

Optimizing Conservation Actions to Prevent the Extinction of 266 Species in Maui Nui, Hawai'i

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Acknowledgements

Maui Nui Landscape Planning
Team

100 Participants & Contributors

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US Fish & Wildlife Service

Hawai'i Division of Forestry &
Wildlife



Endangered Species in Hawai'i

- Endangered Species Act 50 years old
- 586 species listed as Threatened or Endangered
- 0 species recovered (delisted)



Hawai'i: "Extinction Capital of the World"



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US declares 23 species extinct, including 9 in Hawaii

Eight Hawaiian Bird Species to be Declared Officially Extinct

Hope Remains for Other Hawaiian Species Now on the Brink

October 16, 2023 · American Bird Conservancy



Threats: Invasive Mammals





Threats: Invasive Invertebrates



Slugs



Ants



Predatory Snails

■

Threats: Feral Ungulates



Goats



Deer



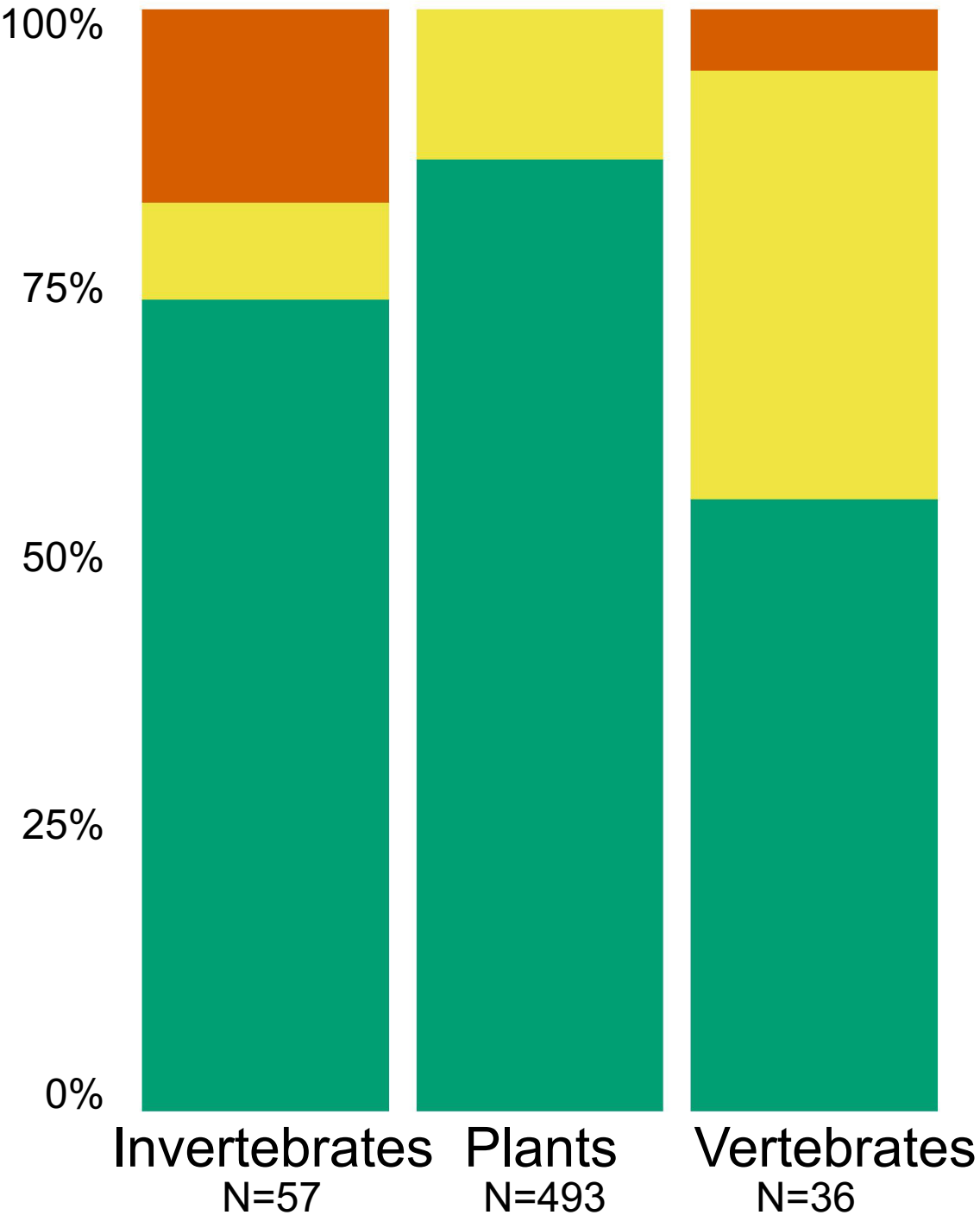
Pigs



Threats: Disease



Do we know how to save these endangered species, and does the technology exist today?

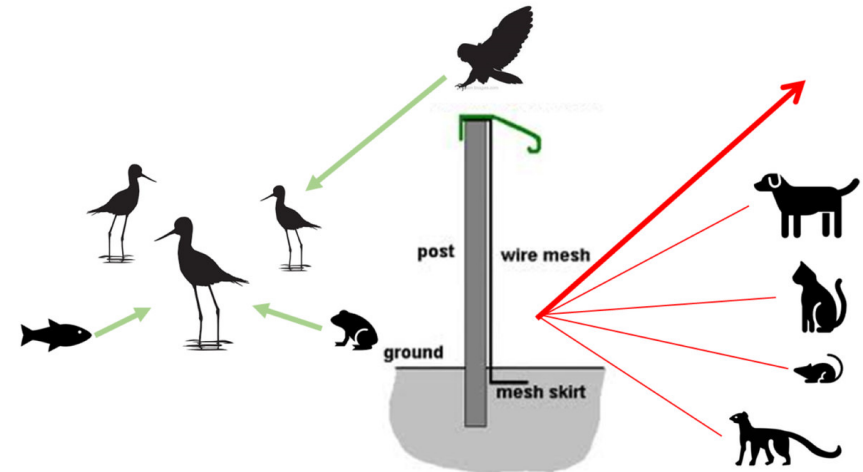


- Unknown solution
- Tech needed
- Known solutions

Actions differ in cost, benefits, and efficacy.

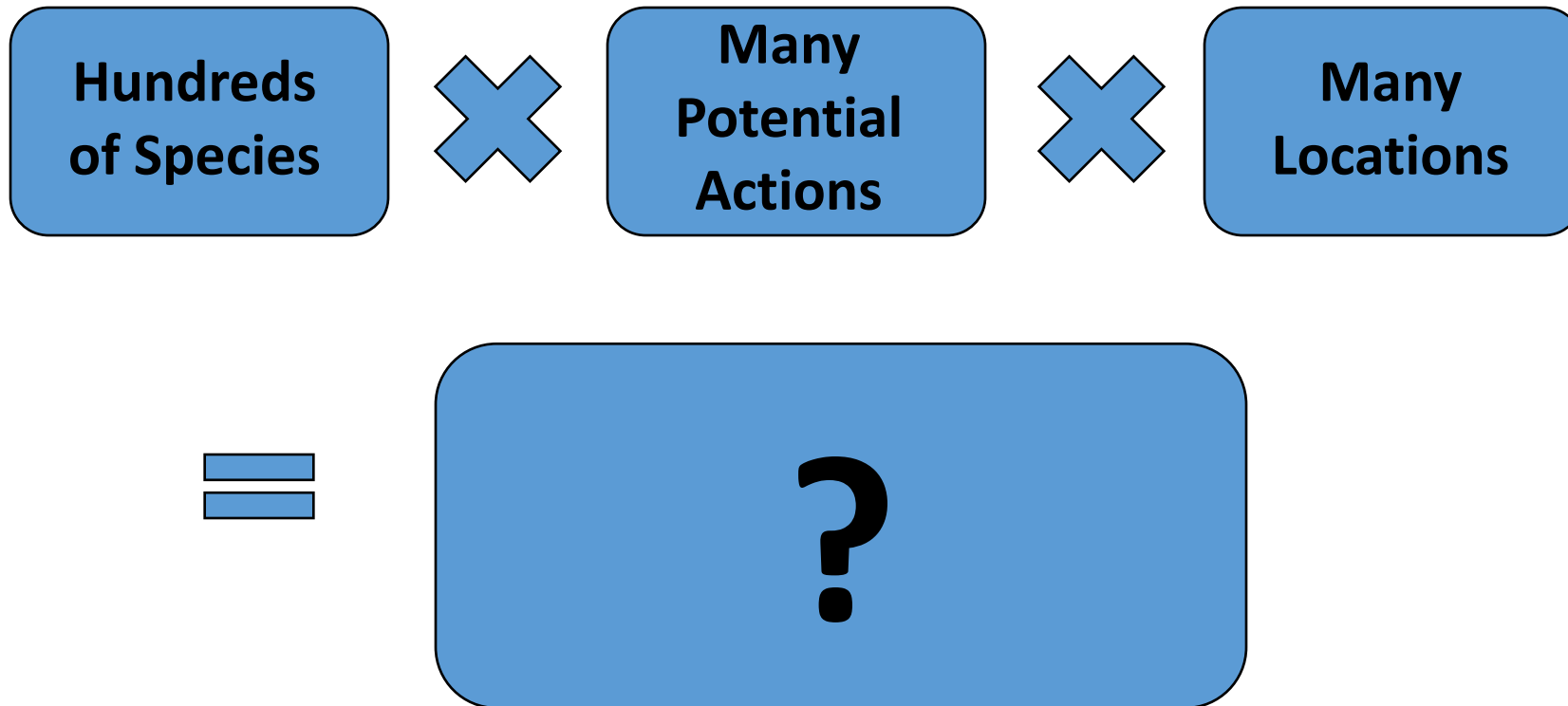


Vs.

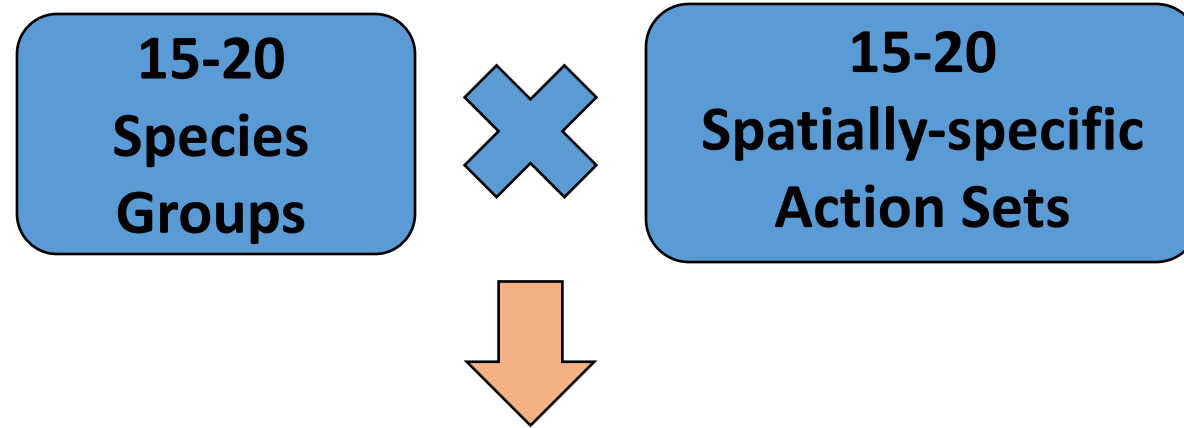


Challenge: How do we decide which actions to take where, when we have hundreds of species to protect across multiple regions?

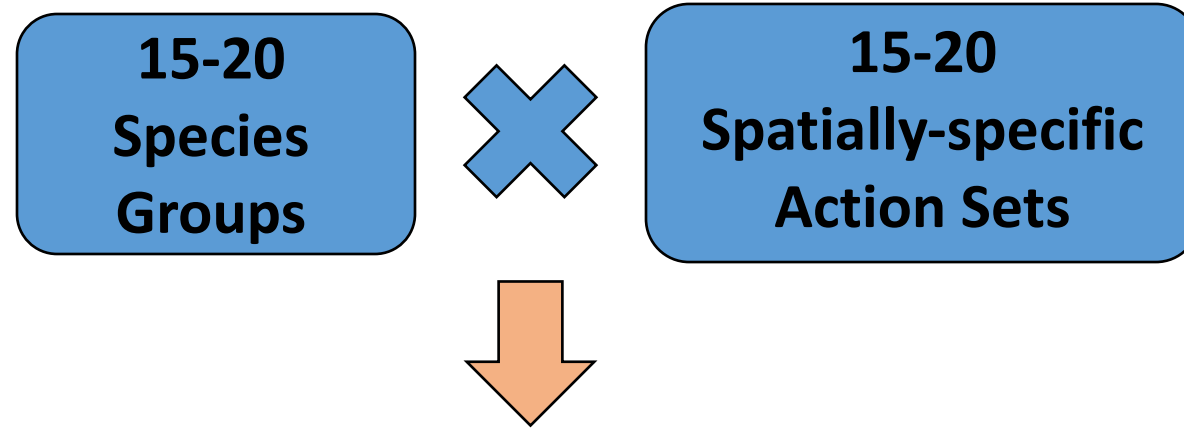
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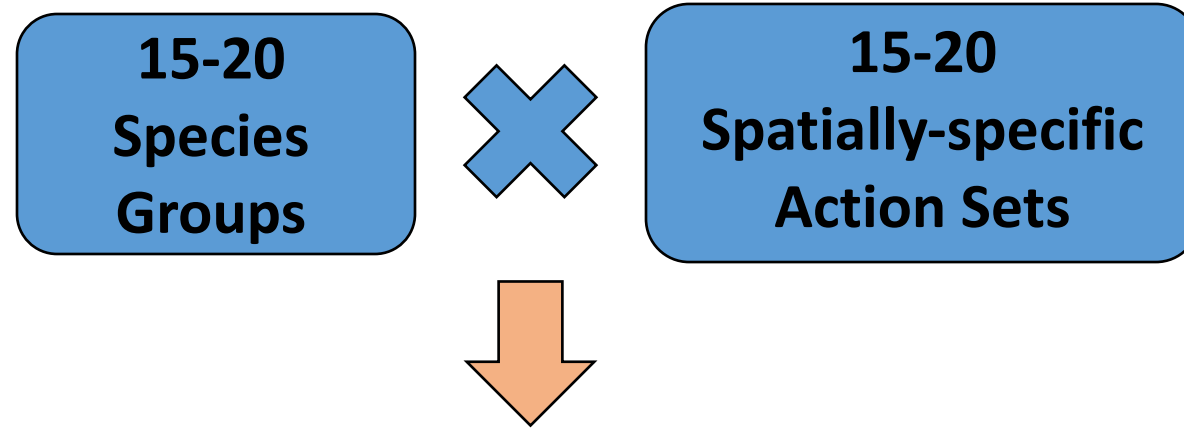


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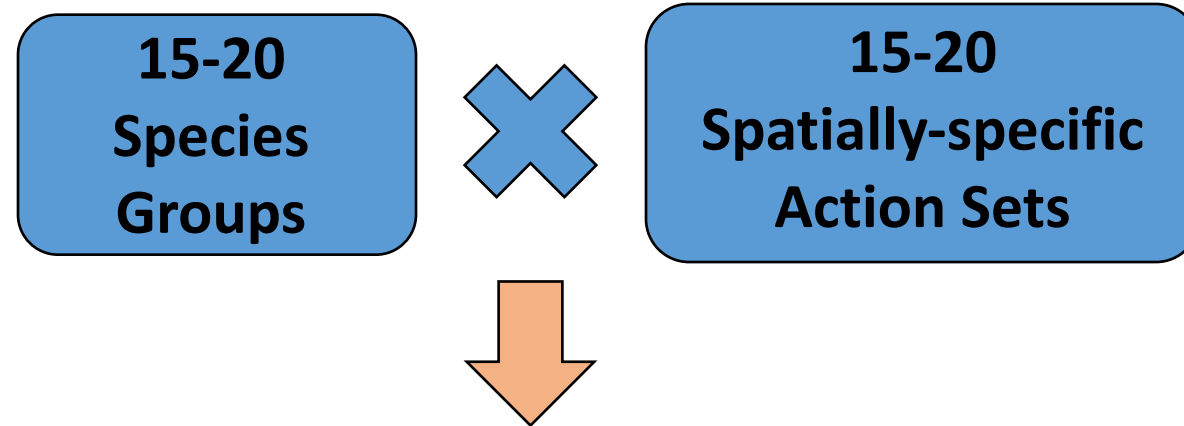
- Costs & feasibility of each action set

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- Benefits across species groups of each action set

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=

**Priority Threat
Management**

Priority Threat Management for Maui Nui



Kaua'i



O'ahu

Moloka'i



Maui



Kaho'olawe



Lāna'i



**Hawai'i
Island**

Priority Threat Management for Maui Nui

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Priority Threat Management for Maui Nui

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1. Identify conservation actions that will result in the highest number of species conserved per cost in Maui Nui over next 20 years
2. Identify actions that may only benefit one or a few taxonomic groups but are necessary to prevent extinction of those groups.
3. Identify species that are unlikely to be conserved without substantial investment in the development of technology or investment in large-scale actions or infrastructure.

Methods

~100 species experts & managers over 4 workshops and pre-workshop focus groups



Methods

15 species groups across 266 species



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Vertebrates

- Waterbirds (4 spp.)
- Forest Birds (4 spp.)
- Seabirds (3 spp.)
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Vertebrates

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Invertebrates

- Terrestrial Snails (49 spp.)
- Insects
 - Yellow-faced bees (10 spp.)
 - Picture-winged flies (2 spp.)
 - Damselflies (5 spp.)
 - Blackburn's sphinx moth (1 spp.)



Methods

15 species groups across 266 species

Plants (grouped by threats)

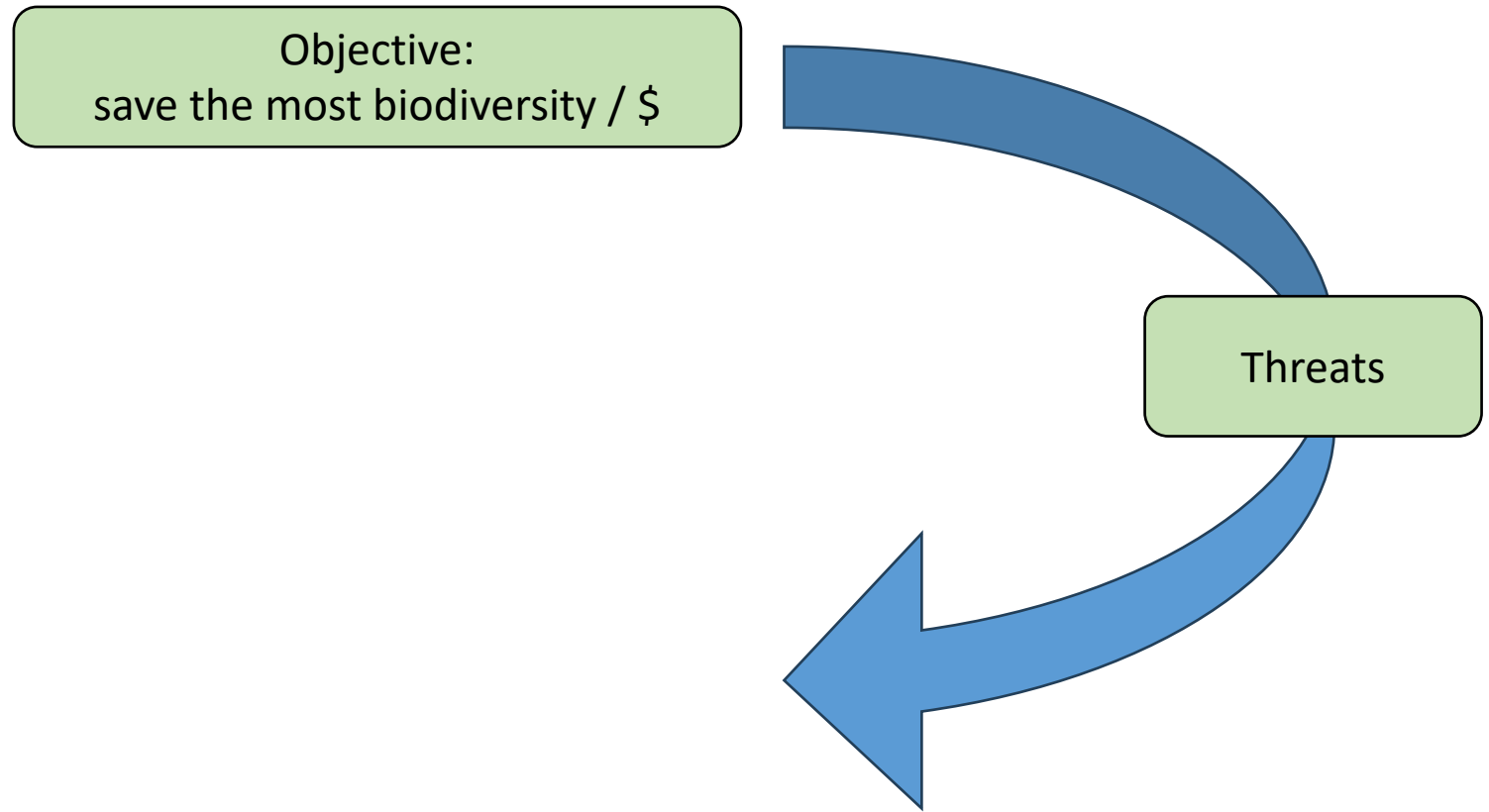
- Group 1 (34 spp.)
- Group 2 (23 spp.)
- Group 3 (30 spp.)
- Group 4 (75 spp.)
- Group 5 (13 spp.)
- Group 6 (13 spp.)



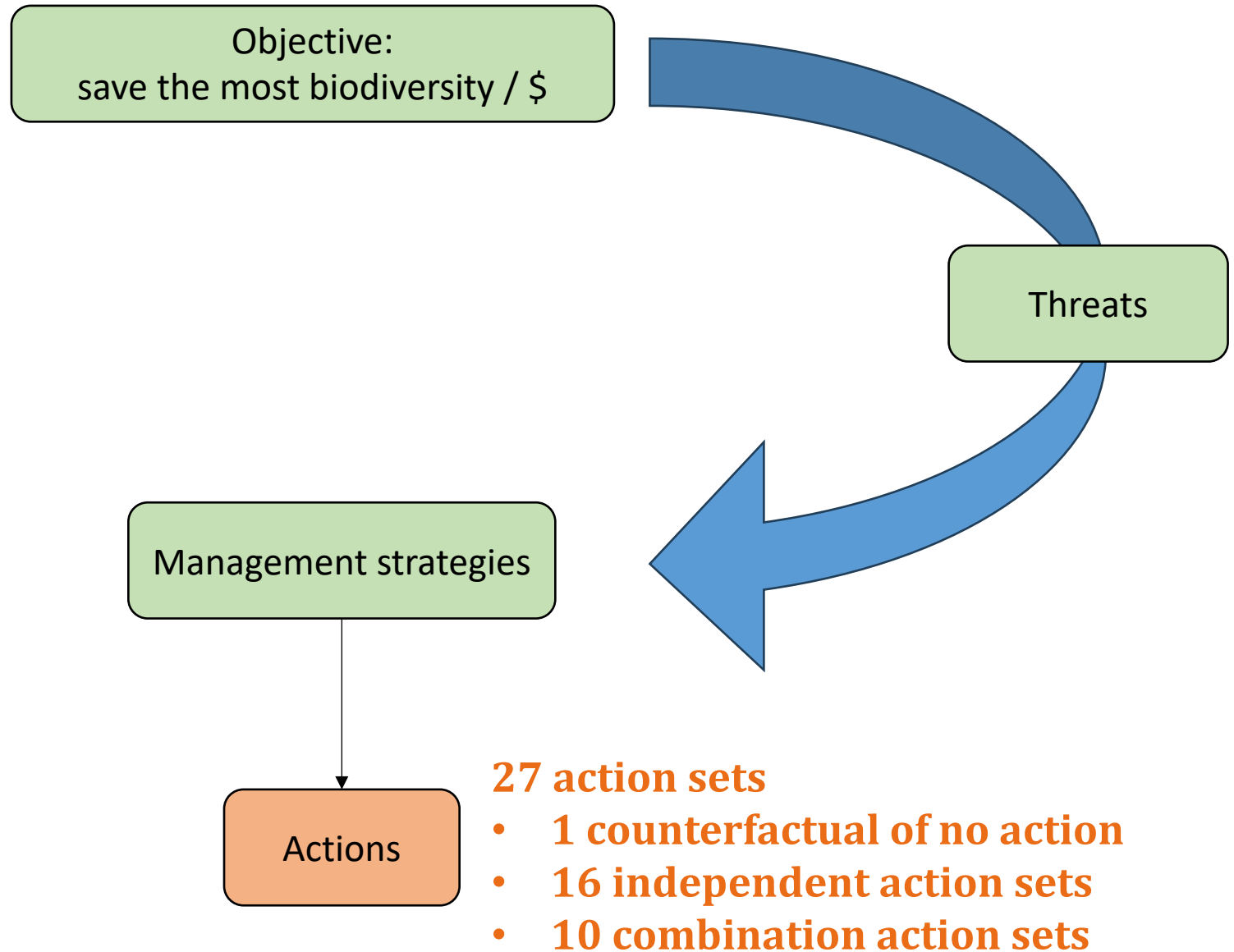
Approach: Priority Threat Management

Objective:
save the most biodiversity / \$

Approach: Priority Threat Management



Approach: Priority Threat Management



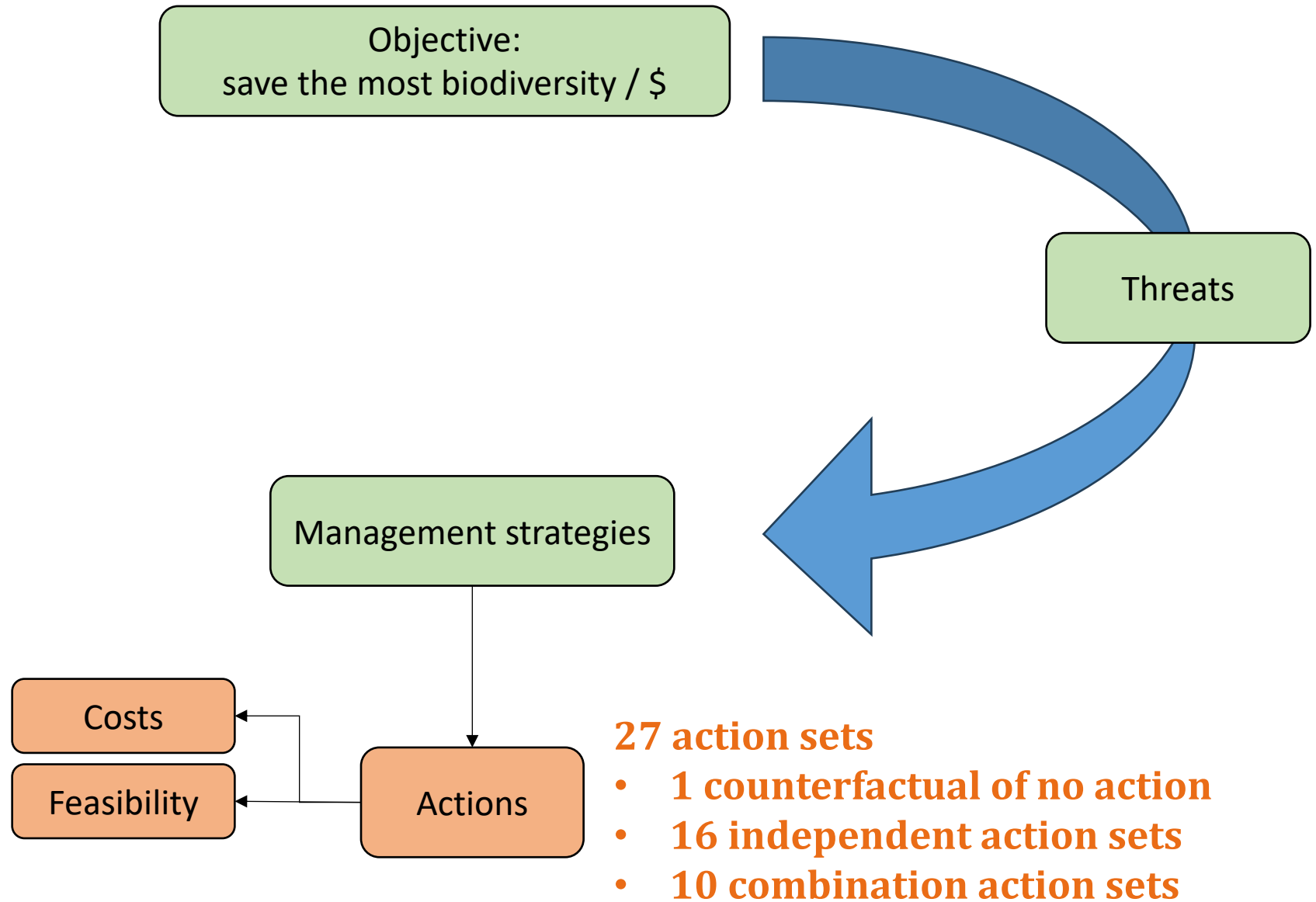
Independent Action Set Example: Invasive Predator Control

1. Remove rodents with A24 traps
2. Trap & remove feral dogs
3. Remove rats, cats, and mongoose with combination of traps (A24, Doc250, leg hold traps)
4. Remove cattle egrets
5. Remove barn owl removal
6. Maintain rodent-free offshore islets

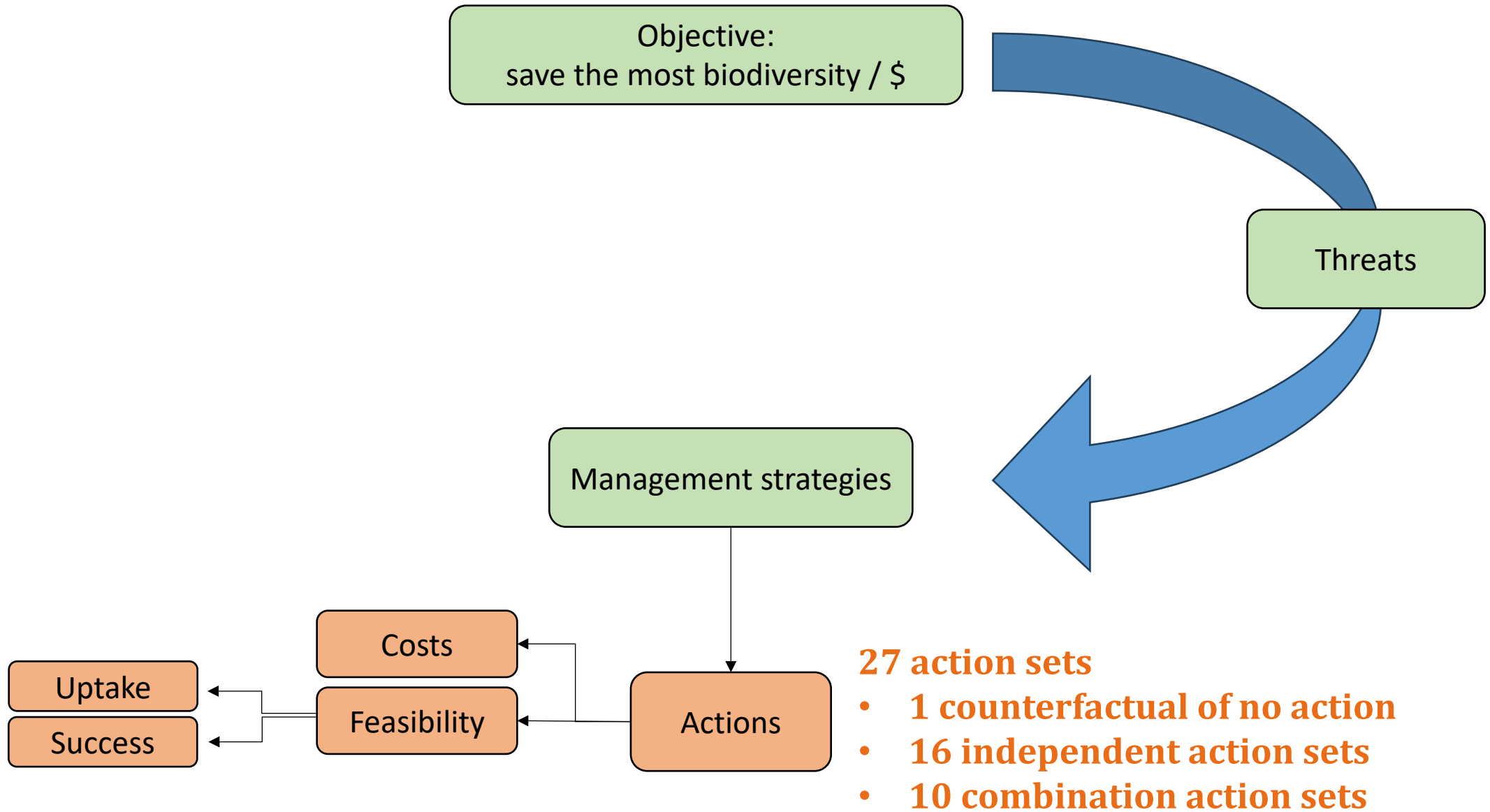
Combination Action Set Example:

1. Invasive Predator Control
2. Maintain Existing Ungulate Fences
3. Invasive Invertebrate Pest Control

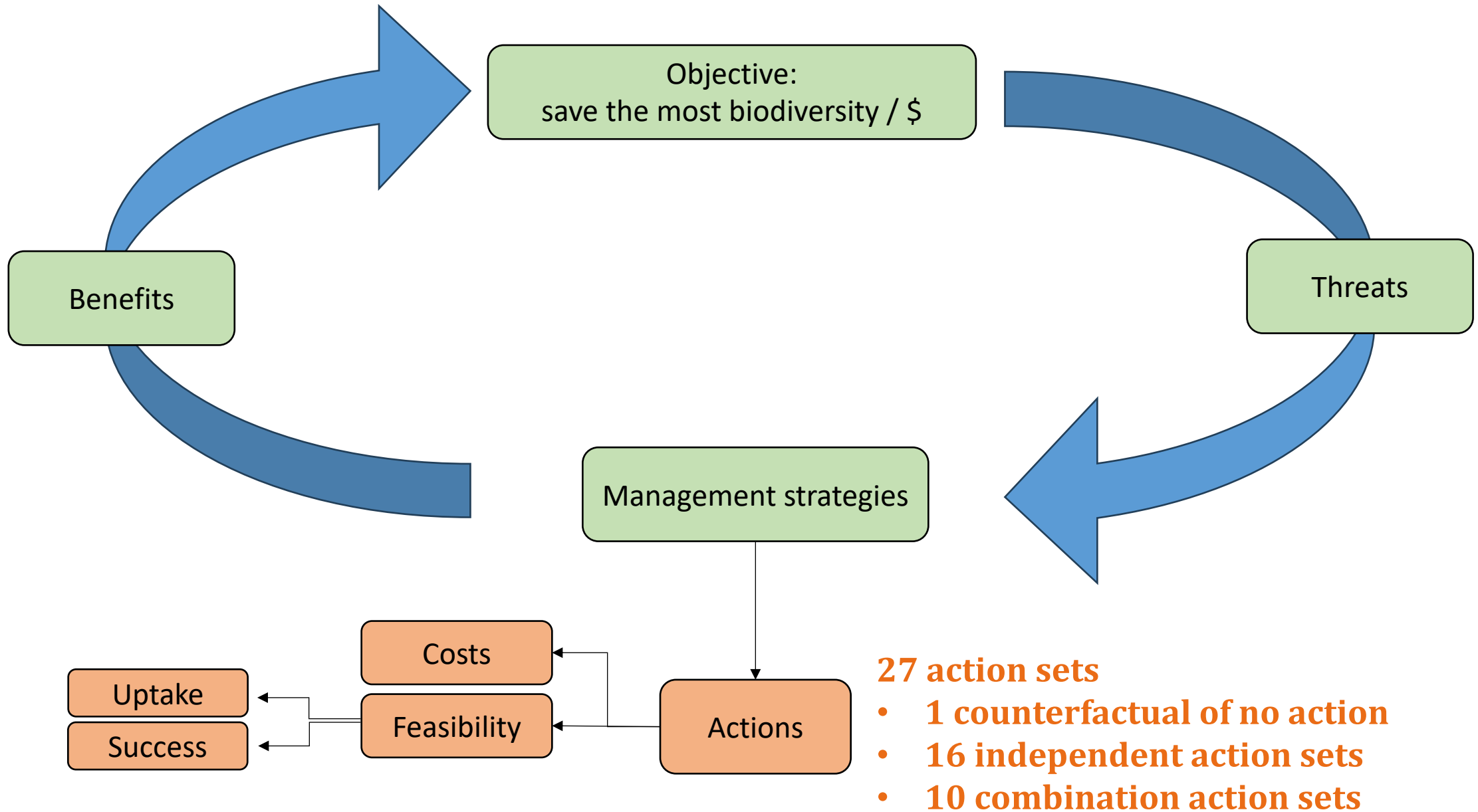
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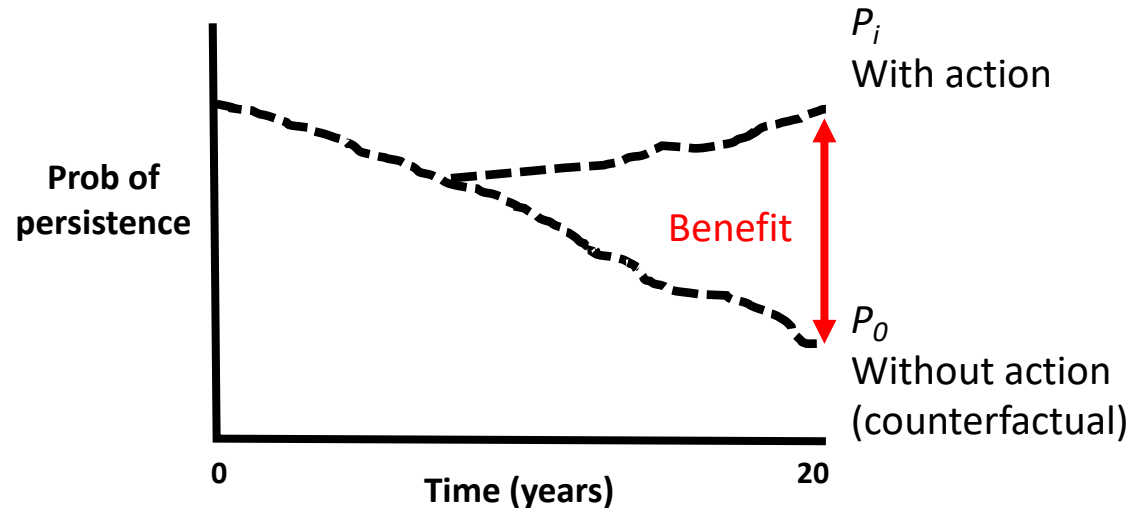
Methods: Benefits Metrics

Probability of Persistence: The chance that species groups will have self-sustaining populations in 20 years

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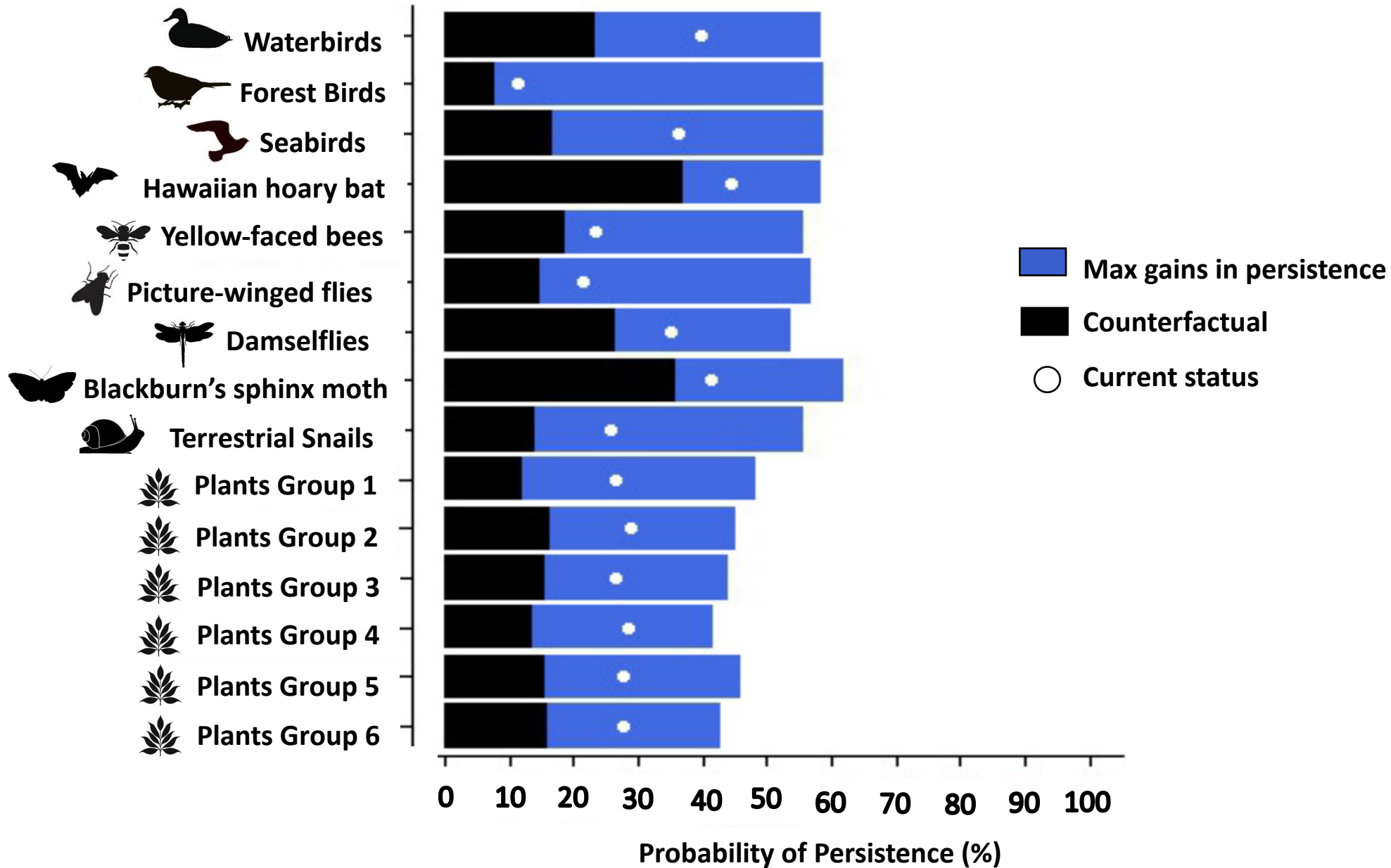
Benefit: Change in the probability of persistence under each action set compared to the Counterfactual (no action)



where benefit (B) of strategy i

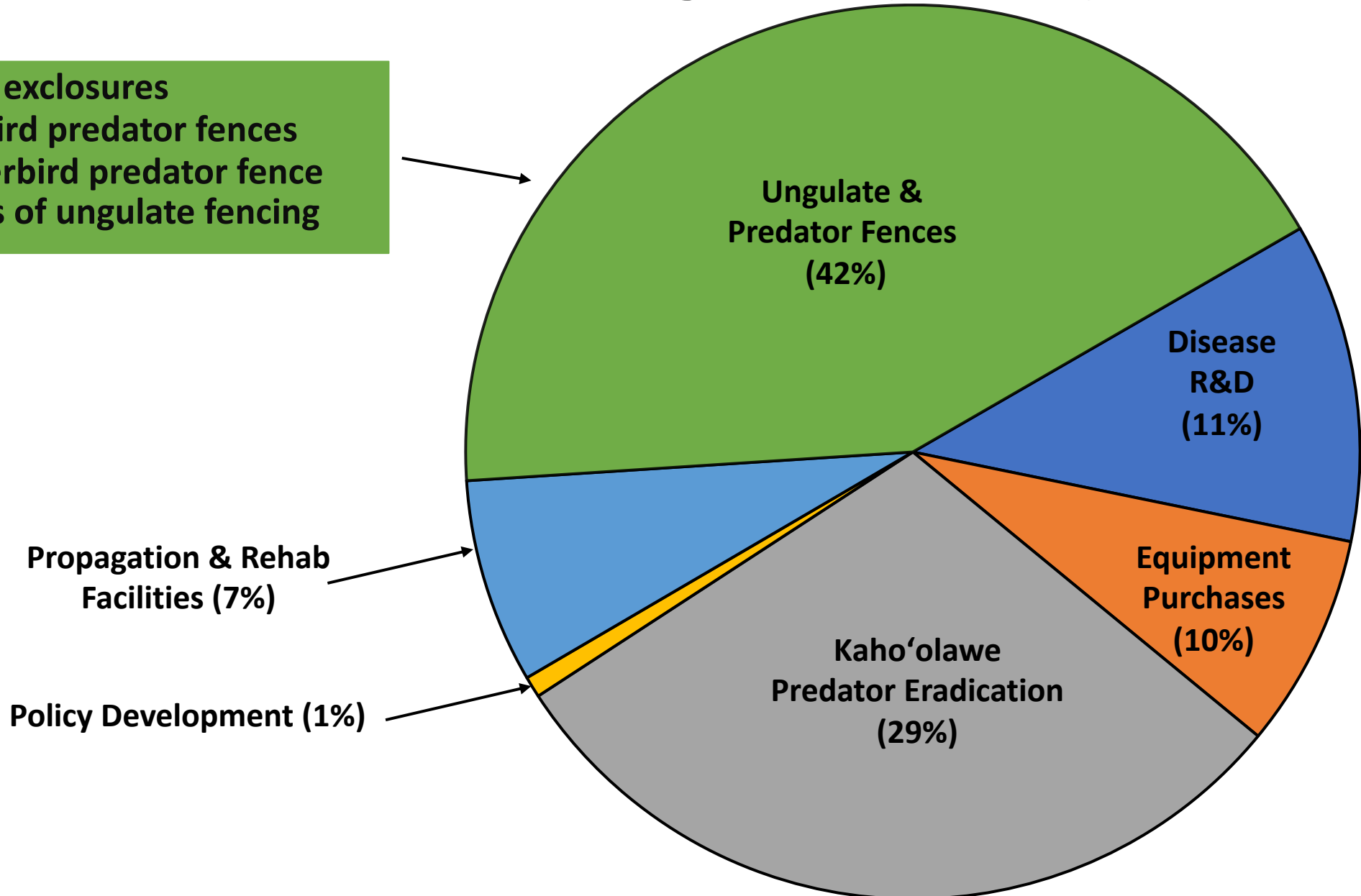
$$B_i = P_i - P_0$$

Results: Maximum Benefits Per Species Group



Results: Non-recurring Costs (~\$80M)

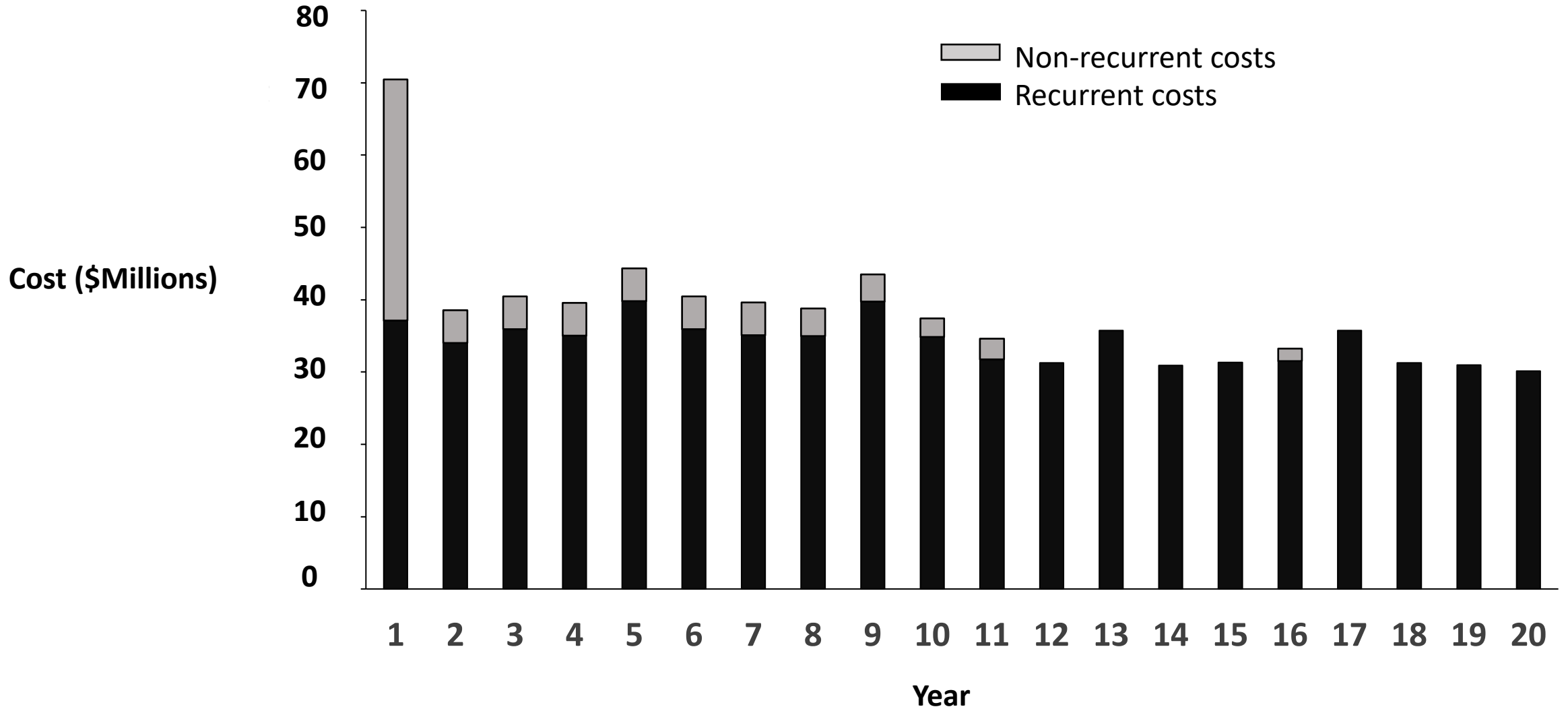
- 20 Snail enclosures
- 20 Seabird predator fences
- 14 Waterbird predator fence
- 30 Miles of ungulate fencing



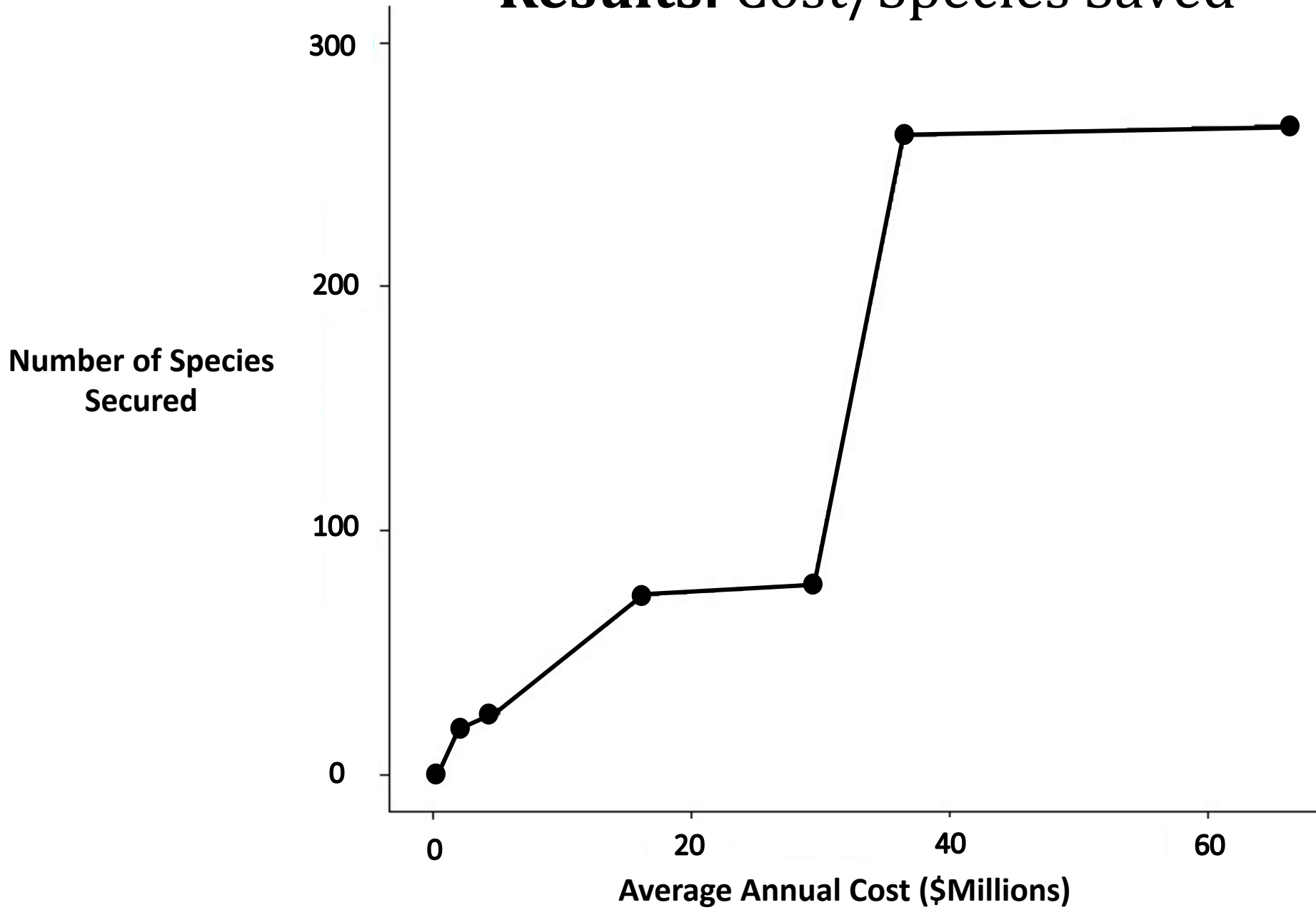
Results: Recurring Costs (~\$34M/year)



Results: Cost/Year



Results: Cost/Species Saved



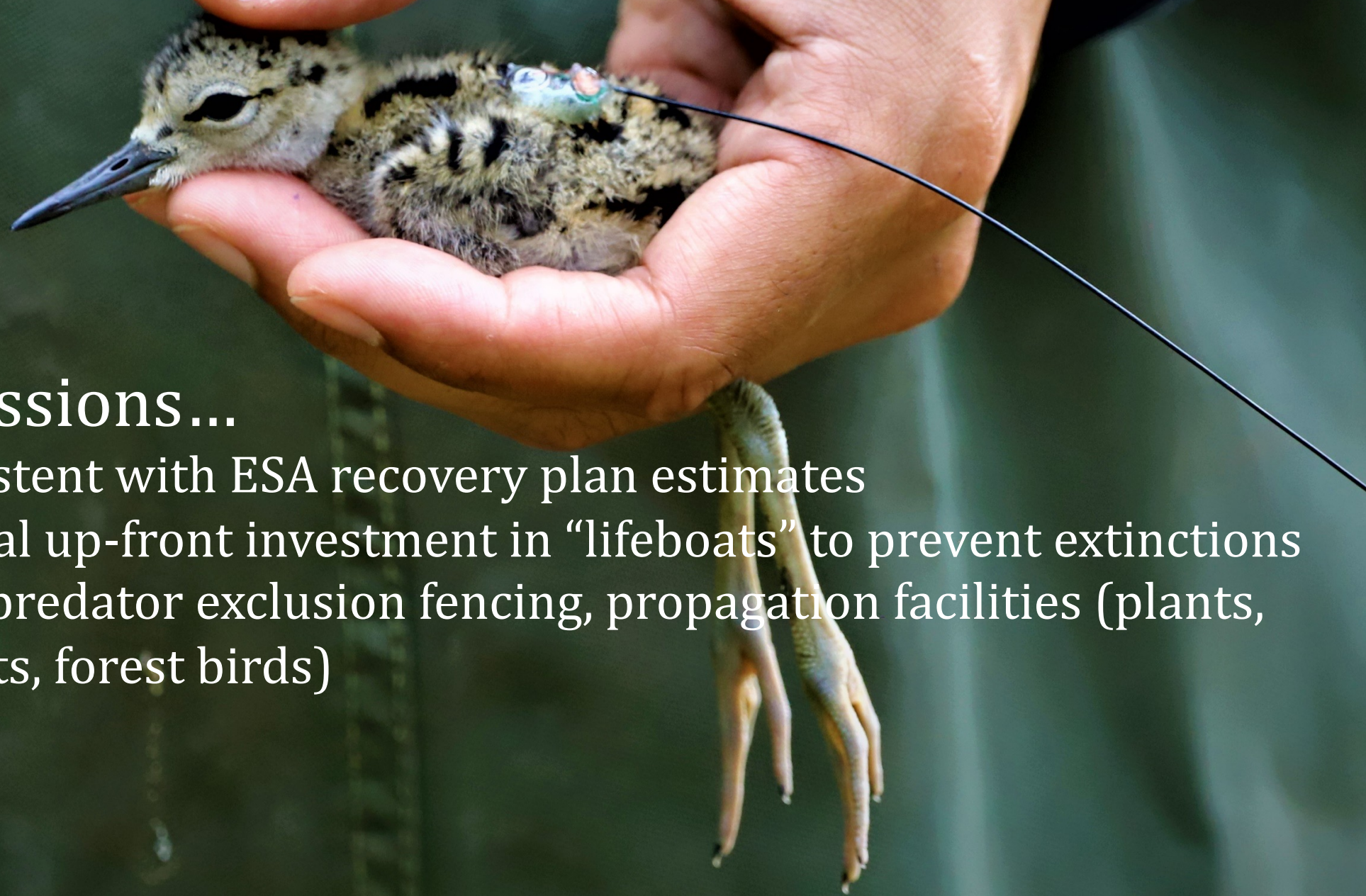


Initial impressions...



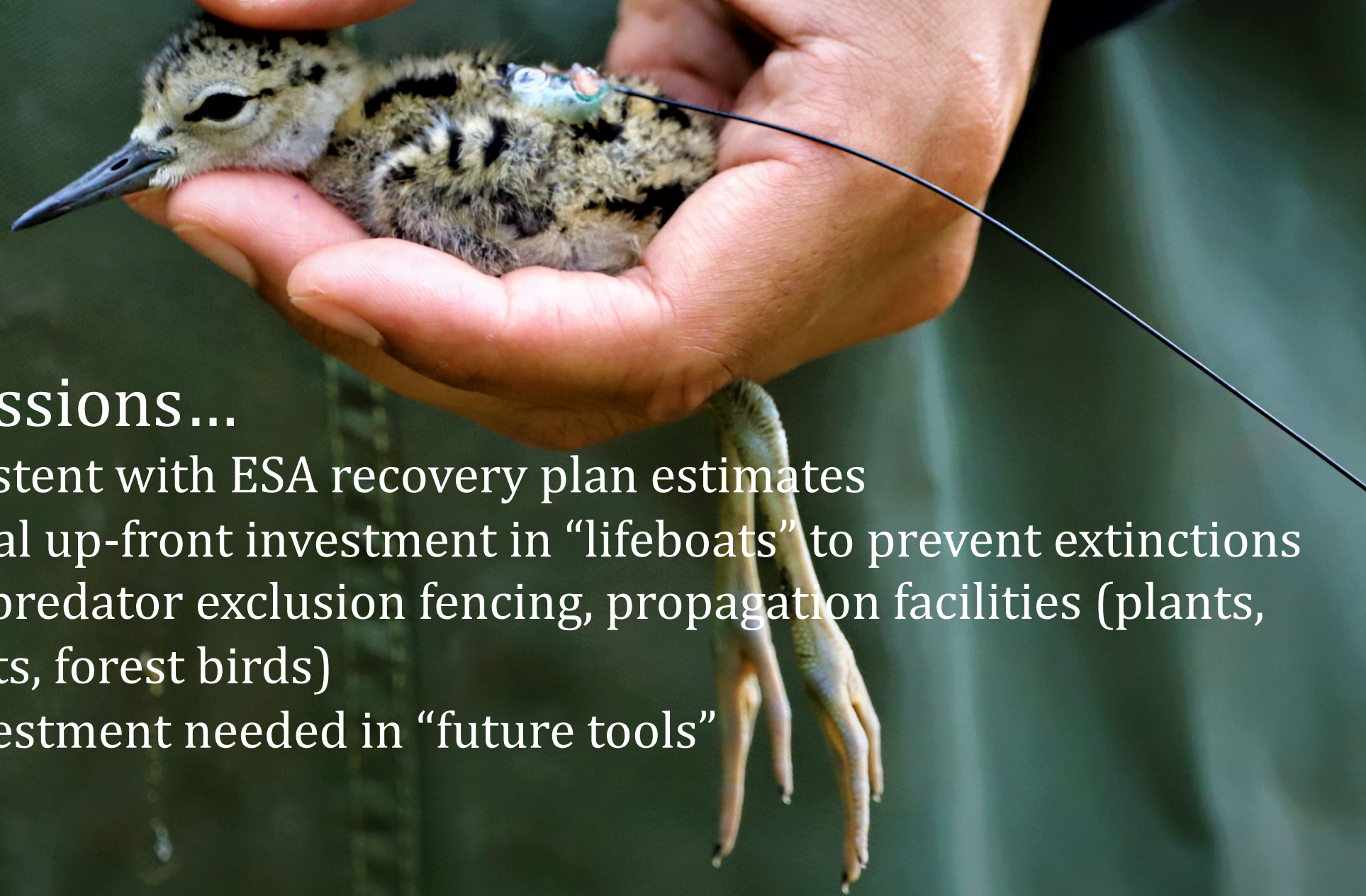
Initial impressions...

- Costs are consistent with ESA recovery plan estimates



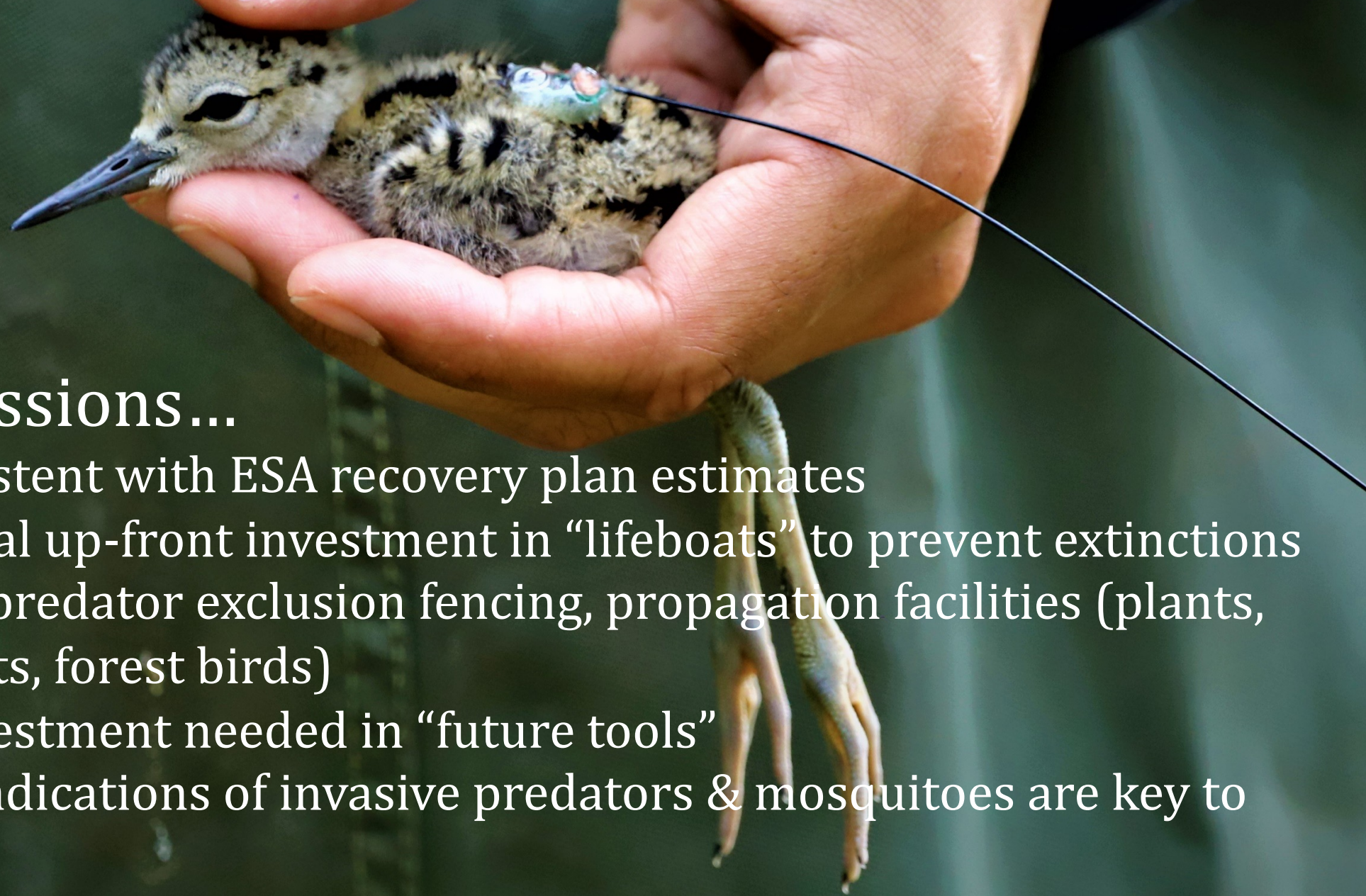
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 - Ungulate & predator exclusion fencing, propagation facilities (plants, snails, insects, forest birds)



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Initial impressions...

- Costs are consistent with ESA recovery plan estimates
- Need substantial up-front investment in “lifeboats” to prevent extinctions
 - Ungulate & predator exclusion fencing, propagation facilities (plants, snails, insects, forest birds)
- Substantial investment needed in “future tools”
- Island-wide eradications of invasive predators & mosquitoes are key to recovery

Transformation

From “Extinction Capital of the World” to
“Recovery Capital of the World”



Questions?



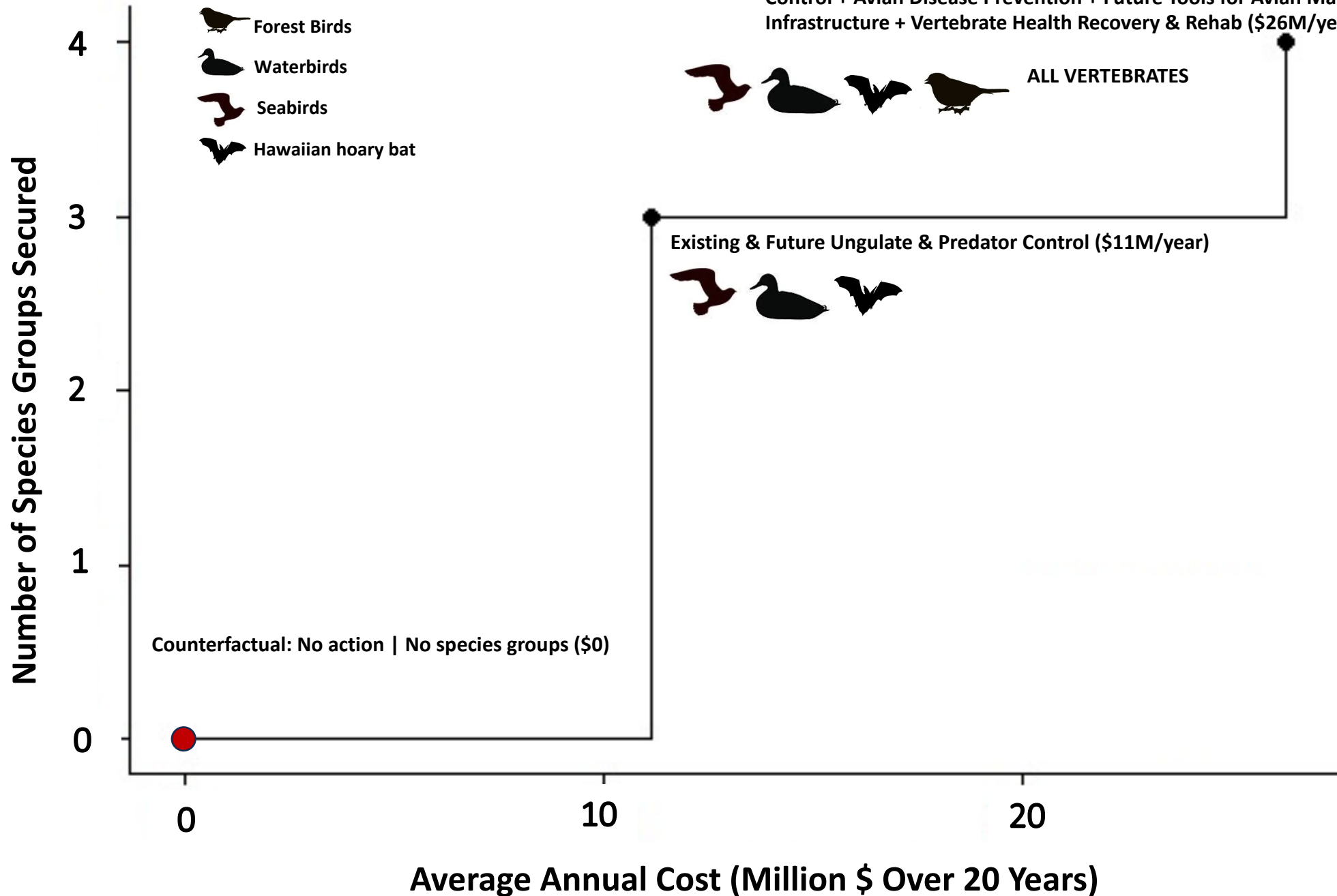
Next steps...

- **Conservation finance:** What are we spending today on conservation actions? Where does the funding come from? Where does it go?
- **Collaboration:** How do we ensure co-occurring threatened species are co-managed?

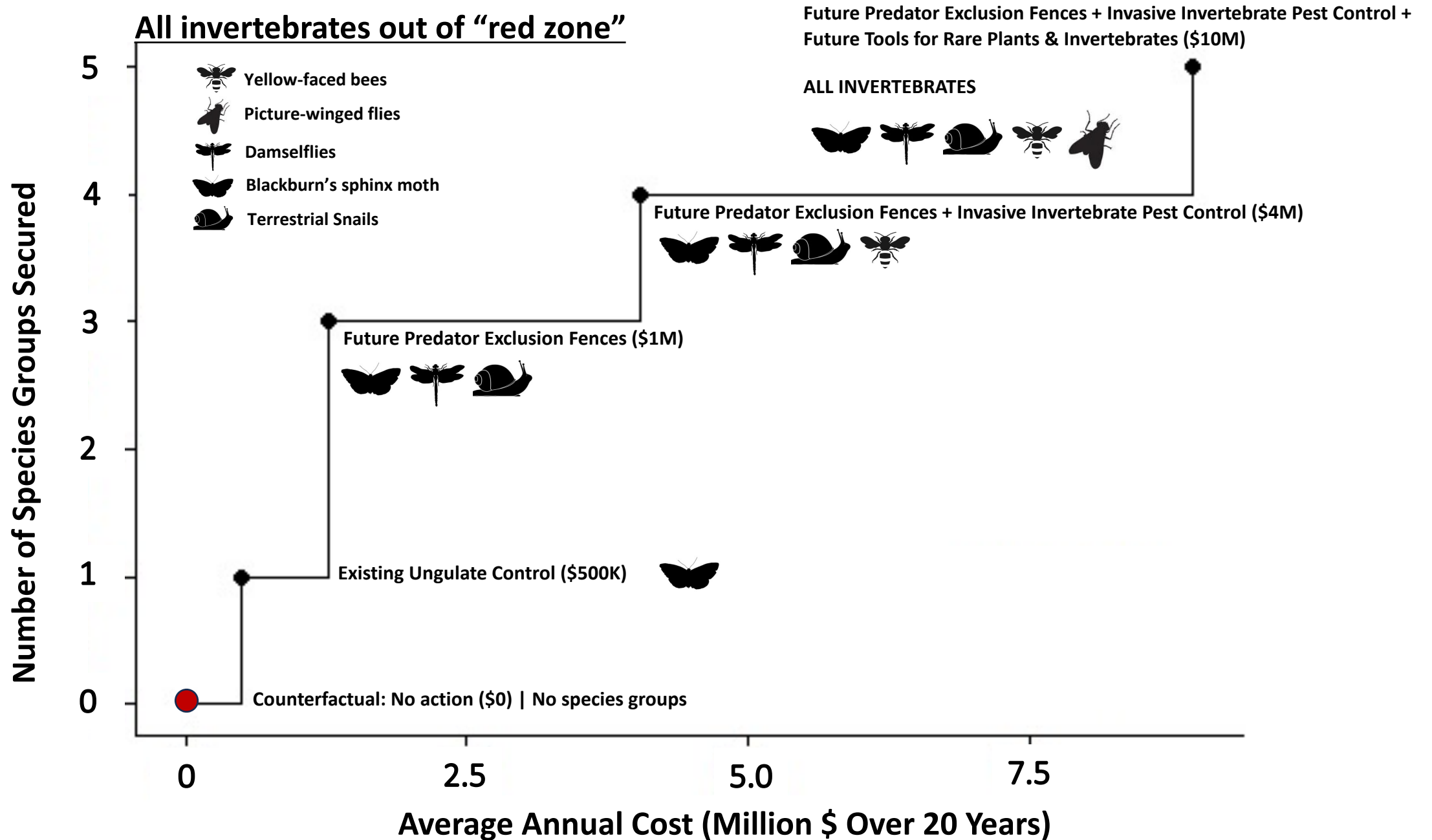


All vertebrates out of "red zone"

All Existing & Future Ungulate & Predator Actions + All Habitat Management + Invasive Pest Control + Avian Disease Prevention + Future Tools for Avian Malaria + Modification of Infrastructure + Vertebrate Health Recovery & Rehab (\$26M/year)



All invertebrates out of "red zone"



All plants out of "red zone"

Number of Species Groups Secured

6
5
4
3
2
1
0

Existing & Future Ungulate & Predator Control + Invertebrate Pest Control + Terrestrial & Wetland/Stream Habitat Management + Existing & Future Tools for Rare Plants & Inverts (\$38M)

ALL PLANT GROUPS



Counterfactual: No action | No species groups (\$0)

0

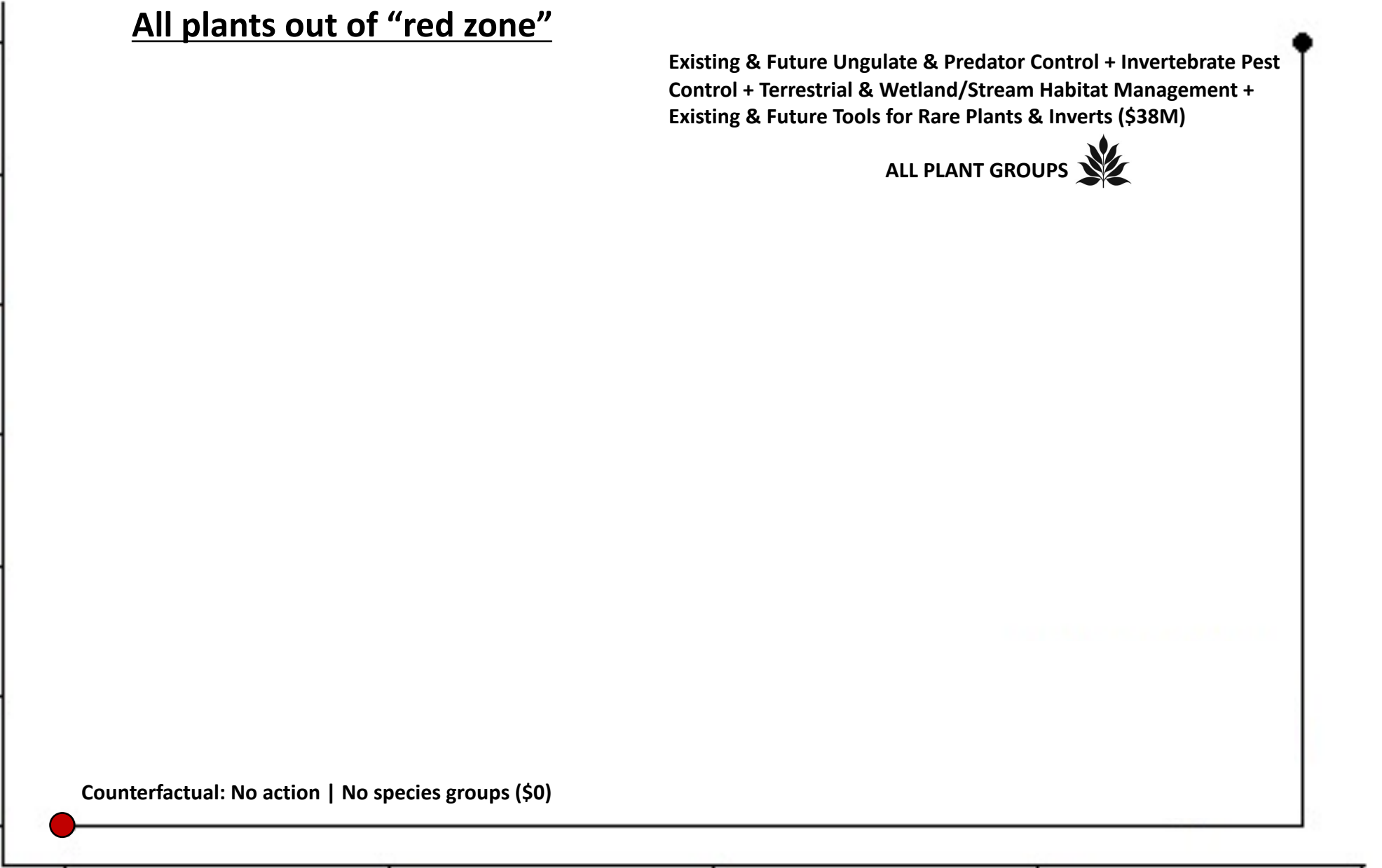
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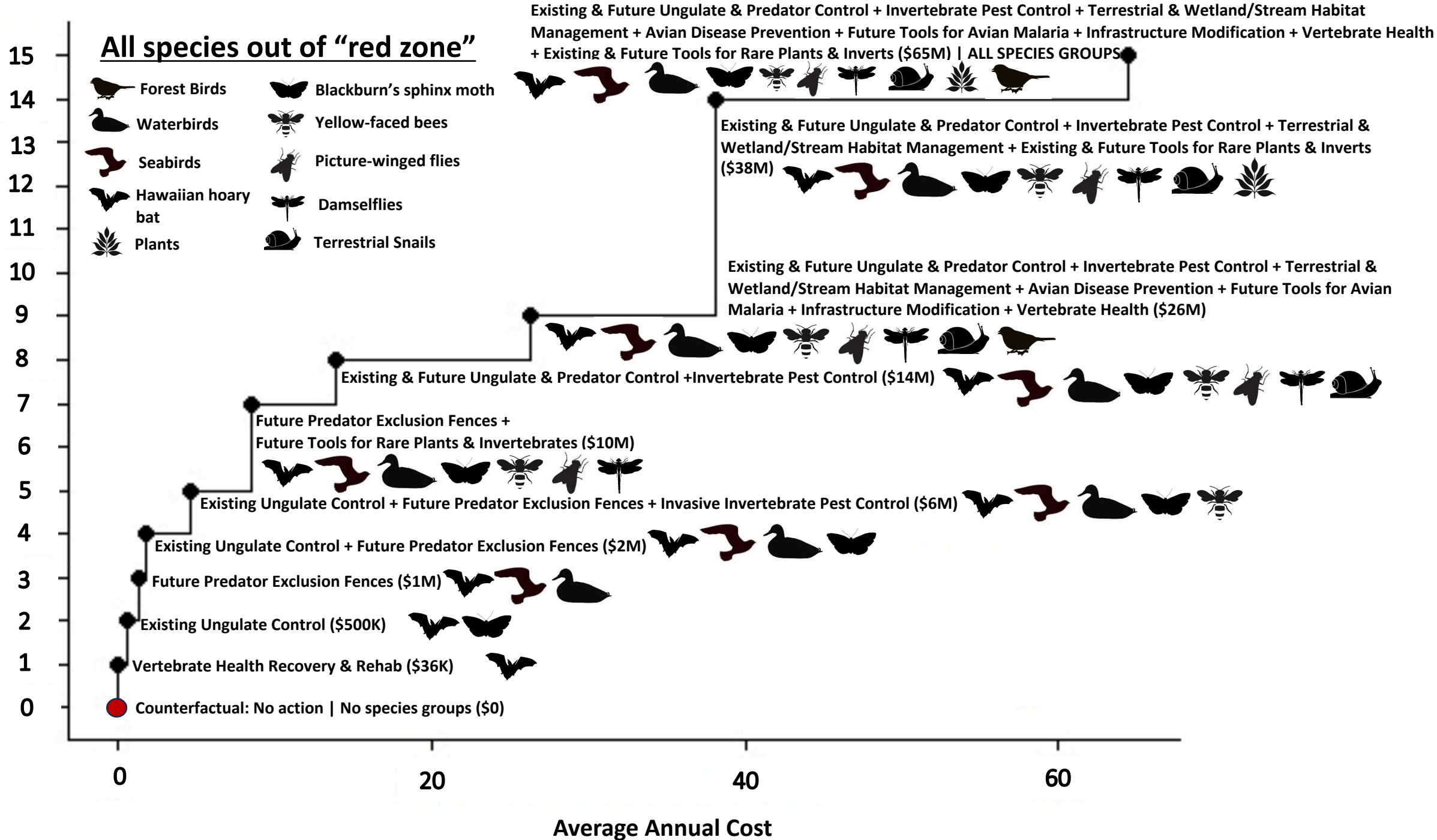
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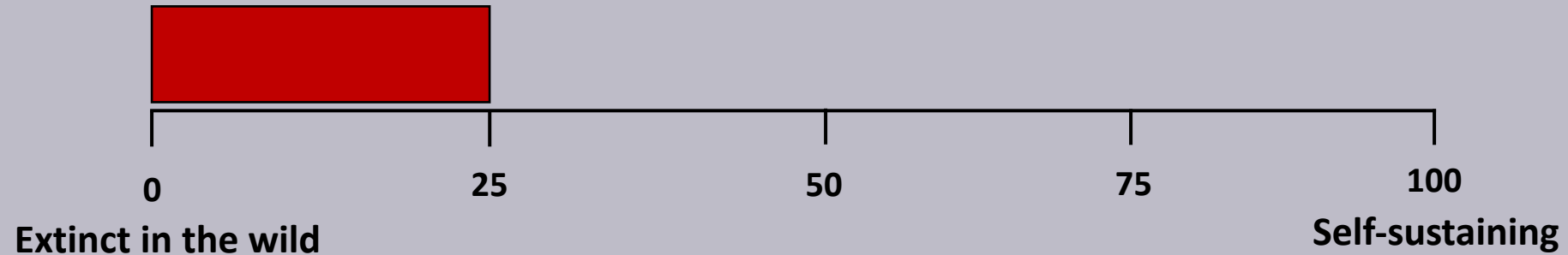
Average Annual Cost (Million \$ Over 20 Years)



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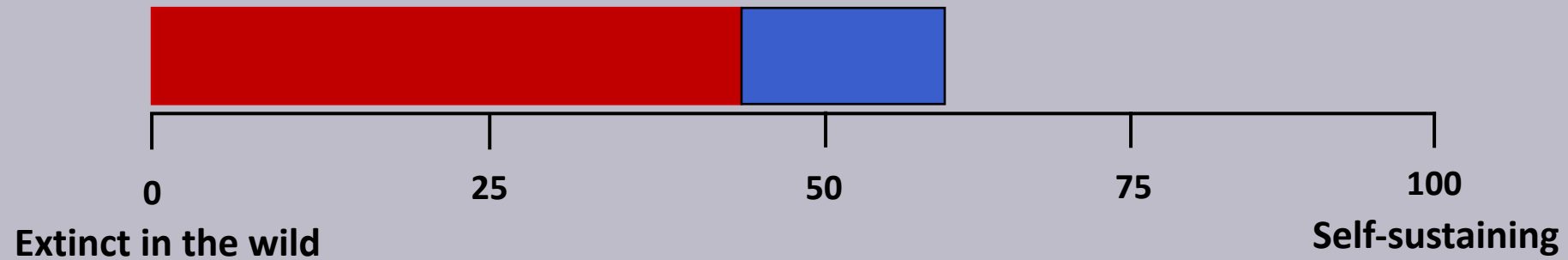


Methods: Estimating Probability of Persistence



Goal: To get all species groups out of the “red zone” (rapidly declining) as efficiently as possible

Results: If we take all actions that benefit species, how high can we get the probability of persistence?



Module	Goal
M1. Counterfactual (no action)	
M2. Existing Ungulate Fences that are already constructed or will be constructed by Dec. 2023	Remove ungulates inside ungulate fences to minimize impacts to sensitive species from wild ungulates
M3. Future Ungulate Fences that are not yet funded and are not under construction	Remove ungulates inside ungulate fences to minimize impacts to sensitive species from wild ungulates
M4. Ungulate Control Outside of Fences	Remove ungulates outside fences to minimize impacts to sensitive species from wild ungulates
M5. Terrestrial Habitat Management	Improve habitat for sensitive species
M6. Stream/Wetland Habitat Management	Improve habitat for sensitive species
M7. Invasive Vertebrate Predator Control	Minimize impacts to sensitive species from vertebrate predators
M8. Invasive Invertebrate Pest Control	Minimize impacts to sensitive species from invertebrate pests
M9. Existing Predator Exclusion Fences that are already constructed or will be constructed by Dec. 2023	Minimize impacts to sensitive species from vertebrate predators
M10. Future Predator Exclusion Fences that are not yet funded and are not under construction	Minimize impacts to sensitive species from vertebrate predators
M11. Landscape-scale Rodent Suppression	Minimize impacts to sensitive species from rodents
M12. Existing Tools for Rare Plants & Invertebrates	Increase populations of rare plants & invertebrates
M13. Future Tools for Rare Plants & Invertebrates	Increase populations of rare plants & invertebrates
M14. Avian Disease Prevention	Reduce risk of diseases to native forest birds and waterbirds
M15. Future Tools to Address Avian Malaria	Reduce outbreaks of avian malaria in native forest birds
M16. Minimization & Modification of Infrastructure	Minimize impacts to sensitive species from powerlines, energy infrastructure, and anthropogenic lighting
M17. Vertebrate Health Recovery & Rehabilitation	Increase capacity for recovering sensitive species that are downed or injured

3-point estimates of probability of persistence

- **BEST GUESS** estimate (the probability under the most likely scenario)
- **LOWEST** plausible estimate (the probability under the most pessimistic/worst case scenario)
- **HIGHEST** plausible estimate (the probability under the most optimistic scenario)

