Resist until when?

Applying adaptive management

Abigail J. Lynch, L. M. Thompson, J. M. Morton, E. A. Beever, M. Clifford, D. Limpinsel, R. T. Magill, D. R. Magness, T. A. Melvin, R. A. Newman, M. T. Porath, F. J. Rahel, J. H. Reynolds, G. W. Schuurman, S. A. Sethi, J. L. Wilkening

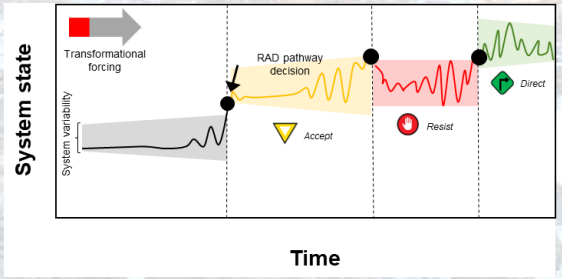
Sara Cottle on Unsplash

Resist until when?

Applying adaptive management

RAD

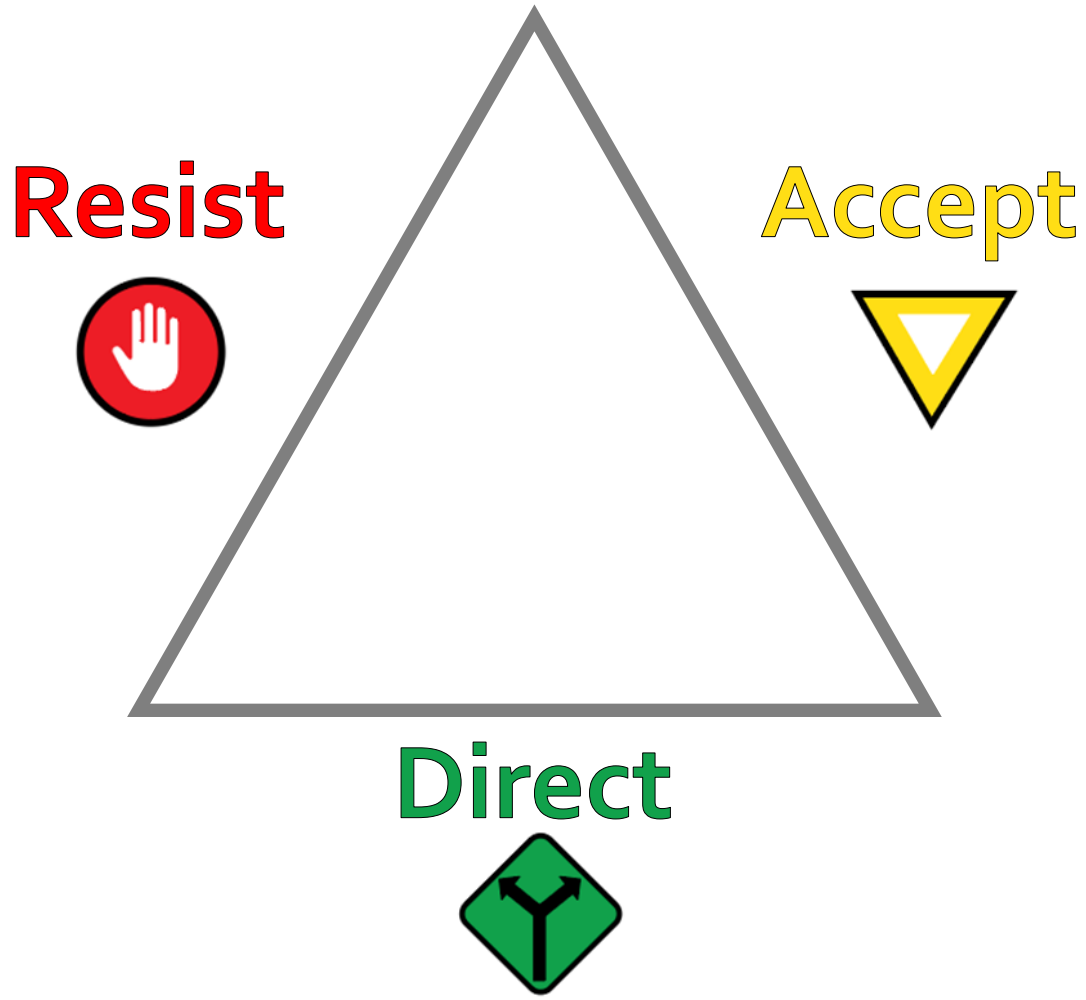
can support management for changing systems.



RAD decisions will need to be revisited.

Familiar tools can help.

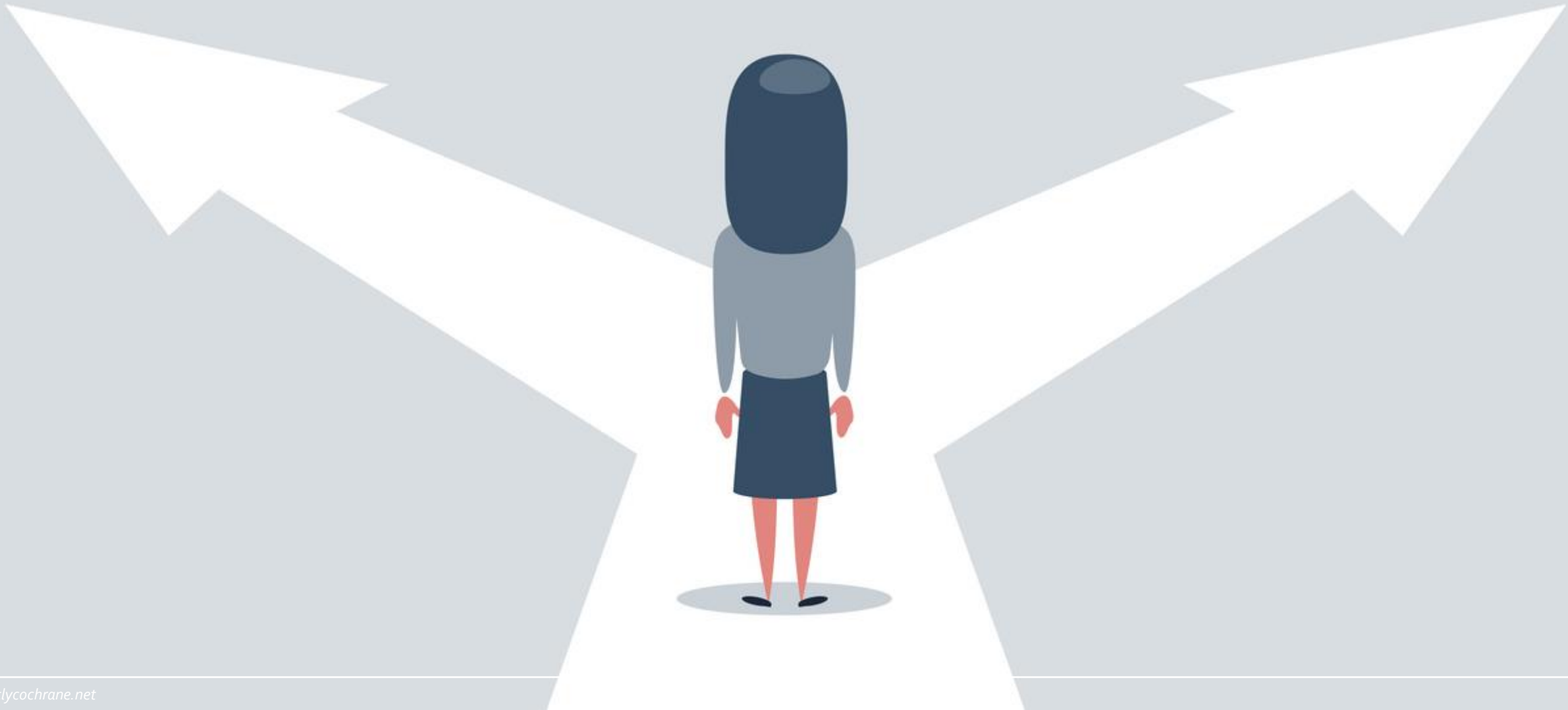
The RAD framework



USGS science for a changing world

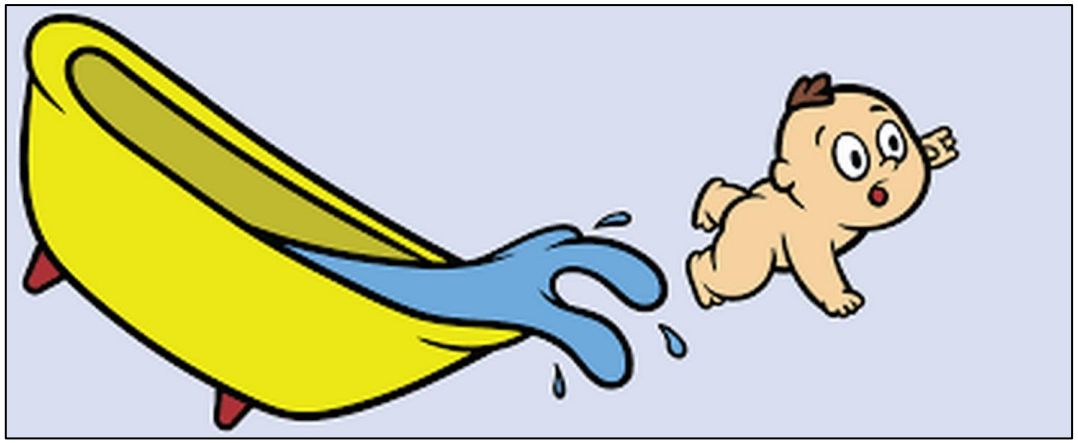
Thompson et al. 2021


RESISTANCE
IS FUTILE
memegenerator.net



Building from a strong foundation

- Scenario planning
- Structured decision making
- Climate-Smart Conservation
- Adaptive management

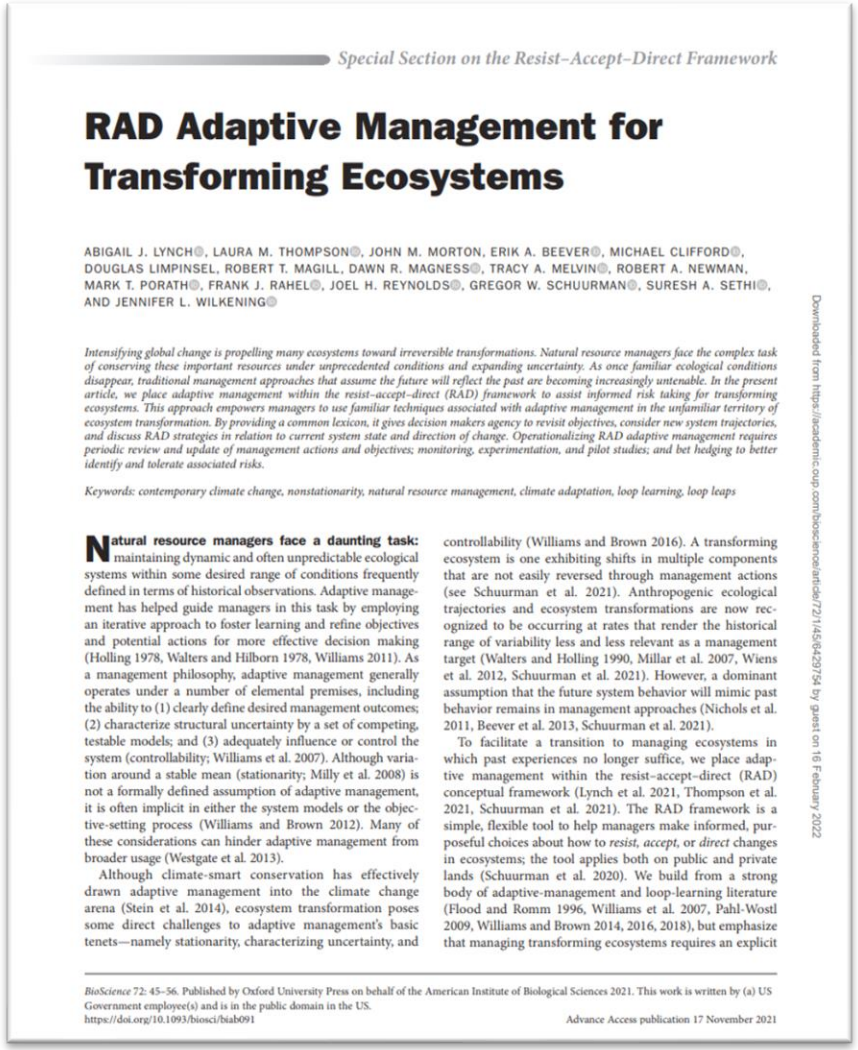


vocal.media

USGS
science for a changing world

Building from a strong foundation

- Scenario planning
- Structured decision making
- Climate-Smart Conservation
- **Adaptive management**



Special Section on the Resist–Accept–Direct Framework

RAD Adaptive Management for Transforming Ecosystems

ABIGAIL J. LYNCH, LAURA M. THOMPSON, JOHN M. MORTON, ERIK A. BEEVER, MICHAEL CLIFFORD, DOUGLAS LIMPINSEL, ROBERT T. MAGILL, DAWN R. MAGNESS, TRACY A. MELVIN, ROBERT A. NEWMAN, MARK T. PORATH, FRANK J. RAHEL, JOEL H. REYNOLDS, GREGOR W. SCHUURMAN, SURESH A. SETHI, AND JENNIFER L. WILKENING

Intensifying global change is propelling many ecosystems toward irreversible transformations. Natural resource managers face the complex task of conserving these important resources under unprecedented conditions and expanding uncertainty. As once familiar ecological conditions disappear, traditional management approaches that assume the future will reflect the past are becoming increasingly untenable. In the present article, we place adaptive management within the resist–accept–direct (RAD) framework to assist informed risk taking for transforming ecosystems. This approach empowers managers to use familiar techniques associated with adaptive management in the unfamiliar territory of ecosystem transformation. By providing a common lexicon, it gives decision makers agency to revisit objectives, consider new system trajectories, and discuss RAD strategies in relation to current system state and direction of change. Operationalizing RAD adaptive management requires periodic review and update of management actions and objectives; monitoring, experimentation, and pilot studies; and bet hedging to better identify and tolerate associated risks.

Keywords: contemporary climate change, nonstationarity, natural resource management, climate adaptation, loop learning, loop leaps

Natural resource managers face a daunting task: maintaining dynamic and often unpredictable ecological systems within some desired range of conditions frequently defined in terms of historical observations. Adaptive management has helped guide managers in this task by employing an iterative approach to foster learning and refine objectives and potential actions for more effective decision making (Holling 1978, Walters and Hilborn 1978, Williams 2011). As a management philosophy, adaptive management generally operates under a number of elemental premises, including the ability to (1) clearly define desired management outcomes; (2) characterize structural uncertainty by a set of competing, testable models; and (3) adequately influence or control the system (controllability; Williams et al. 2007). Although variation around a stable mean (stationarity; Milly et al. 2008) is not a formally defined assumption of adaptive management, it is often implicit in either the system models or the objective-setting process (Williams and Brown 2012). Many of these considerations can hinder adaptive management from broader usage (Westgate et al. 2013).

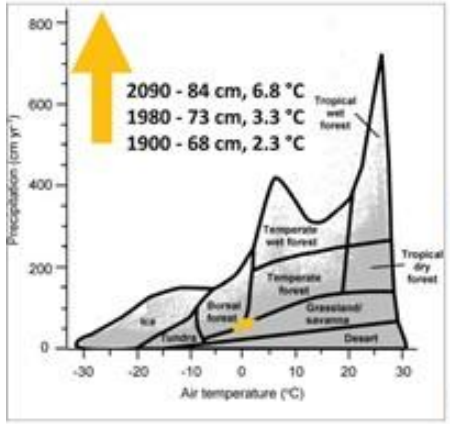
Although climate-smart conservation has effectively drawn adaptive management into the climate change arena (Stein et al. 2014), ecosystem transformation poses some direct challenges to adaptive management's basic tenets—namely stationarity, characterizing uncertainty, and controllability (Williams and Brown 2016). A transforming ecosystem is one exhibiting shifts in multiple components that are not easily reversed through management actions (see Schuurman et al. 2021). Anthropogenic ecological trajectories and ecosystem transformations are now recognized to be occurring at rates that render the historical range of variability less and less relevant as a management target (Walters and Holling 1990, Millar et al. 2007, Wiens et al. 2012, Schuurman et al. 2021). However, a dominant assumption that the future system behavior will mimic past behavior remains in management approaches (Nichols et al. 2011, Beever et al. 2013, Schuurman et al. 2021).

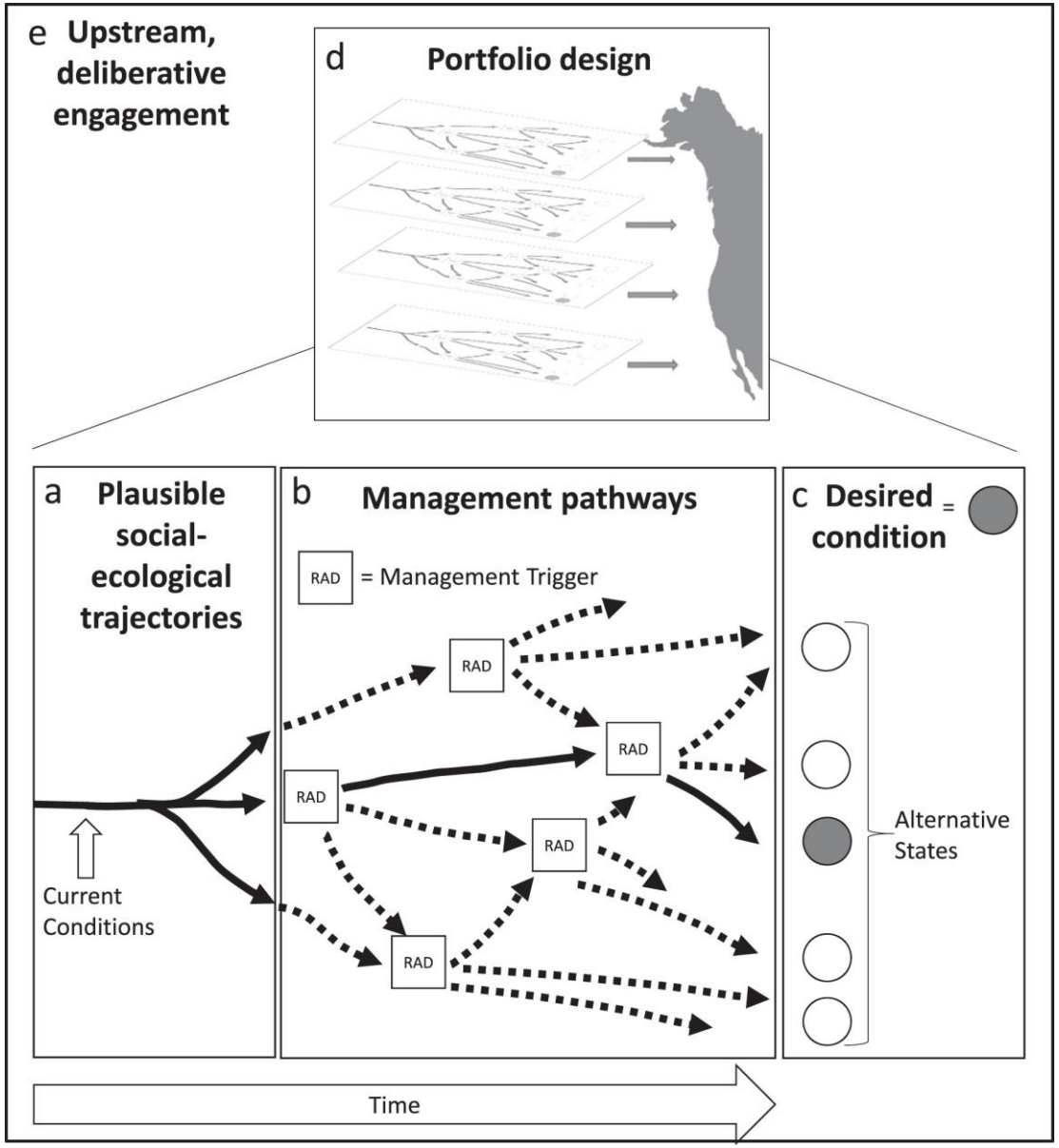
To facilitate a transition to managing ecosystems in which past experiences no longer suffice, we place adaptive management within the resist–accept–direct (RAD) conceptual framework (Lynch et al. 2021, Thompson et al. 2021, Schuurman et al. 2021). The RAD framework is a simple, flexible tool to help managers make informed, purposeful choices about how to *resist*, *accept*, or *direct* changes in ecosystems; the tool applies both on public and private lands (Schuurman et al. 2020). We build from a strong body of adaptive-management and loop-learning literature (Flood and Romm 1996, Williams et al. 2007, Pahl-Wostl 2009, Williams and Brown 2014, 2016, 2018), but emphasize that managing transforming ecosystems requires an explicit

BioScience 72: 45–56. Published by Oxford University Press on behalf of the American Institute of Biological Sciences 2021. This work is written by (a) US Government employee(s) and is in the public domain in the US.
https://doi.org/10.1093/biosci/biab091 Advance Access publication 17 November 2021

USGS
science for a changing world

Decision points

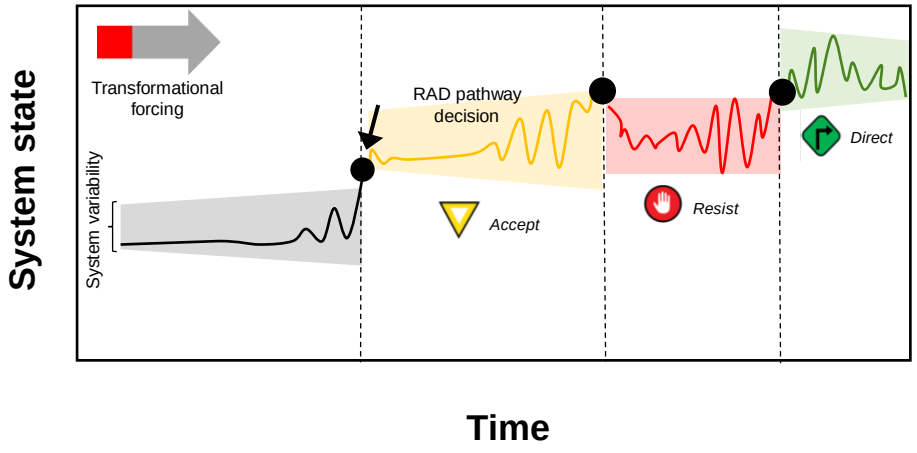


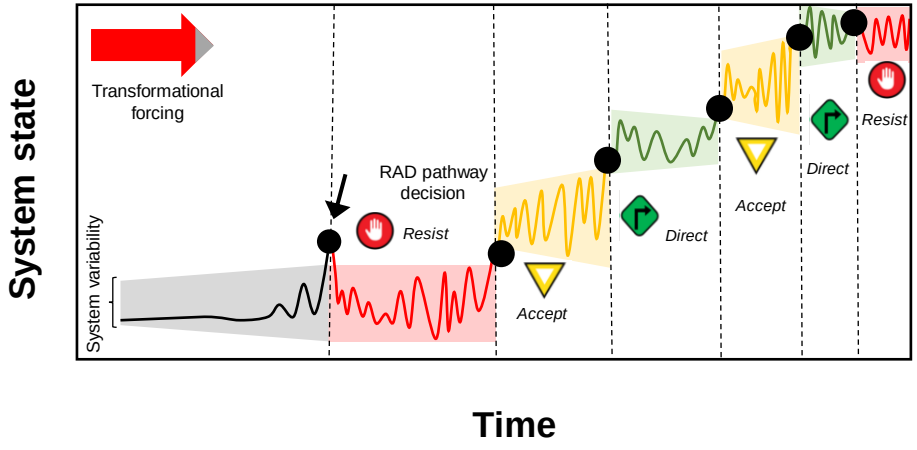


USGS science for a changing world

Magness et al. 2022

Decision path



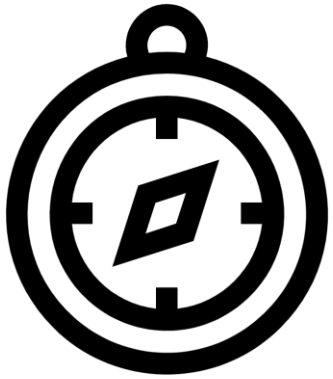


USGS science for a changing world

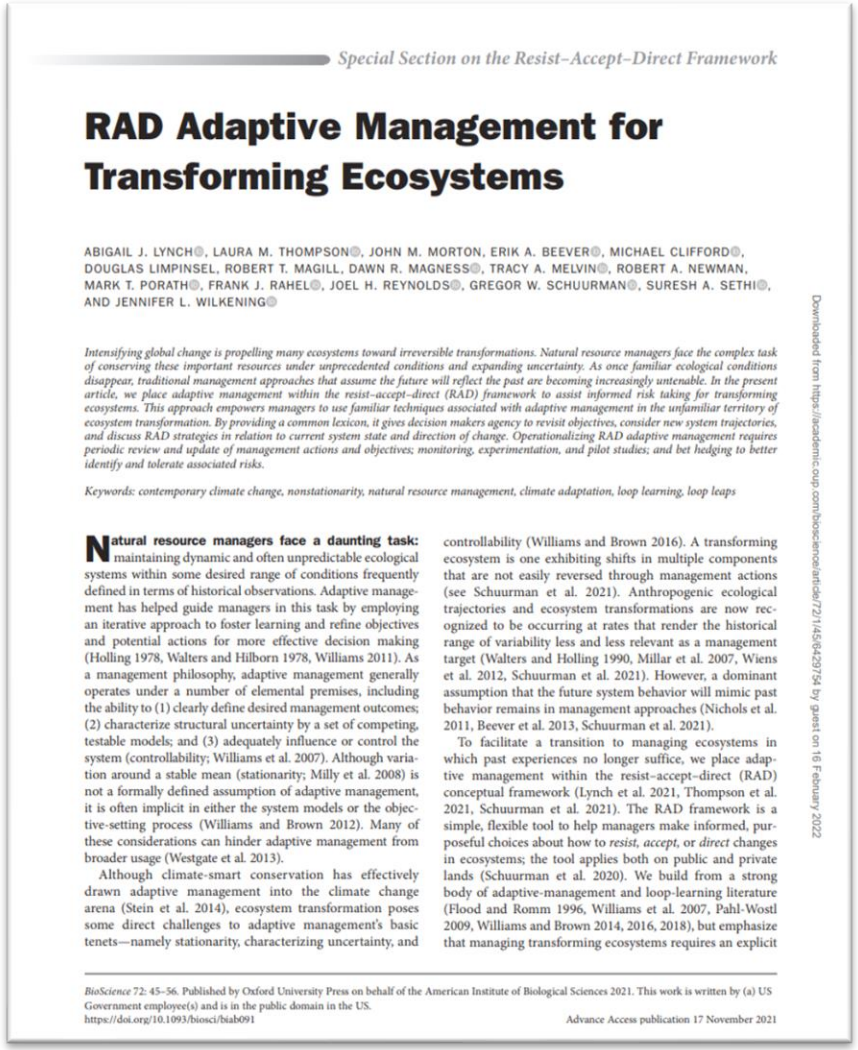
Lynch et al. 2022

Navigating in a transforming world

RAD =



Adaptive management =



Special Section on the Resist–Accept–Direct Framework

RAD Adaptive Management for Transforming Ecosystems

ABIGAIL J. LYNCH, LAURA M. THOMPSON, JOHN M. MORTON, ERIK A. BEEVER, MICHAEL CLIFFORD, DOUGLAS LIMPINSEL, ROBERT T. MAGILL, DAWN R. MAGNESS, TRACY A. MELVIN, ROBERT A. NEWMAN, MARK T. PORATH, FRANK J. RAHEL, JOEL H. REYNOLDS, GREGOR W. SCHUURMAN, SURESH A. SETHI, AND JENNIFER L. WILKENING

Intensifying global change is propelling many ecosystems toward irreversible transformations. Natural resource managers face the complex task of conserving these important resources under unprecedented conditions and expanding uncertainty. As once familiar ecological conditions disappear, traditional management approaches that assume the future will reflect the past are becoming increasingly untenable. In the present article, we place adaptive management within the resist–accept–direct (RAD) framework to assist informed risk taking for transforming ecosystems. This approach empowers managers to use familiar techniques associated with adaptive management in the unfamiliar territory of ecosystem transformation. By providing a common lexicon, it gives decision makers agency to revisit objectives, consider new system trajectories, and discuss RAD strategies in relation to current system state and direction of change. Operationalizing RAD adaptive management requires periodic review and update of management actions and objectives; monitoring, experimentation, and pilot studies; and bet hedging to better identify and tolerate associated risks.

Keywords: contemporary climate change, nonstationarity, natural resource management, climate adaptation, loop learning, loop leaps

Natural resource managers face a daunting task: maintaining dynamic and often unpredictable ecological systems within some desired range of conditions frequently defined in terms of historical observations. Adaptive management has helped guide managers in this task by employing an iterative approach to foster learning and refine objectives and potential actions for more effective decision making (Holling 1978, Walters and Hilborn 1978, Williams 2011). As a management philosophy, adaptive management generally operates under a number of elemental premises, including the ability to (1) clearly define desired management outcomes; (2) characterize structural uncertainty by a set of competing, testable models; and (3) adequately influence or control the system (controllability; Williams et al. 2007). Although variation around a stable mean (stationarity; Milly et al. 2008) is not a formally defined assumption of adaptive management, it is often implicit in either the system models or the objective-setting process (Williams and Brown 2012). Many of these considerations can hinder adaptive management from broader usage (Westgate et al. 2013).

Although climate-smart conservation has effectively drawn adaptive management into the climate change arena (Stein et al. 2014), ecosystem transformation poses some direct challenges to adaptive management's basic tenets—namely stationarity, characterizing uncertainty, and controllability (Williams and Brown 2016). A transforming ecosystem is one exhibiting shifts in multiple components that are not easily reversed through management actions (see Schuurman et al. 2021). Anthropogenic ecological trajectories and ecosystem transformations are now recognized to be occurring at rates that render the historical range of variability less and less relevant as a management target (Walters and Holling 1990, Millar et al. 2007, Wiens et al. 2012, Schuurman et al. 2021). However, a dominant assumption that the future system behavior will mimic past behavior remains in management approaches (Nichols et al. 2011, Beever et al. 2013, Schuurman et al. 2021).

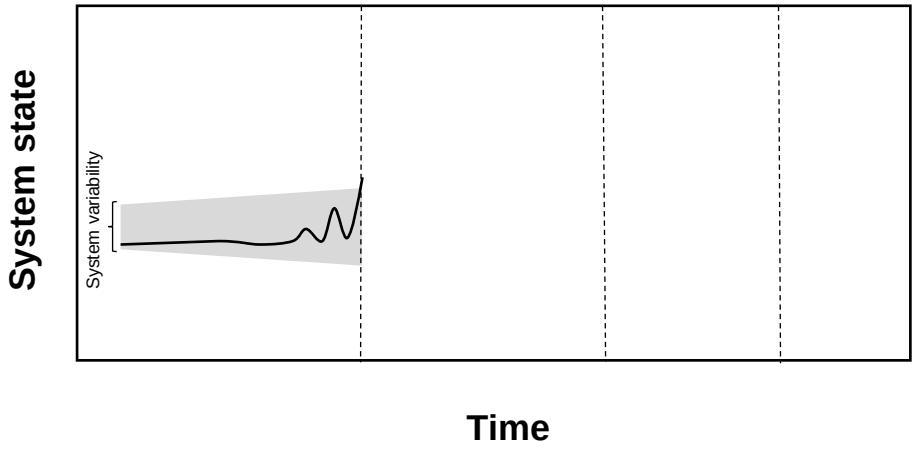
To facilitate a transition to managing ecosystems in which past experiences no longer suffice, we place adaptive management within the resist–accept–direct (RAD) conceptual framework (Lynch et al. 2021, Thompson et al. 2021, Schuurman et al. 2021). The RAD framework is a simple, flexible tool to help managers make informed, purposeful choices about how to *resist*, *accept*, or *direct* changes in ecosystems; the tool applies both on public and private lands (Schuurman et al. 2020). We build from a strong body of adaptive-management and loop-learning literature (Flood and Romm 1996, Williams et al. 2007, Pahl-Wostl 2009, Williams and Brown 2014, 2016, 2018), but emphasize that managing transforming ecosystems requires an explicit

BioScience 72: 45–56. Published by Oxford University Press on behalf of the American Institute of Biological Sciences 2021. This work is written by (a) US Government employee(s) and is in the public domain in the US.
https://doi.org/10.1093/biosci/biab091 Advance Access publication 17 November 2021

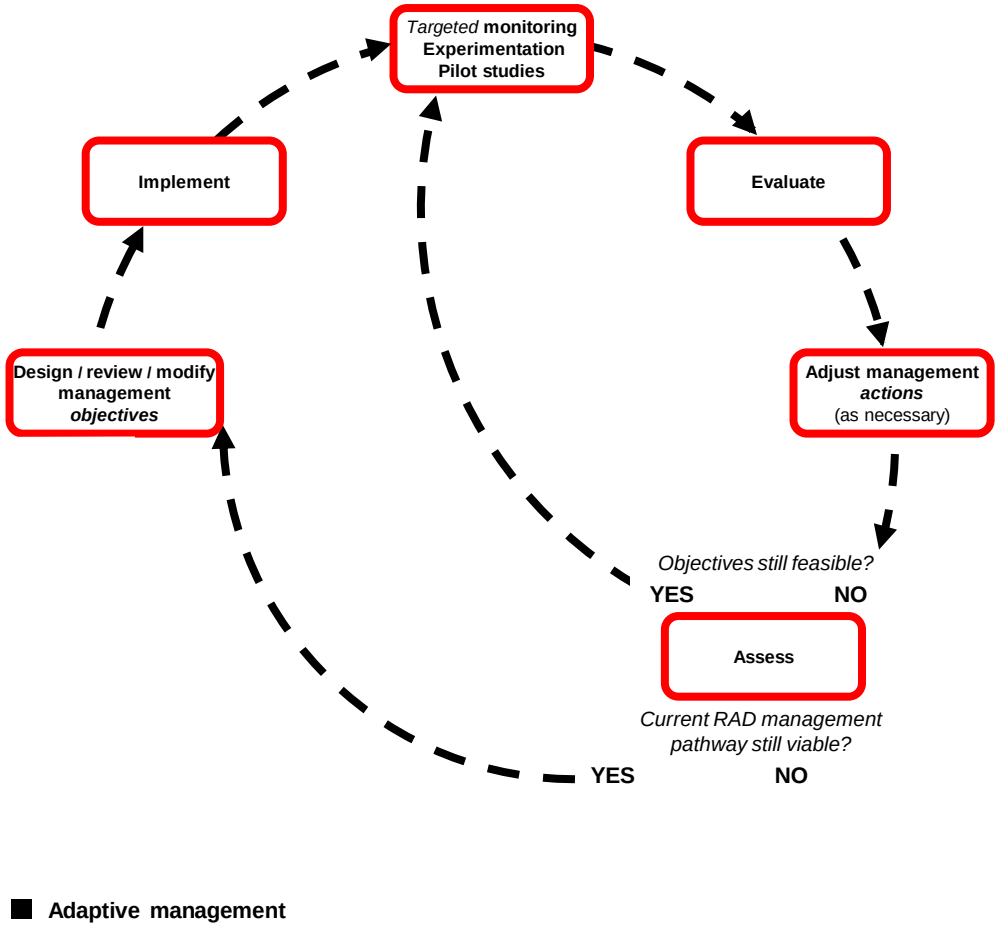
USGS
science for a changing world

RAD Adaptive Management

- *When a system state is **stable**:*



- *Often involves:*
  - **Targeted** monitoring
  - **Pilot** studies and **experimentation**

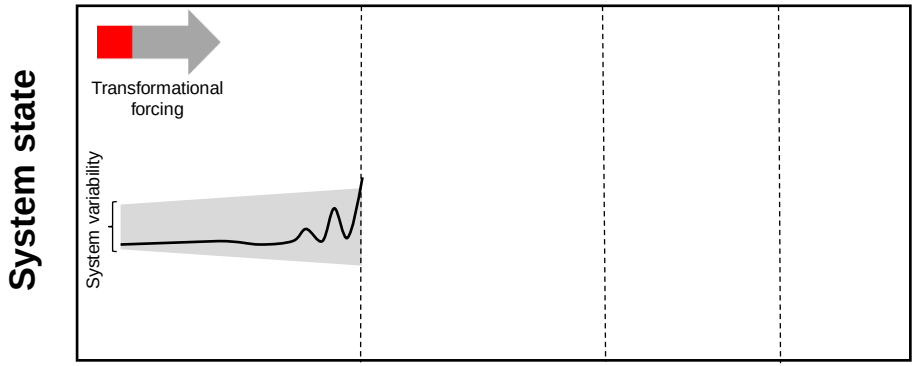


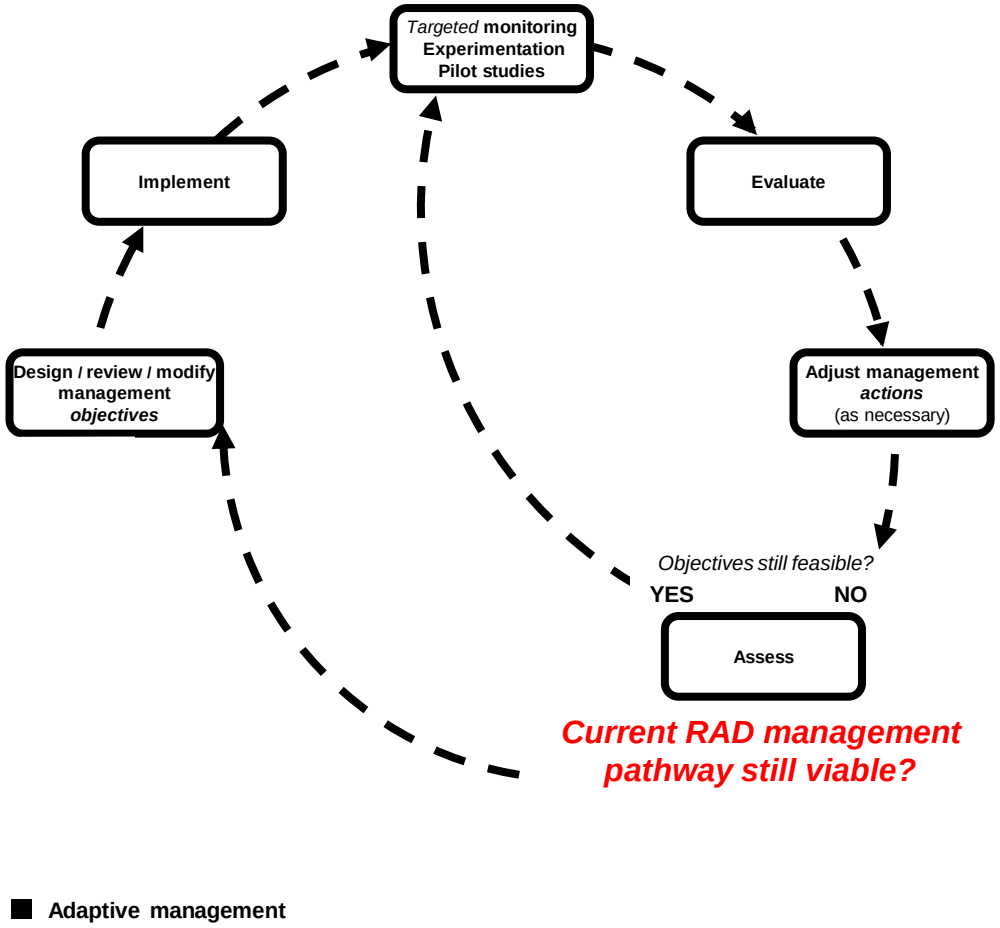
USGS science for a changing world

Lynch et al. 2022

RAD Adaptive Management

- *When a system state is **changing**:*



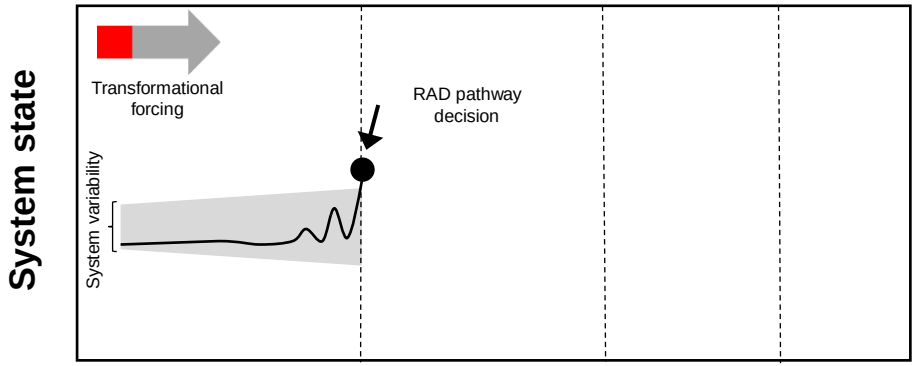


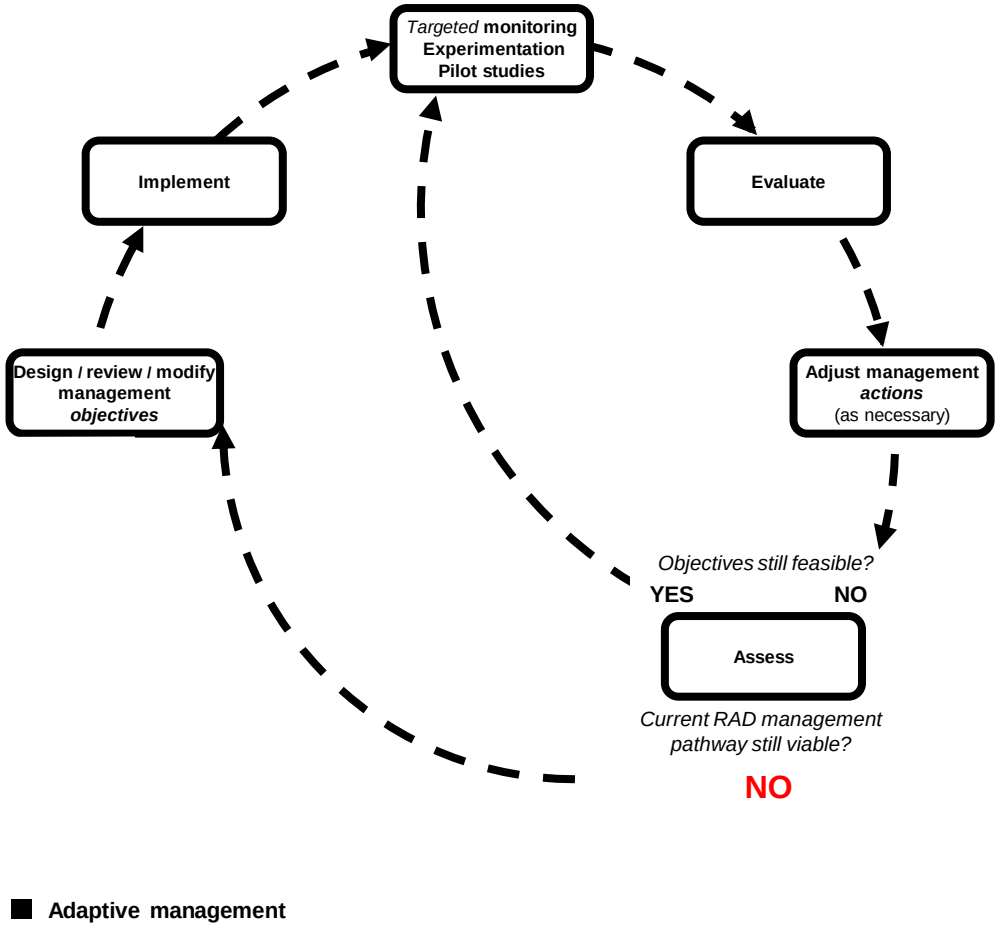
USGS science for a changing world

Lynch et al. 2022

RAD Adaptive Management

- *When a system state is **changing**:*



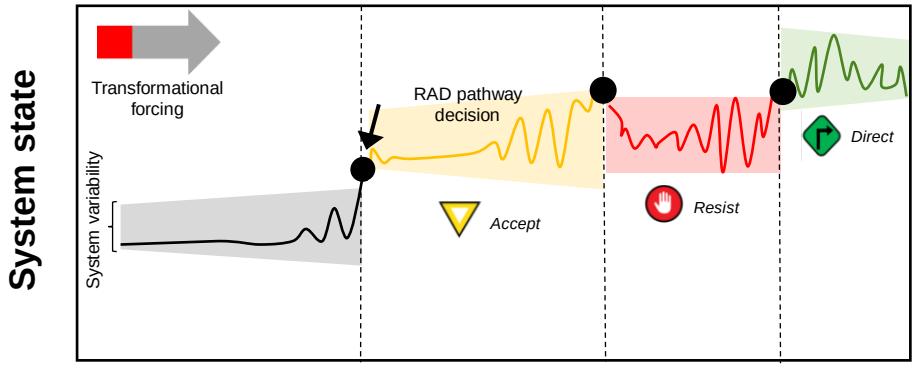


USGS science for a changing world

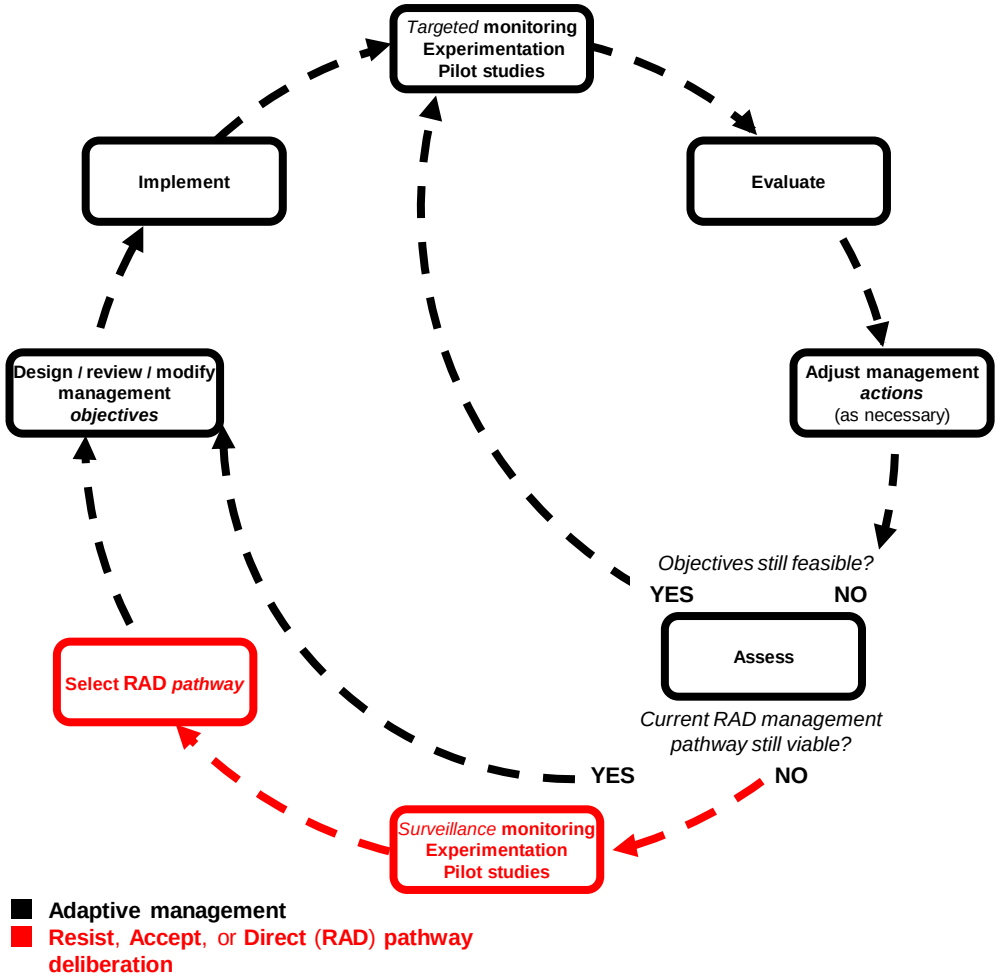
Lynch et al. 2022

RAD Adaptive Management

- *When a system state is **changing**:*



- *Often involves:*
  - **Surveillance** monitoring
  - **Pilot** studies and **experimentation**

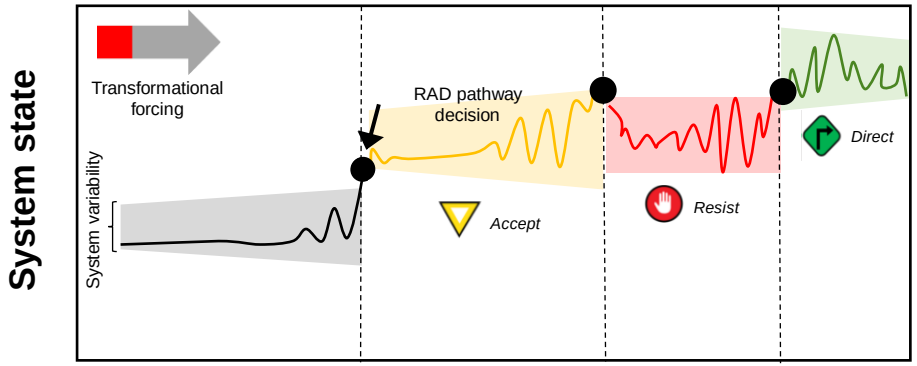


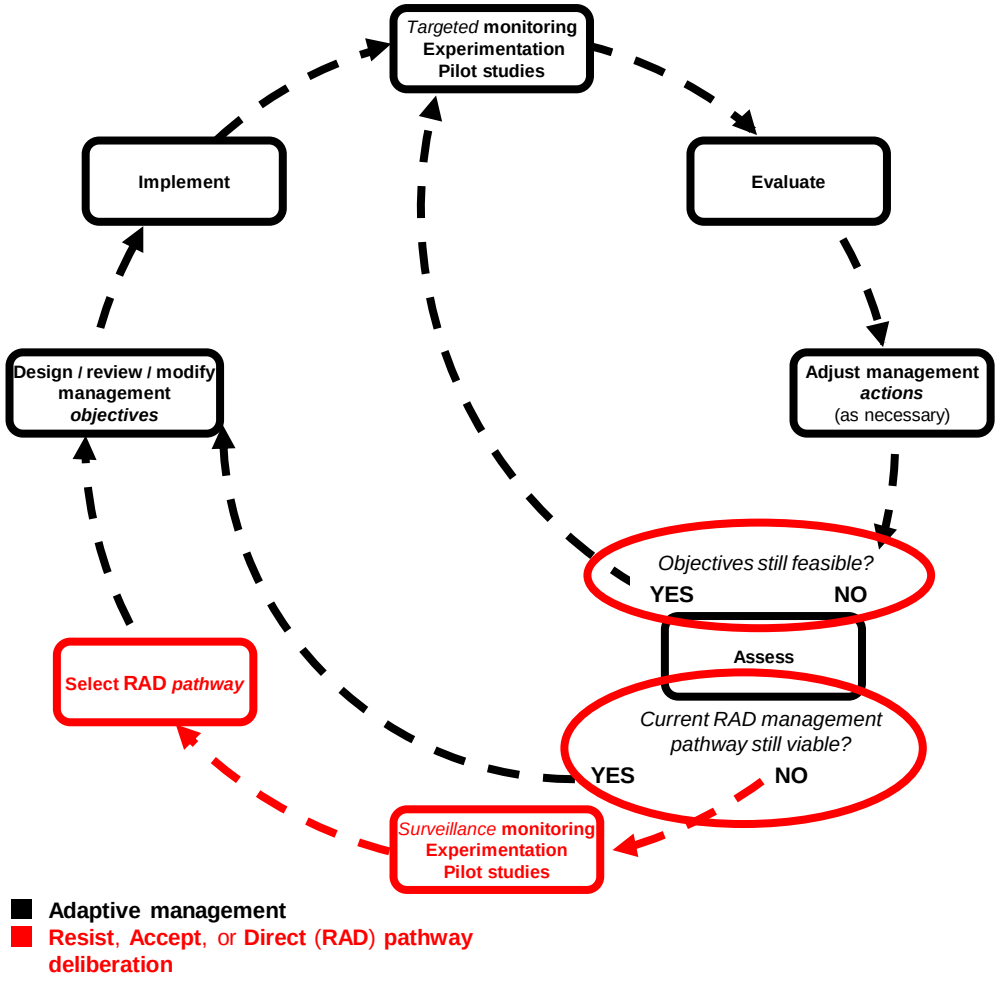
USGS science for a changing world

Lynch et al. 2022

RAD Adaptive Management

- *When a system state is **changing**:*

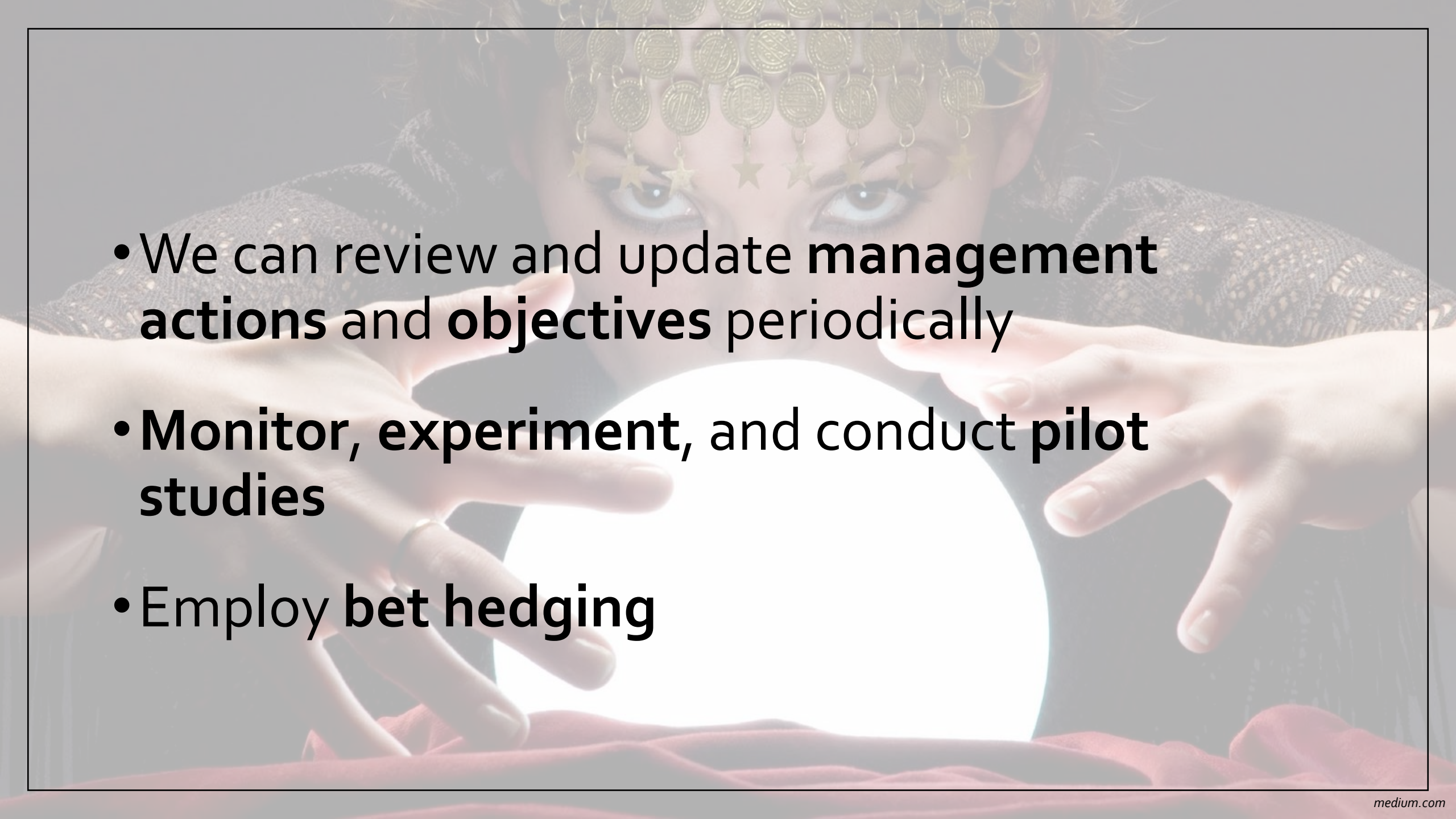




- *Loop **leap** when:*
  - **Objectives** are no longer feasible
  - The **RAD pathway** is no longer viable

USGS science for a changing world

Lynch et al. 2022



- We can review and update **management actions** and **objectives** periodically
- **Monitor**, **experiment**, and conduct **pilot studies**
- Employ **bet hedging**

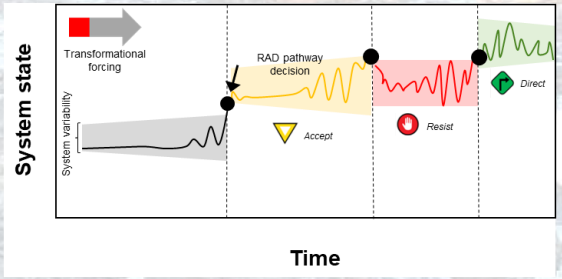
medium.com

Resist until when?

Applying adaptive management

RAD

can support management for changing systems.



RAD decisions will need to be revisited.

Familiar tools can help.

Thank you!

For more info:

Abigail J. Lynch, Ph.D. (ajlynch@usgs.gov)

usgs.gov/rad

Sara Cottle on Unsplash