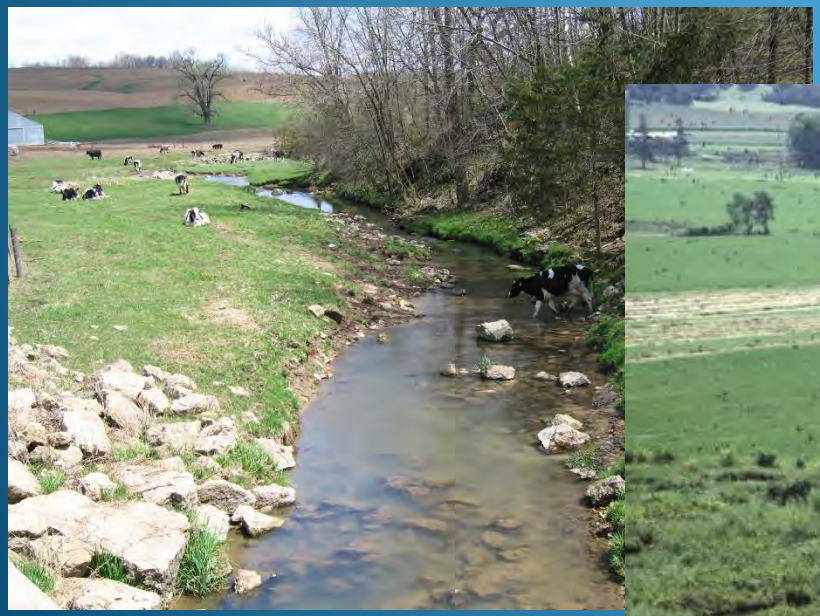
Healing Sick Streams



Healing Sick Streams

Resilient Ecosystems
Not
Artificially Restructured Channels

Aldo Leopold 1926

Credit: Aldo Leopold Foundation

Mount Vernon Creek
Dane County, Wisconsin

Aldo Leopold, 1926

April 14, 1944

SICK TROUTSTREAMS

In the Southwest I have seen many a mountain stream which carried trout when stockmen arrived in the 1880's become a dry rockpile, wet only during floods, at the present time.

Our Wisconsin troutstreams will never experience so radical a change because our rains and our soils are gentler. But all streams, including ours, deteriorate for the same causes:

1. Overgrazing, especially of steep slopes.
2. Exhaustion of organic matter in the soil.

Both have the same effect: they allow the rain to run off instead of sinking in.

It is not within the power of fishermen to rebuild the soils of Wisconsin, but they can do a lot of good by rebuilding the streambank itself. At least they can show the public a few samples of what a "civilized" streambank ought to look like.

My advice is: let's build our samples on headwaters, for floods are less severe there, and there is less chance of their washing out plantings and fences. Plantings in plowland need not be fenced, but plantings in pastures must be. Stick to native trees and shrubs, especially those found elsewhere on the same stream. Be careful not to choke the flood channel with tall trees on both banks; this may cause the creek to move elsewhere. Do not plant tall trees on banks which undercut; they may pry off chunks of bank and thus accelerate erosion. Do not put expensive plantings vulnerable to rabbits near rabbit cover.

I heartily commend the Association for its courageous attack on this difficult problem.

Aldo Leopold

Aldo Leopold, 1944

Credit: Aldo Leopold Foundation

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Furthered the relationship of trust: I heartily commend the Association for its courageous attack on this difficult problem.

Leopold did NOT say: "Build channel devices."

Criteria of Health

1. Inherent potentiality realized, not overstrained or underused; no inherent capacity lacking.
2. Condition stable, not on its way to exhaustion.
3. Capable of response or adjustment to ordinary perturbations with least energy expended . . .
4. Need for external support at an absolute minimum . . . no doctor in visible attendance.

"[T]he natural power of adapted entities to repair themselves if allowed the opportunity . . . is available to the perceptive resource manager whenever he can resist the temptation to think that human destiny is a bigger box of monkey wrenches."

Neess, John. 1974. Protection and preservation of lakes. Unpublished talk, UW-Extension Conference on Lake Protection, University of Wisconsin-Madison campus, October 22, 1974. Available from R. White: rw@seanet.com.

Focus of Talk

Wadable trout streams
in present or former agricultural areas.

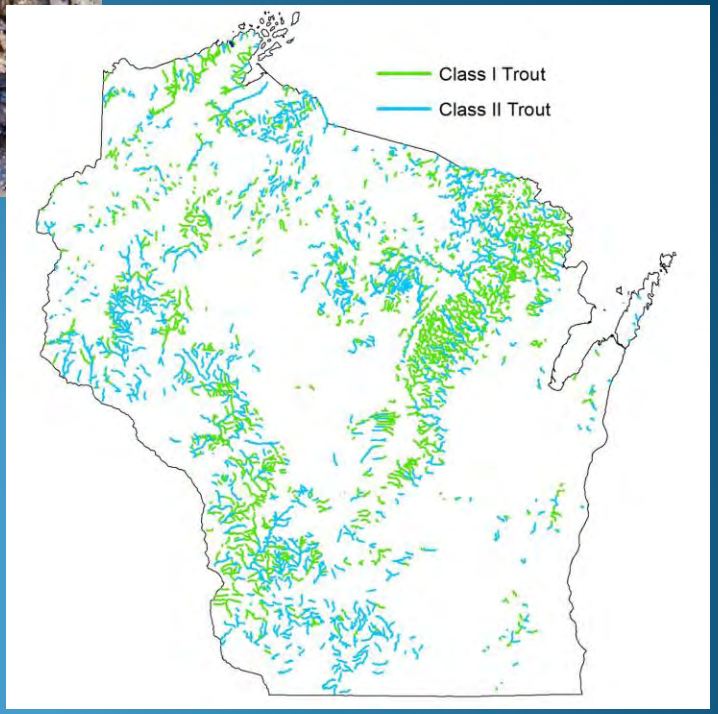
Groundwater-fed, i.e., spring creek trout streams 11,485 mi. (18,483 km) in Wisconsin.

Riparian vegetation.

NOT streams that are urban, dammed, or infrastructure-constrained.

What went wrong with Wisconsin's program to manage stream habitat for trout.

What to do about it.

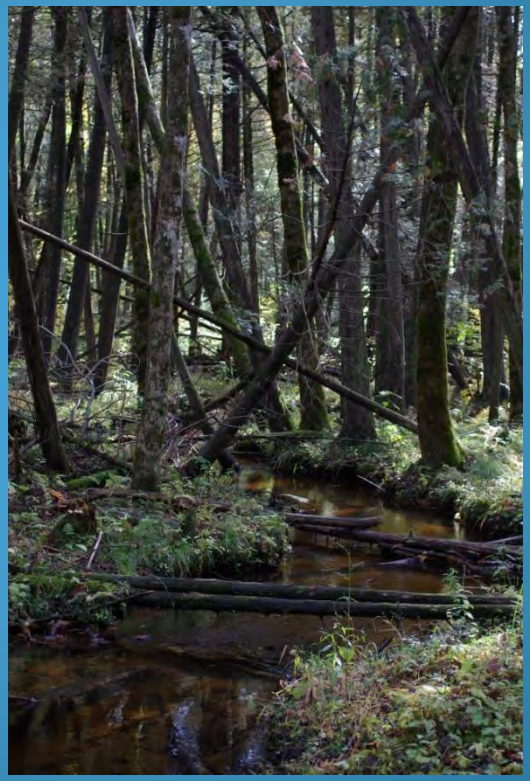


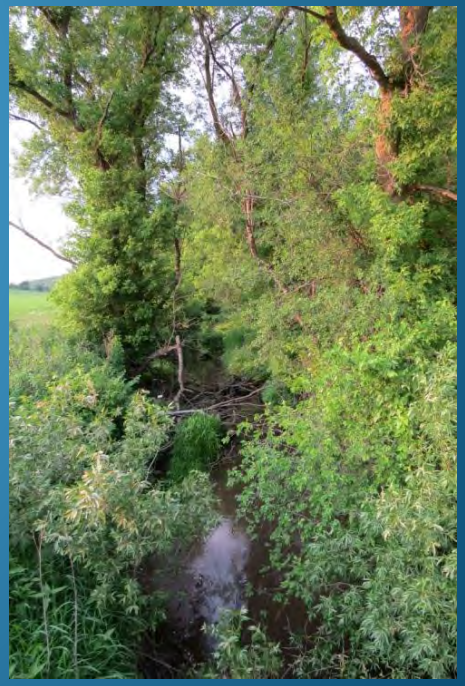
Midwestern Trout Stream Areas

For as long as water has flowed on Earth . . .

Bent Lauge Madsen

For as long as plants have rooted beside streams . . .





For as long as trout have dwelt in streams . . .

Therefore, to properly protect & restore trout streams, we must understand

- How natural streams work
- The habitat-use behavior of wild trout, i.e., how they use natural stream features & processes .

And we must work with human communities to eliminate or reduce human-generated harm.

Setting:

- Climate
- Geology
- Landform

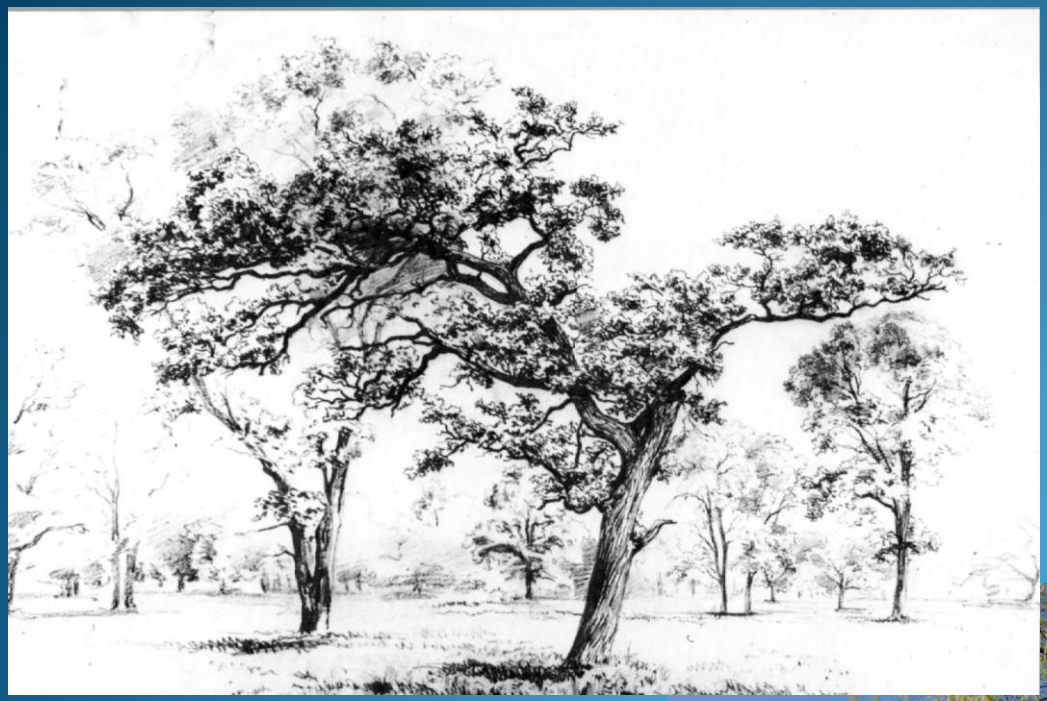
Interacting elements:

- Water
- Ice
- Fire
- Soils
- Plants
- Animals
- Native Americans (ca. 10,000 yrs.)
- Fur trappers/traders (ca.16??-1850)
- Euro-Americans (190 yrs. land & water use)

"If we are serious about restoring ecosystem health and ecological integrity, then we must first know what the land was like to begin with."

- Aldo Leopold

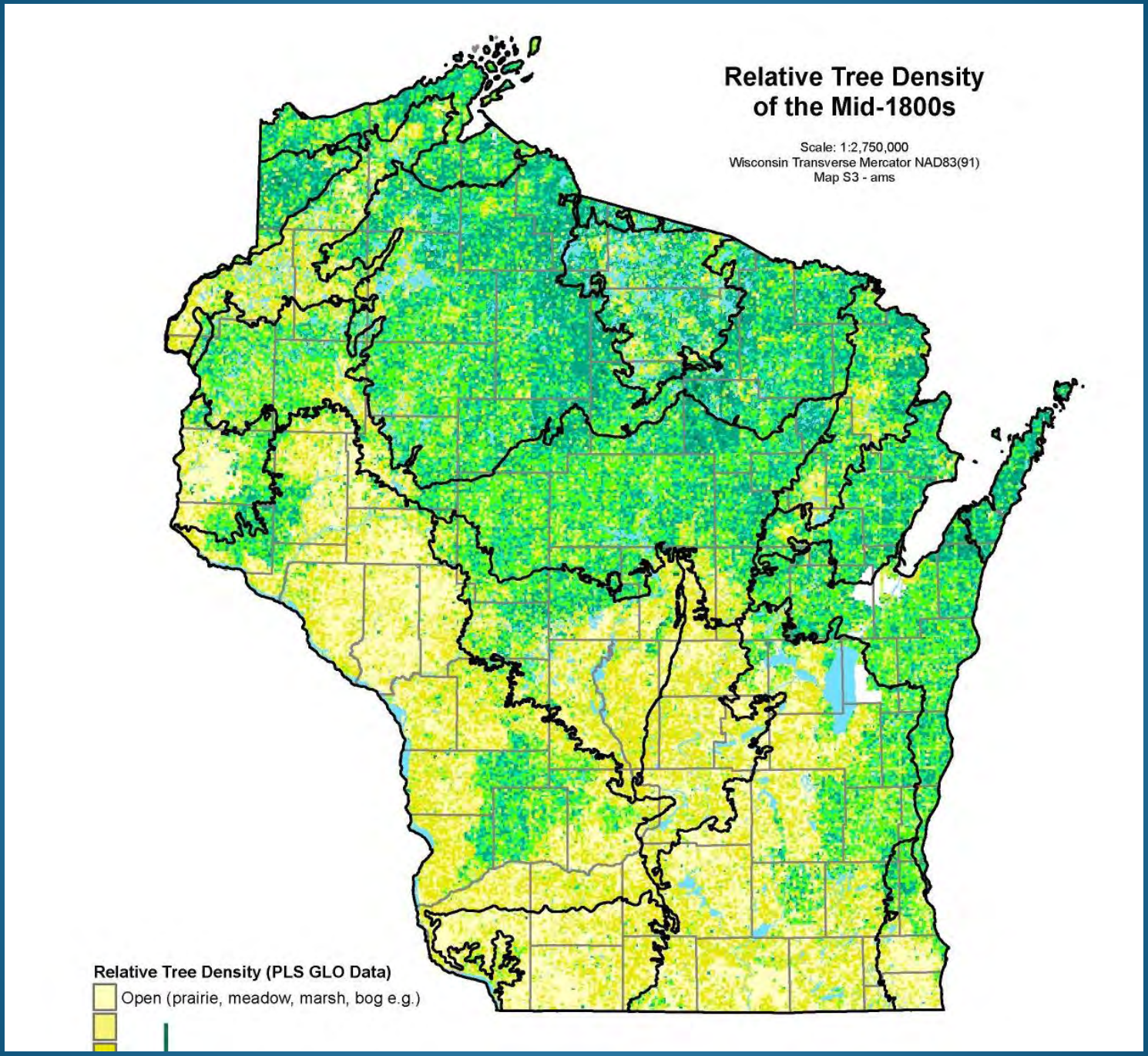
Restore toward forms and functions that streams had before Euro-American influence?



Wisconsin Historical Society

No cows
No plows

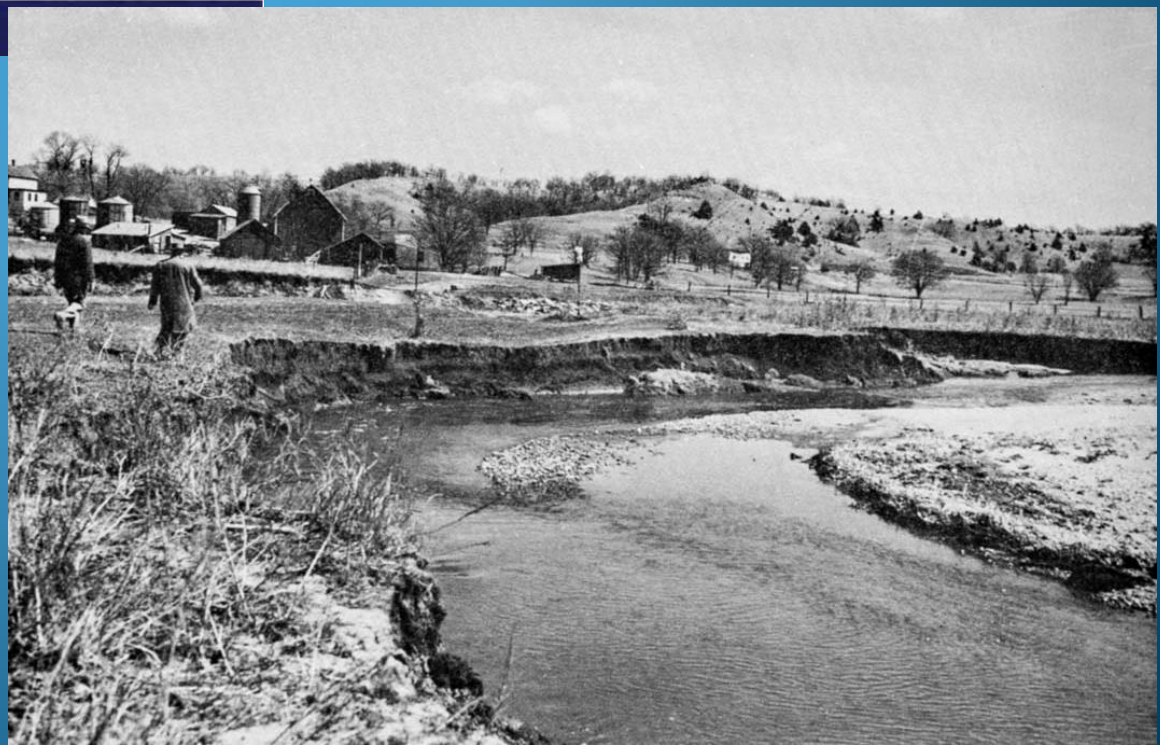
Wisconsin Dept. of Natural Resources


Relative Tree Density
of the Mid-1800s
Scale: 1:2,750,000
Wisconsin Transverse Mercator NAD83(91)
Map S3 - ams
Relative Tree Density (PLS GLO Data)
Open (prairie, meadow, marsh, bog e.g.)

Midwestern Trout Stream Areas

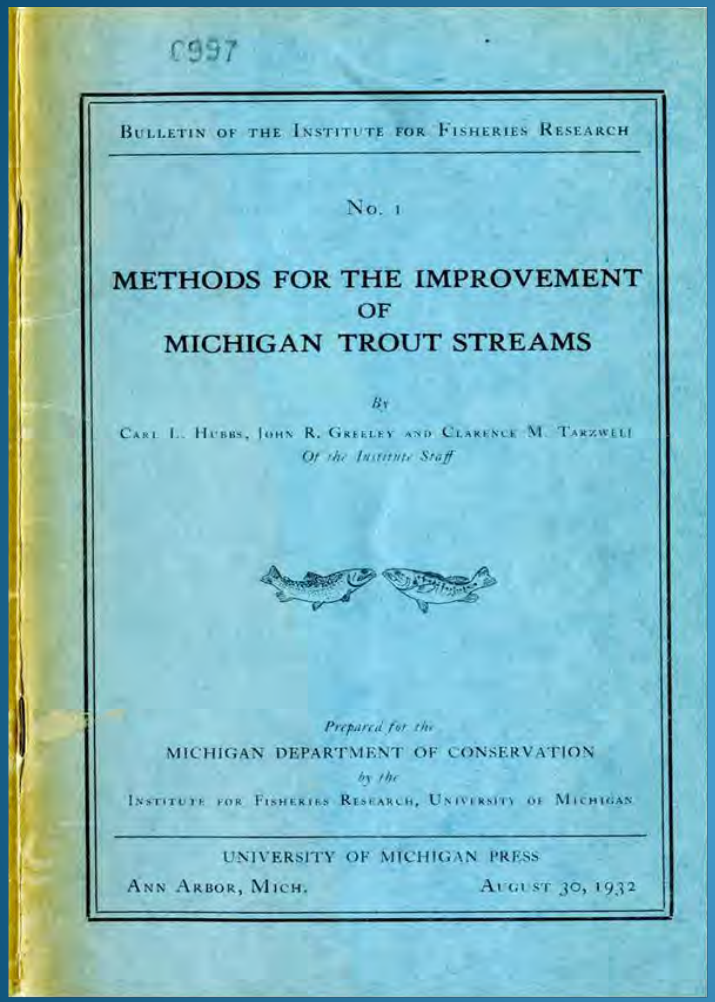
Coon Valley farm, Wisconsin c. 1934

Streams of U.S. agricultural areas lay in ruin by the 1920s-30s.



- Streams were in such bad shape that we thought we had to build habitat structures.
- Government programs began in 1933 as construction crew work; continued that way & expanded greatly since 1950.
- What we built didn't let streams function like the natural ones in which trout had evolved.
- But ecologists and geomorphologists have found how natural streams function, generating habitat--if we let them.
- Therefore, we can concentrate on relieving streams from human-caused harm, and let nature do much healing -- via interaction of plants with water and soils.
- But people prevent fire that (with wild ungulate grazing) originally controlled plant succession in some landscapes.
- Therefore, to restore streams there, we must simulate natural control of vegetation.

The start of government trout habitat work - Michigan, 1932


C997

BULLETIN OF THE INSTITUTE FOR FISHERIES RESEARCH

No. 1

METHODS FOR THE IMPROVEMENT OF MICHIGAN TROUT STREAMS

By

CARL L. HUBBS, JOHN R. GREELEY AND CLARENCE M. TARZWELL
Of the Institute Staff

Prepared for the
MICHIGAN DEPARTMENT OF CONSERVATION
by the
INSTITUTE FOR FISHERIES RESEARCH, UNIVERSITY OF MICHIGAN

UNIVERSITY OF MICHIGAN PRESS
ANN ARBOR, MICH. AUGUST 30, 1932


Fig. 1

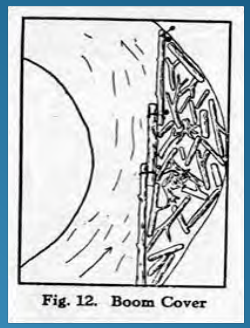


Fig. 12. Boom Cover


Fig. 18. Tepee-Cover

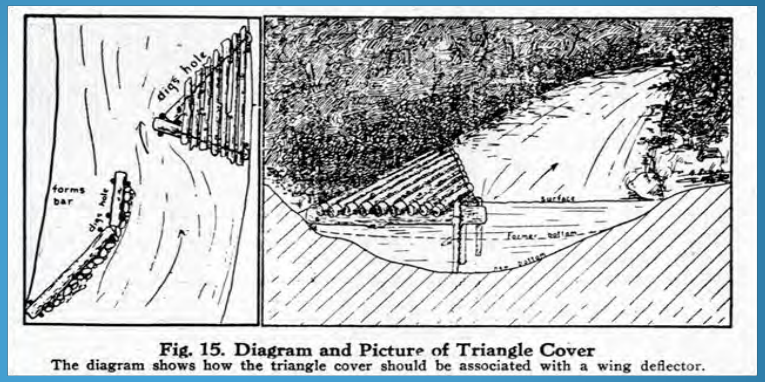


Fig. 15. Diagram and Picture of Triangle Cover
The diagram shows how the triangle cover should be associated with a wing deflector.

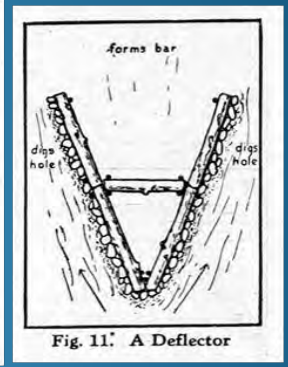


Fig. 11. A Deflector

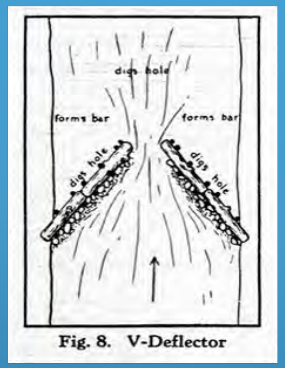


Fig. 8. V-Deflector

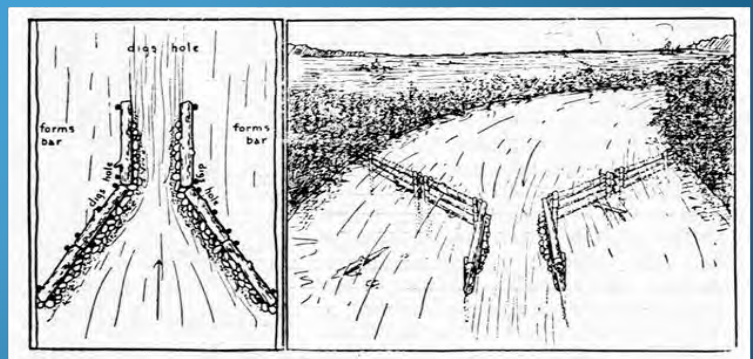


Fig. 9. Diagram and Picture of Y-Deflector

Primarily a manual on artificial structures. Mere treatment of symptoms, because:
No mention of agricultural causes of stream habitat problems.
Little material on streamside vegetation, other than as shade and cover.

Stabilization with riprap prevents undercut banks

Rèprinted from Transactions of the Twenty-second North American Wildlife Conference, March 4, 5, and 6, 1957. Published by the Wildlife Management Institute, Wire Building, Washington 5, D. C.

WATER, WATERSHEDS . . . AND YOU

D. JOHN O'DONNELL

Wisconsin Conservation Department, Madison, Wisconsin

Our future rests upon our basic natural resources, water and land. If we are to use wisely our basic resources of water and land, we must consider these resources as having a sustaining value to our way of life.

The historical belief in this country was that the resources were inexhaustible, and with promotion from "economists" the belief was and is held that the public good could be best served by all individuals serving his own interest. These attitudes and beliefs have led to the greatest destructive exploitation of natural resources that the world has ever experienced.

Conservation of water and land resources can no longer be viewed as an independent, individual problem. It is a problem of society, in the framework of education, research, production, credit, tax base and all of the other ramifications of a great society. The metropolitan centers must be enlightened. The problem is equally urban and rural. The approach must be American and on a community basis—all people working together for the common good; working as a group and not as individuals. Patterns of life can best be changed when they are group-formed and group-accepted.

The sentiments and emotions of people must become aroused over basic water and land conservation. Continualy re-define conservation as a value and a belief. A positive interest must be developed in indi-

1957

D. J. O'Donnell

Wisconsin Watershed Program

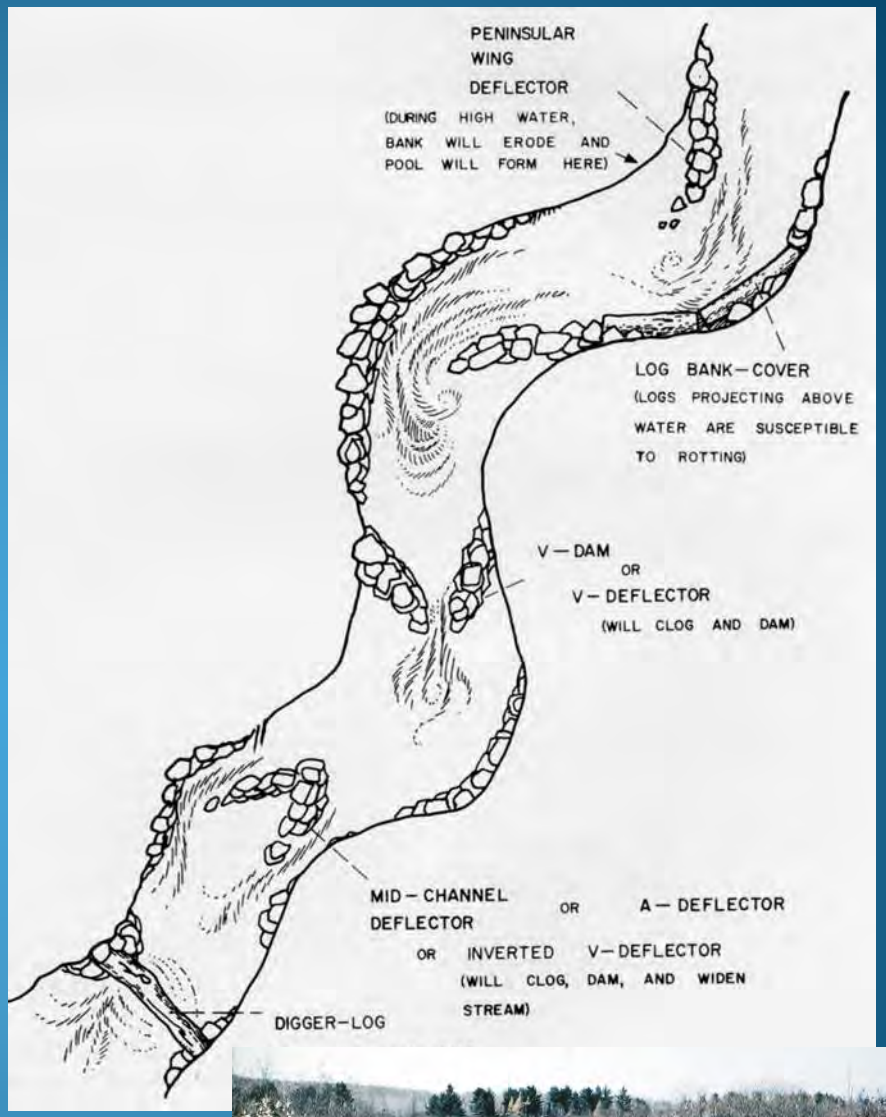
"Mother Nature operates on a watershed basis. We should follow this lead and . . . operate our programs on such a natural basic unit . . ."

"The time is here for bold vision and strong, resourceful leadership."

Transactions of the 22nd North American Wildlife Conference, March 1957. Published by the Wildlife Management Institute, Washington, D.C.

Wisconsin's Watershed Program, begun 1950, soon became mainly channel work & bank fencing.

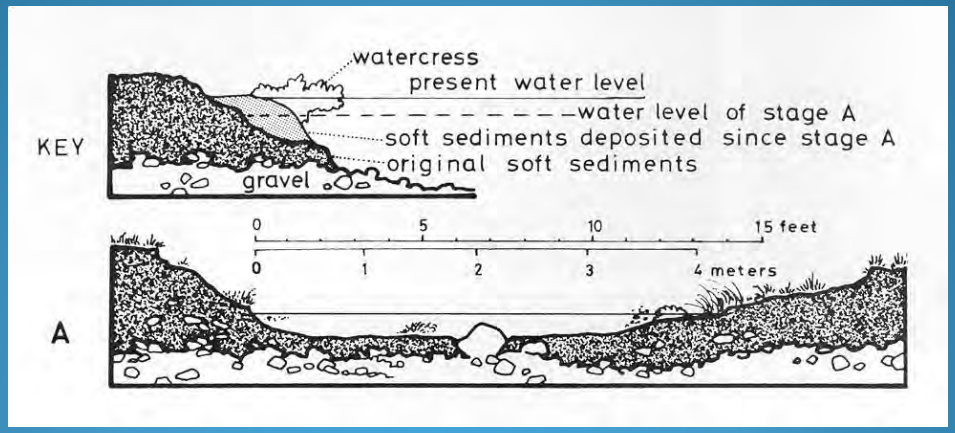
The state's 5 habitat managers were labor-crew foremen with no biological training. Only one knew about trout.

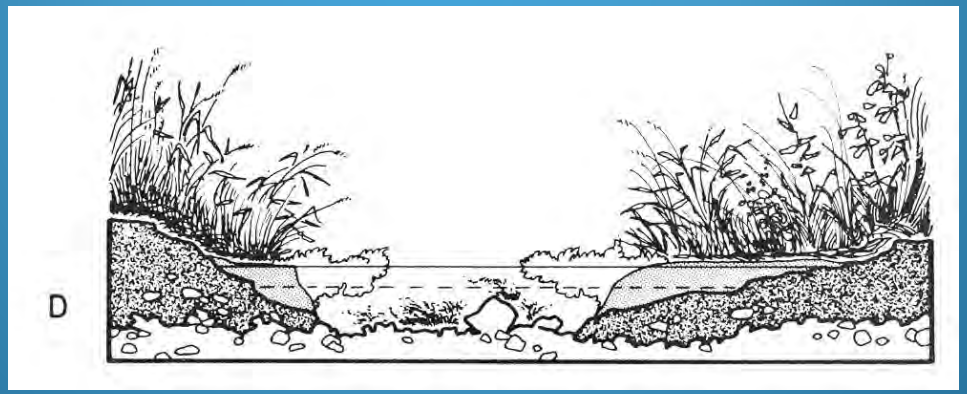


Black Earth Creek

Ca.10 years after fencing

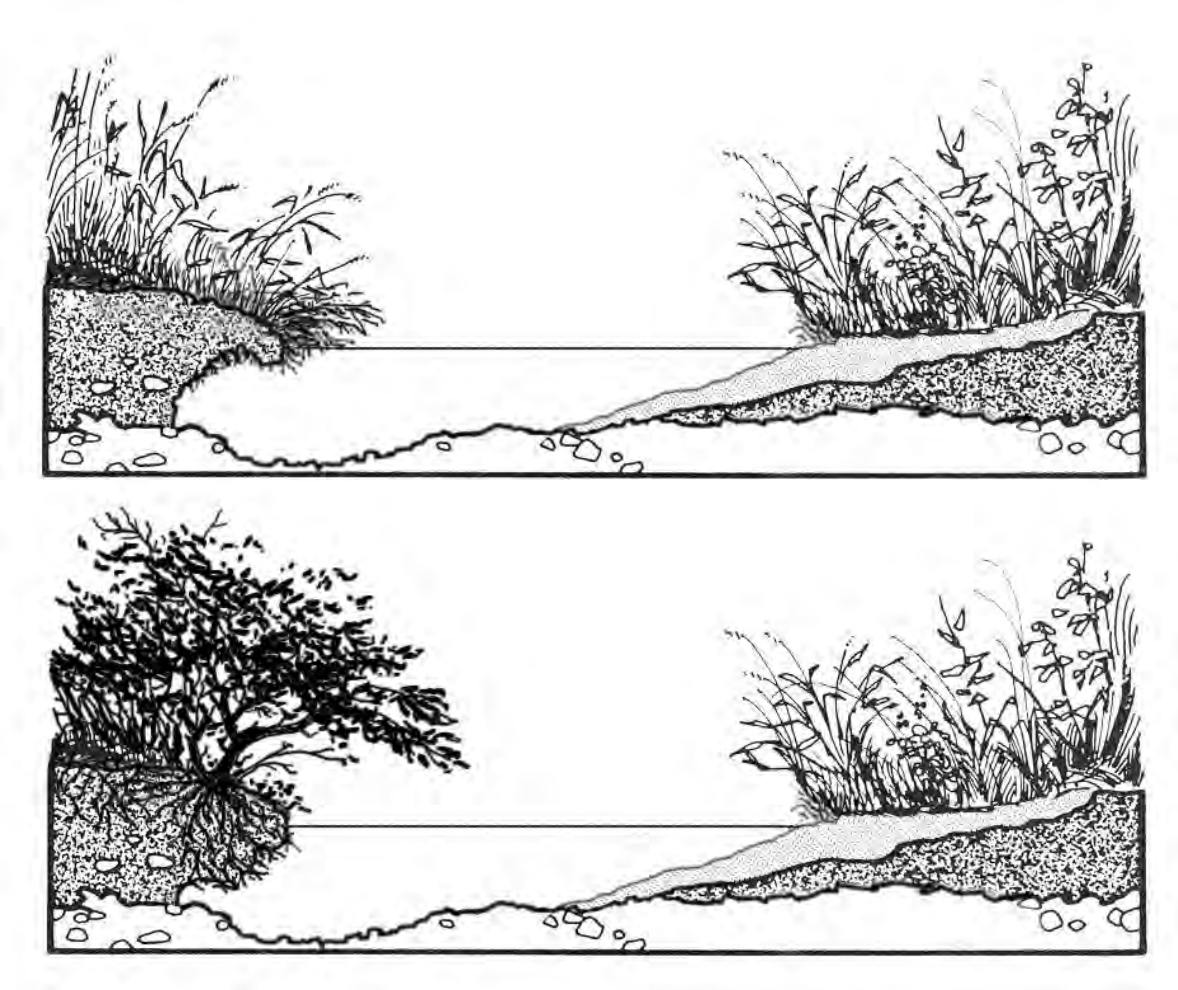
Vegetation rebuilds stream banks.





Natural regeneration - self healing!

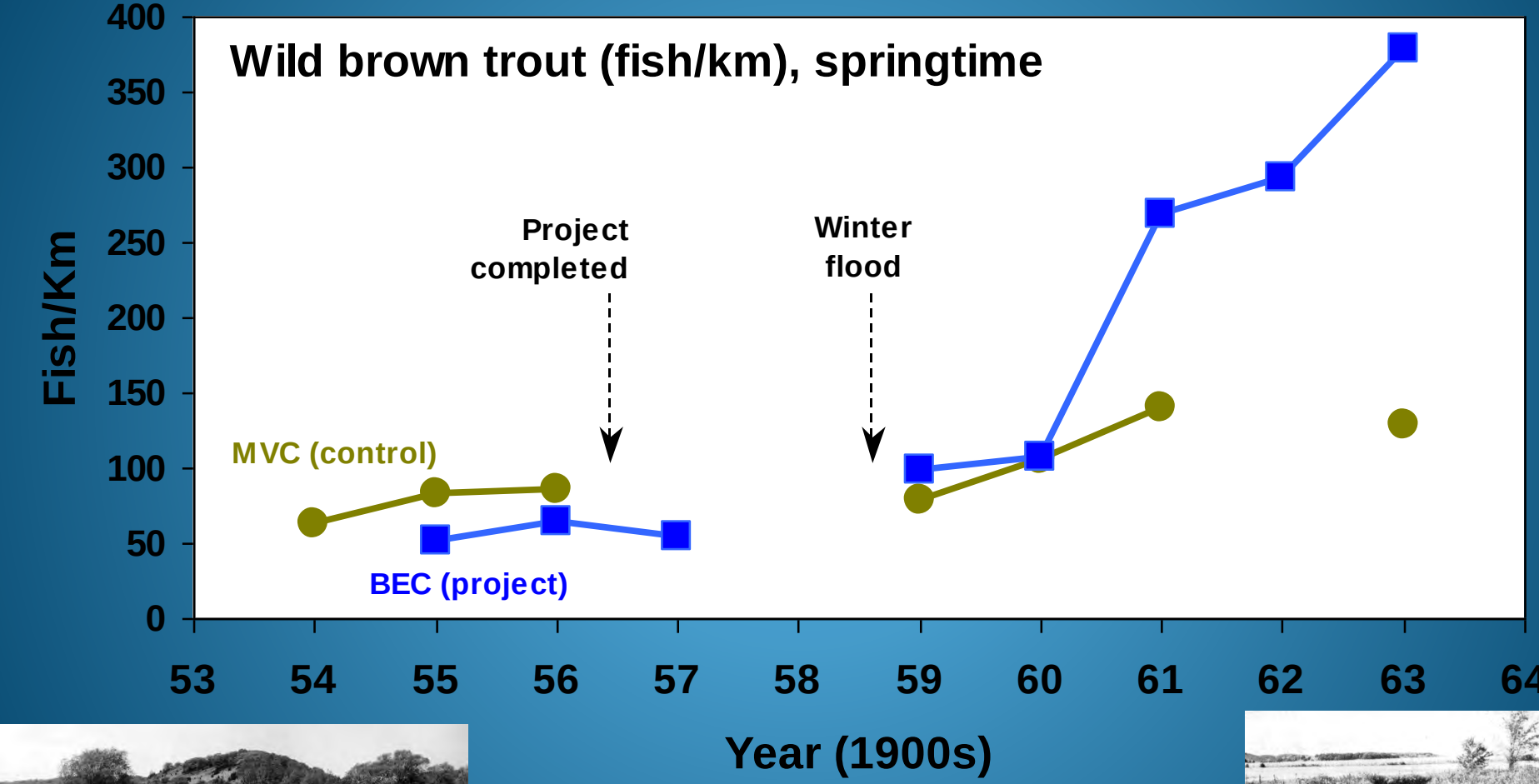
Natural undercutting of banks at meander bends . . .
tough turf slows channel migration.



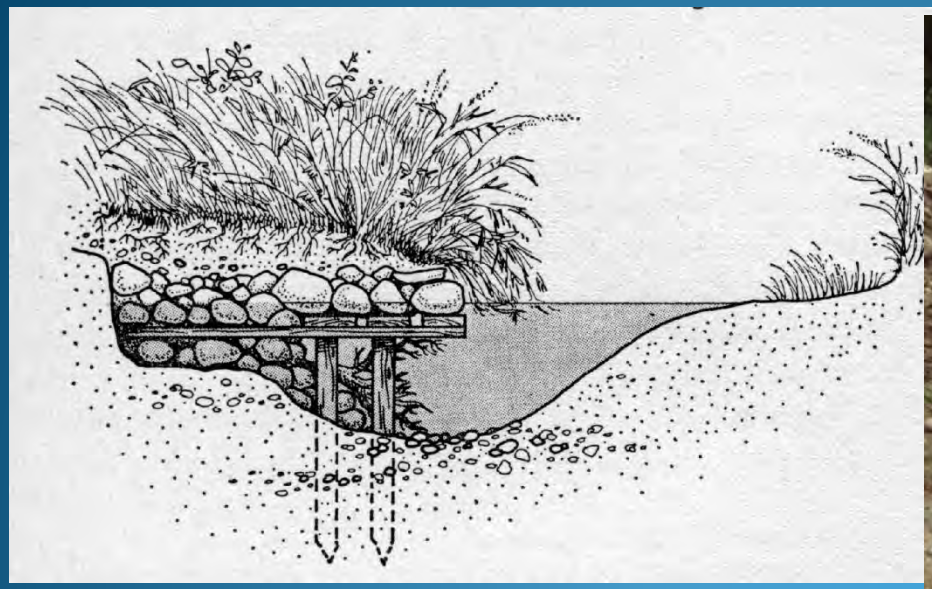
How do trout use undercut banks?

- Hide from predators.
- Rest in slow current.
- Close to fast current, which brings drifting food.
- Thus, energetically advantageous.

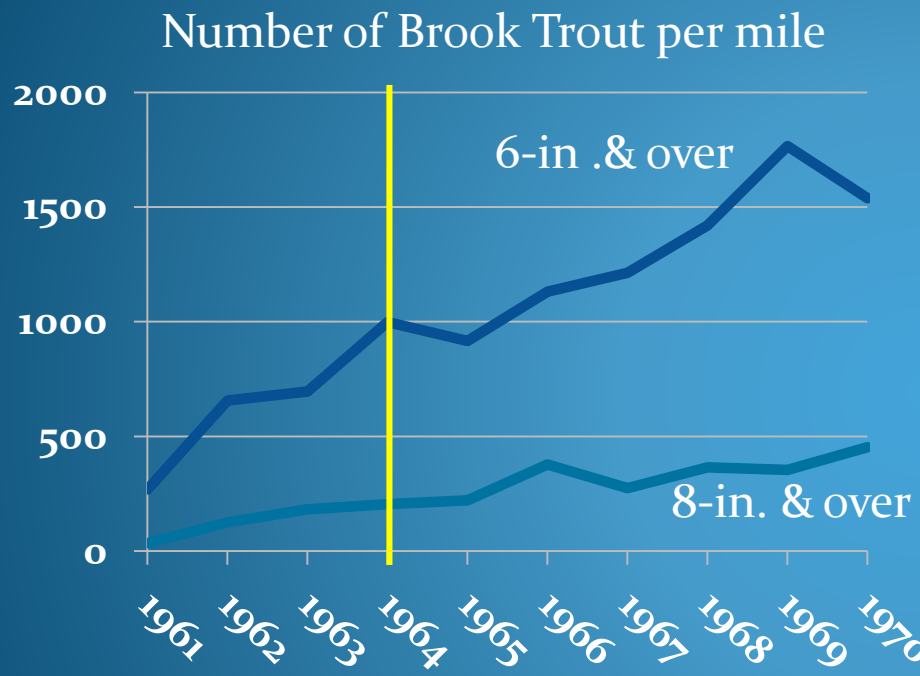
Results: Black Earth & Mt. Vernon Creeks

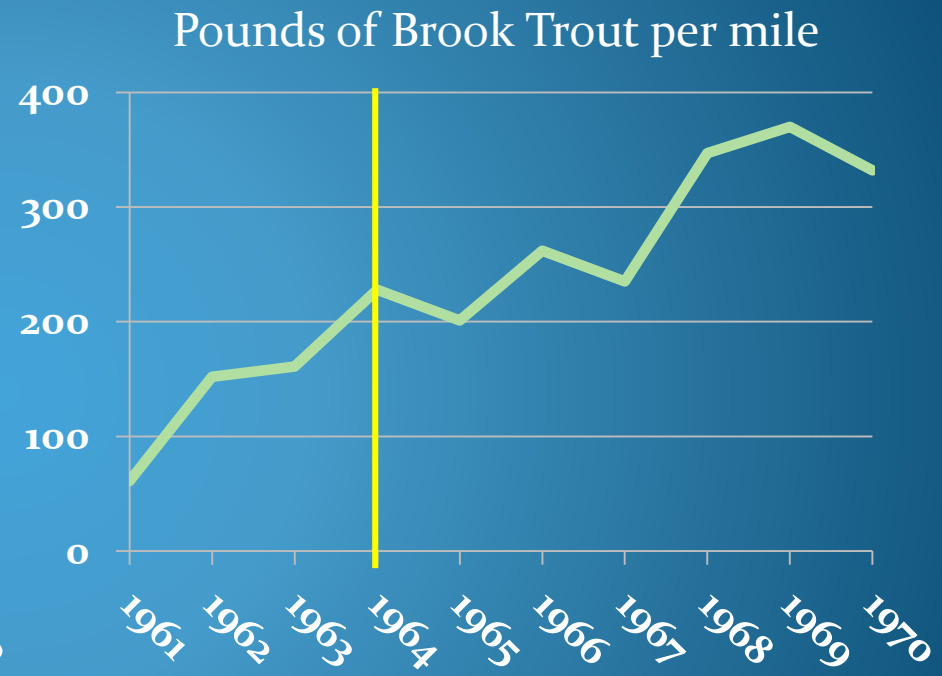


Hedding Bank-Cover Wings = Simulated Undercut Banks



Results of Habitat Experiment
Lawrence Creek, Section A





Yellow line = year when crew installed structures

Artificial structures eventually fall apart -- maintenance always needed, usually neglected

Problems:

Faulty conceptual foundation, resistance to change (Lichatowich 2013) → wrong objectives

Biologists think like technicians, not scientists

Cookbook performance of techniques

Project design & supervision not by multi-field team

Little pre-project watershed assessment or other proper examination & diagnosis

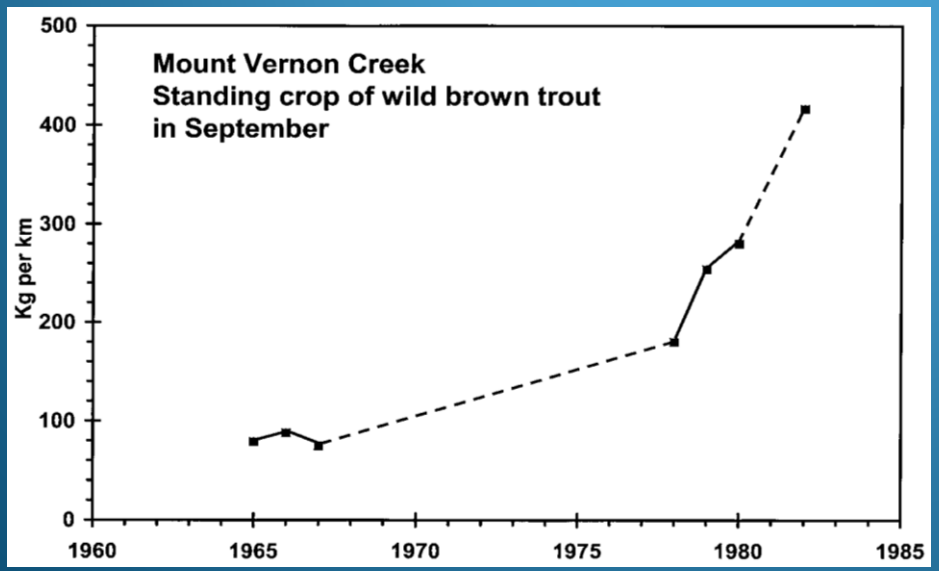
No true cost/benefit analysis of techniques, including external and long-term costs

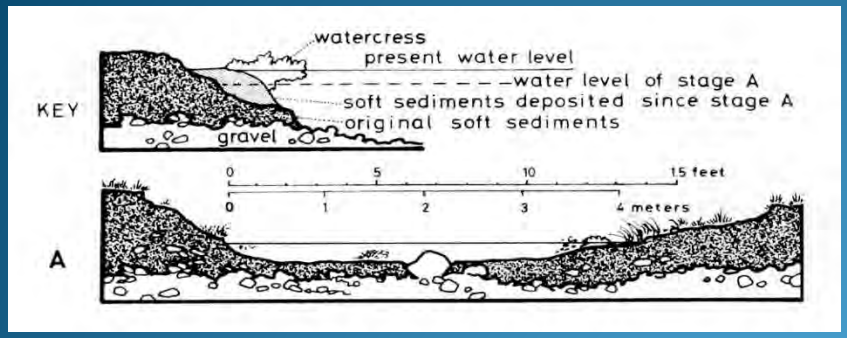
Unnecessary management – "improving" on nature

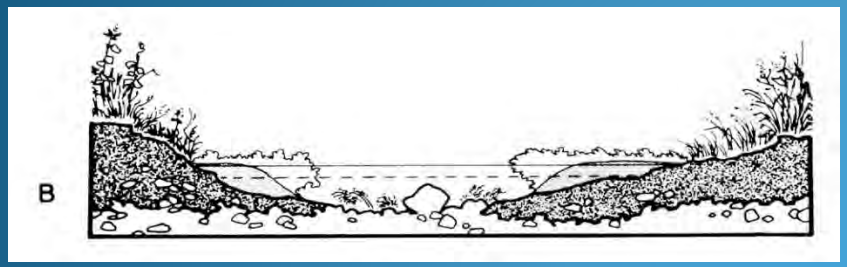
If it ain't broke, don't fix it!

Big land-use change in 1970's: most dairy farmers switched from pasturing to confinement-feeding.

Example: Mt. Vernon Cr. before & after cows excluded




KEY
watercress
present water level
water level of stage A
soft sediments deposited since stage A
original soft sediments
gravel
0
5
10
15 feet
0
1
2
3
4 meters
A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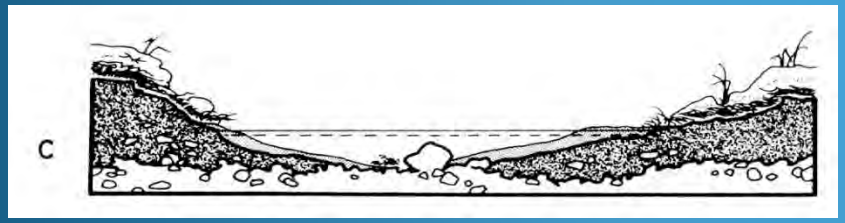
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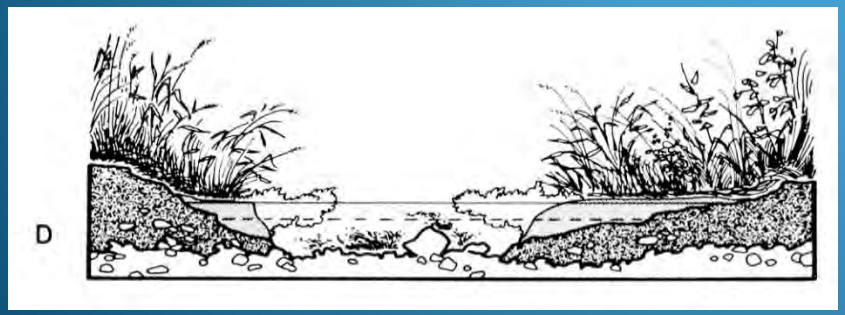
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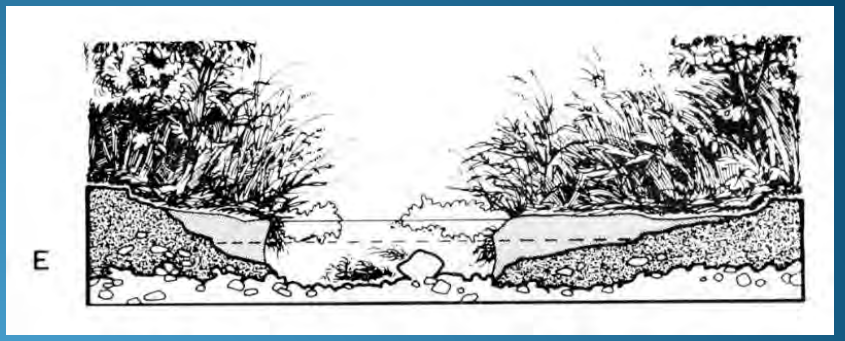
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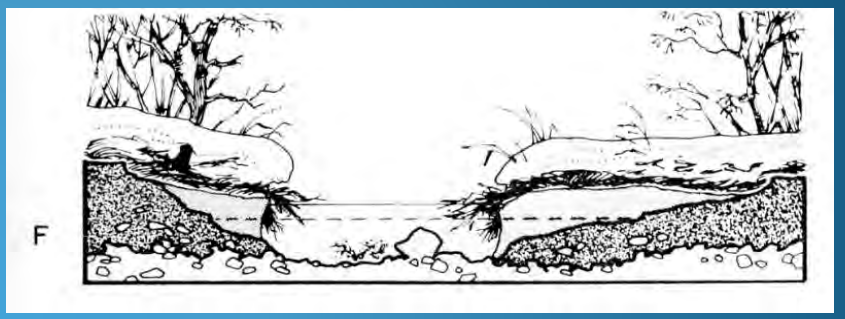
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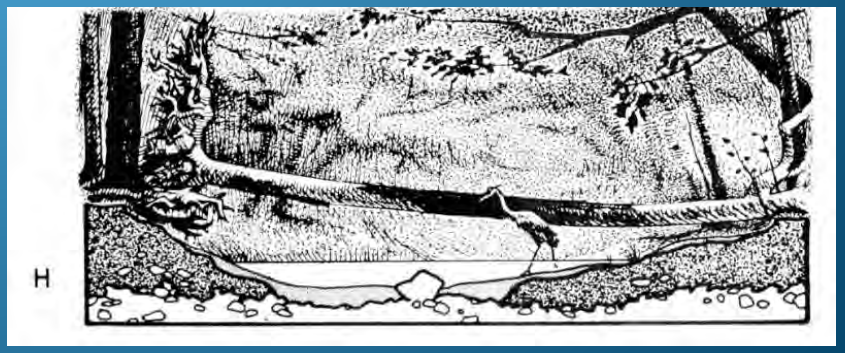
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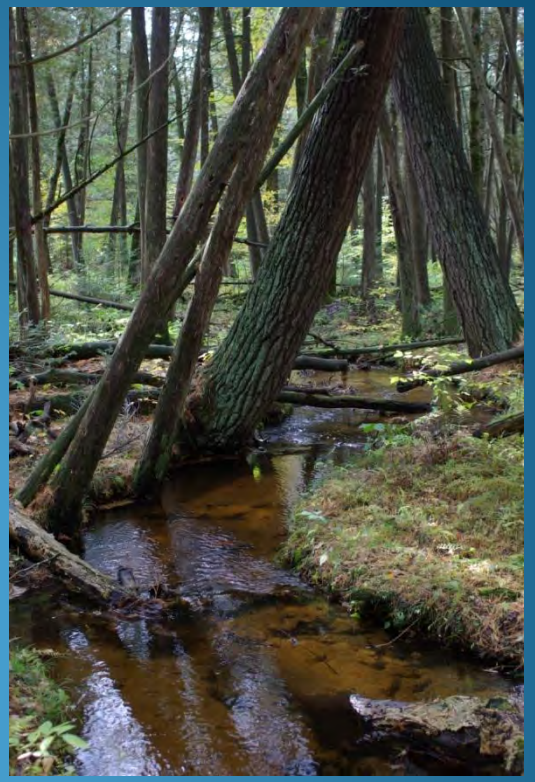
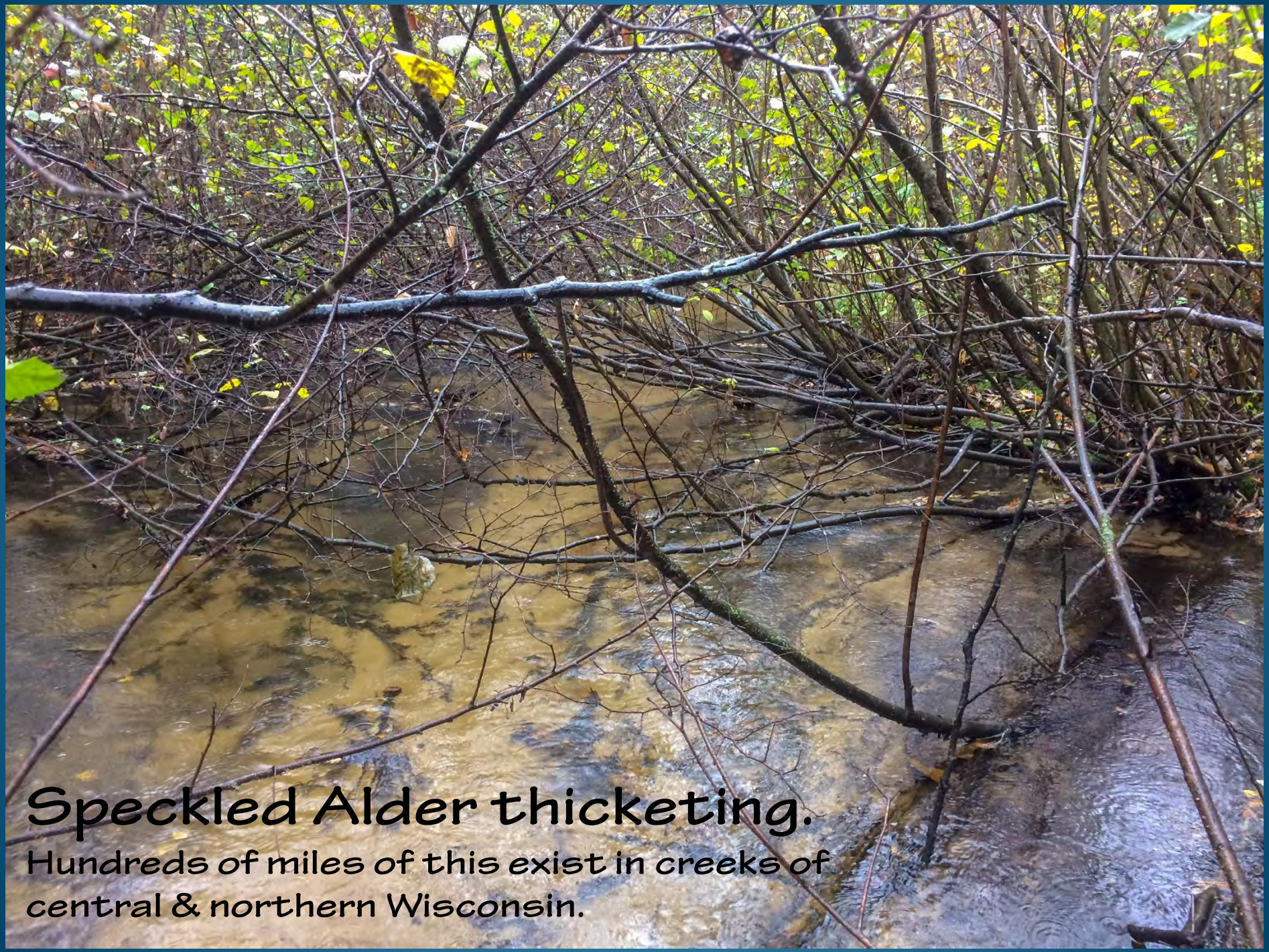


Riparian vegetation in forests. Three of these photos indicate how the last panel of the foregoing slide should be re-drawn to show tree fallen limbs & logs in the channel.

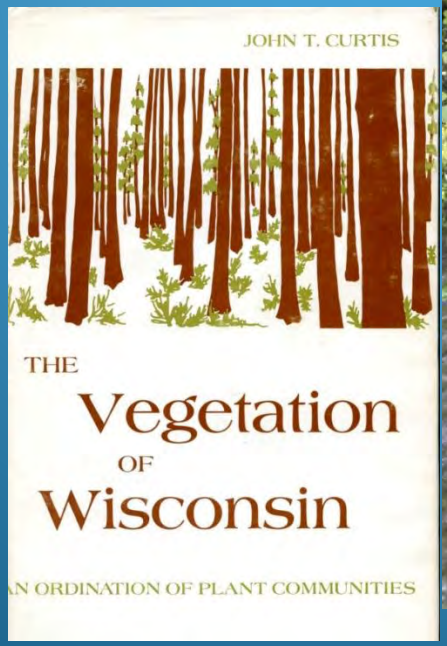

Speckled Alder thicketing.
Hundreds of miles of this exist in creeks of central & northern Wisconsin.

Brush cutting to promote healthy streambank turf in central Wisconsin. This can be followed by periodic re-cutting or by other methods to control woody vegetation.

Brush is cut here every 7 to 10 years. The latest cutting was during fall-winter 2012-2013

During the 1970s, most cattle pasturing stopped in southern Wisconsin. Box Elder trees canopied creeks 20 years later.

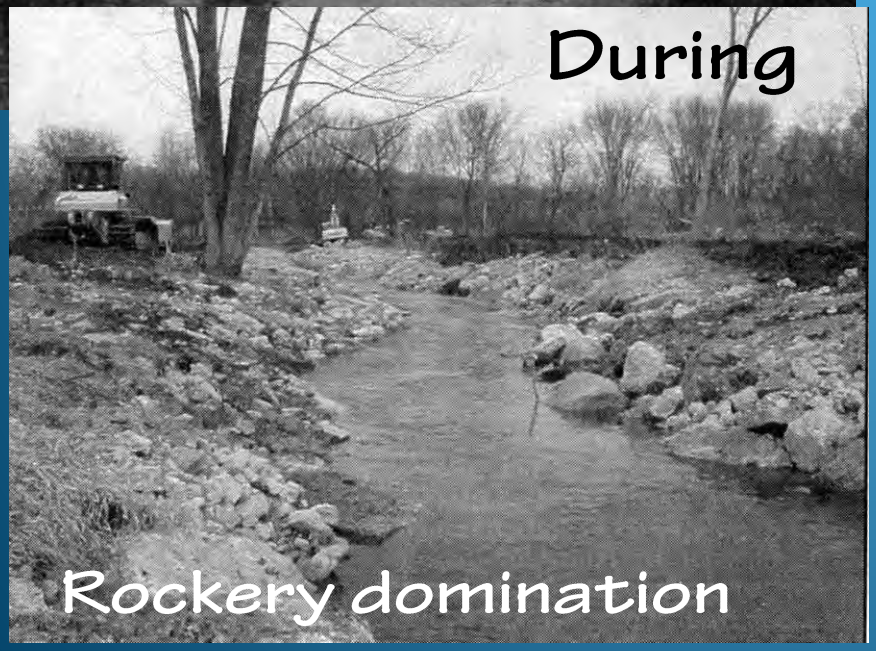
The comprehensive 1959 book on Wisconsin plant life had almost no mention of Box Elder.



Under well-managed rotation grazing woody vegetation is controlled, and cattle do not go onto stream banks. Prescribed burning also works.

But crews are still replacing natural stream banks with rock in the name of trout stream restoration.

Wisconsin's worst project?



Not restoration

Stream bed still silty, so no trout spawn, but a few more trout exist (immigrate from main stream).

Prevents channel migration

Hinders lateral connectivity

Effects on other wildlife?

Cost/benefit vs. other methods?

But stream science has developed significantly.

Fluvial geomorphology since 1960s → Field of Dreams hypothesis
but without plant life

↓

Pacific NW fluvial geomorphology & ecology advance since 1990 in response to Pacific salmon crisis

↓

Understanding of physical & ecological processes in streams

↓

Process-based stream restoration, i.e., ecological restoration
including plant life

Wisconsin didn't get the news.

"Process-based restoration aims to reestablish normative rates and magnitudes of physical, chemical, and biological processes that create and sustain river and floodplain ecosystems."

Restoration actions should

(1) address the root causes of degradation,

(2) be consistent with the physical and biological potential of the site,

(3) be at a scale [that matches] environmental problems,

(4) have clearly articulated expected outcomes [i.e., objectives] for ecosystem dynamics.

Beechie et al. (2010). Process-based principles for restoring river ecosystems. *BioScience, 60*(3).

“The ecological integrity of river ecosystems depends on their natural dynamic character.”

Poff et al. 1997. The natural flow regime: a paradigm for river conservation & restoration

“River restorations must use natural templates and account for river processes if they are to restore stream functions over the long term.”

L. Aadland (Minnesota DNR) Driftless Area Symposium 2006

Iowa DNR is “reducing the dependence on rock for bank stabilization and relying more on native vegetation to stabilize entire riparian zones.”

Bill Kalishek (Iowa DNR) Driftless Area Symposium 2006

“Good news—I hear the paradigm is shifting.”

What to do:

Ecological restoration – natural process-based

Learn from national & international advances

Look before we leap

- Assess the watershed
- Analyze the hydro-geomorphic situation
- Consider how the whole stream functions

Have expert team design/oversee each project

Involve the human community

Evaluate results & adapt further management

Analyze cost/benefit of techniques

Further research

"Manage for the mess!" - Sedell's slogan

Diversity that evolved naturally.
Not just any old kind of diversity.

Self-Healing of Sick Streams

Resilient Ecosystems
Not
Artificially Restructured Channels

End of Presentation

A few “bonus” slides follow for further study.

Trout stream management has too often been displacement activity.

Hatcheries & stocking (1855 onward)

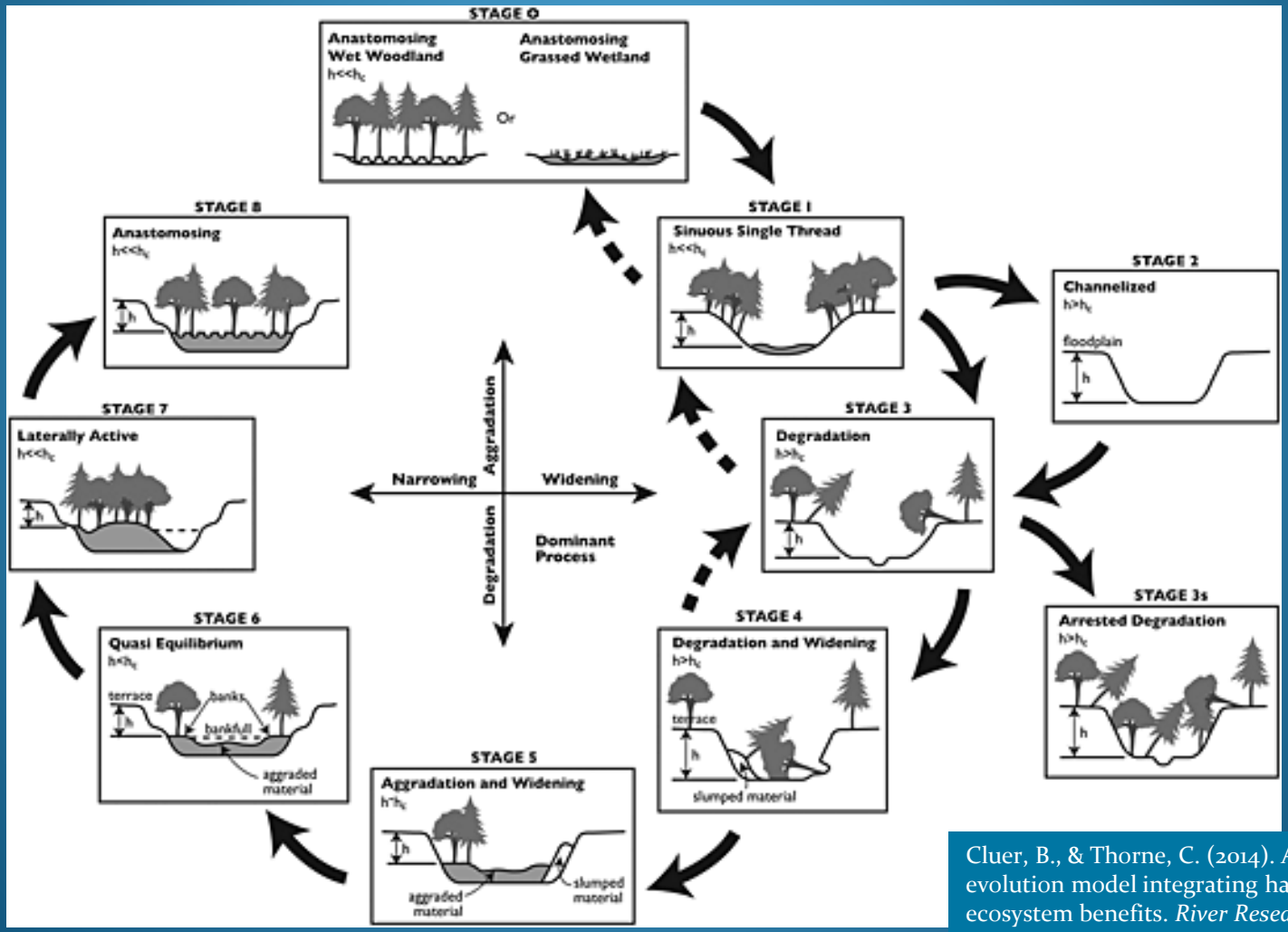
Techno-fix – managing fish instead of managing human activities that overharvest fish & destroy fish habitat.

Habitat management (1933 onward)

Techno-fix – (1) managing stream channels instead of managing human activities that destroy fish habitat and (2) managing where not needed (if it ain't broke, don't fix it!).

"Tinkering with evolved and adapted entities . . . generally means spoiling their adaptedness and decreasing their stability, which [stimulates] continued tinkering, [with] increasing cost and dwindling gain." – John Neess 1974

STREAM EVOLUTION: INTEGRATING HABITAT AND ECOSYSTEM BENEFITS



Cluer, B., & Thorne, C. (2014). A stream evolution model integrating habitat and ecosystem benefits. *River Research and Applications, 30, 135-154.*

Conceptual foundation:

- What you believe the world (or part of it) is like.
- What you know about how it operates.
- What you think your actions within it should be.

Example:

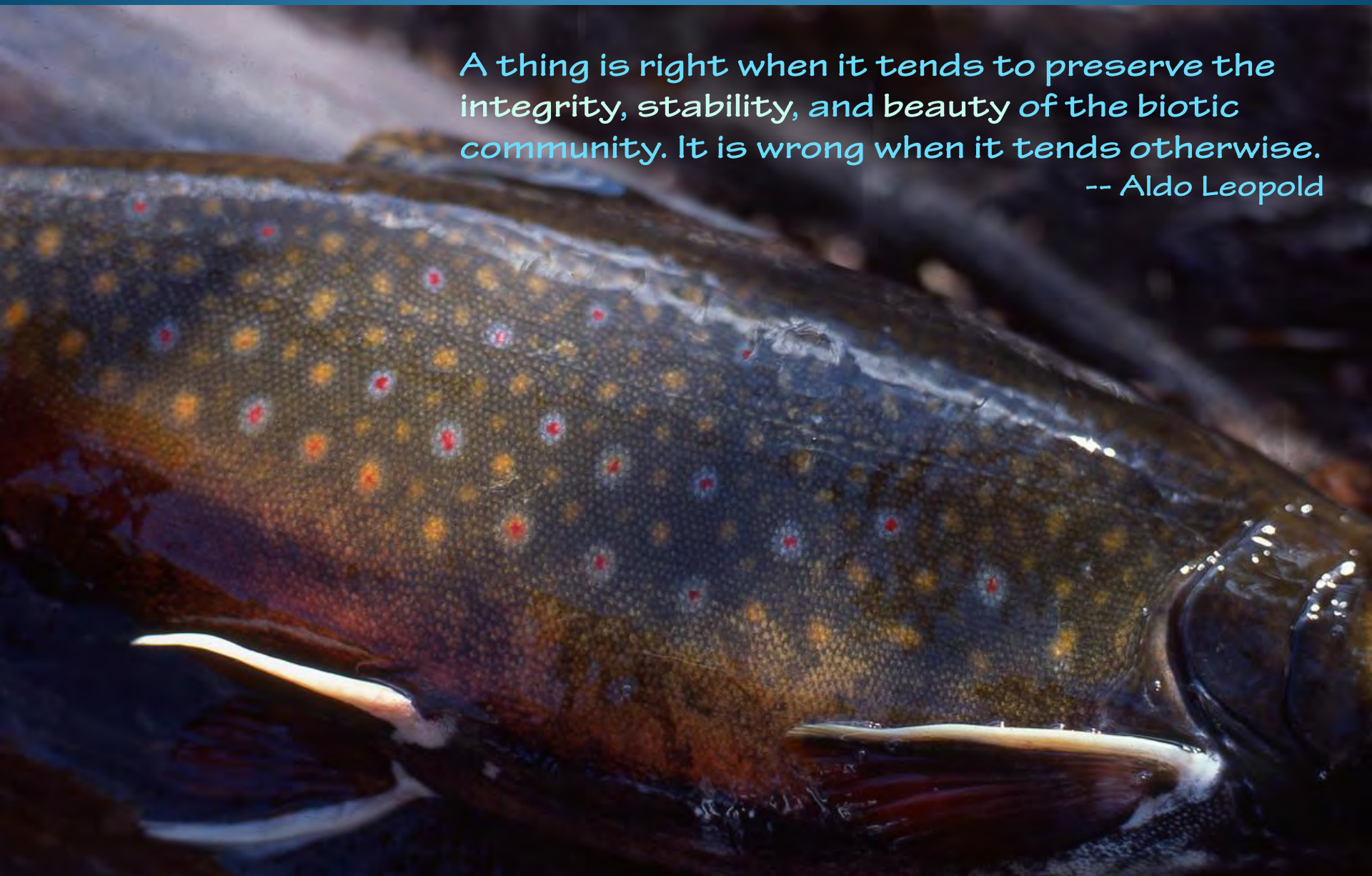
- A stream is a living entity that includes its riparian corridor, is part of a watershed ecosystem (often human-affected), and evolves.
- Nature knows best (Commoner's 3rd law).
- Manage according to science and ethics.

Restoration:

The relaxing of human constraints on natural development of patterns of diversity.

Restoration measures should NOT focus on directly recreating natural structures or states but on re-establishing the conditions under which natural states create themselves.

Modified from Minnesota DNR & other sources


A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.
-- Aldo Leopold

Aldo Leopold's Wisdom - 1939

A wildlife professional has:

Conviction of need for science in accomplishing conservation

Ability to diagnose the landscape to discern trends in its biotic community and modify them where necessary for conservation

Knowledge of plants, animals, soil and water

Familiarity with other professions and their influence on the landscape

This was inadequately followed in the watershed program of the Wisconsin Conservation Department (Department of Natural Resources after 1965).