Acute and chronic effects of ammonia and copper on 2-month-old juvenile mussels

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Chicago, IL, August 23 and 24, 2005

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Study objective

Evaluate acute and chronic toxicity of ammonia and copper to 2-month-old juvenile mussels in water-only exposure

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Conditions for static tests with juvenile mussels

Test species: Pink mucket, rainbow, fatmucket
Test type: Static renewal
Chemicals: Copper sulfate or ammonia chloride
Test duration: 10 d (also check survival on Day 2 and 4)
Temperature: 20±1ºC
Photoperiod: 16L:8D
Test solution volume: 40 ml
Age of organism: 2-month old
organisms/chamber: 5
replicates/concentration: 4
Feeding: None
Dilution water: ASTM hard (170 mg/L, pH 8.3)
Dilution: Control and 5 concentrations
Water quality: DO, pH, hardness, alkalinity, and conductivity
Endpoint: Survival (foot movement)
Acceptability: >90% survival in control

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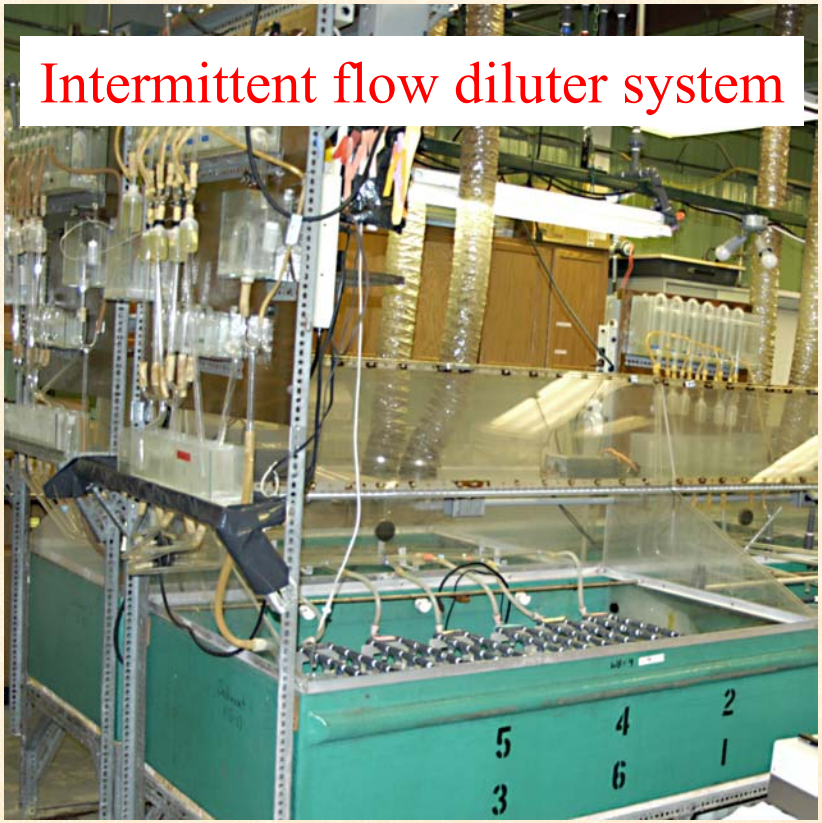
Conditions for flow-through tests with juvenile mussels



Test species: Rainbow, fatmucket, pink mucket
Test type: Flow-through
Test duration: 28 d (also check survival on Day 4, 10, or 21)
organisms/chamber: 10
replicates/concentration: 4
Temperature: 20±1°C
Test solution volume: 200 ml
Feeding: Twice daily with instant algae
Dilution: Control and 5 concentrations
Water quality: DO, pH, hardness, alkalinity, conductivity, ammonia, and DOC

Endpoint: Survival (foot movement); Growth (shell length)
Acceptability: >80% survival in control

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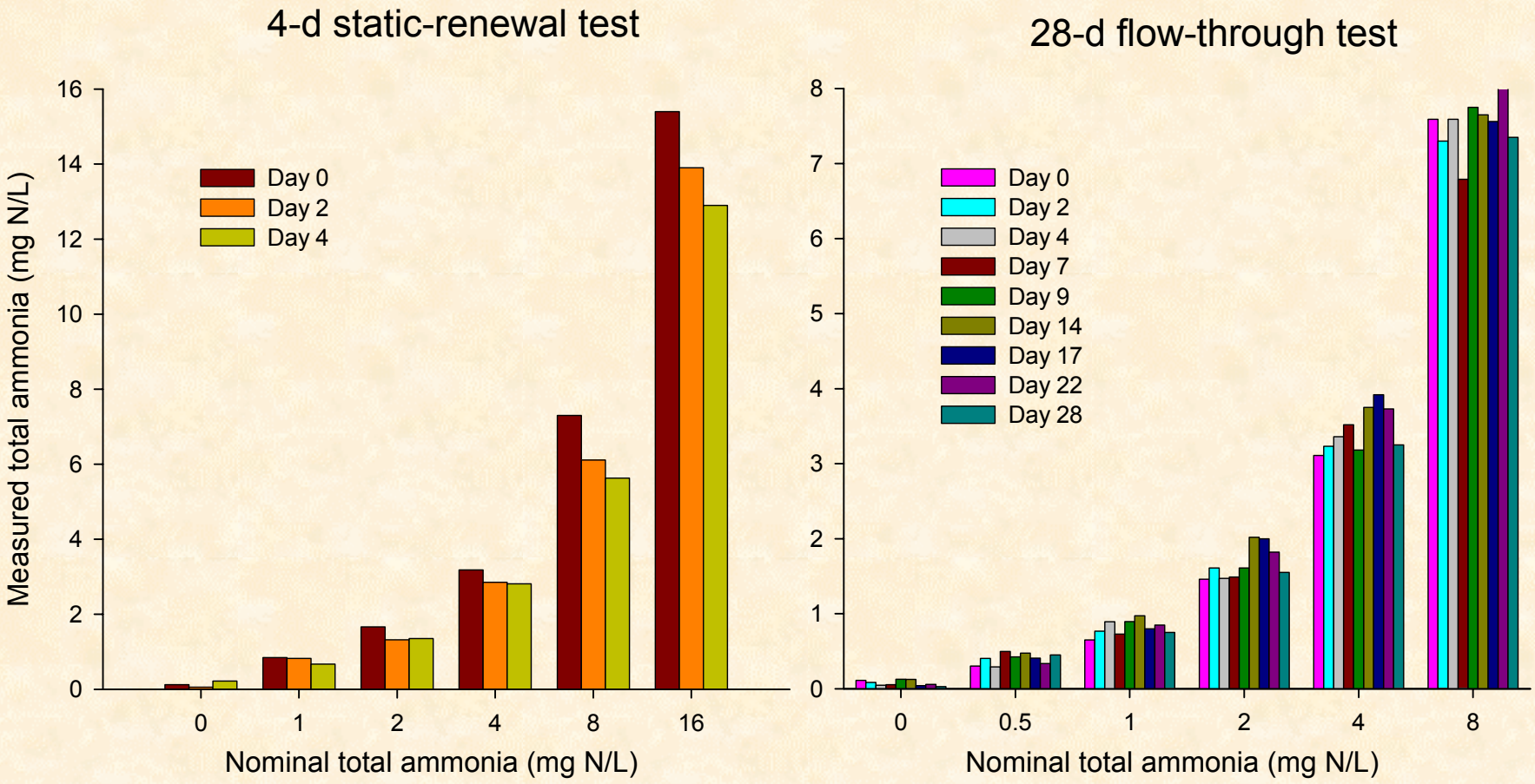
Measured total ammonia concentrations during 4- and 28-d test with juveniles of rainbow mussels



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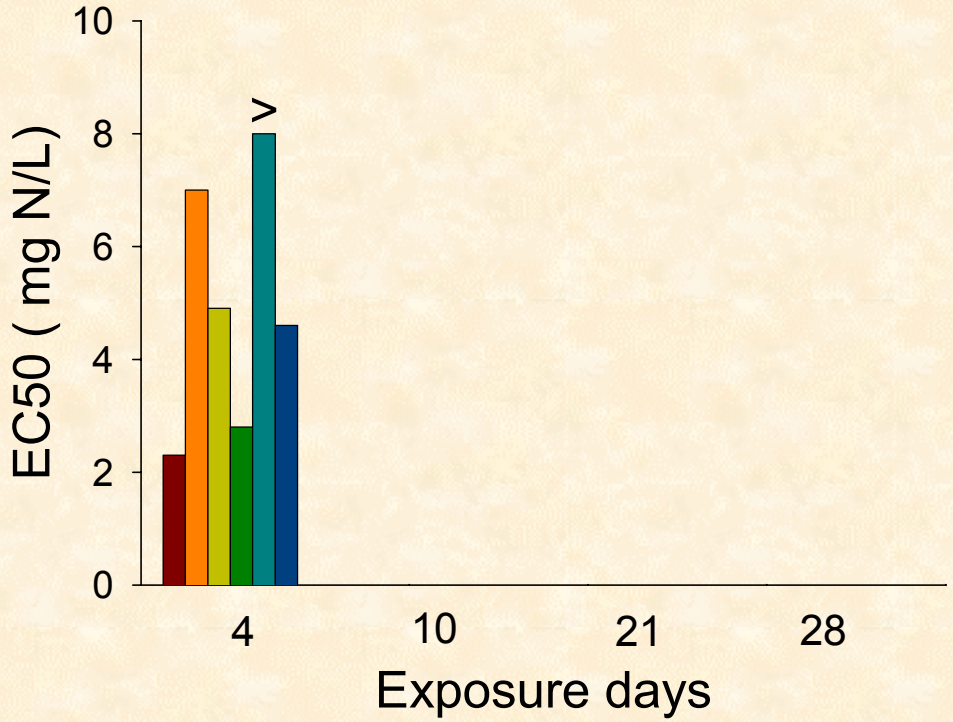
Total ammonia EC50s for survival of 2-month-old juvenile mussels



Pink mucket* (static-renewal)
Rainbow (static-renewal)
Fatmucket (static-renewal)
Pink mucket* (flow-through)
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Fatmucket(flow-through)

* US federal endangered species

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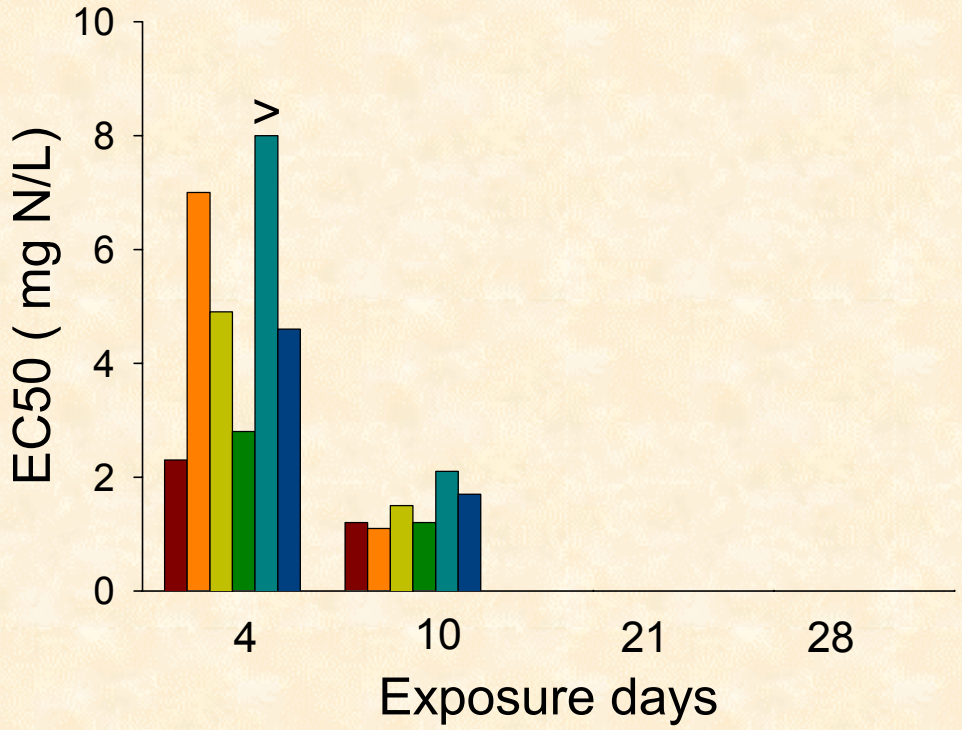

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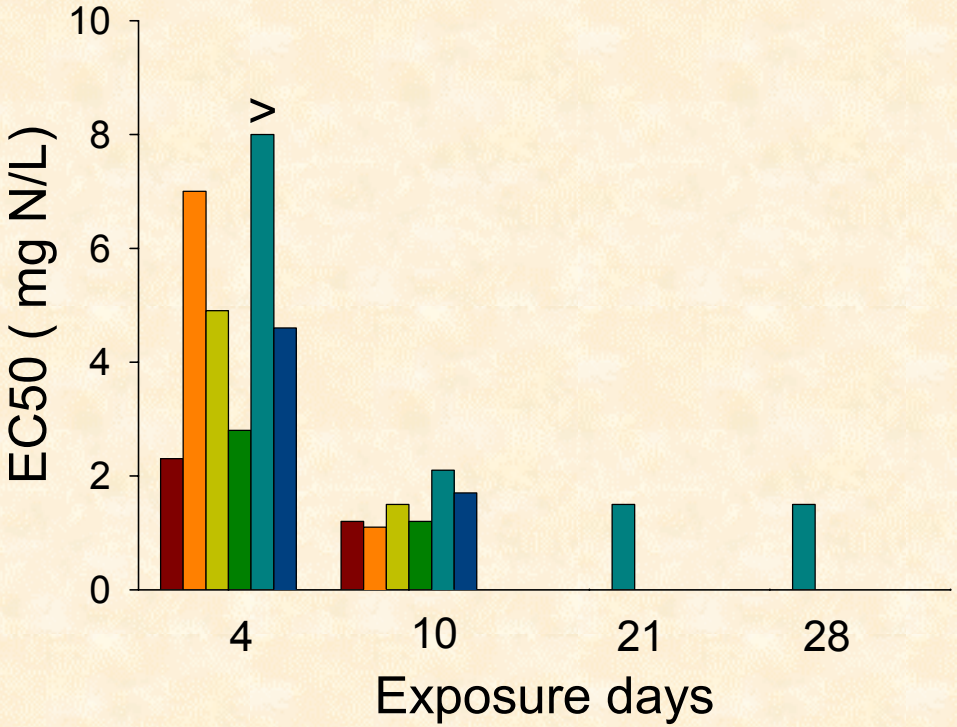

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Mean (±SD) survival and shell length of mussels by the end of 28-d ammonia tests

Total ammonia (mg N/L)	Rainbow	
	Survival (%)	Length (mm)
Control	100 (0)	1.52 (0.11)
0.5	98 (5)	1.32 (0.05) *
1	98 (5)	1.10 (0.08) *
2	15 (24) *	
4	0 *	
8	0 *	
NOEC	1.0	<0.5
LOEC	2.0	0.5
Chronic Value	1.4	<0.5
IC10	1.1	<0.5

* significant reduction relative to controls (Dunnett's test, $p < 0.05$)

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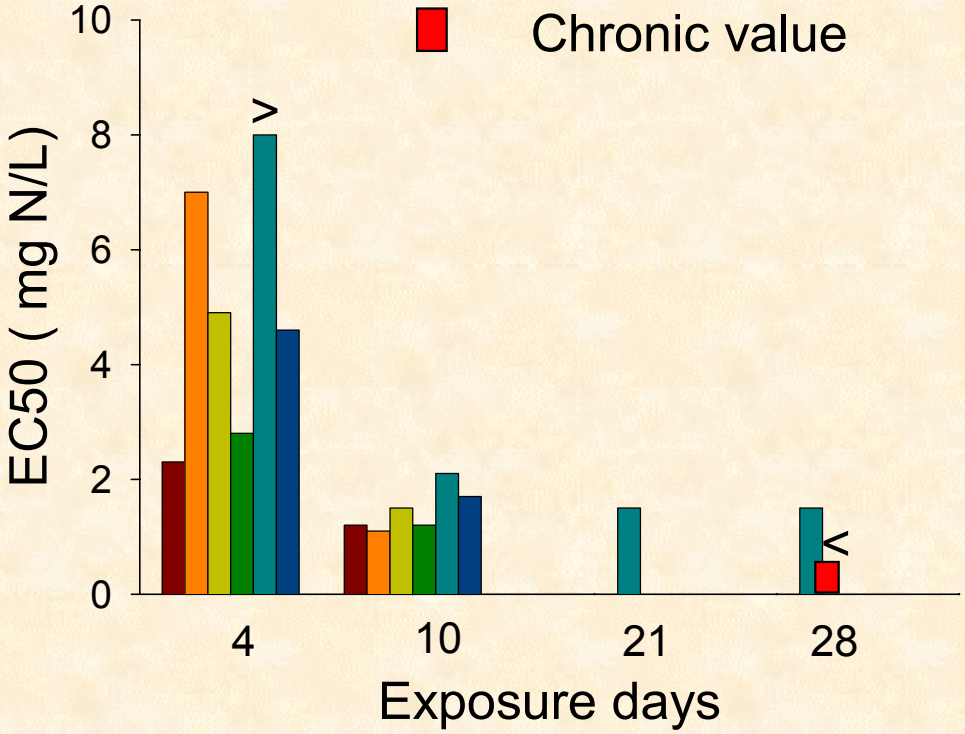
Total ammonia EC50s for survival and chronic values for survival and growth of 2-month-old juvenile mussels



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Acute-Chronic Ratio:
>20 for rainbow

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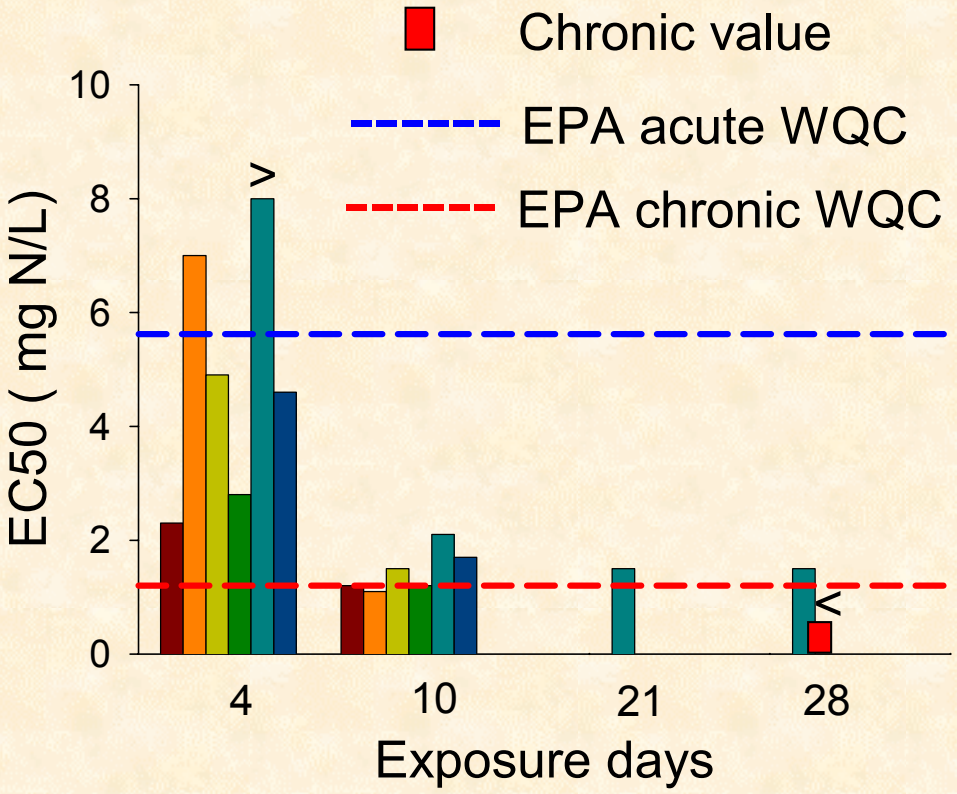
Total ammonia EC50s and chronic values for 2-month-old juvenile mussels



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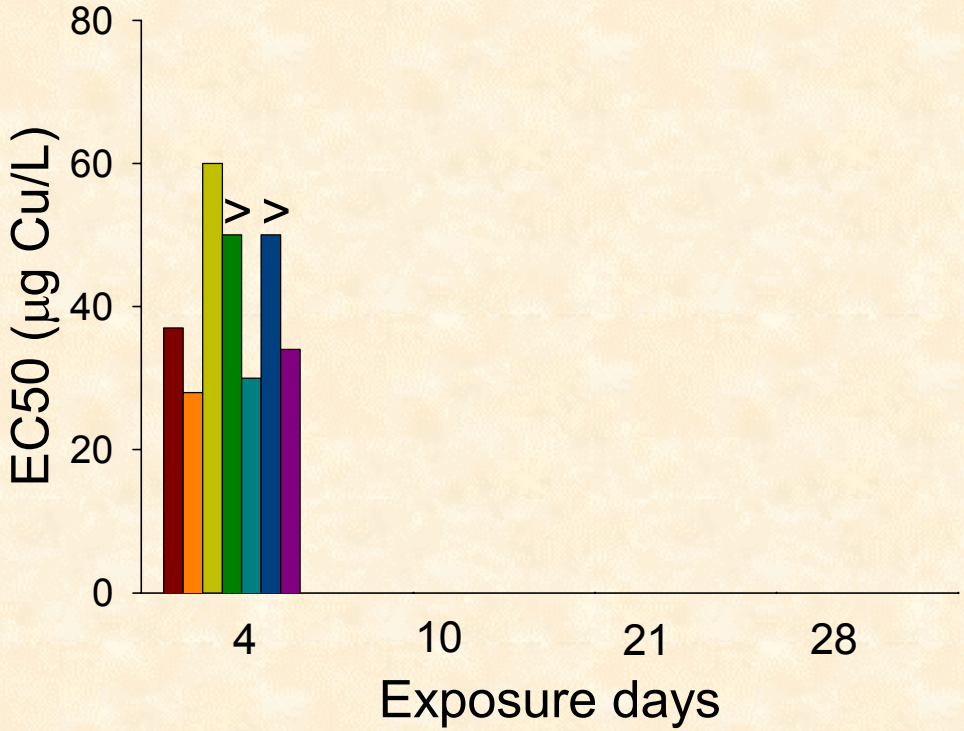
Copper EC50s for survival of 2-month-old juvenile mussels



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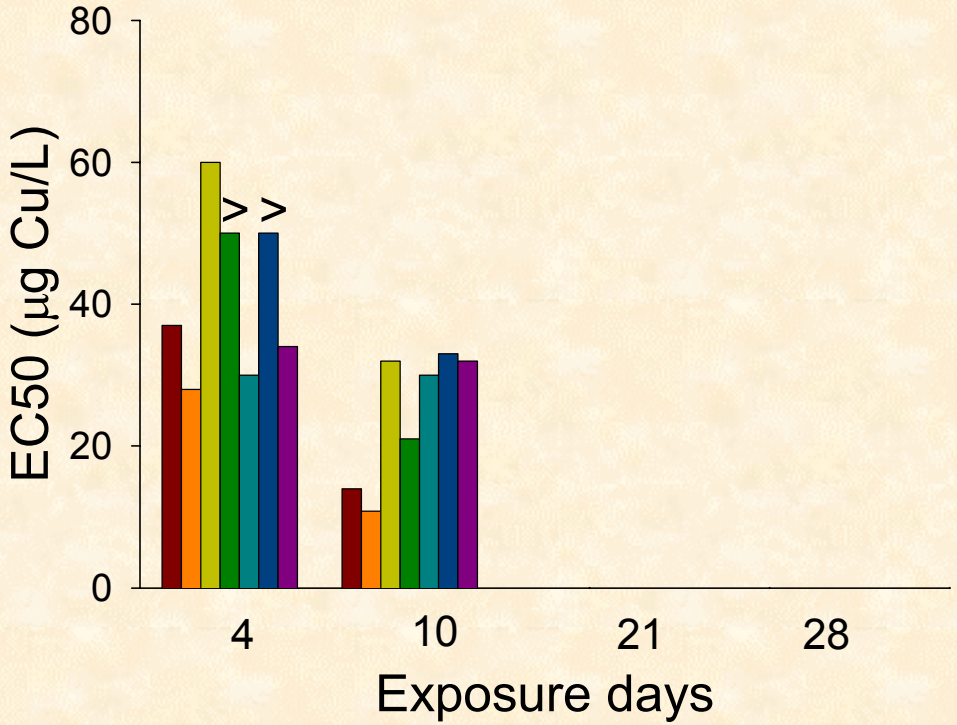

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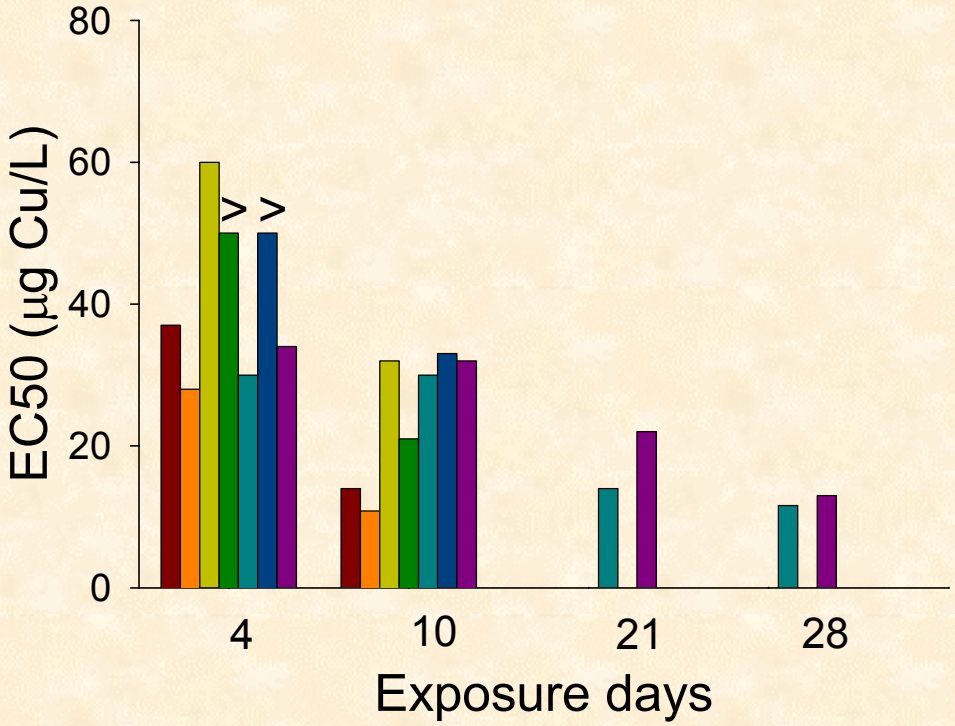

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Mean (±SD) survival and shell length of mussels by the end of 28-d copper tests

Copper (ug/L)	Rainbow		Fatmucket	
	Survival (%)	Length (mm)	Survival (%)	Length (mm)
Control	88 (10)	1.31 (0.11)	98 (5)	1.15 (0.11)
3.125	96 (7.5)	1.34 (0.11)	80 (14)	1.30 (0.19)
6.25	68 (13)	1.13 (0.05) *	80 (12)	1.09 (0.12)
12.5	48 (29) *		58 (17) *	
25	13 (19) *		5 (10) *	
50	0 *		0 *	
NOEC	6.1	3.1	6.3	6.3
LOEC	12.5	6.3	12.5	12.5
Chronic Value	8.7	4.4	8.8	8.8
IC10	4.3	5.3	<3.125	5.9

* significant reduction relative to controls (Dunnett's test, $p < 0.05$)

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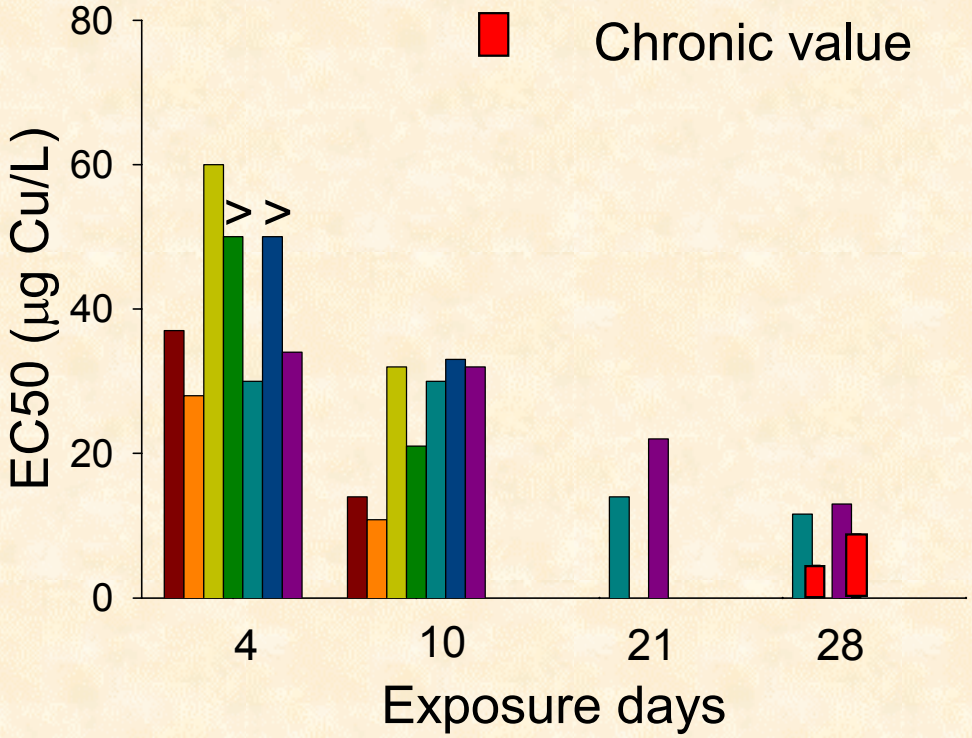
Copper EC50s for survival and chronic values for survival and growth of 2-month-old juvenile mussels



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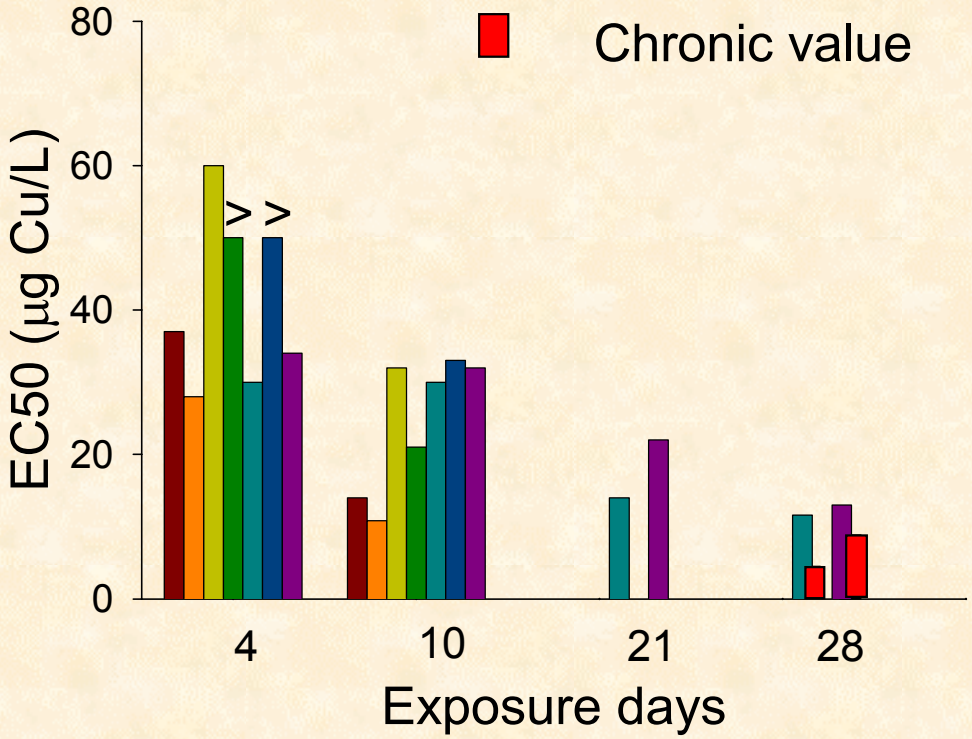

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Acute-Chronic Ratio:
5.4 for rainbow
6.8 for fatmucket

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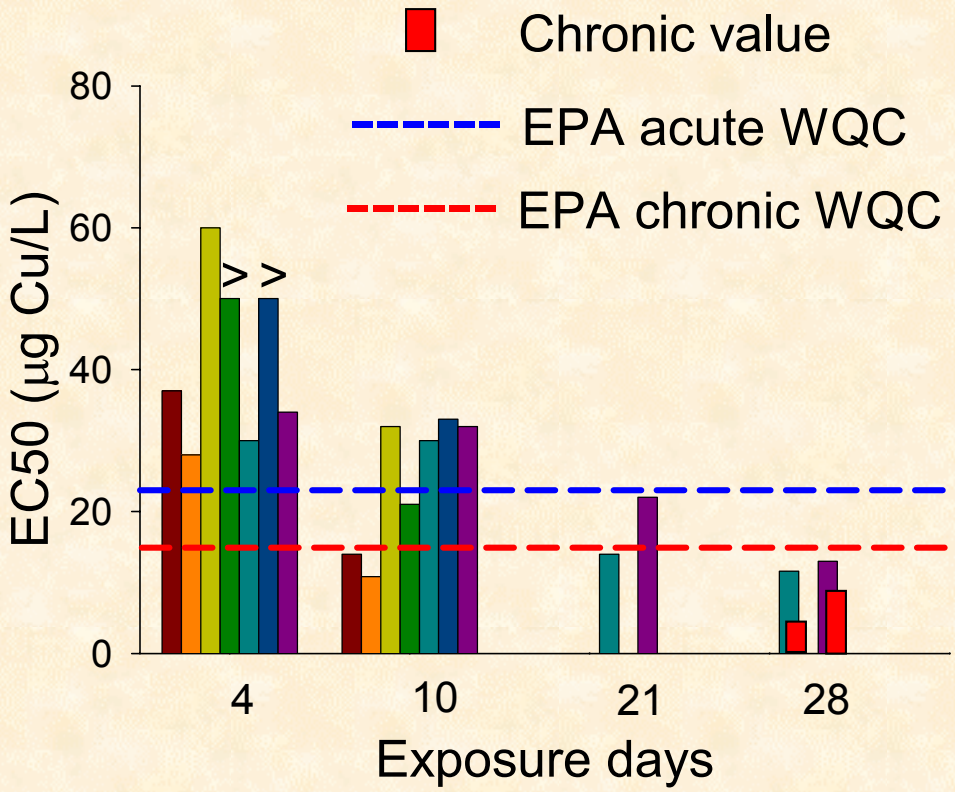
Copper EC50s and chronic values for 2-month-old juvenile mussels



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Conclusions

- Control survival met test acceptability requirements outlined in ASTM E2455-05
- Growth was generally more sensitive than survival in chronic tests
- Effect concentrations decreased with exposure period during the 28-d ammonia and copper tests

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Conclusions (cont)

- 96-h copper EC50s were above the EPA acute WQC, whereas 96-h ammonia EC50s were at or below the WQC
- Chronic effect concentrations of copper and ammonia were below the EPA chronic WQC

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