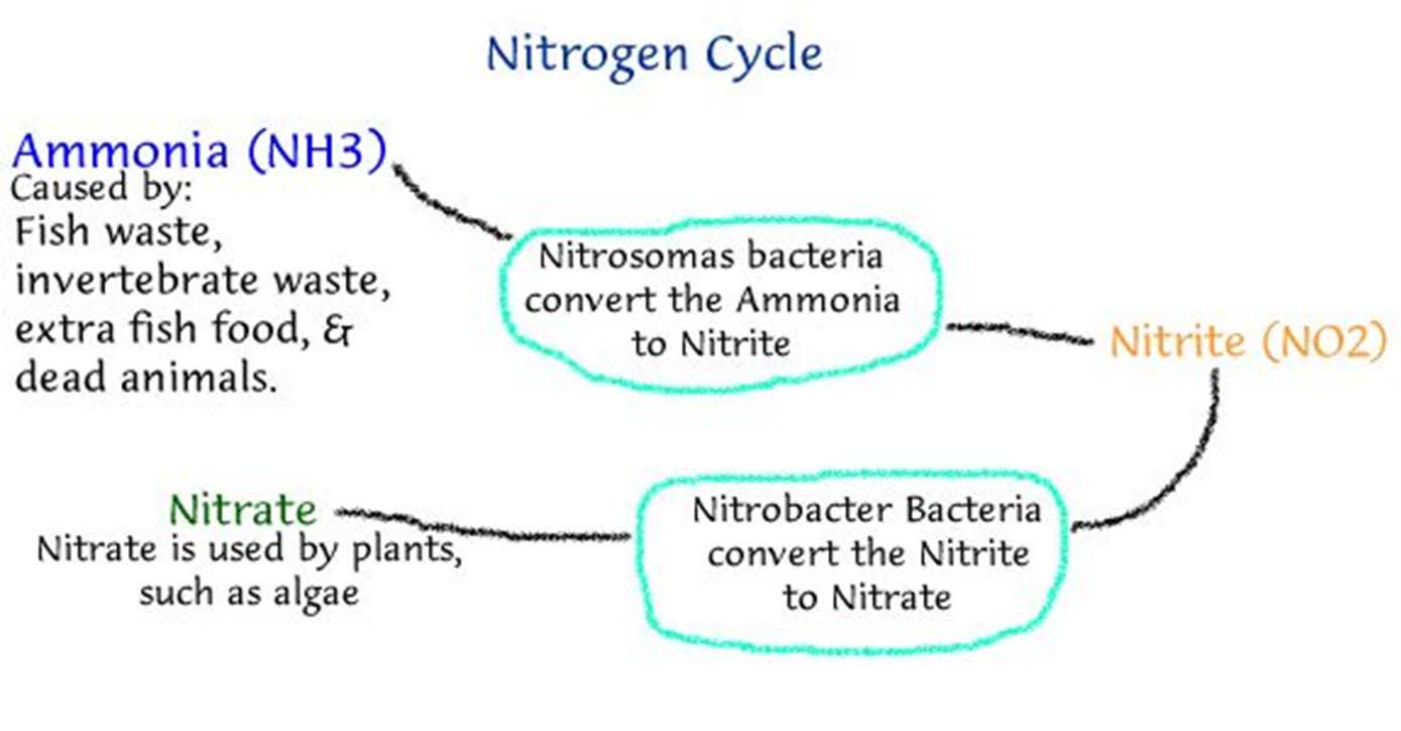


SODIUM CARBONATE
"SODA ASH"

+ Heat

- NA2CO3(S) → 2NA+ (AQ) + CO32-(AQ)
- PRESENT IN ALL TREATED DRINKING WATER
- COOKED BAKING POWDER
- INCEASES PH TEMPORARILY
- BUFFERED BY MINERALS IN THE SUBSTRATE





Why Ammonia?

-easy to monitor

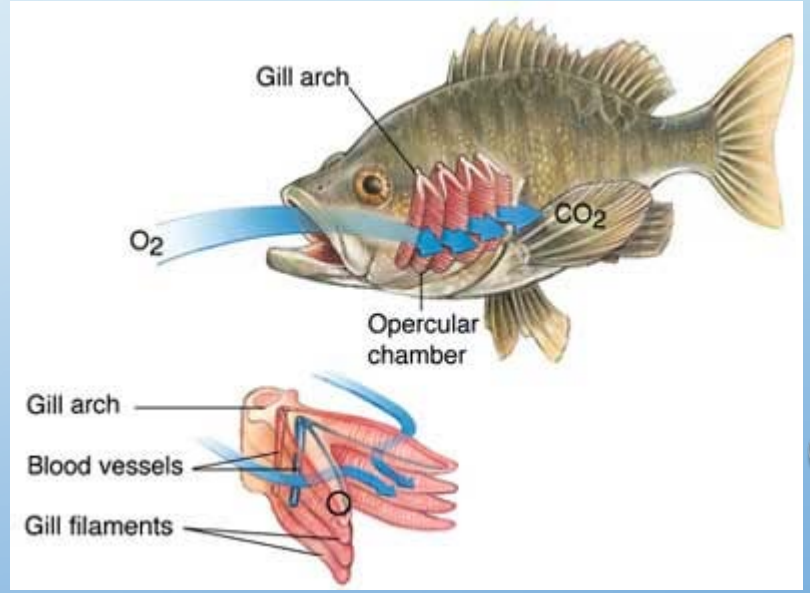
-super effective

-cheap

-promising alternative piscicide

Why not?

-Not registered by the EPA



DAMON MCRAE

- LIQUID TREATMENT
- TOOK MONTHS TO CLEAN UP
- OVERDOSED
- NO PRESENCE OF INVASIVE FISH IN THE FIRST PLACE
- GOOD LEARNING EXPERIENCE

2 / 8 117%

Environmental Protection Agency (EPA), and (5) commit to fill all applicable data requirements. After the registrants generate the additional data, EPA reviews the submissions to determine whether the pesticide can be reregistered.

Presently, the cost to meet basic data requirements for an unregistered pesticide is $5.2 million (R. A. Schnick, U.S. Fish and Wildlife Service, personal communication; Table 2). A compound with unique characteristics requires more extensive tests and increases costs accordingly.

Replacement Fish Toxicants

A search for replacement fish toxicants has continued for several decades, primarily to provide an alternative if rotenone became illegal, in short supply, or too expensive. Candidate toxicants were evaluated by criteria that they should be specific to target species, easy to apply, harmless to nontarget animals and plants, safe to human handlers, subject to rapid and complete degradation or detoxification, nonpersistent in the environment, and registerable with minimum effort and cost. Few chemicals meet all these requirements; consequently, only four of the listed toxicants are fully registered.

Lake and stream reclamation with toxicants is an established, successful, and economic management practice. Worldwide, many intensively managed production ponds are treated with toxicants to eradicate competing or undesired populations of fishes (e.g., antimycin treatments to remove scaled fishes from commercial catfish ponds). Consequently, better or replacement fish toxicants need to be developed. This report summarizes the results of studies

Data requirements	Cost
Background	$ 20,000
Product performance	200,000
Product chemistry	25,000
Hazard evaluation:	
Wildlife and aquatic organisms	310,000
Human and domestic animals	3,325,000
Nontarget plants	10,000
Environmental fate	660,000
Residue chemistry	650,000
Data package	25,000
Total	$5,225,000

Antimycin

Alternate name: Fintrol
Molecular nomenclature: $C_{28}H_4ON_2O_9$
Primary use: Fish toxicant in the United States and Canada
Secondary use: Fungicide; miticide
Toxicity to fishes: (Berger et al. 1969)

Species	96-hour LC50 (µg/L)
Rainbow trout	0.04
Common carp	0.35
Fathead minnow	0.21
Bluegill	0.14

Toxicity to mammals: Highly toxic to mice, rats, rabbits, guinea pigs, dogs, and lambs.

Safety hazard: Conjunctivitis; protect eyes with safety glasses.

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QUESTIONS,
COMMENTS,
CURSORY REMARKS?