eDNA: Bridging the Gap Between Science and Management

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Collaborators

National Aquatic Invasive Species Committee (NAISC)

Manitoba
Department of Sustainable Development

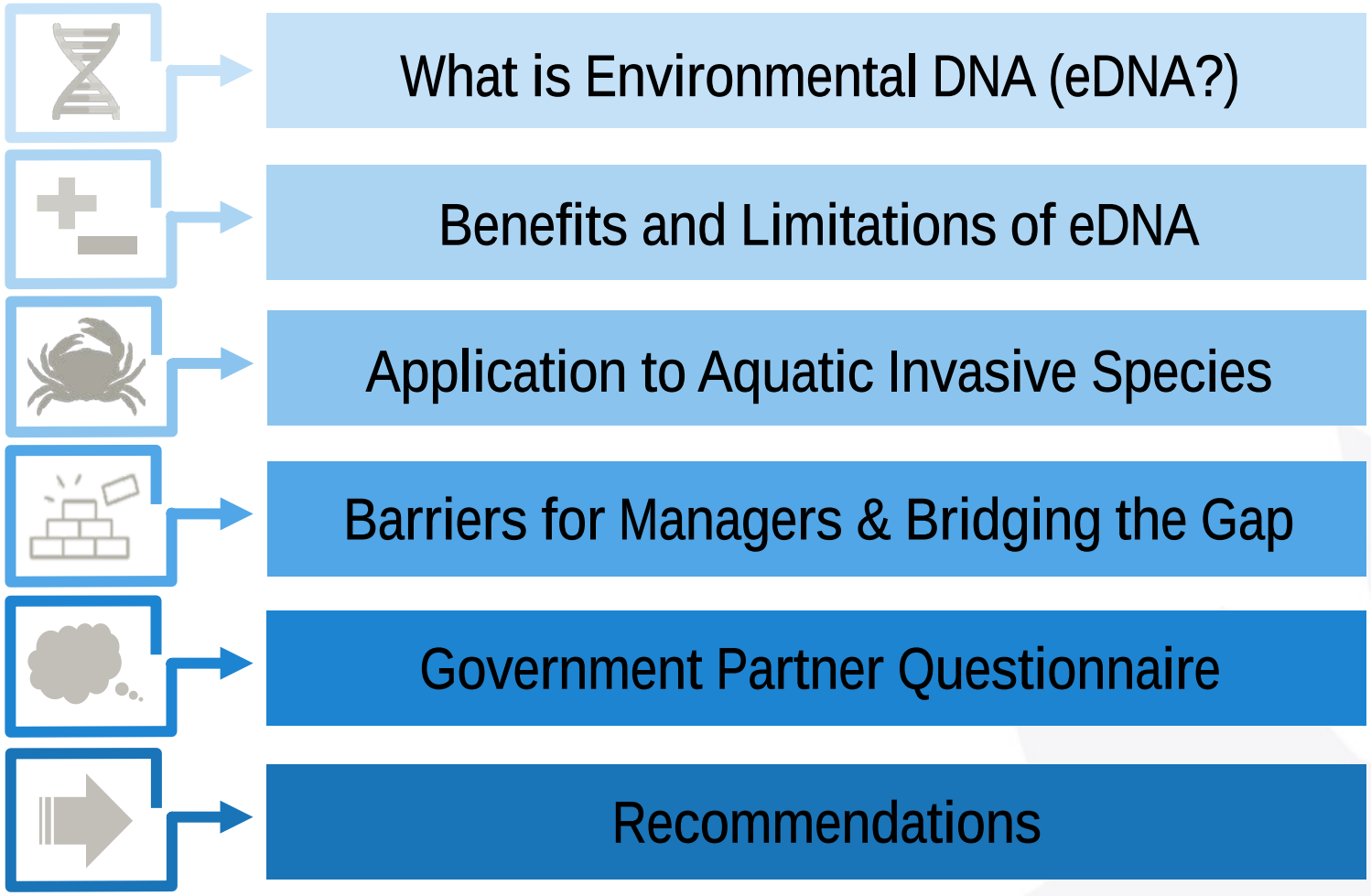
Québec
Ministère des Forêts, de la Faune et des Parcs du Québec

British Columbia
Ministry of Environment and Climate Change Strategy

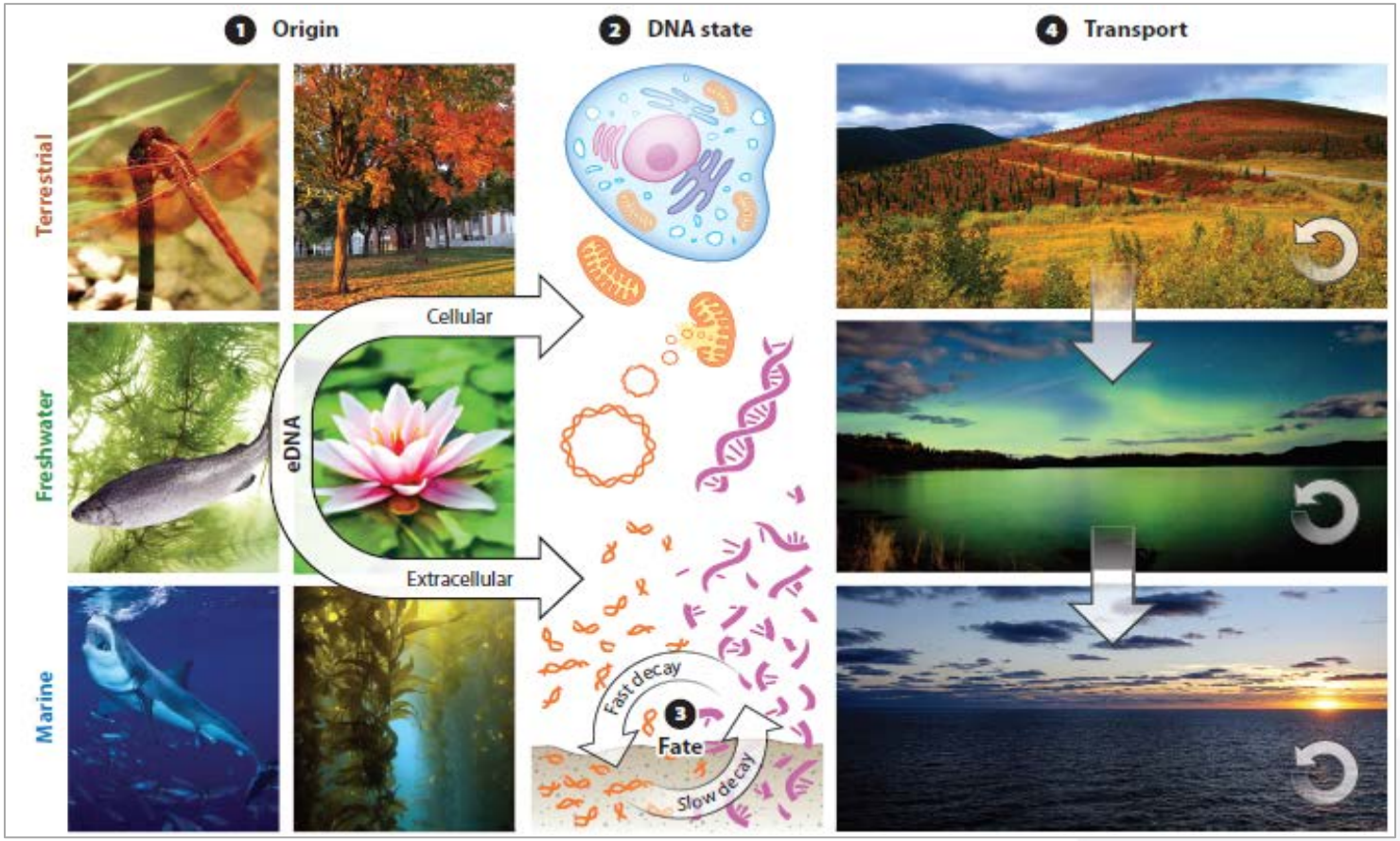
Parks Canada / Parcs Canada

Transports Canada / Transport Canada

Overview


What is Environmental DNA (eDNA?)
Benefits and Limitations of eDNA
Application to Aquatic Invasive Species
Barriers for Managers & Bridging the Gap
Government Partner Questionnaire
Recommendations

What is Environmental DNA (eDNA)?



Credit: Annu. Rev. Ecol. Evol. Syst. 2018. 49:209-230

Benefits and Limitations of eDNA

Benefits	Limitations
Detection in timely manner improves prevention	Technology is still developing
Many species can be detected simultaneously	Variation in sampling locations/environments; not possible to strictly standardize sampling and analysis protocols
Avoids direct contact with sensitive species	
Less effort than conventional survey methods	Should not be used as a sole indicator of presence
Can cover large/remote areas	Lack of reporting standards and standardized terminology

Application to Aquatic Invasive Species

Prevention

- Surveillance of commercial bait and live fish trades (Nathan et al. 2015; Roy et al. 2017)

Early Detection

- Identifies areas to focus monitoring
- Ballast water screening
- Sea Lamprey in Great Lakes and Zebra Mussels in Lake Winnipeg (Gingera et al. 2016, 2017)

Response

- Facilitates decision making to take timely action

Control & Mgmt.

- May help confirm eradication success after intensive effort
- Long-term monitoring of Asian Carps in Chicago Area Waterway System (USFWS)

What Can eDNA Tell Us?

A positive eDNA detection tells us:

- Water sample contains genetic material from a target species

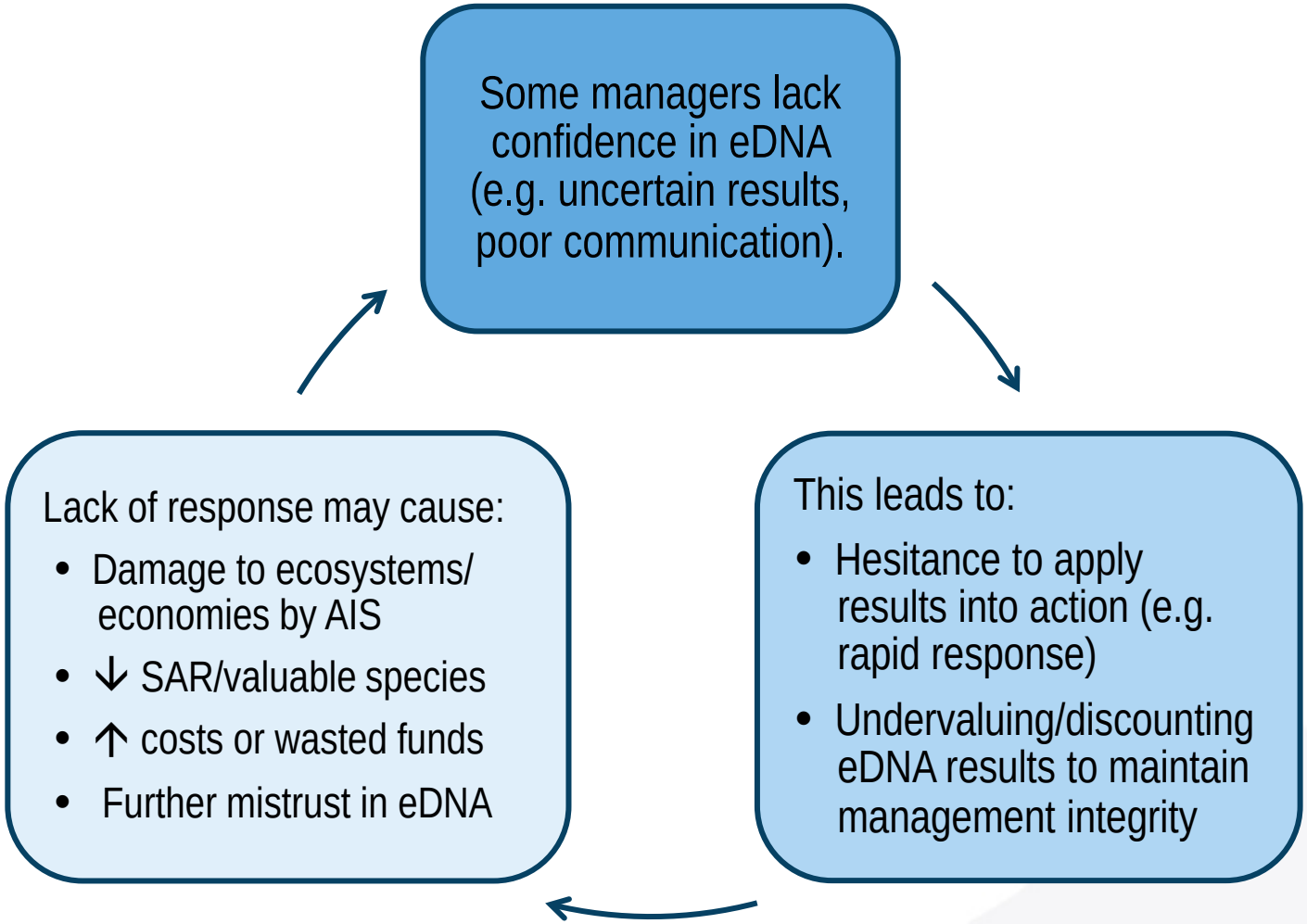
A positive detection *does not* tell us:

- If the organism is living or dead
- When the organism was present
- Abundance or concentration of organisms in the sample area

* Positive detections can be false (e.g. sample contamination)

** Spatial/temporal replication for certainty is often needed before taking action

Barriers for Managers

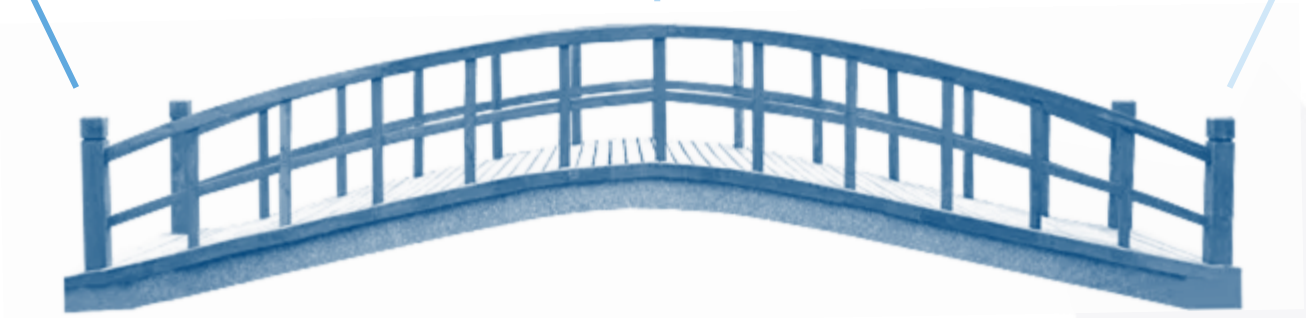


Bridging the Gap

How should we **respond** to positive eDNA detections?

What **reporting best practices** can scientists and managers develop so results can be effectively applied to decision-making?

Uptake by FPT and cross-border partners/ scientists/stakeholders



Recommendations

- Uncertainty must be communicated clearly by scientists to managers
- Reporting standards can help managers interpret results to inform decisions
- Standardized language may further reduce confusion

Reporting Standards	Best Practices	Standard Terminology

May include, but not limited to:
• Error sources, direction and magnitude
• Minimum information across different methodologies, species and environments
• Report format
• Mandatory content for consistency across studies
  • Descriptions of methodology
  • Sample size
  • Statistical power
  • Uncertainty
	Develop a communication plan between managers and scientists before projects start
	
	Communicate the implications and limitations of eDNA early and clearly to the public
	• e.g. positive is bad, negative is good;
	eDNA ≠ fish,
	more eDNA ≠ more fish
		The repeated use of the word "positive" is not clear and can be misinterpreted.
		
		Define:
		• Positive detection
		• Suspect positive
		• Confirmed positive
		• Weak positive
		• False positive
		• etc.

Conclusion

- eDNA presents a unique opportunity to detect AIS easily, quickly, and cost-effectively, facilitating action to preventing their introduction and spread.
- However, managers must be able to interpret eDNA results if they are expected to inform decision-making.
- Communication between scientists and managers must improve to maximize the applicability of eDNA. In turn, this will improve communicating decisions to the public.

- Our recommendations are complementary to the scientific community continuing to refine methodologies and sampling protocols, etc.

References

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