Principles of a National Strategy for the Conservation of Freshwater Mollusks

Bob Anderson, U.S Fish and Wildlife Service , Pennsylvania Field Office

Commercial Exploitation 1900 to 1941

- U.S. Bureau of Fisheries
  - Fairport Laboratory 1908- ~1941
    - 1914 (Curtis and Lefevre)
    - 1920's (Coker)
    - 1930's (Ellis)

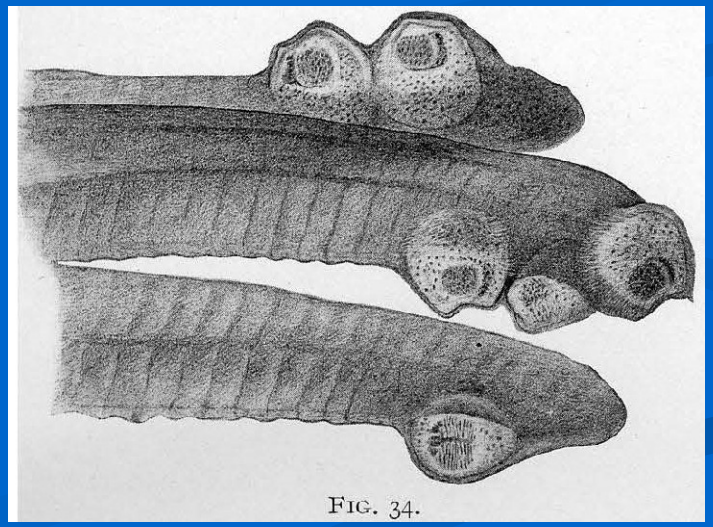
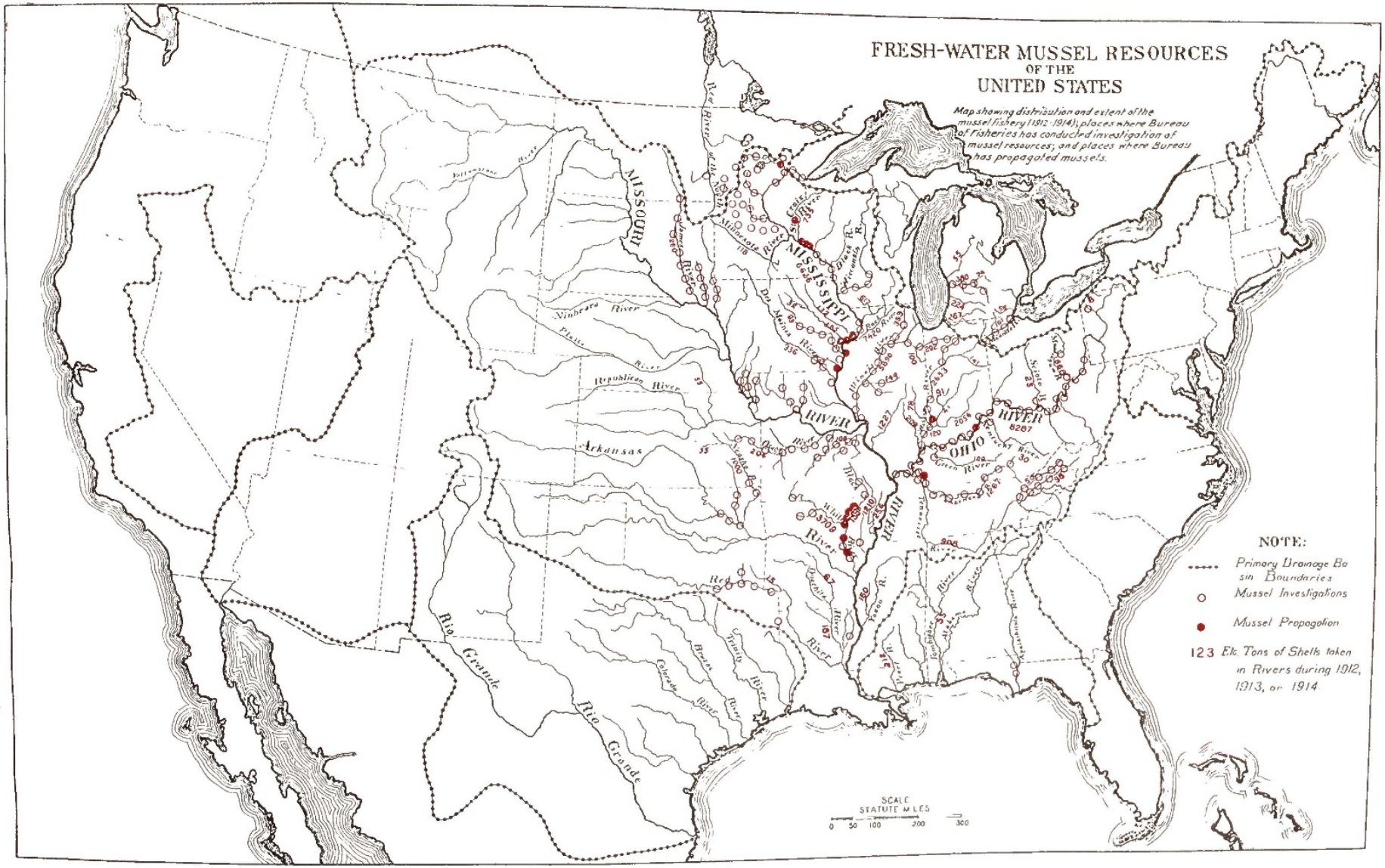


FIG. 34.

Coker 1910



From: Coker, R. 1919. Freshwater mussels and mussel industries of the United States. U.S. Bureau of Fisheries.

Systematic habitat destruction 1930s – 1970s

- Endangered Species Protection Act of 1966
- Endangered Species Conservation Act of 1969
- Endangered Species Act of 1973 (as amended)

Enigmatic declines 1970s to 1990s

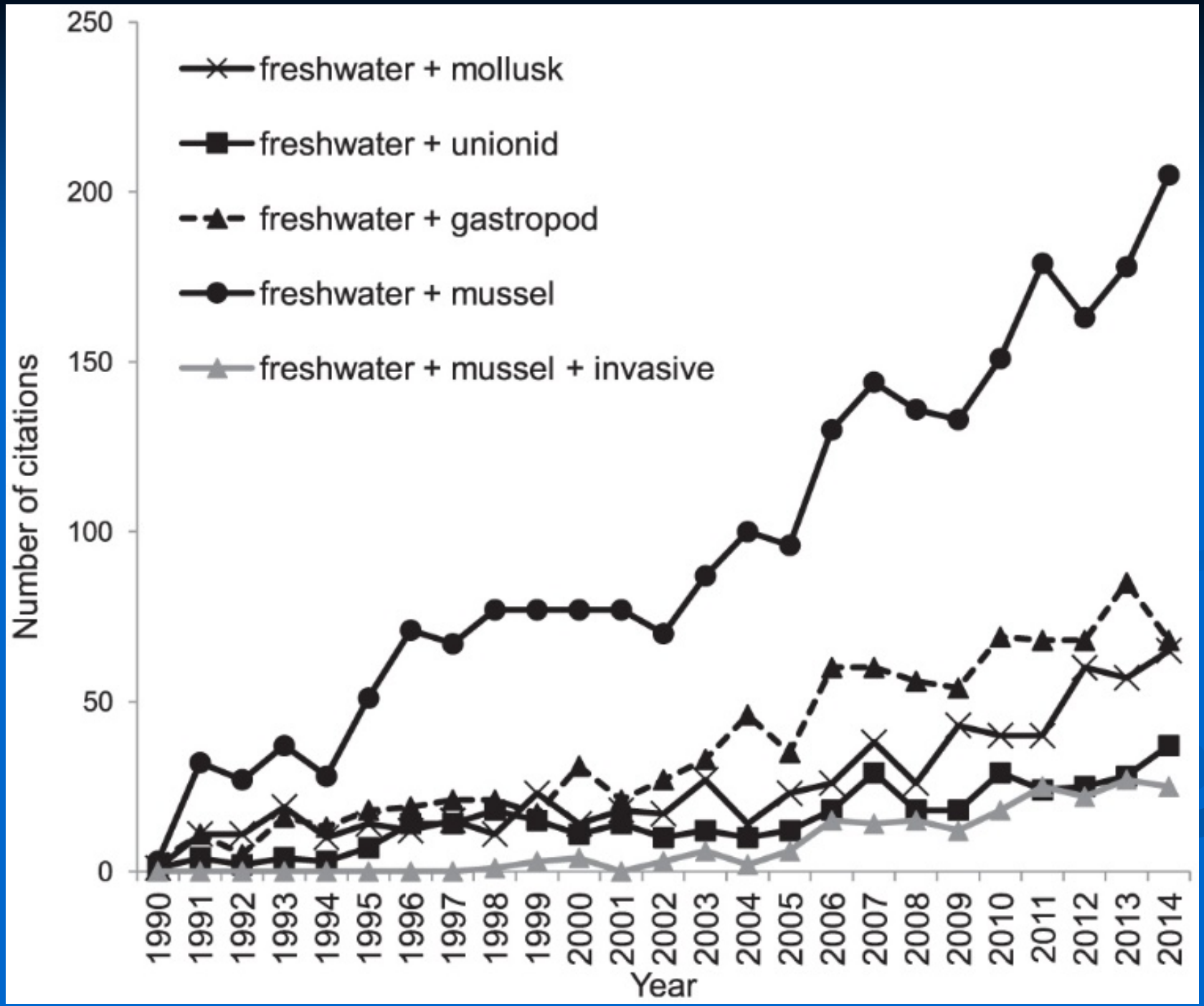
- Mussel populations crashed abruptly
- Often in otherwise intact streams
- Fragmentation and isolation significant

Faunal Group	Extinct Species	Federally listed imperiled species	Imperiled species from independent assessments
Mussels	29 (10%)	8328%)	199 (65%)
Aquatic snails	67 (10%)	24 (4%)	452 (64%)
Fishes	30 (1%)	122 (5%)	700 (39%)
Crayfish	2 (<1%)	4 (1%)	172 (47%

Adapted from Haag and Williams 2016

1999 National Strategy

1. Need a coordinated national strategy
2. Habitat is being lost
3. Basic biology unknown
4. Distribution and health is lacking
5. Anthropogenic factors are negatively affect mussels but poorly documented
6. Zebra mussels a new and significant threat
7. Ecological and economic value by public lacking
8. Need to develop mussel reintroduction techniques
9. Need captive holding techniques
10. Need funding


freshwater + mollusk
freshwater + unionid
freshwater + gastropod
freshwater + mussel
freshwater + mussel + invasive
Number of citations
0
50
100
150
200
250
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year

2016 National Strategy

1. Distribution and taxonomy of mollusks
2. Impacts of past, ongoing, and emerging
3. Conserve the quantity and quality of suitable habitat
4. Understand ecology at multiple scales
5. Restore abundant and diverse mollusk populations
6. Identify the ecosystem services
7. Strengthen advocacy
8. Educate and train the conservation community
9. Seek consistent, long-term funding
10. Coordinate a national strategy

Issue 1: Increase knowledge of their distribution and taxonomy at multiple scales

1.1. Continue to refine knowledge of systematics, taxonomy, and genetic structure of species.

1.4. Identify uniform data collection and reporting standards that will support periodic status assessments.

Goal: Understand the status and trends of mollusk populations to better manage and conserve species.

Issue 2: Address the impacts of past, ongoing, and newly emerging stressors

2.1. Describe risks:

- Contaminant
- Runoff
- Invasive species
- Climate change

Manage threats:

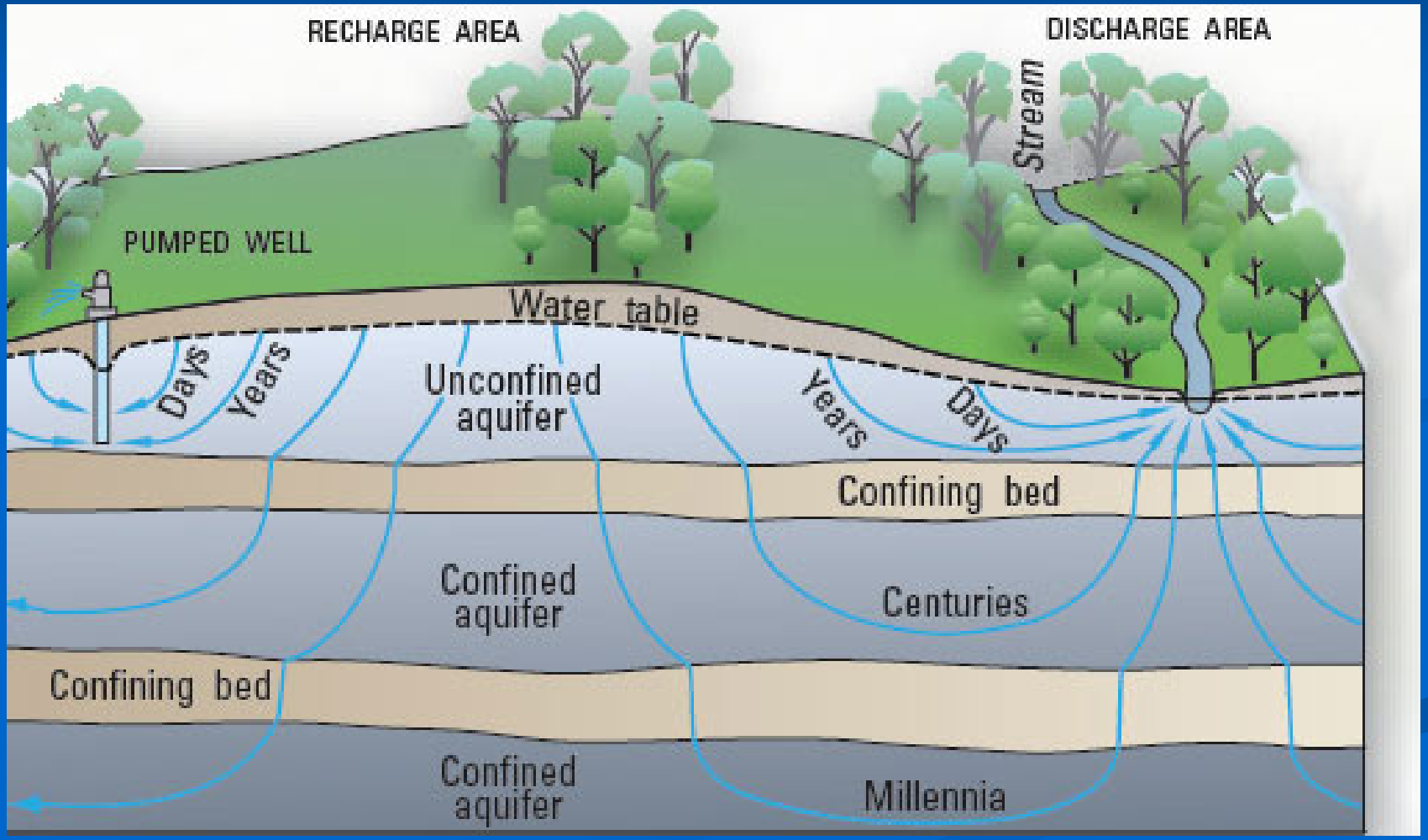
2.5. Work to modify water quality criteria, develop new standards, TMDL to protect mollusks

2.6. Advocate for consistent enforcement of environmental laws

2.7. Early detection and rapid response to invasive species

Goal: Minimize threats to mollusks and their habitats.

Groundwater Ecology



Gleick, 1996

Water Quality

- Ammonia (EPA 2013 – 17 mg/L; 1.9 mg/L at pH 7 and 20^{O}C)
- Metals
- Nutrients
- Some Pesticides
- Chloride
- Sediment

Integrated physical and biotic variables

90% survival at 96 days

Chronic stress evident in 'defaunted' streams compared to streams with a health mussel community

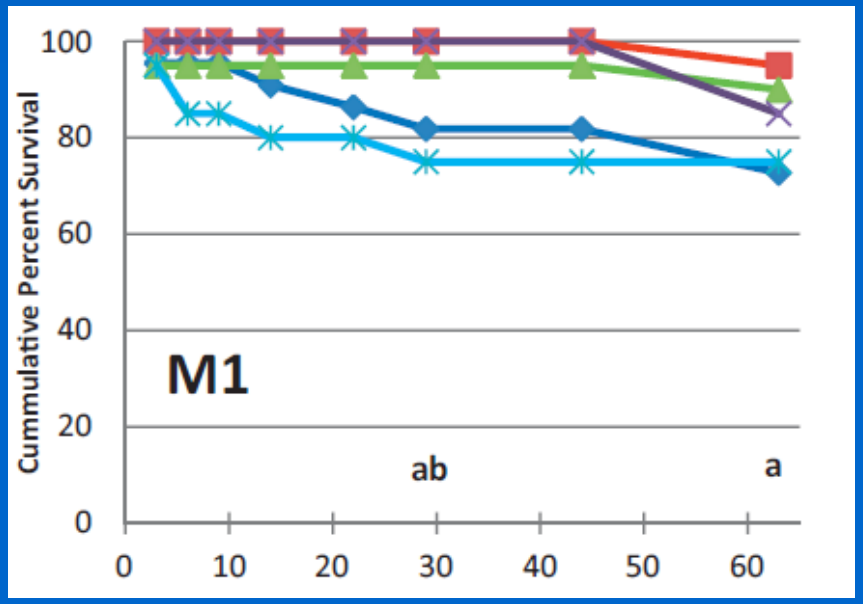
Growth is a sensitive endpoint for assessing mussel responses to stream conditions

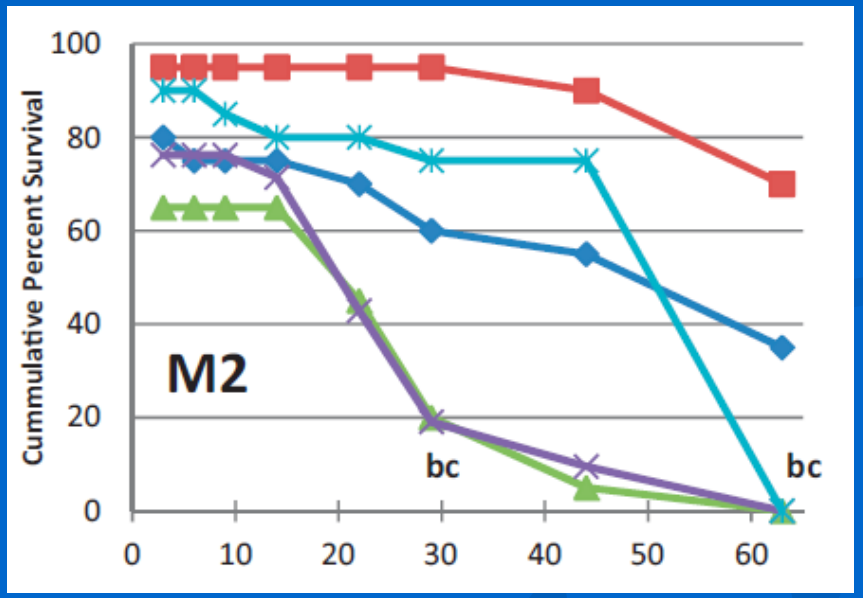
Association of growth reduction with agricultural contaminants

The technique is especially valuable for measuring sublethal or chronic effects

Haag et al. 2019

Direct exposure





Upstream control

Downstream exposure

Patnode et al. 2015

Issue 3: Understand and conserve the quantity and quality of suitable habitat

3.4 Identify climate change resilient habitats

3.6. Conserve and restore habitats

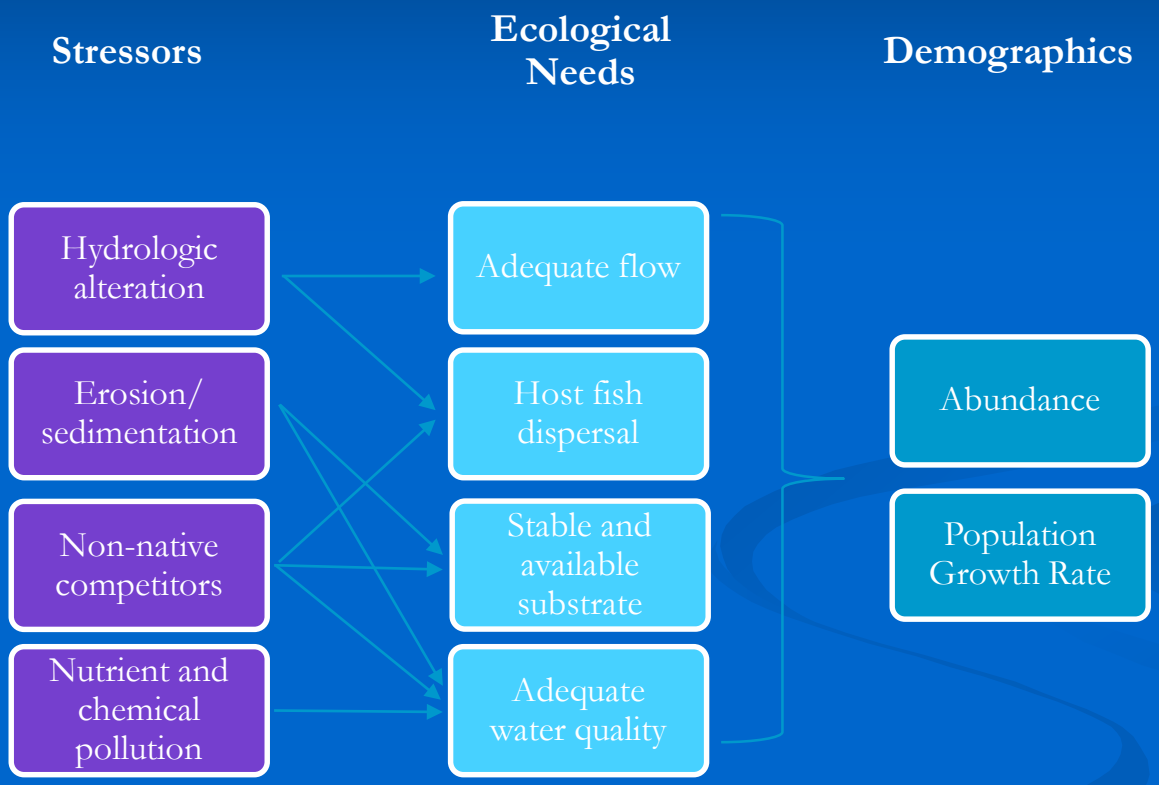
3.7. BMPS for management and restoration

3.8. Develop effective mitigation alternatives

3.5. Reduce habitat fragmentation

Goal: Increase understanding of physical, chemical, and biological characteristics of habitat to support sustainable assemblages of mollusks.

Conceptual Model



Restoration and management

- Fish passage
- Stream Bank / Slope Stabilization
- Hydrologic and Hydraulic Modeling
- Dam Removals
- Riparian Enhancement / Reforestation
- Invasive Species Control

Issue 4: Understand their ecology at the individual, population, and community levels

4.7. Develop population goals for managing rare and common species.

4.3. Describe ecological function

Goal: Increase fundamental knowledge of the biology of mollusks so managers can more effectively conserve them.

Issue 5: Restore abundant and diverse populations until they are self-sustaining

5.1. Develop indices to monitor and evaluate sustainability over time

5.2. Develop conservation and restoration plans

5.5. Identify uniform methods for augmentation and reintroduction

Goal: Conserve and restore viable populations and communities of mollusks.

Issue 6: Identify the ecosystem services provided by mollusks and their habitats

6.1. Describe ecosystem services provided by mollusks to humans and river ecosystems

Goal: Improve science-based consideration of the social and economic values of mollusk communities and functioning aquatic systems.

Outreach, support, training, monitoring, adaptive management

Issue 7. Strengthen advocacy

Issue 8: Educate and train the conservation community

Issue 9. Seek consistent, long-term funding

Issue 10. Coordinate a national strategy