Regime Changes, Resilience, And Restoration: No Reverse Gear

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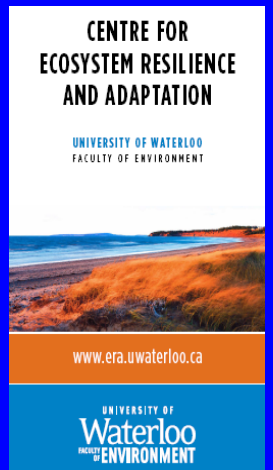


Ecosystem Resilience

- ‘Resilience is a term that can mean the ability of the environment, resources, and dependent societies to adapt and withstand challenges from environmental, economic, and social changes

- However, that definition can be too optimistic as, really, resilience could be a positive or a negative in terms of our perspective

Bridger-Teton NF (WY)

Undesirable Ecosystem Resilience via Climate/Environmental Change

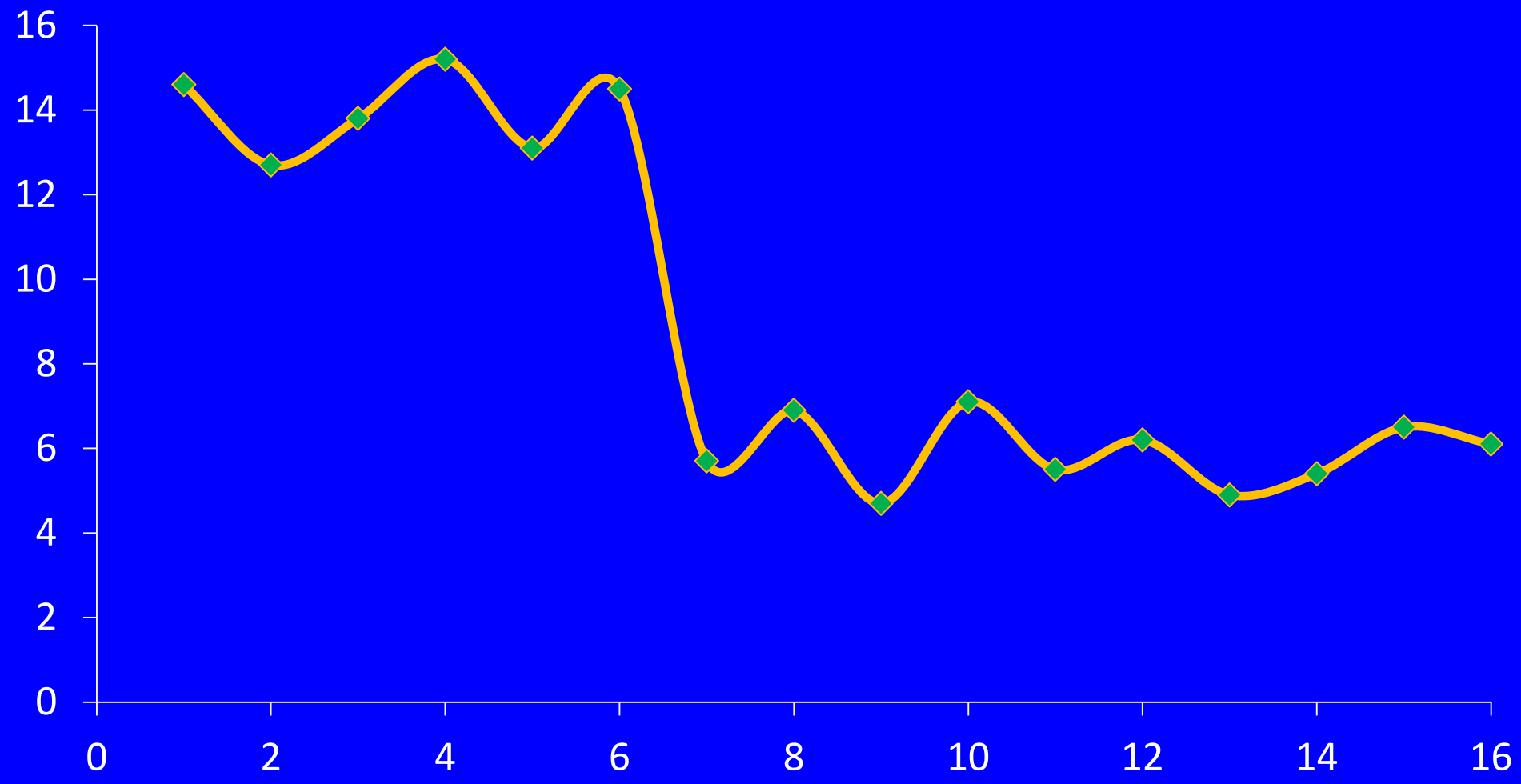
- Vernal dam in some remote eastern Ontario hardwood forests seems to have undergone a rapid and likely permanent shift 2004-2006

- This is manifested by a drop in the mean nitrification rate from 13.7 $g/m^2/year$ to 5.6 $g/m^2/year$

- It appears to be a combination of cumulative stresses – acid rain legacy, 1998 ice storm, over-development creating edge effects and erosion, diseases, climate shifts in temperature and precipitation that are not buffered by bedrock based nutrient refreshment

Beech bark disease caused here by Cryptococcus fagisuga and *Neonectria faginata*

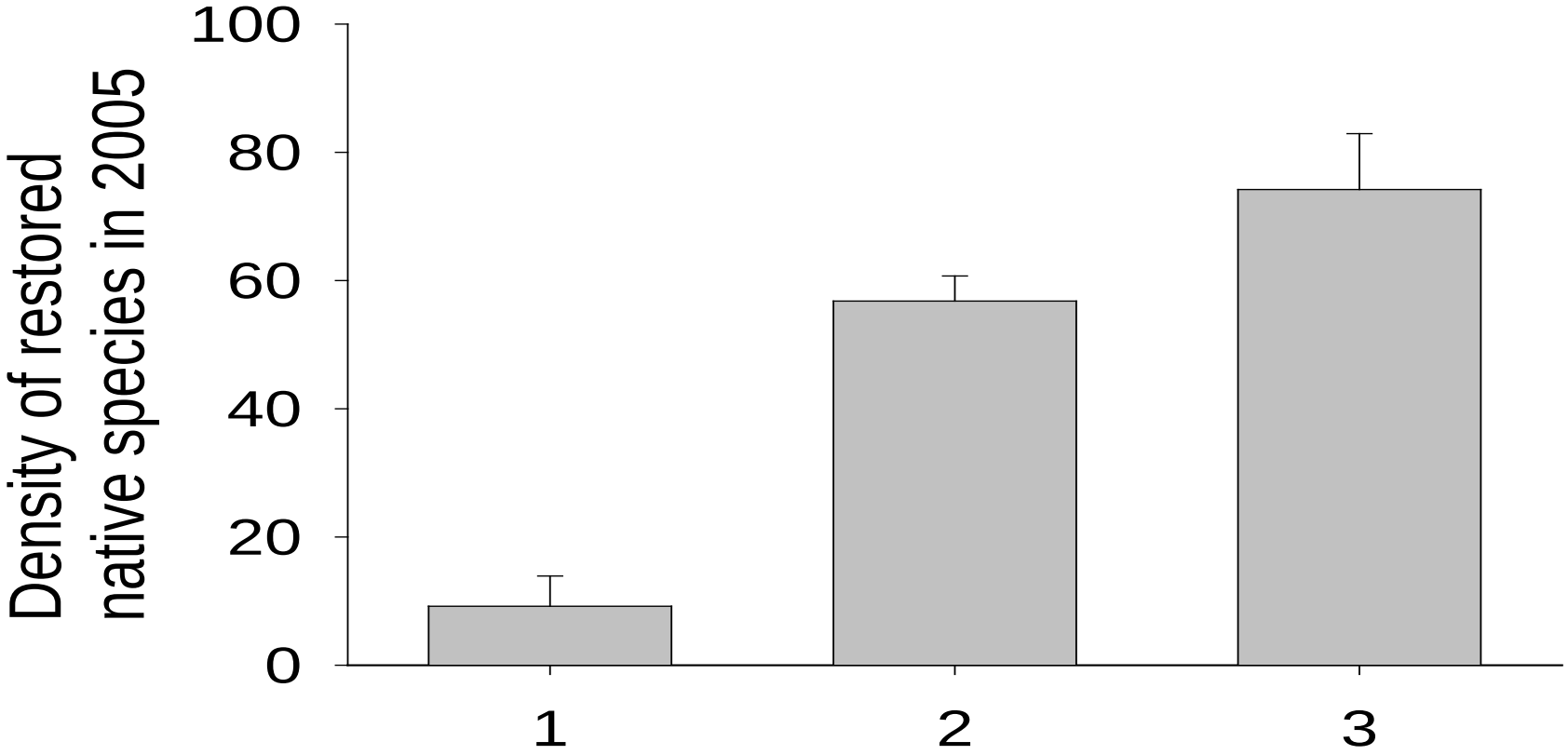
The resultant reduction in nitrification is destroying the nitrogen dependent plants – restoring species will do no good unless the nitrification component is restored *en masse*



We can restore the nitrification components – from the key bacteria via inoculation to the mycorrhizal fungi via the "chop-slop-drop-inoc" method

It can work for awhile – locally – but if the whole regime of 'attractors' like nutrient cycling has changed then the system will revert to its degraded state

Ecological restoration of four upland woodlots 1996-2005 using medium density herb & tree species transplants



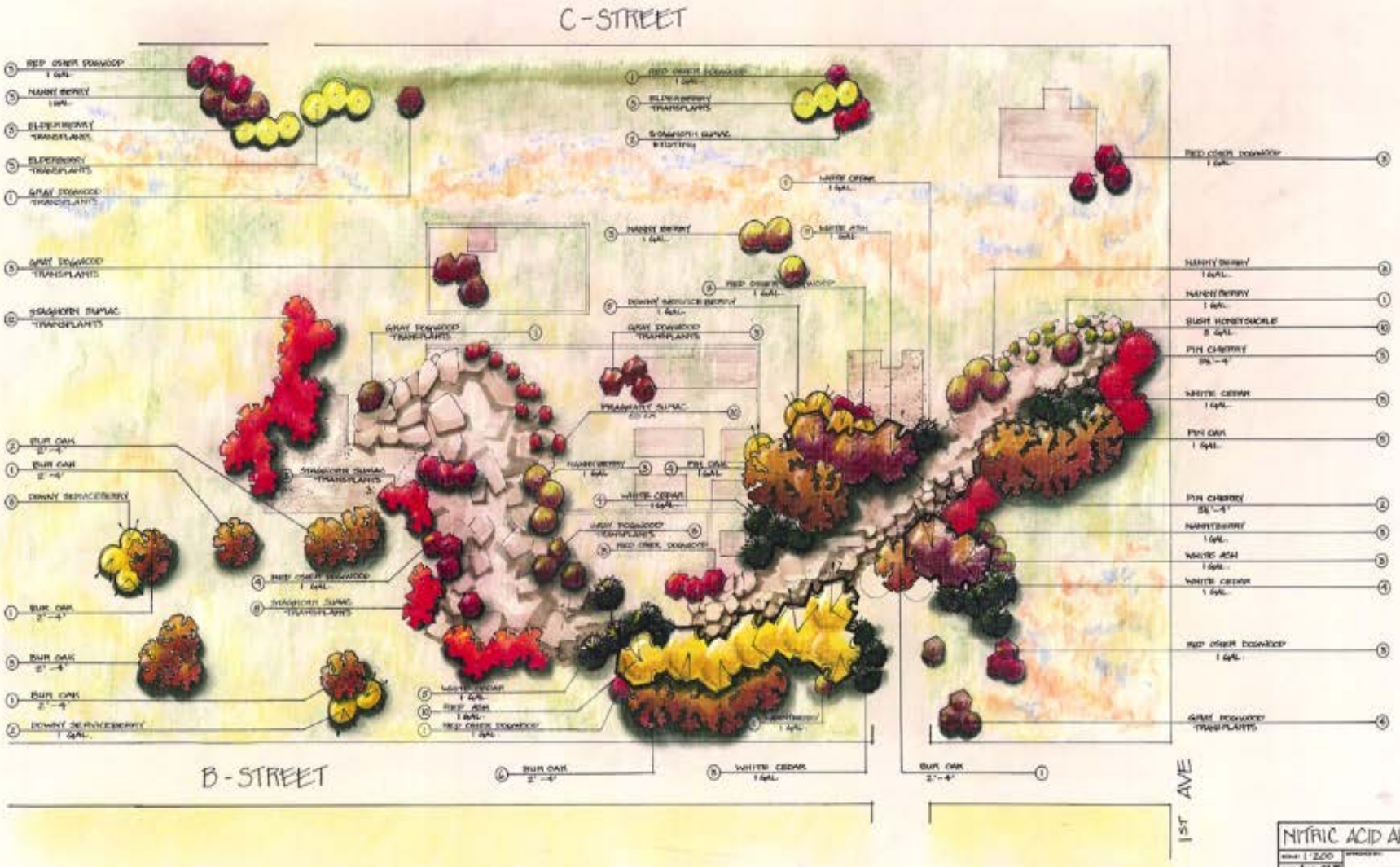
Treatments:
1 = Disturbed soil used
2 = Rescued soil used
3 = VAM trap capture + rescued soil used

Alvar Planting -- Fall 1998

Botanical Name	Common Name	Mature Size height	Mature Size spread	Quantity	Planting Form	Phase	Comments
Trees							
Amelanchier arborea	Downy Serviceberry	3 m	4 m	10	60 cm/B	1	
Fraxinus americana	White Ash	15 m	7 m	8	1 gal (3-2yr)	1	
Fraxinus pennsylvanica	Red Ash	15 m	7 m	10	1 gal (3-2yr)	1	
Prunus pensylvanica	Pin Cherry	7 m	7 m	7	5"	1	
Quercus macrocarpa	Bur Oak	16 m	14 m	11	2.5"	1	
Quercus palustris	Pin Oak	20 m	7.5-12 m	9	1 gal (2yr)	1	poorly drained soils, prefer wet soil, shallow roots, intolerant of high pH soilsvery profitably and tolerates some soil conditions
Rhus typhina	Staghorn Sumac	8m	8m	21	transplants	1	
Thuja occidentalis	White Cedar	8 m	3.5 mpa	30	5"	1	

Botanical Name	Common Name	Mature Size height	Mature Size spread	Quantity	Comments		
Shrubs							
Cornus canadensis	Grey Dogwood	0.5 m	2 m	11	transplants	1	small white flower, unpleasant smell, in moist sand b.c. medium deep rooted, in moist/damper cracks and soils depends
Cornus sericea	Red-osier Dogwood	2.5 m	2 m	10	1 gal (2-3 yr)	1	
Diervilla lonicera	Bush honeysuckle	0.5 m	1 m	10	1 gal	1	
Rhus aromatica	Fragrant Sumac	1-1.5 m	1.5	10	30 cm	1	tolerates dry conditions well
Viburnum trilobum	Nanabiri	5 m	3 m	17	1 gal (2-3 yr)	1	may use some of these in bioblo areas as well

* Phase 1 -- Fall 1998
* Phase 2 -- Spring 1999
* Phase 3 -- 1-3.5 yrs (with establishment of some cover)



NITRIC ACID ALVAR

SCALE: 1:200 | DRAWN BY: | DESIGNED BY: THEK

DATE: Aug 28/98 | REVISED:

PLANTING PLAN - FALL '98

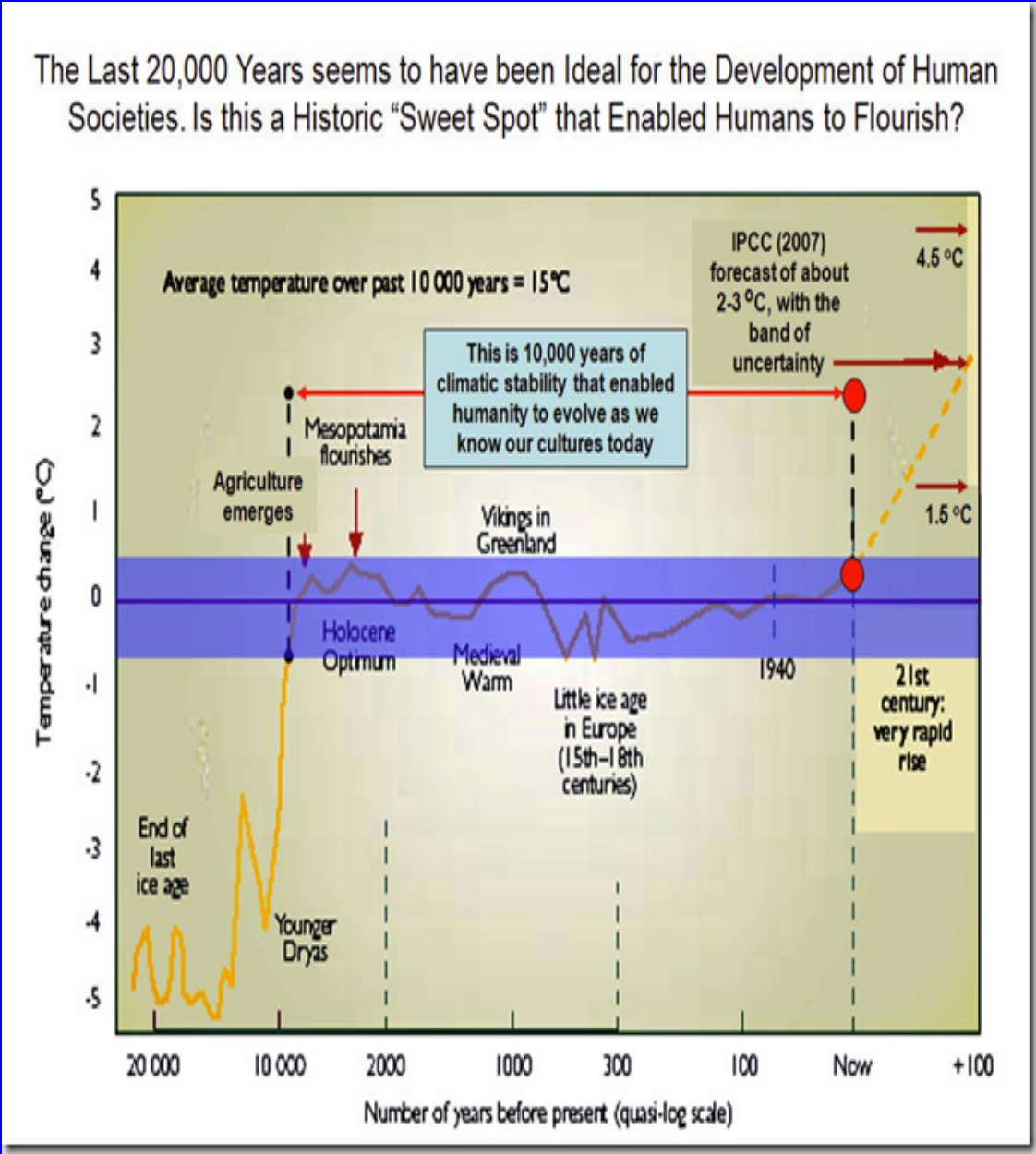
- WOODY PLANT MATERIAL -

DRAWING NUMBER

Can We Build Resilience in the face of Climate/Environmental Change?

- A management vision should rest on socioecological interdependence and the 'sweet spot' of ecological features that allows human enterprise to thrive

- This is the fundamental issue to societies but also one not well recognized in everyday lives or even long-term planning



Building Resilience to Climate/Environmental Change?

- Humans rely on a relatively narrow range of ecological conditions but in our short lifespans we don't fully perceive real trends or shifts

- That is a feature not a 'bug'

- Paying attention to ecosystem changes and knowing how and when to react is what has kept human civilization expanding – with a lot of localized societal crashes when our ancestors ignored the warning signs.

Euphrates River Iraq (Sumeria) – Resilient Ecosystem is Resilient

Building Resilience to Climate/Environmental Change?

- Humans have created the age of the Anthropocene as our economies – our very societies – depend on an environment and its ecological services that do not change rapidly over large scales

- We are ill-equipped to withstand repeated large variations in ecological services and long-term flips of established ecosystem norms - when these happen, societies suffer

How to Start Building Resilience in the Face of Climate/Environmental Change: A Focus on Landscapes

- Example: In Canada, the provincial and Federal budgets have created both crisis and opportunity for ecological systems

- Some decisions were ideologically driven but some indicate a useful shift away from isolated and silo based planning – especially around species

- Of course, this works ONLY if legislation and budget actually enforce and facilitate work at the larger (regional and landscape) scales

Building Resilience in the Face of Climate/Environmental Change: A Focus On Regimes

- In terms of climate change, we have to look even further – to entire regimes of biophysical and social interactions that construct a complex ecosystem

- This is because climates operate largely at that scale – spatial and temporal

- Trying to scale up from local studies or scale down from macroecological studies is one off the thorny problems we face

Lake Erie – In all its scummy glory

Building Resilience in the Face of Climate/Environmental Change: A Larger Scale Focus Does Not Preclude Local Community Planning

- The future of planning for ecological resilience requires a more sophisticated and intentional cross-scalar approach

- We still need local planning and community participation – more if possible – but these need to avoid being isolated as unique studies or situations

- Administratively, this will be difficult – there will be both inertia but also actual challenges in making it all work

Cape Breton Highlands NP

Strategic Planning and Action on Resilience – A Pipe Dream?

- But who will do this? The answer that emerges is that academic, government, and private practitioners are recognizing this need but rather than wait for political decisions are creating tools and forums where exactly these large-scale databases and planning may occur

- We see a role for Governments —but do they see a role? And if they do, how to this with true collaboration and transactive planning?


TORONTO
SUN
WEDNESDAY, NOVEMBER 6, 2013
Tonight's Jackpot
$8,000,000
THE NEW 649 LOTTO
PLUS A GUARANTEED $1 MILLION PRIZE DRAW
14 FORD PAGES INSIDE
Joe Warmington
Don Peat
Michele Mandel
Christina Blizzard
Mike Strobel
Antonella Artuso
Shawn Jeffords
Jenny Yuen
Maryam Shah
Rob Ford
GLOBAL STUPORSTAR
All eyes on T.O. as mayor fesses up to drunken crack smoking


Have a Great Day...

"…not one person on Earth who could name a single green/enviro prognostication of disaster that has ever come true or even been ballpark"

- "New Orleans is sinking. **And its main buffer from a hurricane, the protective Mississippi River delta, is quickly eroding away**, leaving the historic city perilously close to disaster. So vulnerable, in fact, that earlier this year the Federal Emergency Management Agency ranked the potential damage to New Orleans as among the three likeliest, most catastrophic disasters facing this country.".
- - Houston Chronicle.com (originally published **1 December 2001**)

King Canute Would Weep at This…

10 (e) The Division of Coastal Management shall be the only State agency authorized to
11 develop rates of sea-level rise and shall do so only at the request of the Commission. These
12 rates shall only be determined using historical data, and these data shall be limited to the time
13 period following the year 1900. Rates of sea-level rise may be extrapolated linearly to estimate
14 future rates of rise but shall not include scenarios of accelerated rates of sea-level rise. Rates of
15 sea-level rise shall not be one rate for the entire coast but, rather, the Division shall consider
16 separately oceanfront and estuarine shorelines. For oceanfront shorelines, the Division shall use

Figure 2. This chart illustrates the magnitude of SLR resulting from differing rates of acceleration. The most likely scenario for 2100 AD is a rise of 0.4 meter to 1.4 meters (15 inches to 55 inches) above present.

Desirable Resilience Depends on Cross Scalar Ecosystem Restoration

- Its misleading to compartmentalise restoration ecology by scale (genetic, population, community, landscape)

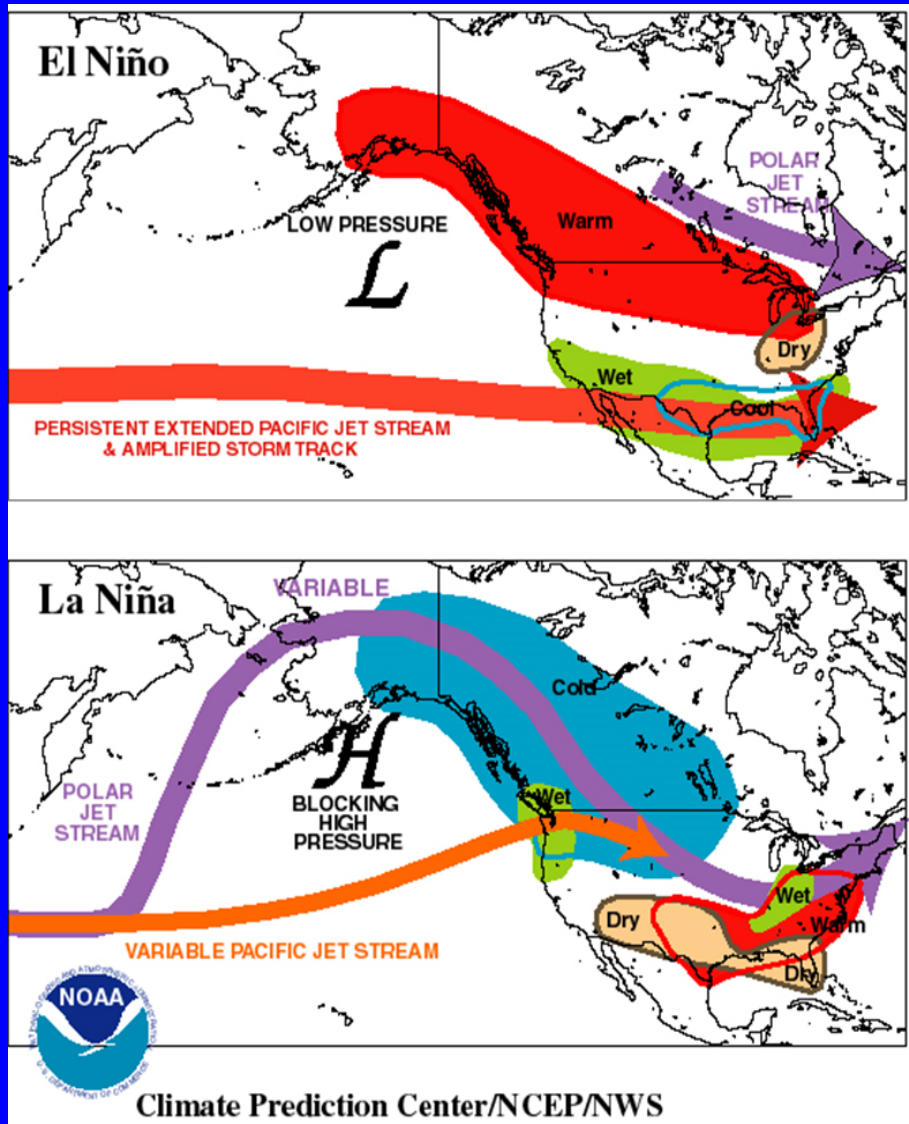
- We only do this because it is easier to organize the world more neatly in this way – and humans are truly anal retentive organizers

- The reality is that restoration ecology (like most environment/social issues) is cross-scalar and transdisciplinary – let's see what we can use to grapple with that reality

The Lookoff, Canning NS

Ecological trajectory & state analyses for ecosystem resilience

- How will cross-scalar (space and time) dynamics affect trajectories?
- One example: El Niño Southern Oscillation (ENSO) has strong effects on the dynamics of plant and animal populations in a wide range of terrestrial ecosystems ranging from arid and semiarid ecosystems to tropical and boreal forests

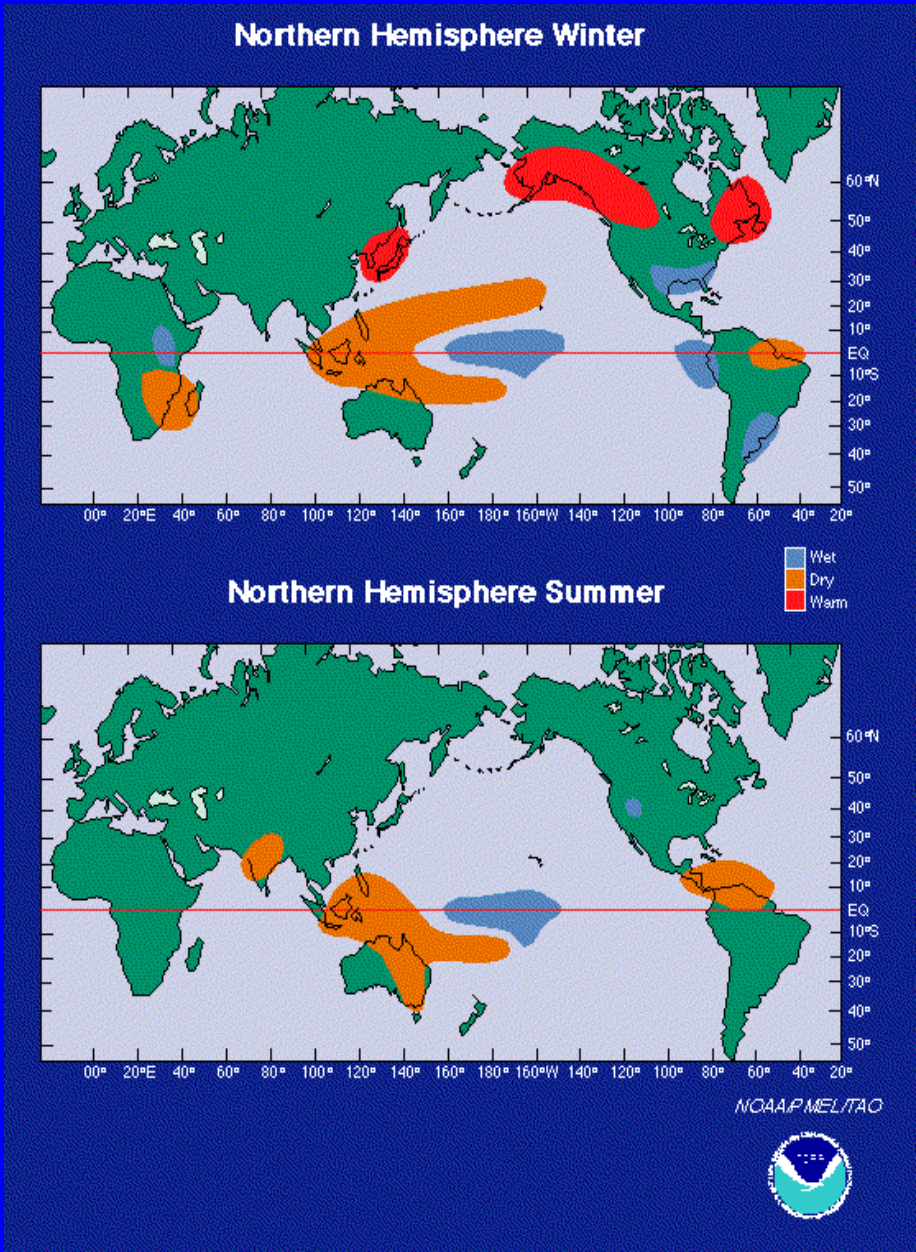


Ecological trajectory & state analyses

- Rainfall increases dramatically (4-10 X) in some areas and others experience droughts occur in other regions.

- La Niña reverses these after ~ 1 year

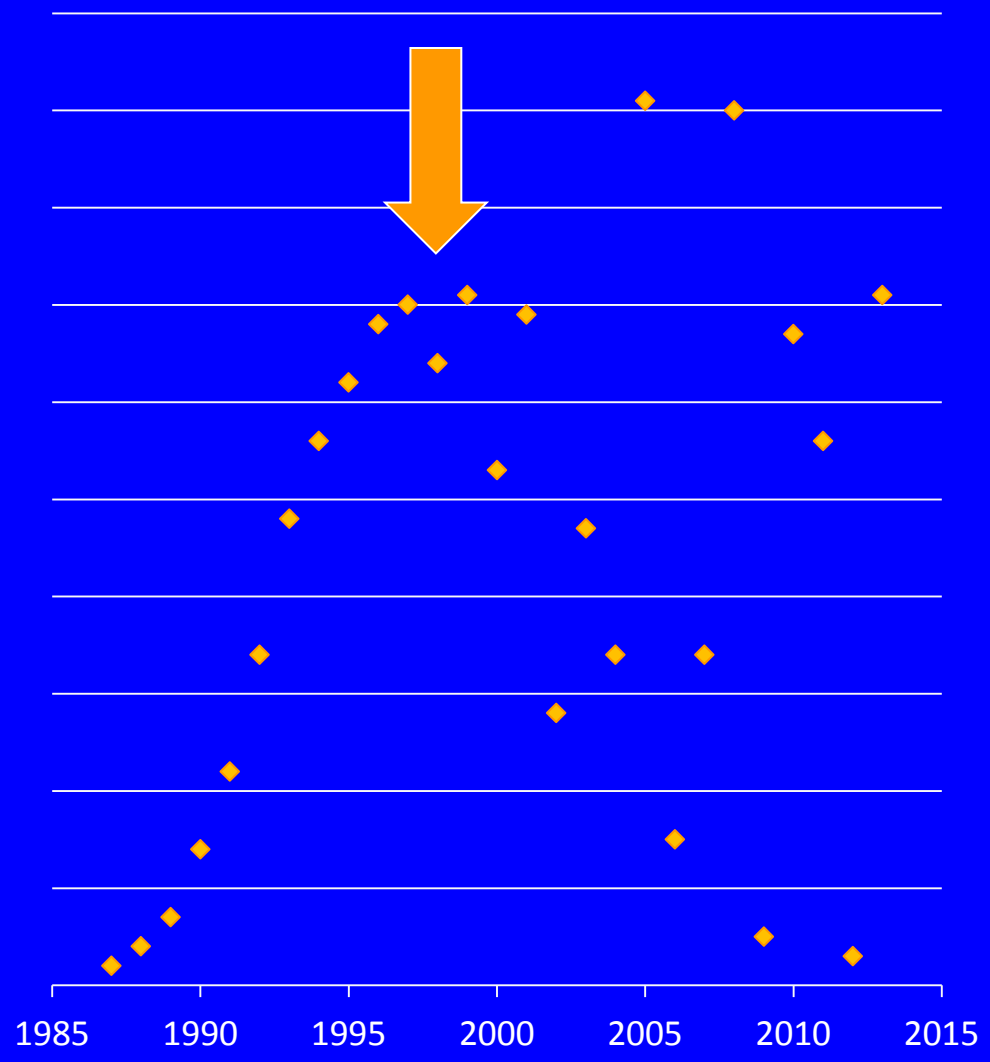
- Occurs ~ 3-6 years; probably will increase with anthropogenic climate changes



Ecological trajectory & state analyses: How we get fooled in ecological restoration and ecosystem resilience

- We might consider restoration in some New Brunswick coastal meadows a success in the short-term (1987-1999), based on a DCA of the successional trajectory (nutrient cycling + native species richness)

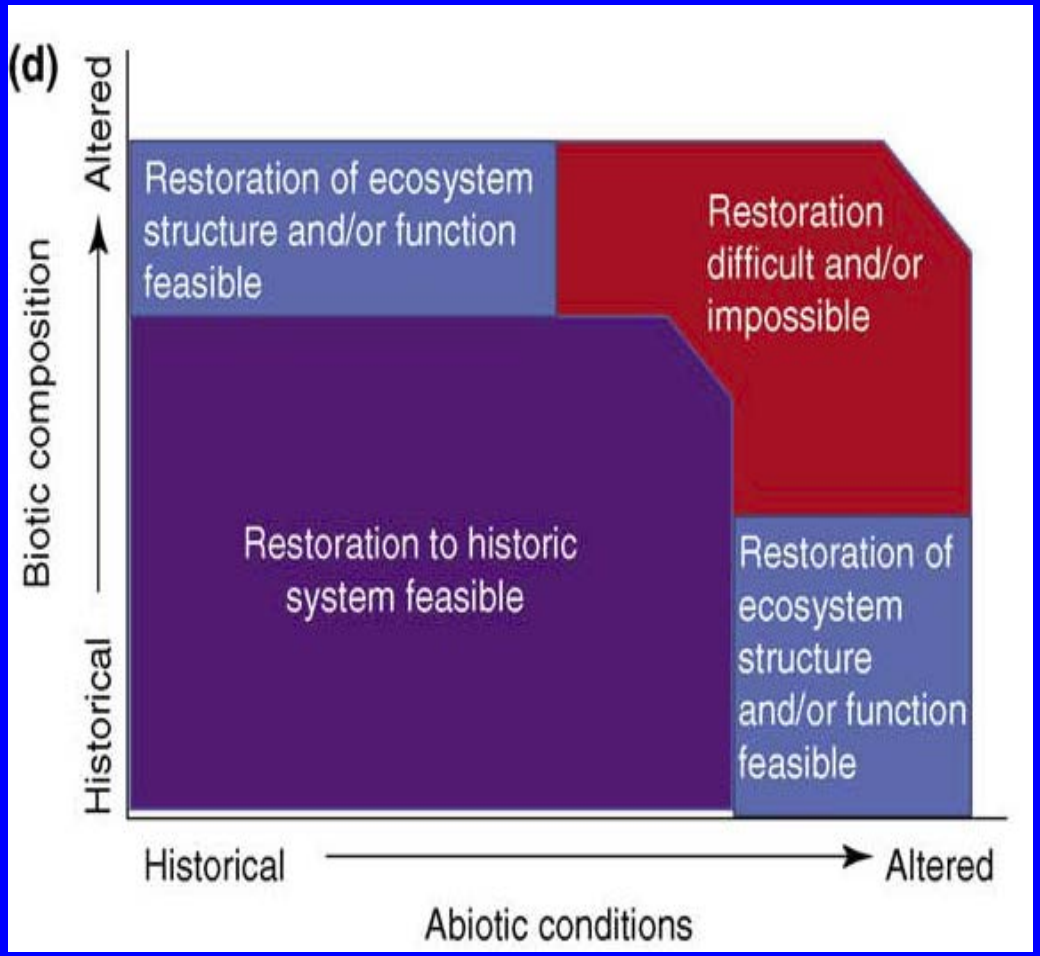
- A "failure" in the long-term as the successional trajectory became stochastic and it appears to be related to the changing ENSO patterns plus changes in the Gulf Stream



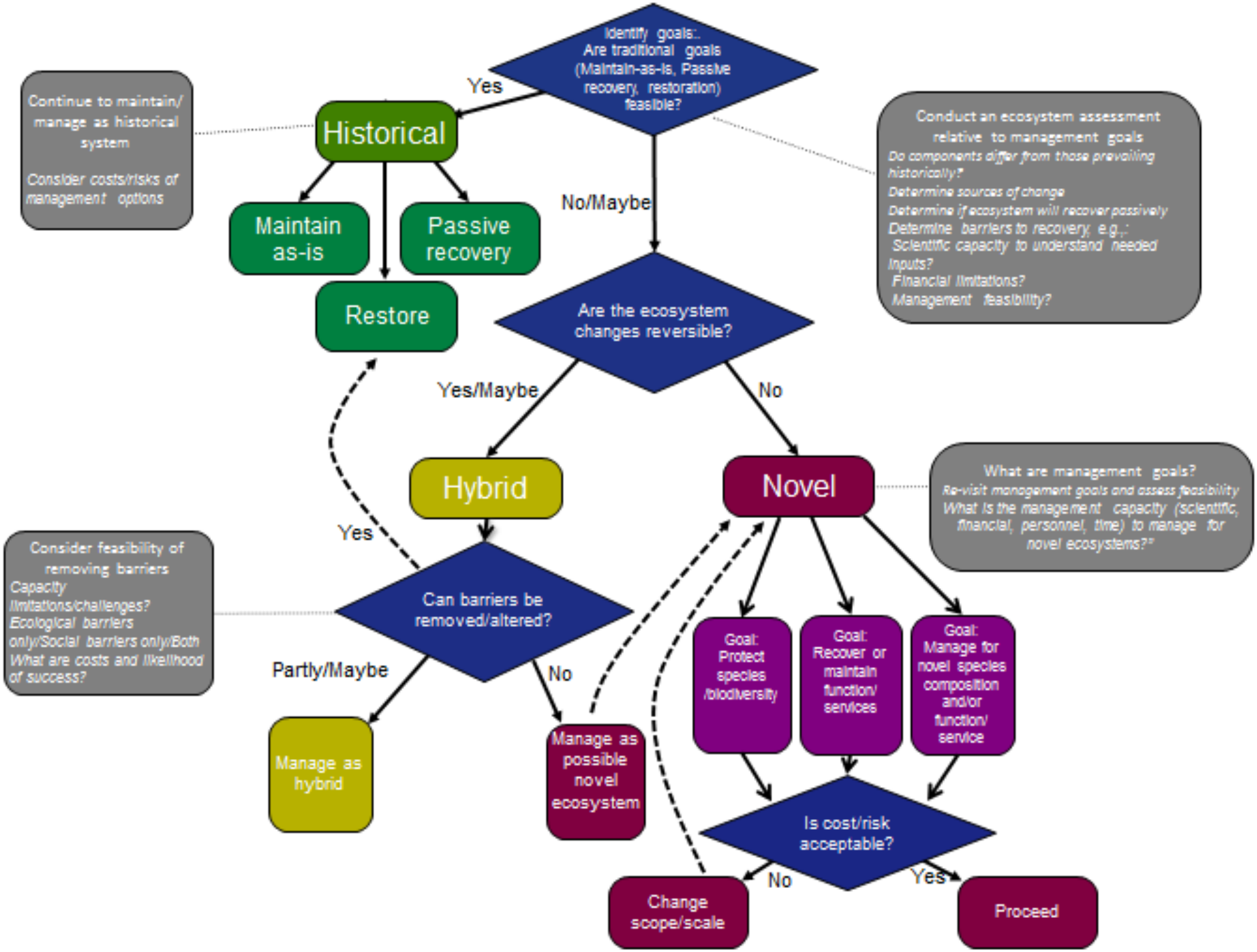
The Future May Be in 'Restoring' Ecosystems to a Novel Ecosystem State and Function Space

- As we farm, urbanize, mine, explore and so forth, we alter ecosystems so much that we anticipate that we will have novel ecosystems where most of the function exists but the structure (species) differ

- In many cases, there is no anticipation needed, those conditions already exist and are in fact permanent



Hobbs et al 2009 TREE 24: 599-605


Identify goals:. Are traditional goals (Maintain-as-is, Passive recovery, restoration) feasible?
Yes
No/Maybe
Historical
Continue to maintain/ manage as historical system
Consider costs/risks of management options
Maintain as-is
Passive recovery
Restore
Conduct an ecosystem assessment relative to management goals
Do components differ from those prevailing historically?
Determine sources of change
Determine if ecosystem will recover passively
Determine barriers to recovery, e.g.,:
Scientific capacity to understand needed inputs?
Financial limitations?
Management feasibility?
Are the ecosystem changes reversible?
Yes/Maybe
No
Hybrid
Novel
What are management goals?
Re-visit management goals and assess feasibility
What is the management capacity (scientific, financial, personnel, time) to manage for novel ecosystems?"
Yes
Consider feasibility of removing barriers
Capacity limitations/challenges?
Ecological barriers only/Social barriers only/Both
What are costs and likelihood of success?
Can barriers be removed/altered?
Partly/Maybe
No
Manage as hybrid
Manage as possible novel ecosystem
Goal: Protect species /biodiversity
Goal: Recover or maintain function/ services
Goal: Manage for novel species composition and/or function/ service
Is cost/risk acceptable?
No
Yes
Change scope/scale
Proceed

An example of how novel ecosystem analysis may translate into assessment of resilience

→

Cranberry production in some locales is threatened by a combination of regional climate change, overharvest, diseases, runoff from urban areas; if these cannot be mitigated, then the system is not resilient

One alternative novel ecosystem that can arise or can be directed via managed succession is to create blueberry driven agroecosystems; this assumes factors like pollinators services exist to ensure resilience

↓

↘

↓

A 2nd alternative novel ecosystem is to use directed succession to create a peatland bog that could focus on commercial peat production; this is not necessary exclusive of attempts at ecological restoration in some locales

A 3rd alternative is restore the system back to a bog that is not used for peat production; this would be used if there are no commercial alternatives and there are policy incentives that financially compensate landowners

Less Fealty to Historical Perspective + Greater Political Will Achieving Goals of Resilience Requires Rethinking Restoration

- This is true only if these ideas are not merely code for austerity or deregulation
- We simply have to recognize Novel ecosystems & the Anthropocene
- But recognition is not about compromise or giving up
- It is about better planning for socioecological resilience and sustainability