Resisting, Accepting or Directing Change: A new way to think about climate adaptation

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Kenai National Wildlife Refuge
Resisting, Accepting or Directing Change: A new way to think about climate adaptation

- A decision framework
- Neither linear nor mutually exclusive in its application
- Can (and should) be guided by landscape considerations but it's a local-scale decision
- ACCEPT does not imply the absence of management
- Acknowledgment of the 3 bins promotes novel thinking and betting
Adaptation is...

“an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities”

— Intergovernmental Panel on Climate Change (2007)
Resistance vs Resilience vs Transformation

NFWPCAS developed to promote unified agency responses to climate change impacts

— National Fish, Wildlife, and Plants Climate Adaptation Strategy 2012
RAD framework squarely assigns the adaptation response to a managerial decision

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<tr>
<th>RESIST</th>
<th>ACCEPT</th>
<th>DIRECT</th>
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<tr>
<td>Many changes will be <strong>RESISTED</strong> by managers, to maintain ecosystem processes, function, and composition toward a historical baseline</td>
<td>Many changes will be <strong>ACCEPTED</strong> by managers, perhaps because...</td>
<td>Some changes will be <strong>DIRECTED</strong> by managers toward a specific future state because...</td>
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<td>• Infeasible to be managed</td>
<td>so dramatic that resisting is untenable and there is a feasible opportunity to steward change towards a more desirable outcome than what would be achieved with acceptance</td>
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<td>• Insufficiently impactful to warrant response</td>
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<td></td>
<td>• Acceptable to (even desirable by) stakeholders</td>
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<td></td>
<td>• unknowingly occurring</td>
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<td>• Lack of will or impetus despit sufficient knowledge or resources</td>
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...with the goal of a self-sustaining, self-organizing system
Directional Change
unrelenting and unprecedented change in key drivers of ecological conditions

Ecological Transformation
“a dramatic, persistent, and statistically ‘extreme’ shift in multiple ecological characteristics, the basis of which is dramatic changes in species composition”

Harris et al. 2018. Nature Climate Change 8:579-587
DIRECTIONAL CHANGE:
Responses of three National Wildlife Refuges to sea-level rise
1-ft Sea Level Rise Scenario

Blackwater NWR

Chincoteague NWR

Chafee NWR
RESISTING CHANGE: Chafee National Wildlife Refuge

- $1.4 million project uses thin-layer deposition to keep *Spartina patens* saltmarsh in situ
- 3,000 bags of clam and oyster shells hold sediment and water on elevated marsh
- Amphibious excavator to disperse sediment
ACCEPTING CHANGE: Chincoteague National Wildlife Refuge and Assateague Island National Seashore

✓ After 6 decades of maintaining artificial dunes, island will be allowed to overwash during storm events and migrate in response to long-shore current

✓ Since 2003, increasing storm damage to infrastructure (visitor center, roads, parking lots) has cost $3.5 million

✓ NPS beach facilities moved inland and two refuge waterfowl impoundments will be allowed to deteriorate
DIRECTING CHANGE: Blackwater National Wildlife Refuge

✓ Since 1938, 5,000 acres of tidal wetlands converted to open water, but 2,700 acres of new marsh created by upslope migration (ACCEPT)

✓ A partnered $475K demonstration project facilitates marsh migration by extending the head of tidal creek with low-ground-pressure excavator (DIRECT)

✓ Thin-layer deposition holds some marsh in situ (RESIST)
RESIST

Stream banks are restored, some invasive species are eradicated, fire is managed progressively, and landscape connectivity is maintained through fish and wildlife passages under or over highways. Many invasives are not managed either due to infeasibility or lack of perceived threat.

ACCEPT

Glaciers are melting, non-glacial streams are warming, tree line is rising, and wetlands are drying. Yet, the effects have not been severe enough to prompt a management response. Society has accepted the changes in fish and wildlife communities, even with higher costs to ecosystem services.

DIRECT

A spruce bark beetle epidemic and human-caused fire have shifted white spruce forests into a novel grassland ecosystem. Non-native trees are being planted, and the introduction of large grazers is being considered to stabilize the new grasslands and related communities.

Kenai Peninsula, Alaska: A Case Study

Conventional management issues

Most ecological responses to climate change

Deforestation
RESIST
DIRECT
RESIST

Traditional management issues

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DIRECT

Deforestation

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ACCEPT

Most ecological responses to climate change

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Dramatic changes in last 5 decades in response to warming and drying

- available water declines (60% loss since 1968)
- wetlands dry (6 – 11% per decade), peatlands afforest
- glaciers recede (11% surface area, 21 m elevation)
+ nonglacial salmon streams warm (17 of 48 sublethal in July)
+ afforestation (trees~1 m per yr, shrubs~2.8 m per yr)
+ spruce bark beetle outbreaks (triggered by 2 consecutive warm summers)
Δ fire regime (lightning, grass, spring, shorter MFRI)
RESIST: Could engineering by beavers and humans recharge drying peatlands?

Peatlands 55% of streamflow during low flow

Beaver dams increase groundwater discharge 70% (no clay) to 90% (clay pan)
Ice911 is a “Silicon Valley moonshot aiming to stabilize climate by restoring ice in the Arctic”
RESIST: Could Ice911 stabilize ice in the Harding Icefield?
It’s not rocket science...

...it’s harder