Expanding the scope of restoration monitoring: Practical methods for amphibians

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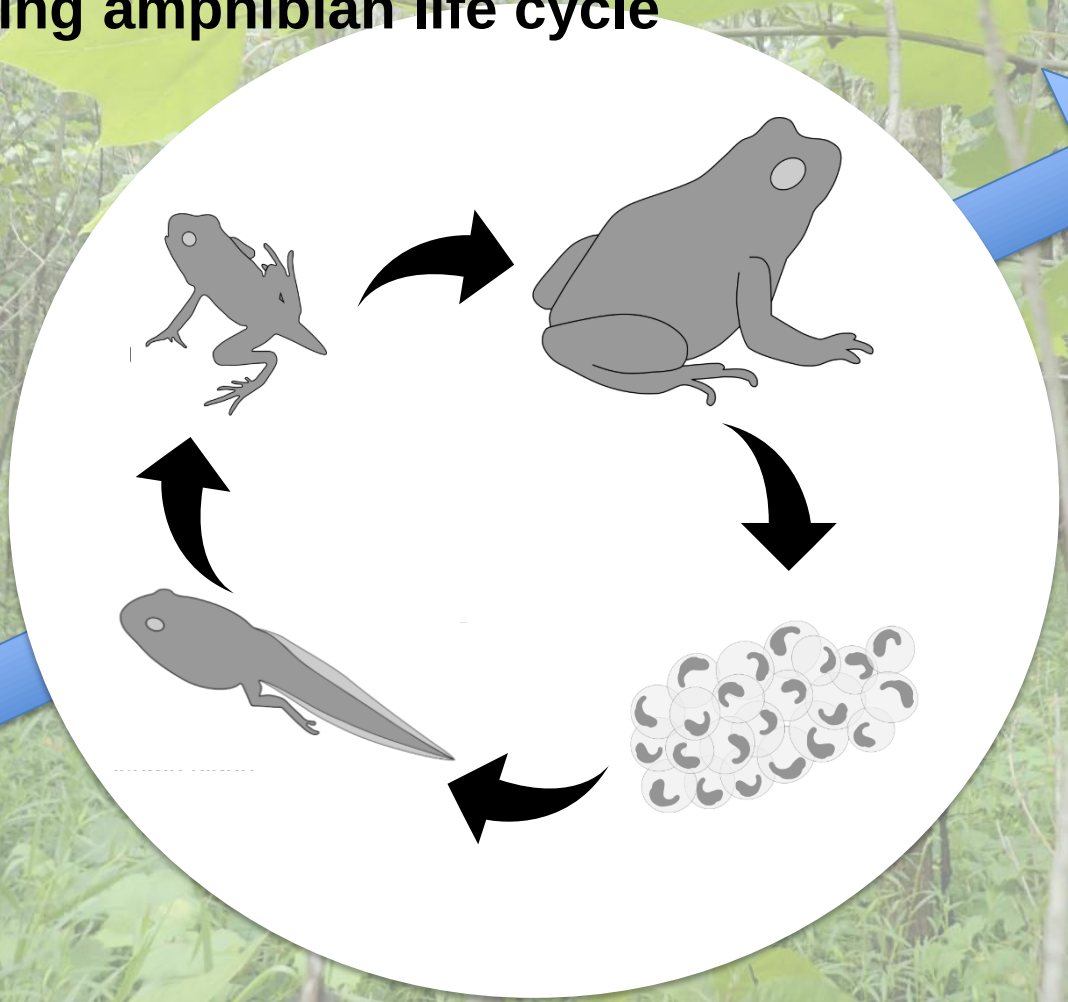
U.S. Department of the Interior
U.S. Geological Survey

Pond-breeding amphibian life cycle



Terrestrial food webs

Aquatic food webs

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Importance and status of amphibians

Ecosystem services

- **Provisioning**
- **Cultural**
- **Regulating**
- **Supporting**

41%

Face a high risk of extinction

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Millennium Ecosystem Assessment 2005; Hocking and Babbitt 2014; IUCN 2018

Indiana hardwoods restoration monitoring project

Bell and Holden
(The Nature Conservancy)

Deetz Nature Preserve
(New Haven Parks & Recreation)

Bluffton Native Habitat Waterway
(City of Bluffton)

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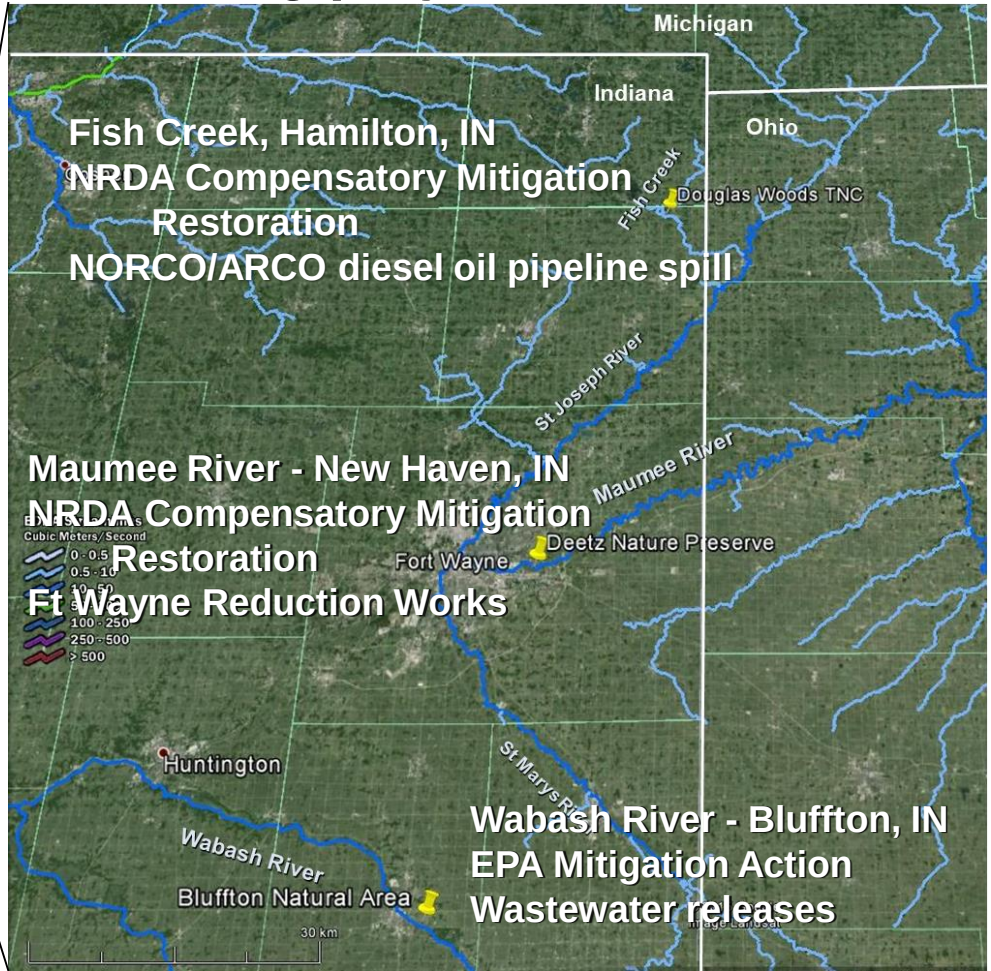

Indiana hardwoods restoration monitoring project

Goal: Assess the progress and effectiveness of afforestation performed as part of NRDA and EPA restorations

- **Evaluate a broad range of ecological elements - Soils, vegetation, trees, wildlife communities (invertebrate, amphibian, avian, mammal)**
- **Apply a range of methods from thorough (labor intensive and expensive) to rapid (labor sparse and not expensive)**
- **Evaluate information gained vs. level-of-effort to determine detail required to assess restoration progress and management needs**






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Key questions

1. What amphibian methods are good candidates?
2. Which methods detect the greatest observed amphibian species richness?
3. Which methods have the greatest catch per unit effort (CPUE)?
4. What are the relative costs?
5. How can automated recording units (ARUs) be used most effectively?

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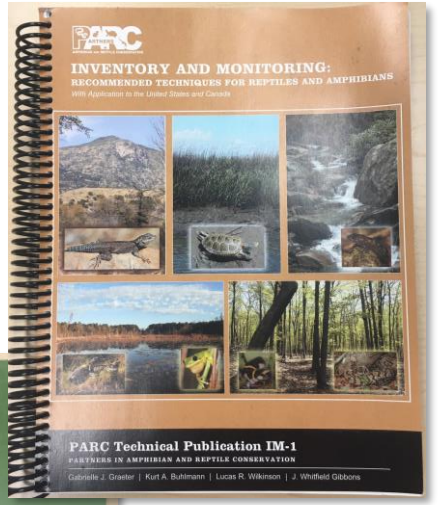
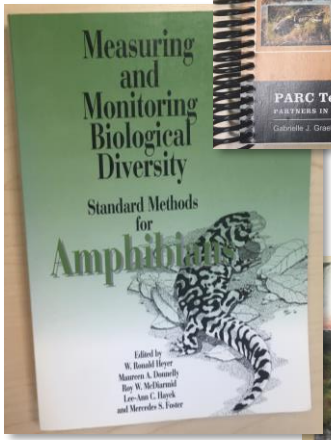
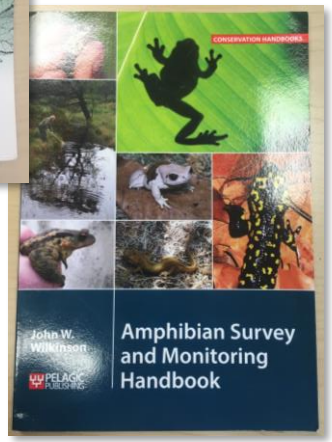
What amphibian methods are good candidates?

David Munoz, Penn State







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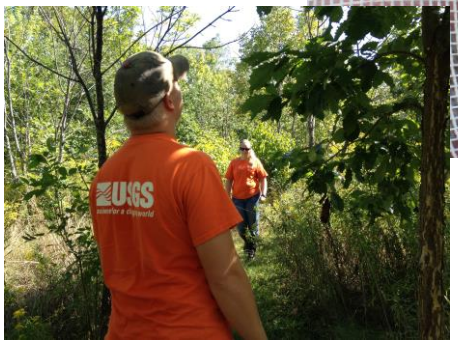
Selected amphibian methods

Automated recording units (ARUs)

Diurnal visual encounter surveys (VES)

Nocturnal aquatic transects

Amphibian rapid assessment (RA)



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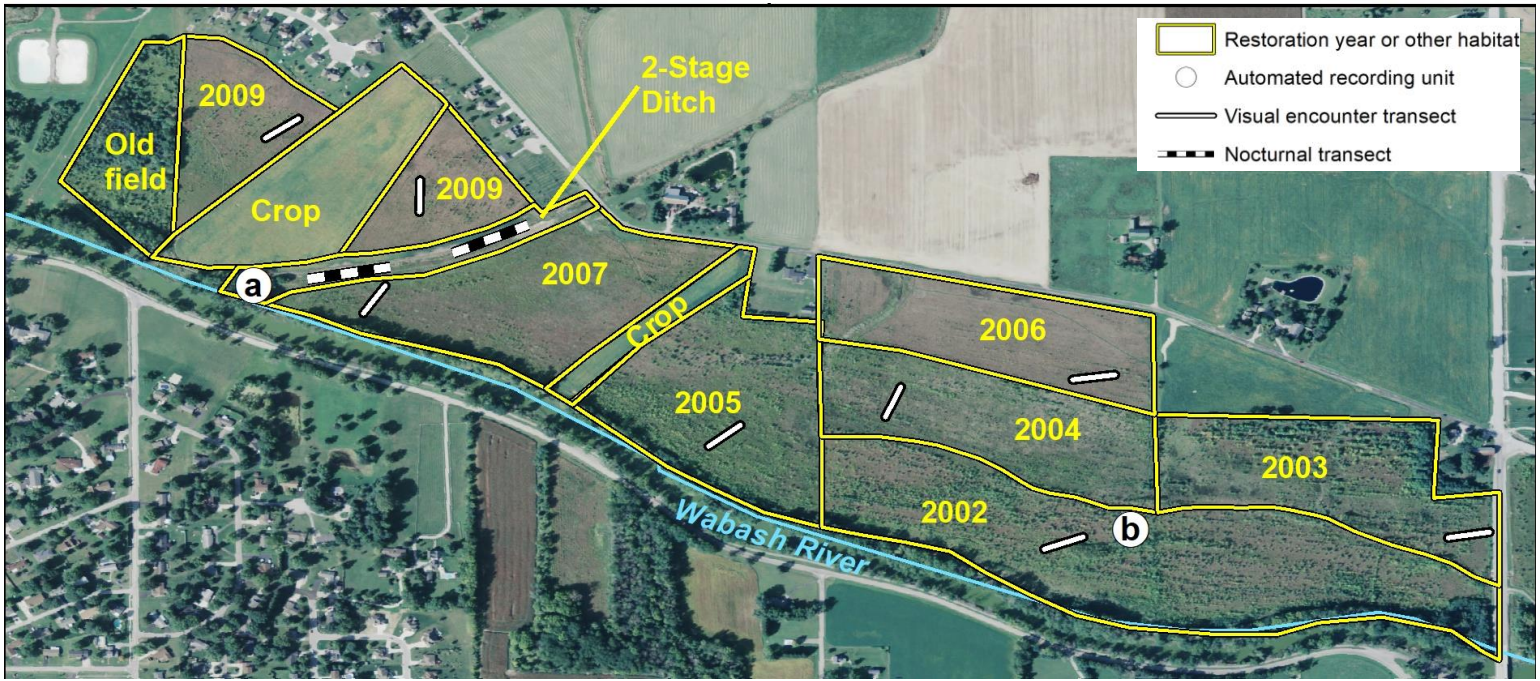
Acevedo and Villanueva-Rivera 2006; Crump and Scott 1994; Vonesh et al. 2010

Amphibian methods

Site example



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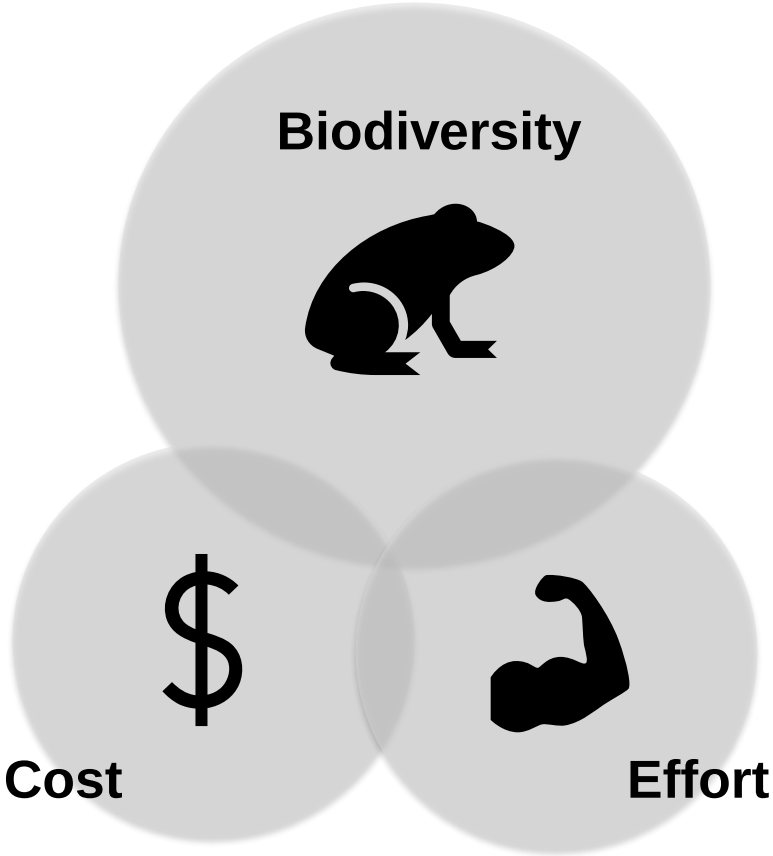
Striking a balance

Method comparison



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Which methods detect the most species?

Observed species richness

13 species (62% of species present in area, 93% of species present and likely to be detectable)

2016

- RA- 9 species (3 unique)
- ARUs- 7 species (1 unique)
- Nocturnal surveys- 7 species (1 unique)
- Diurnal VES- 2 species (0 unique)


Northern leopard frog
(*Lithobates pipiens*)


Blanchard's cricket frog
(*Acris blanchardi*)

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Which methods have the greatest catch per unit effort (CPUE)?

~~Automated recording units (ARUs)~~	
Amphibian rapid assessment (RA) 2015	6.29 animals per person-hour
Nocturnal aquatic transects	4.88 animals per person-hour
Amphibian rapid assessment (RA) 2016	3.06 animals per person-hour
Diurnal visual encounter surveys (VESs)	0.10 animals per person-hour

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What are the relative costs?

Per-site calculations

Method	Sampling effort	Equipment costs per site	GS-05 Team Member GS-11 Team Leader Total personnel cost	Total cost per site
ARUs	March-Sept	$1,233	$314	$1,547
RAs	One visit	$30	$161	$191
Nocturnal surveys	Two rounds	$499	$71	$570
Diurnal VES	Two rounds	$429	$261	$690

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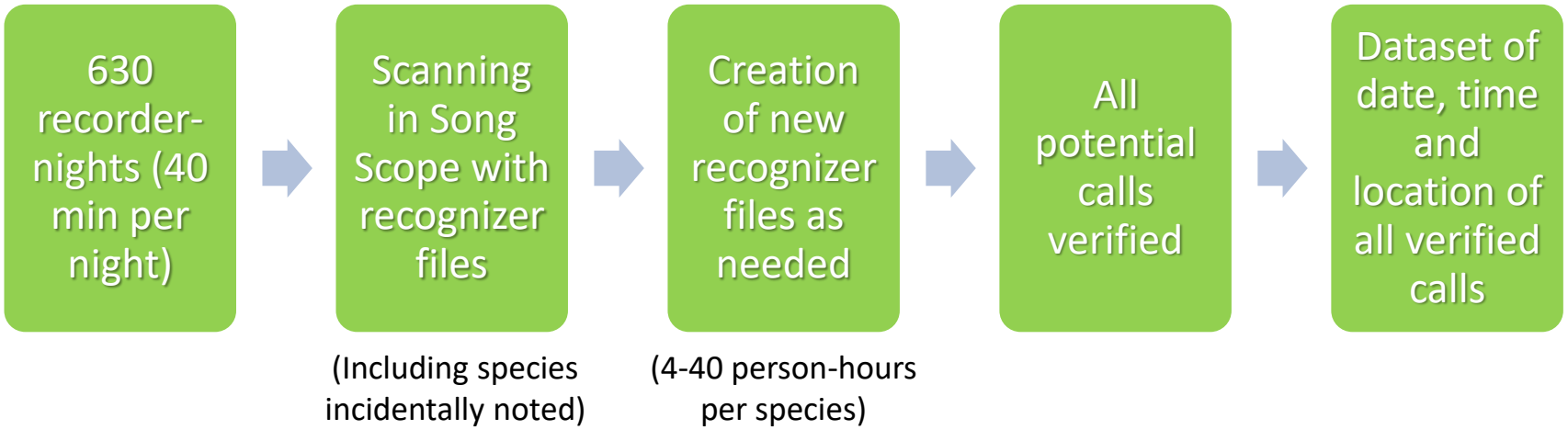
Kunz et al. 2019

How can ARUs be used most effectively?

Automated computer recognition of calls



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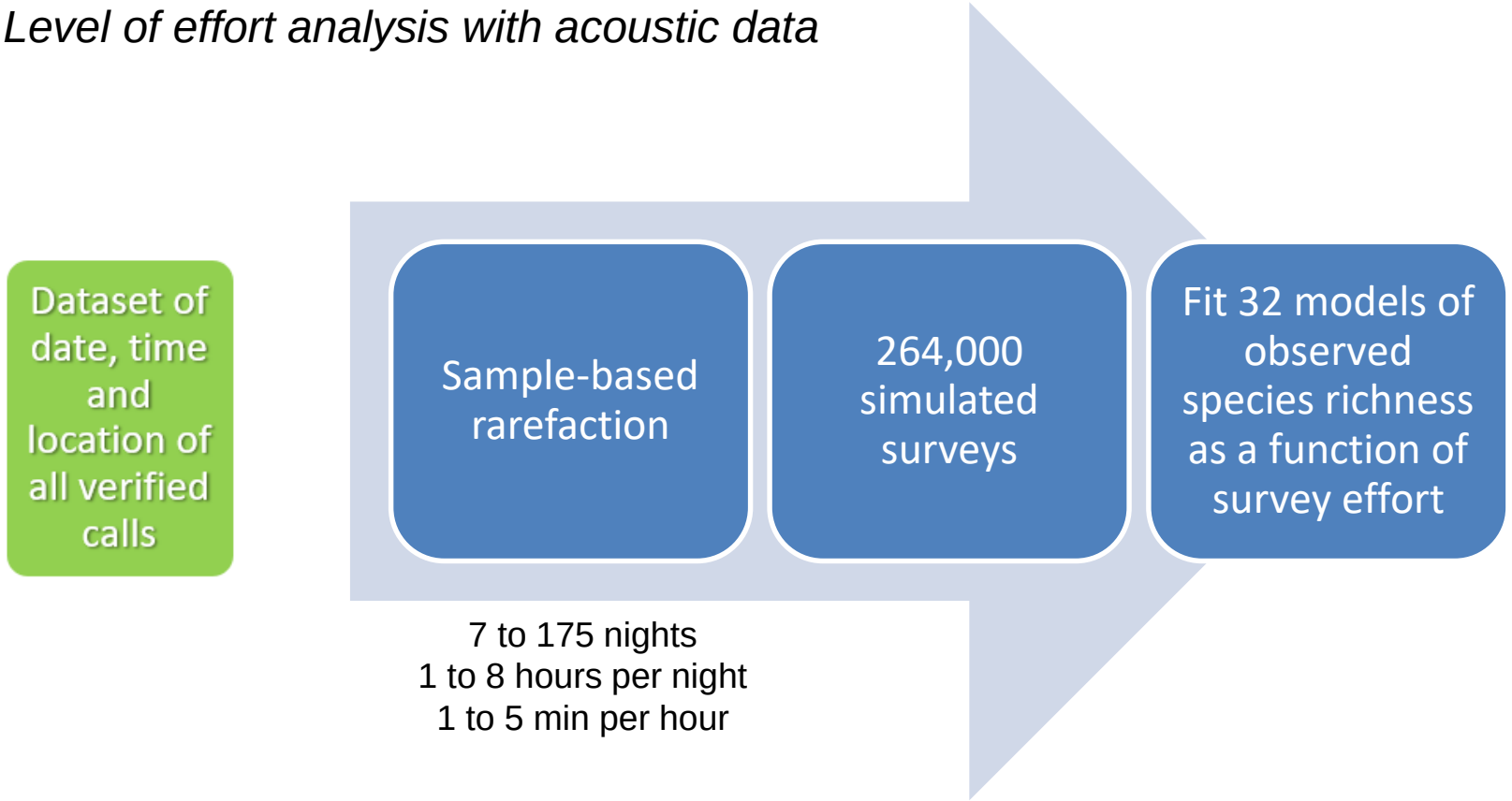
How can ARUs be used most effectively?

Level of effort analysis with acoustic data



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How can ARUs be used most effectively?

Level of effort analysis with acoustic data

Dataset of date, time and location of all verified calls

Take home message: Maximize observed species richness by increasing nights sampled, rather than hours per night or minutes per hour

1 to 8 hours per night
1 to 5 min per hour

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Practical considerations
Amphibian rapid assessment (RA)

- Effective and economical
- May be particularly useful in early stages of monitoring or as a supplement to other methods (limited utility for full-scale monitoring)
- Conduct several times/year, based on life history of relevant species
- Great potential for citizen science involvement

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Practical considerations
Automated recording units (ARUs)

Benefits

- Generate large volumes of data with minimal in-field time
- Benefits of automated analysis
- Sharing/reuse of recorders and recognizer files
- Can be deployed with recording programs targeting both amphibians and birds

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Practical considerations
Automated recording units (ARUs)

Challenges

- Larger up-front investment (recorders, software*)
- Time required to create recognizer files
- Trade-off between false positives and false negatives
- Cannot provide information on non-vocal amphibians (i.e., salamanders)

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*Song Scope now available for free
Kaleidoscope Pro $299-$399/year
Other software available

Other lessons learned for compensatory restorations

- Availability of surface water will influence success of most methods
- Randomly placed diurnal transects may be less effective when densities are low

Logistically reasonable tools can be used within the context of a larger monitoring plan to capture valuable information about amphibian recovery

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Special Series

Amphibian Monitoring in Hardwood Forests: Optimizing Methods for Contaminant-Based Compensatory Restorations

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