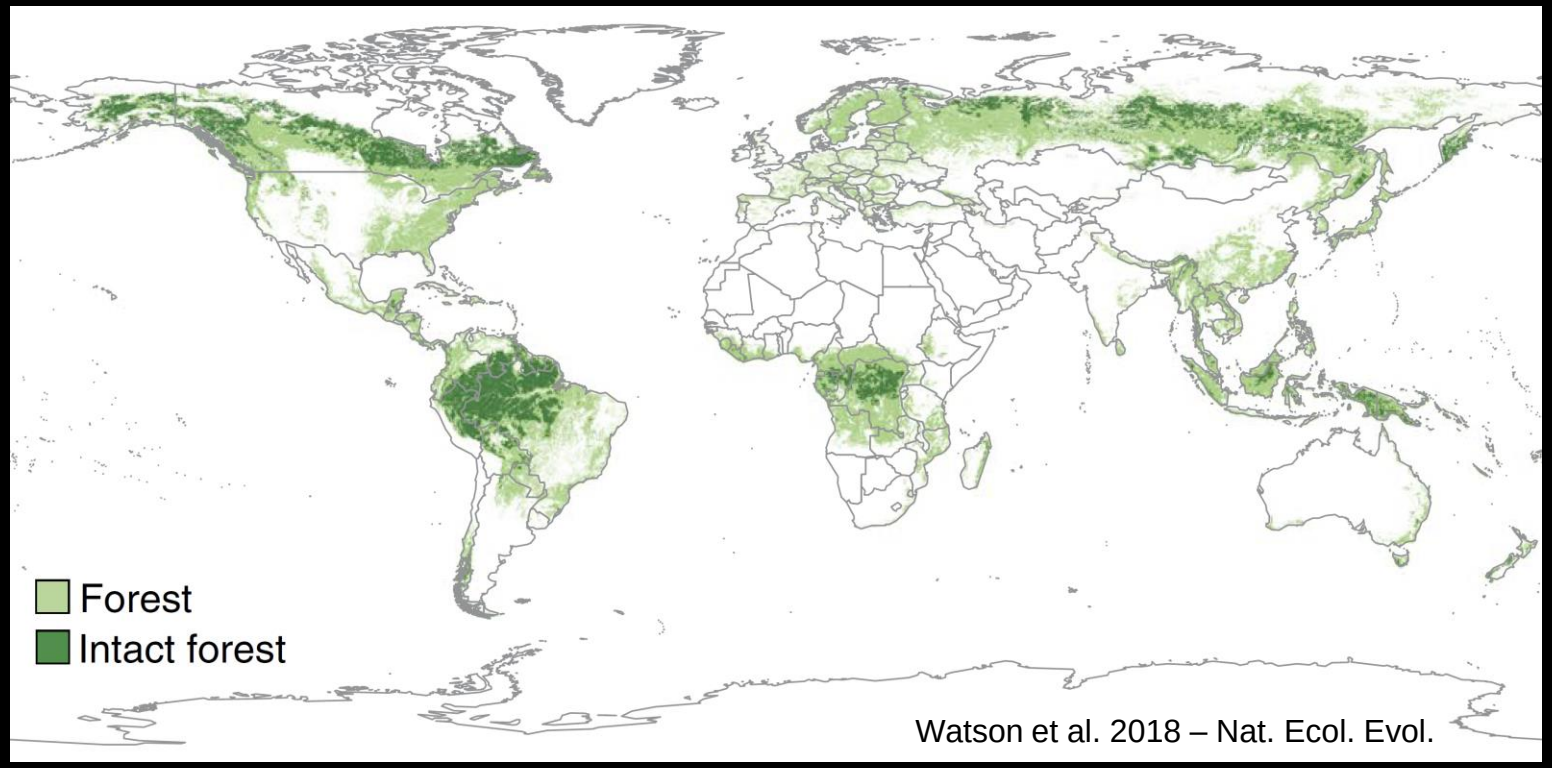
Shifting baselines provide over-optimistic assessments of the impacts of land-use change on biodiversity



Anderson Saldanha Bueno
University of East Anglia, UK


MONGABAY.COM


Impacted sites
MONGABAY.COM


Impacted sites
Control
MONGABAY.COM


Impacted sites
Control
Reference
Baseline
MONGABAY.COM

Scenario I

High contrast = severe impact

Scenario II

Low contrast = light impact

Intact baseline

Modified from Bennett et al. 2016 – Ecol. Lett.

Intact baseline

Past disturbance

Modified from Bennett et al. 2016 – Ecol. Lett.

Intact baseline

Past disturbance

Shifting baseline[1,2]

Modified from Bennett et al. 2016 – Ecol. Lett., [1]Pauly 1995 – Trends Ecol. Evol., [2]Papworth et al. 2009 – Conserv. Lett.

Intact baseline

Shifting baseline[1,2]

Past disturbance

Retention Loss Gain

Modified from Bennett et al. 2016 – Ecol. Lett., [1]Pauly 1995 – Trends Ecol. Evol., [2]Papworth et al. 2009 – Conserv. Lett.

Shifting baseline

Intact baseline

Past disturbance

Shifting baseline[1,2]

Retention Loss Gain

Change in the reference level from which we measure the impacts of land-use change on biodiversity

Modified from Bennett et al. 2016 – Ecol. Lett., [1]Pauly 1995 – Trends Ecol. Evol., [2]Papworth et al. 2009 – Conserv. Lett.

CONSERVATION PROBLEM: Hydropower causing forest fragmentation

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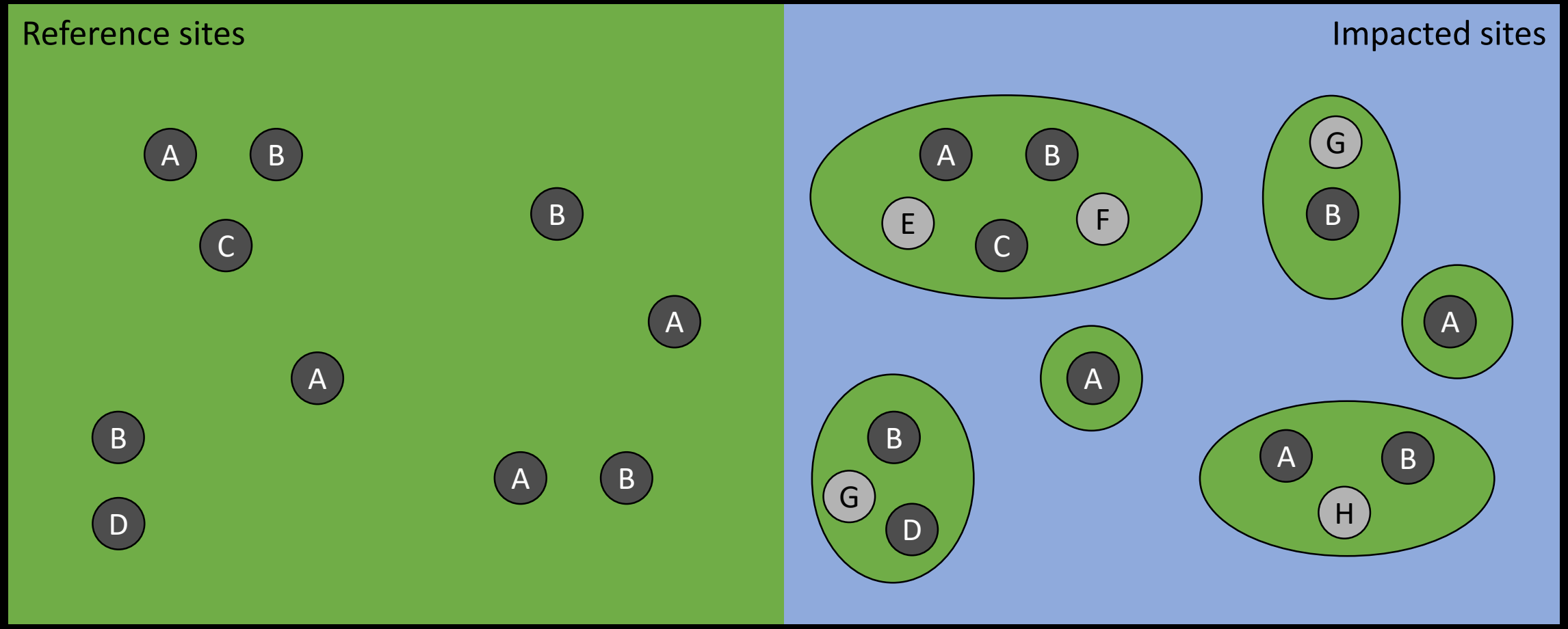
Pithys albifrons

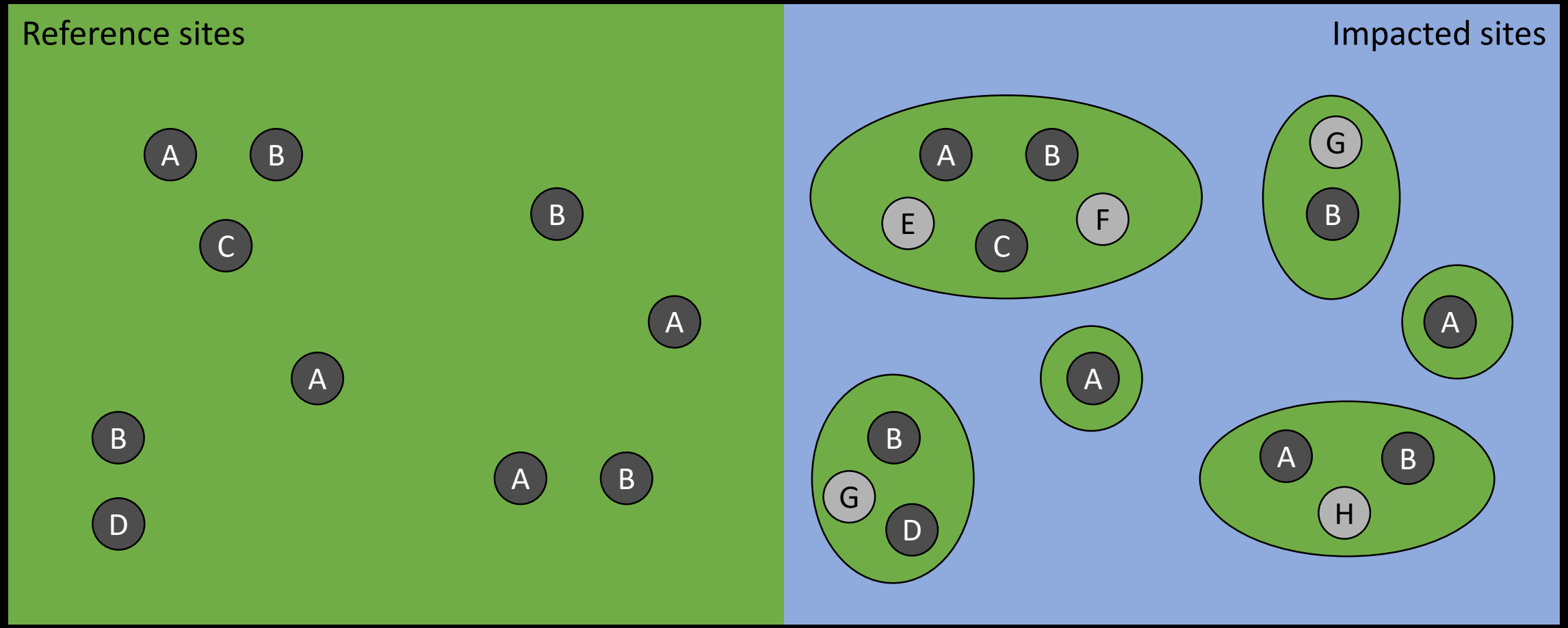
Xiphorhynchus pardalotus

Ceratopipra erythrocephala

Land-use change = Forest fragmentation

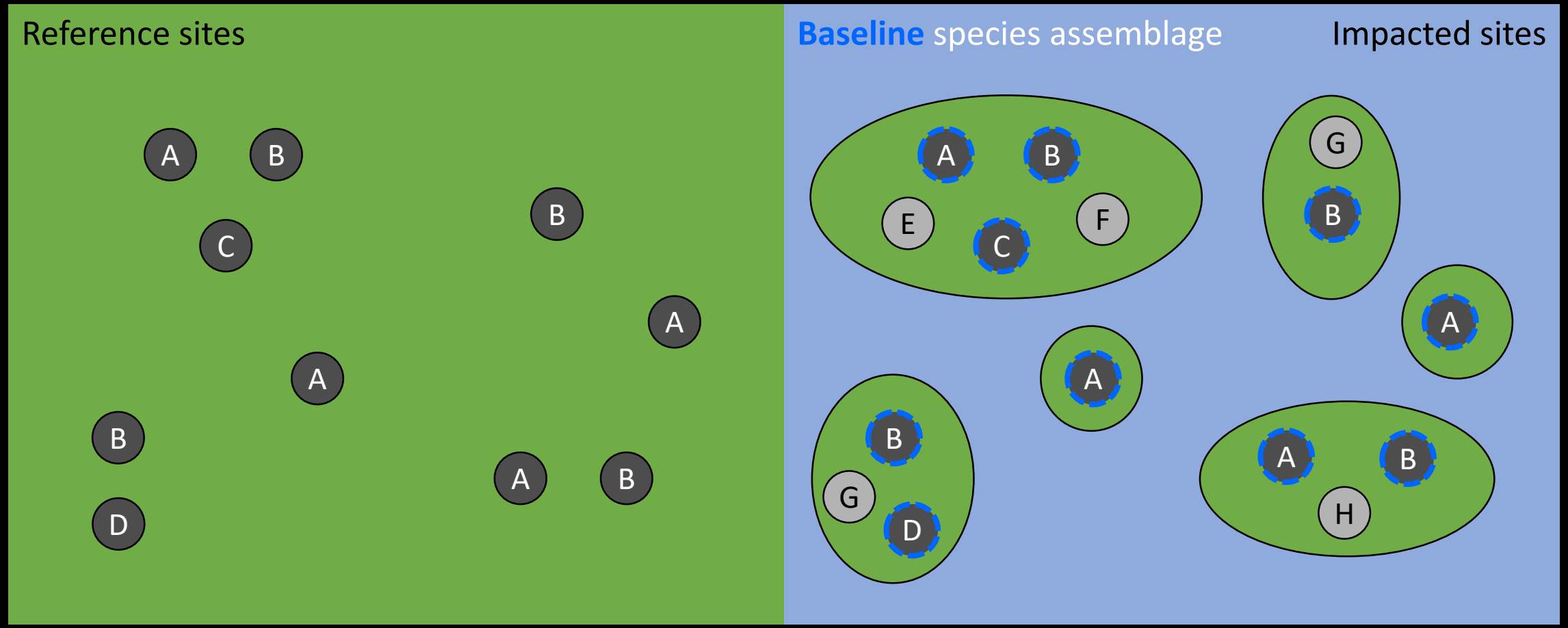


Land-use change = Forest fragmentation
Biodiversity = Species richness

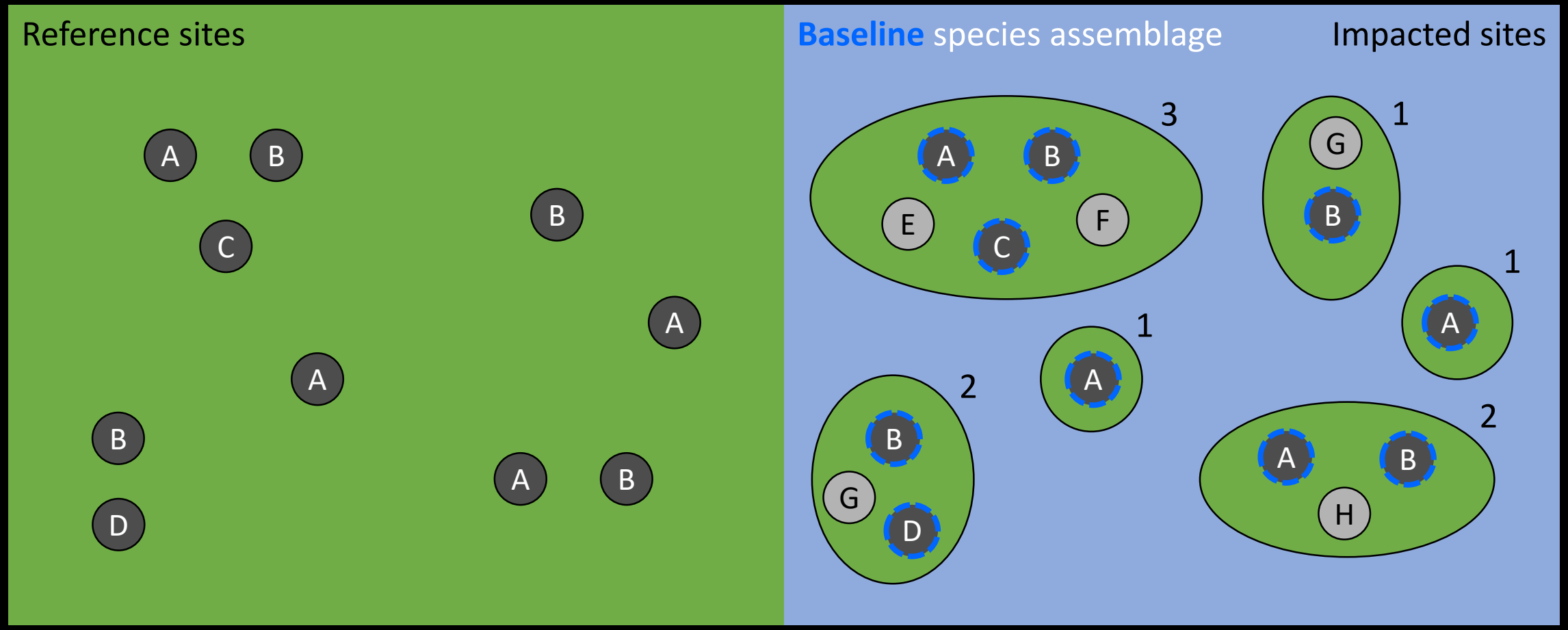


Land-use change = Forest fragmentation

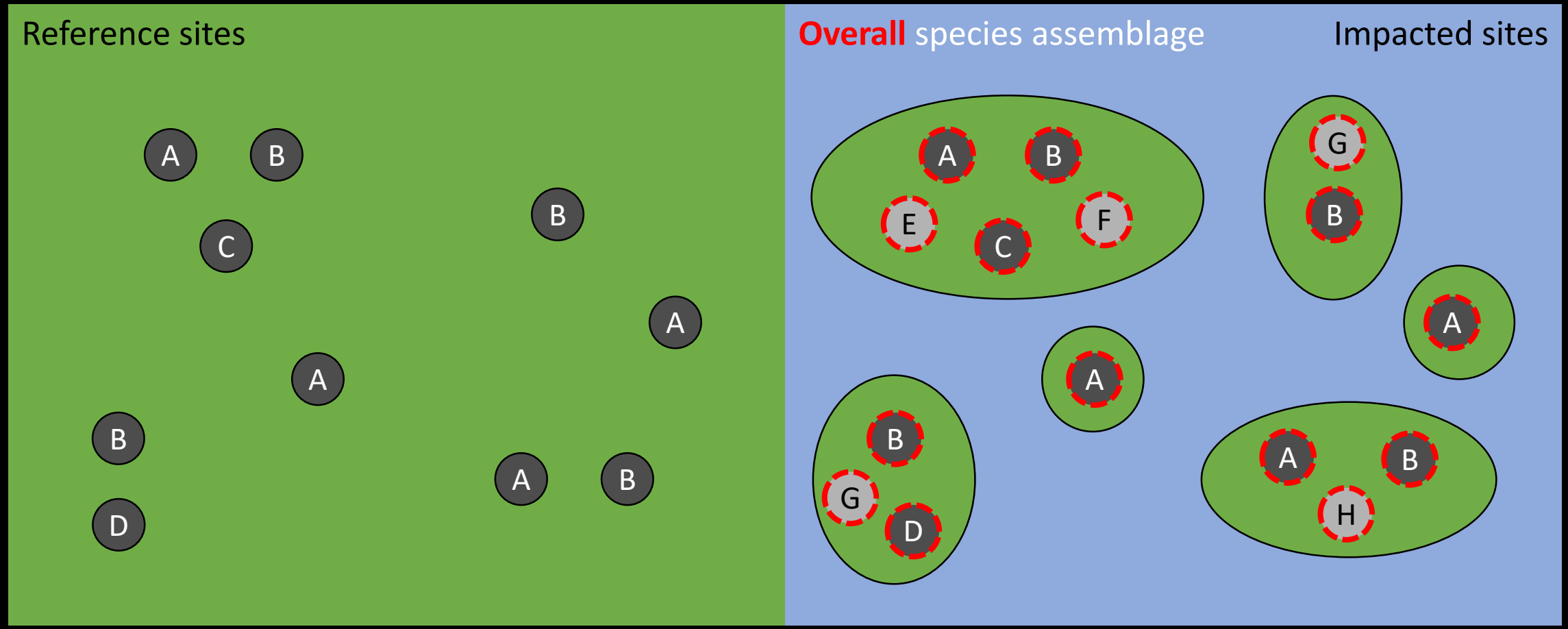
Biodiversity = Species richness



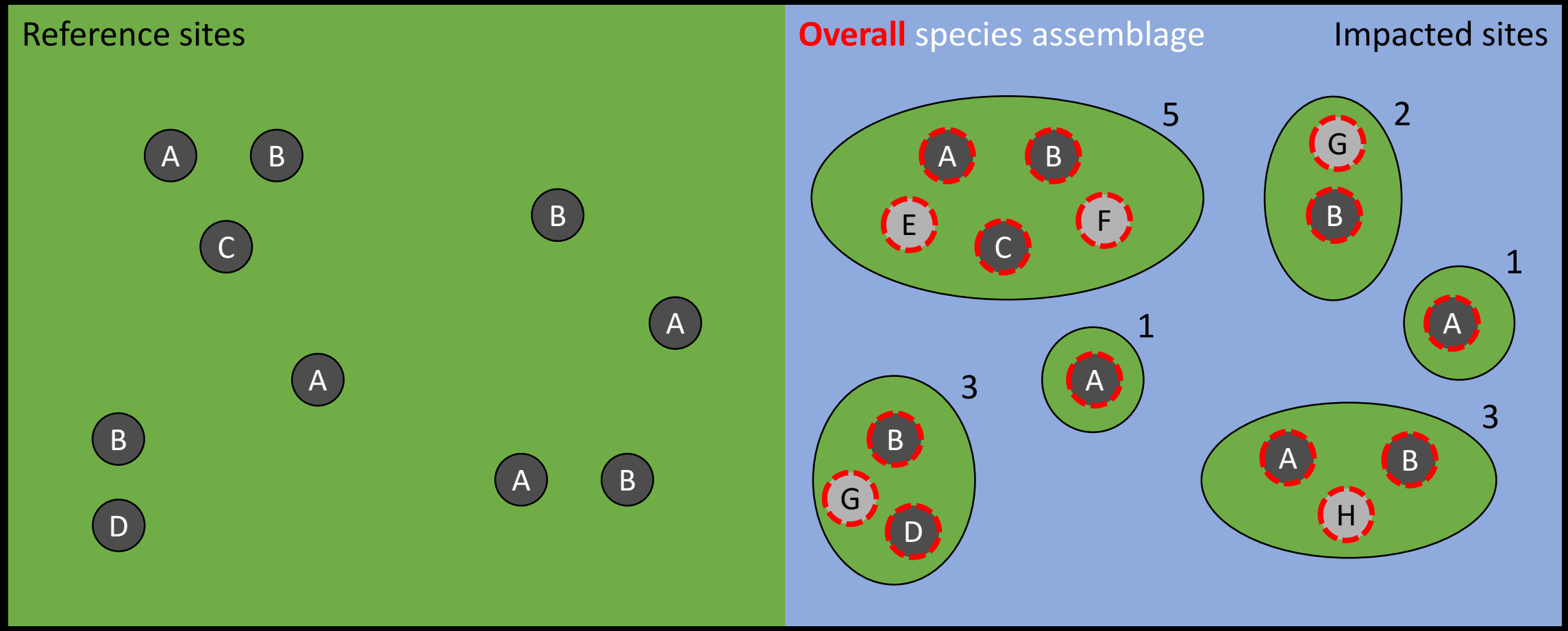
Land-use change = Forest fragmentation
Biodiversity = Species richness



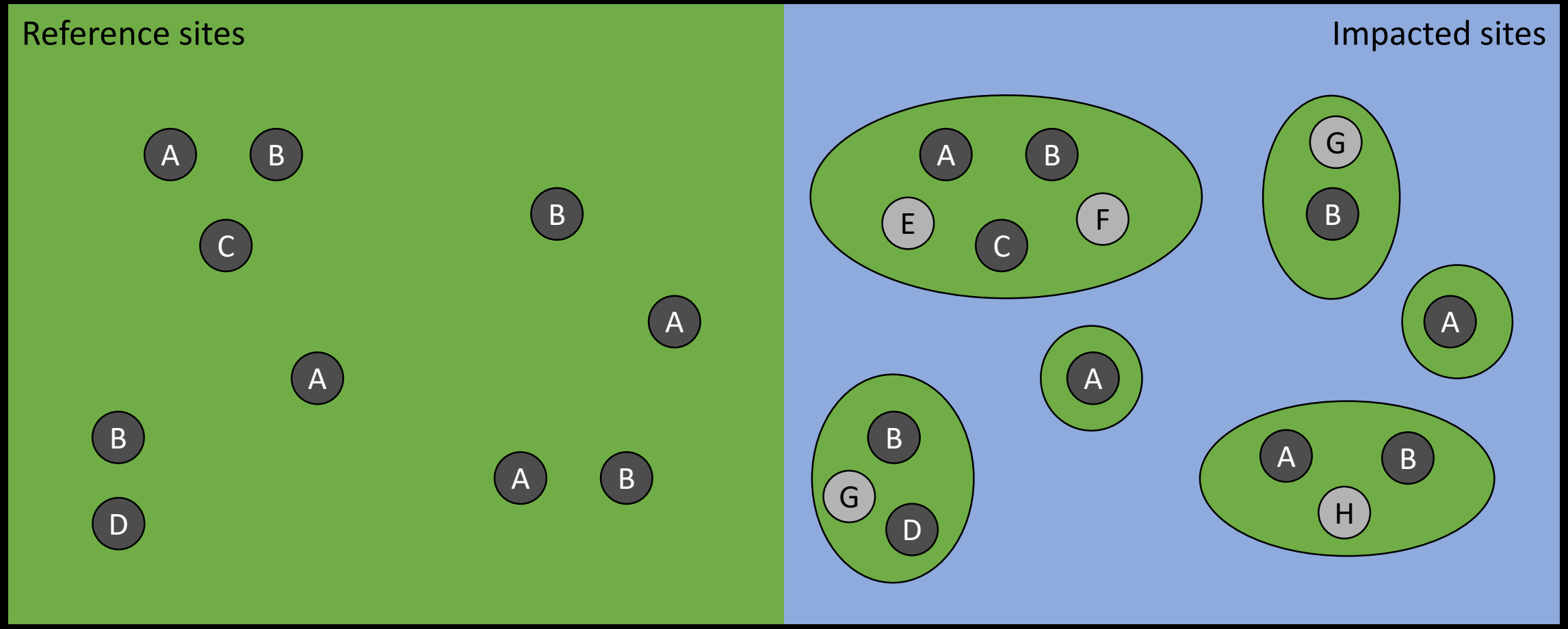
Land-use change = Forest fragmentation
Biodiversity = Species richness



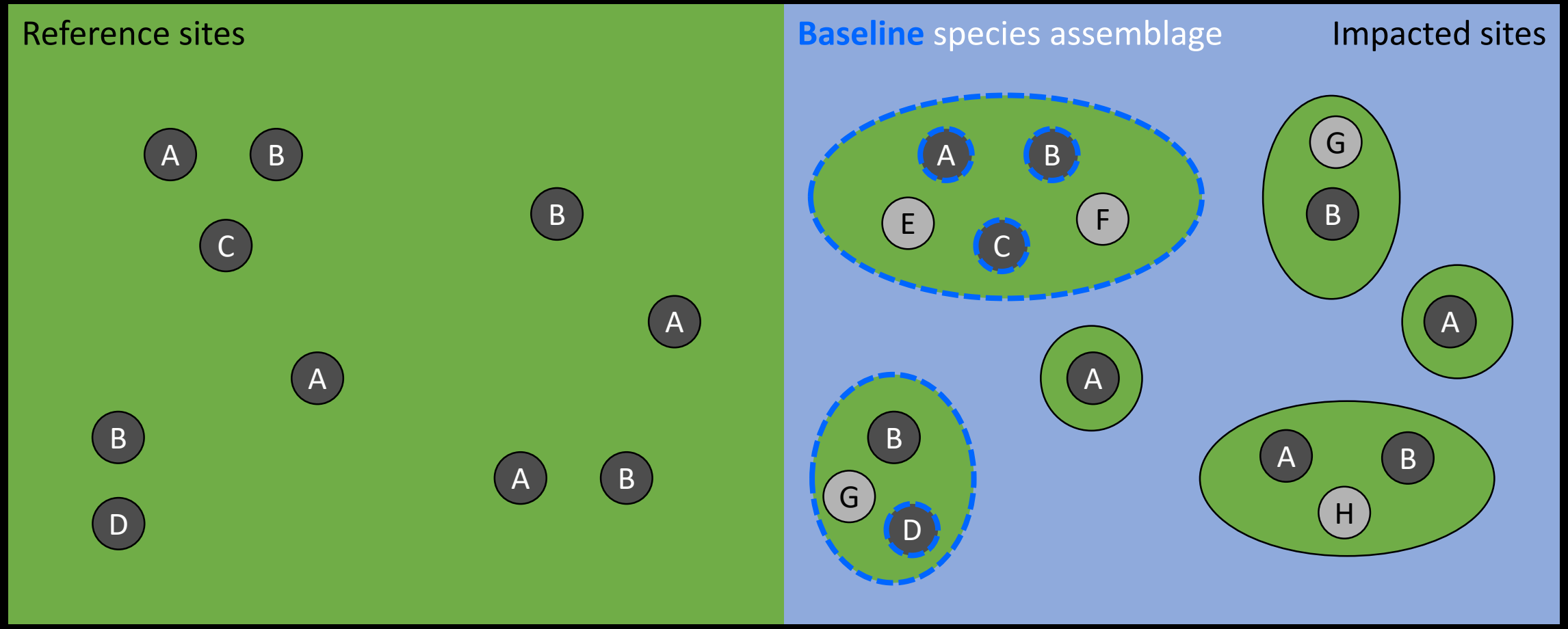
Land-use change = Forest fragmentation
Biodiversity = Species richness



Land-use change = Forest fragmentation
Biodiversity = Species richness
Site prioritisation = Minimum set problem



Land-use change = Forest fragmentation
Biodiversity = Species richness
Site prioritisation = Minimum set problem



Land-use change = Forest fragmentation
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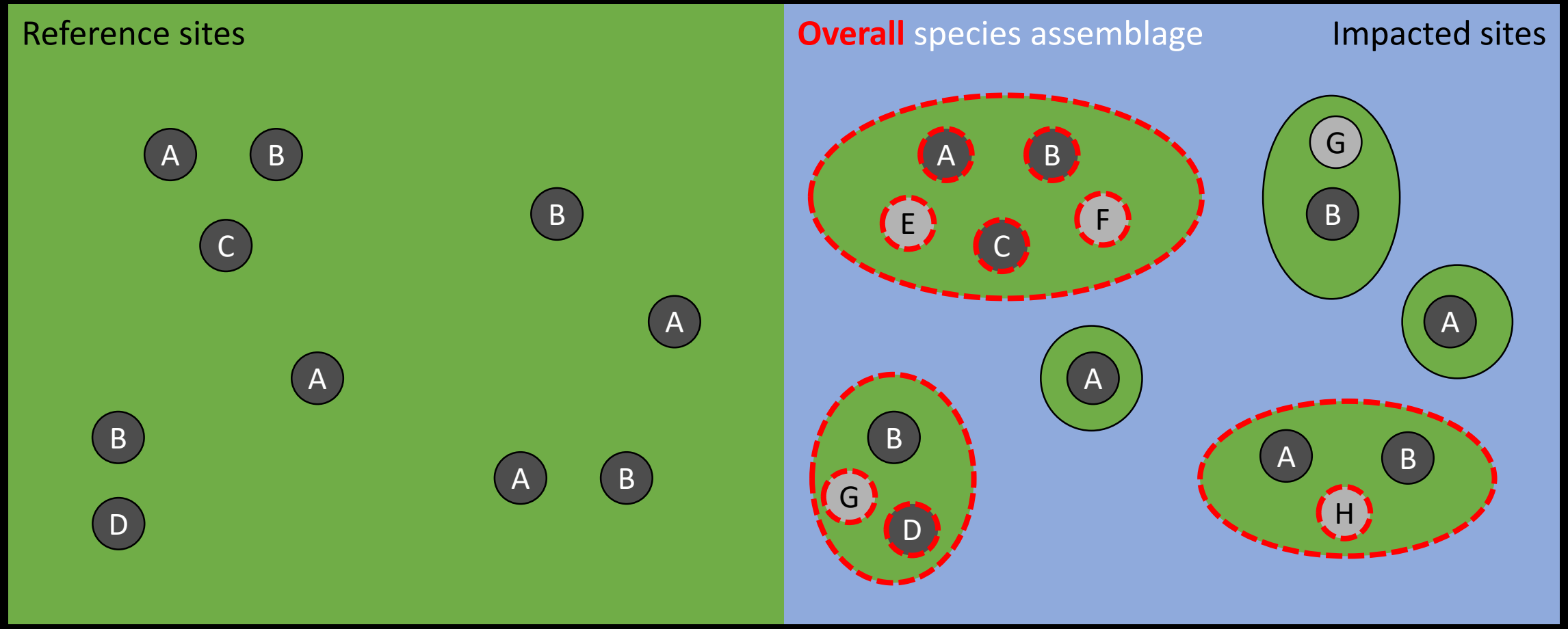
Site prioritisation = Minimum set problem



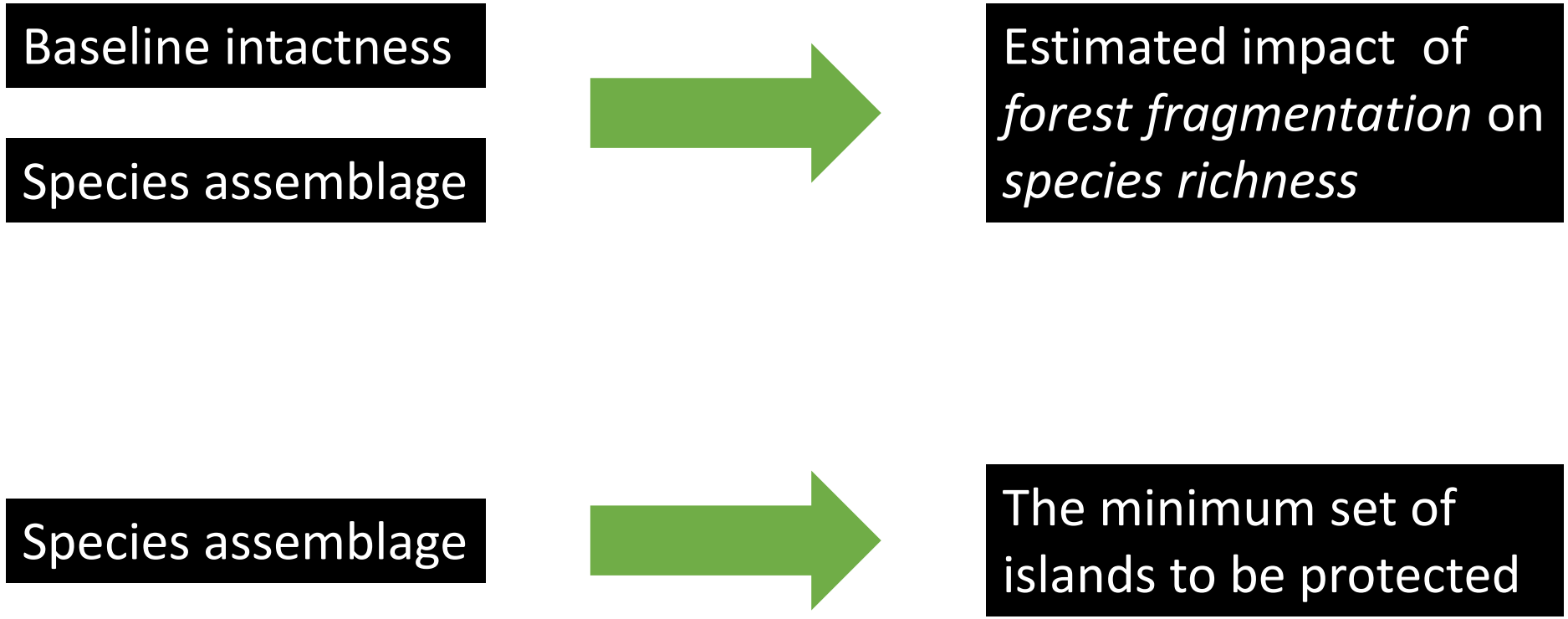
Research questions

Baseline intactness

Species assemblage

Estimated impact of *forest fragmentation* on *species richness*

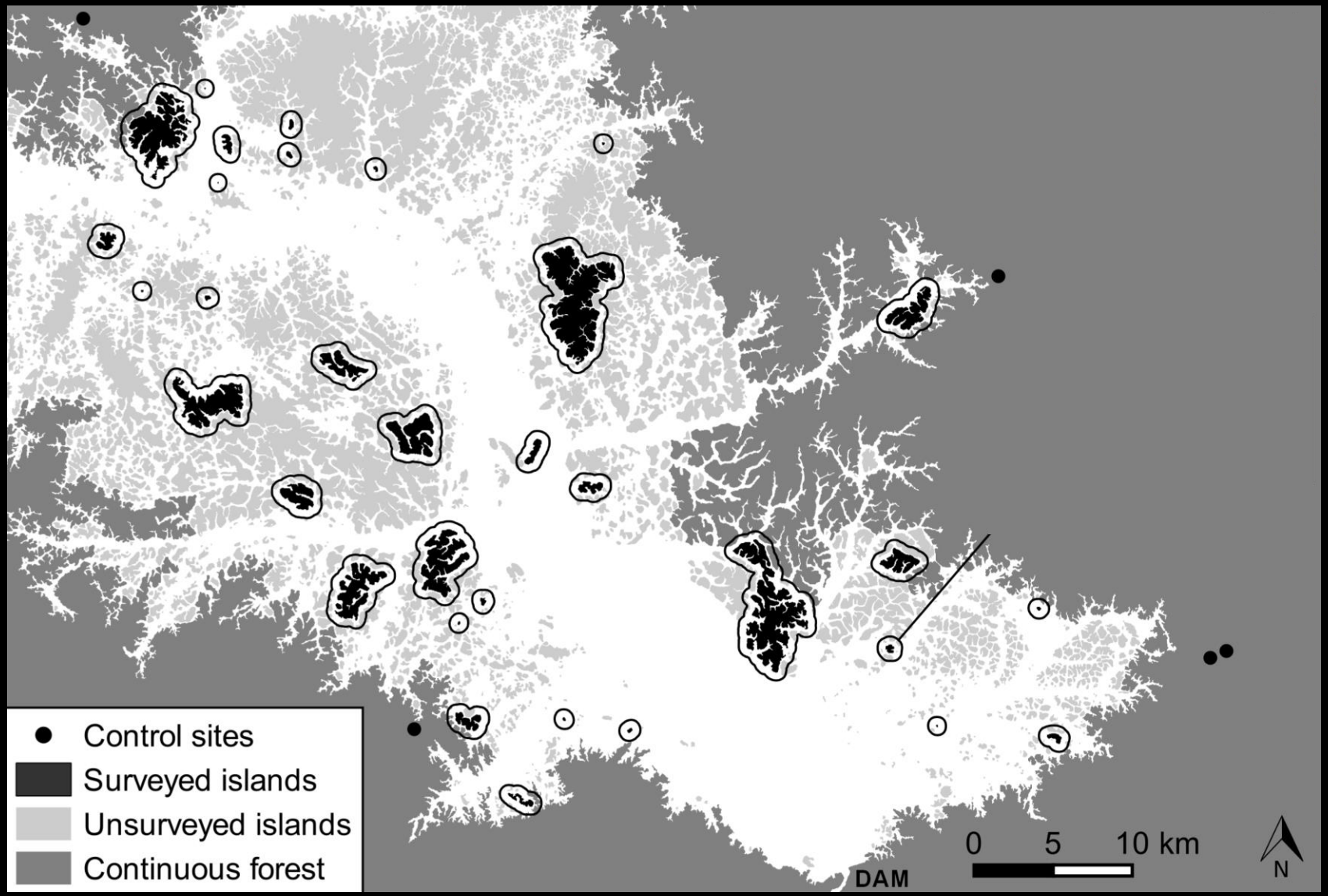
Research questions



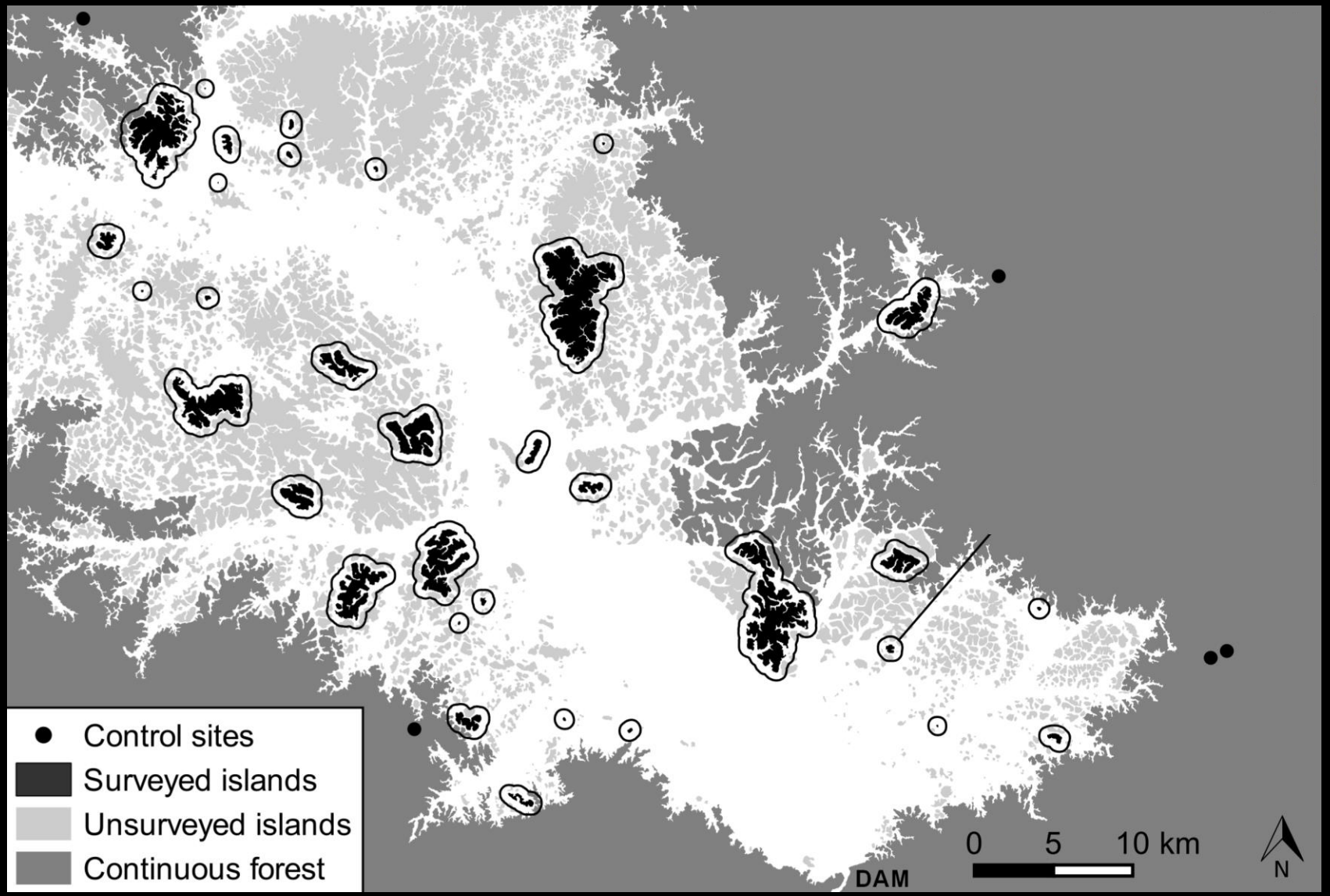
Study area

Credits: florestapraque.wordpress.com, Eduardo M. Venticinque

Sampling design



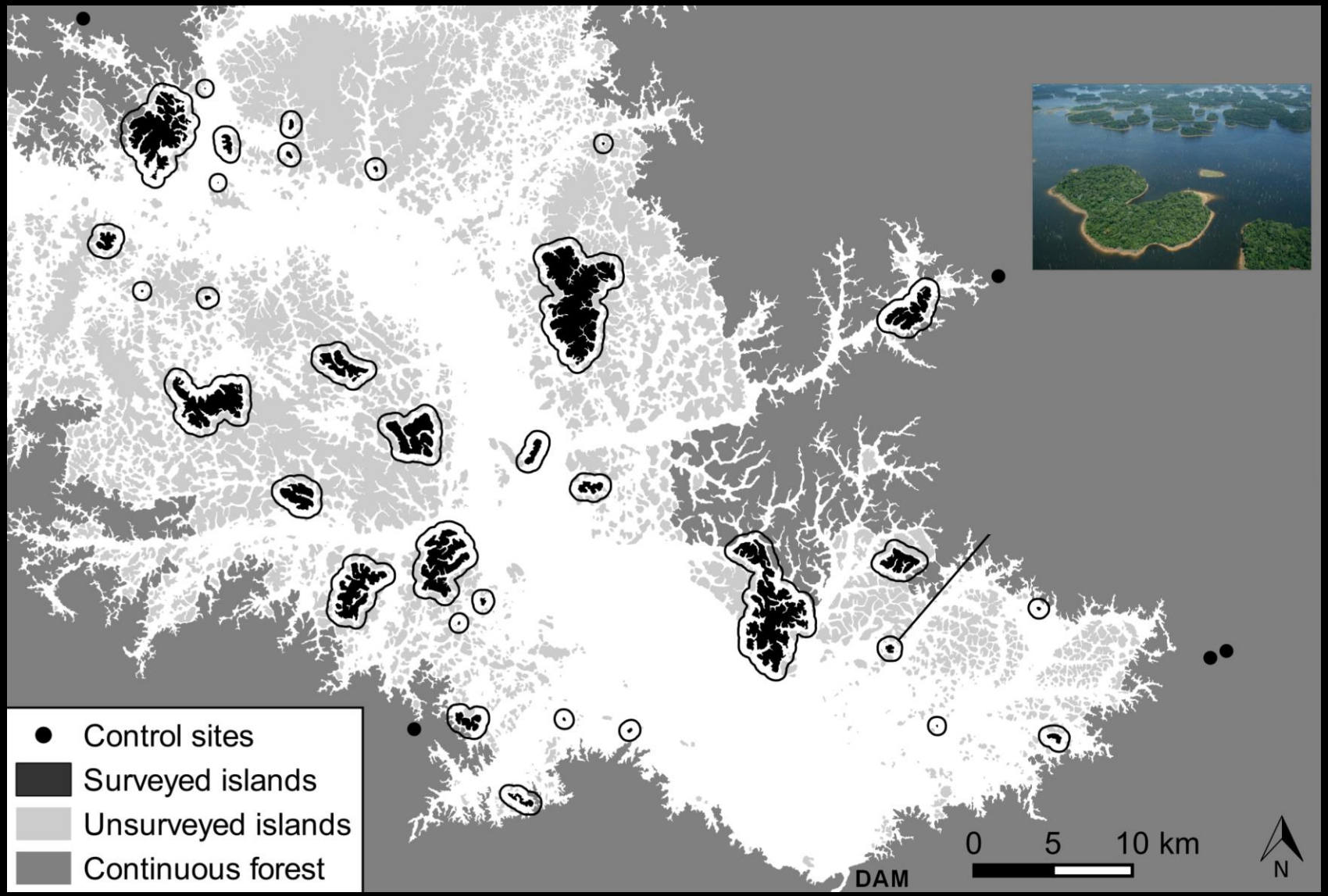
Sampling design



- 5 continuous forest sites

Credit: Neil Palmer

Sampling design



- 5 continuous forest sites
- 33 forest islands
- Island range in size 0.63 to 1,678 ha

Avifaunal surveys

Avifaunal surveys

- 16 mist nets (≈ 200 m)

Avifaunal surveys

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- July to December 2015 and 2016
- 2 days per year
- 6am to 3pm

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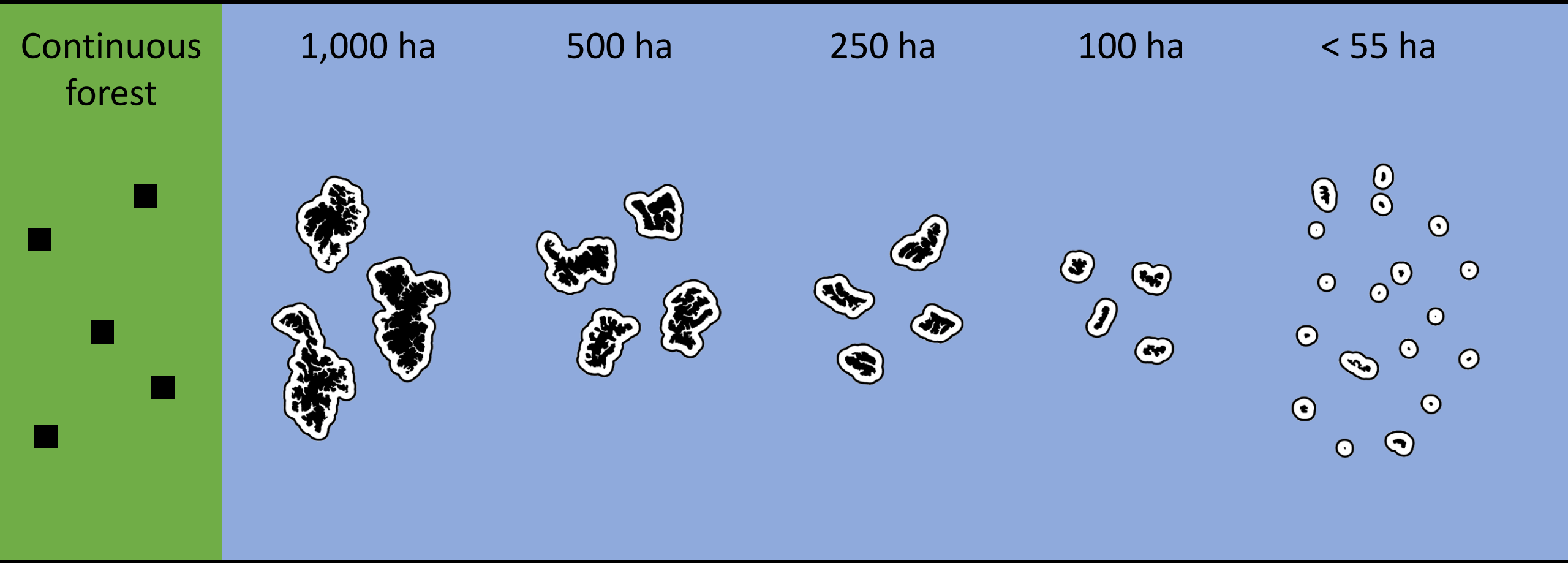
- 576 net-hours per site
- 21,888 net-hours in total

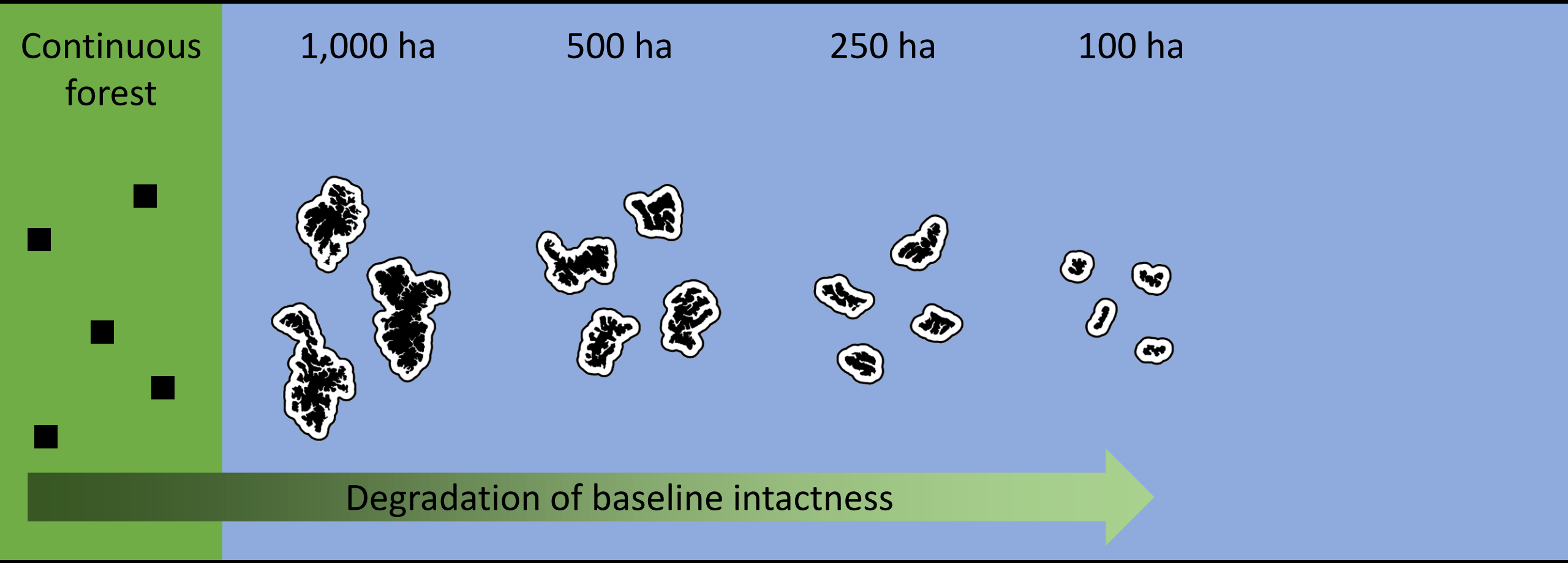
Avifaunal surveys

- 16 mist nets (≈ 200 m)
- July to December
  2015 and 2016
- 2 days per year
- 6am to 3pm
- 576 net-hours per site
- 21,888 net-hours in total
- 2,115 captures
  130 species

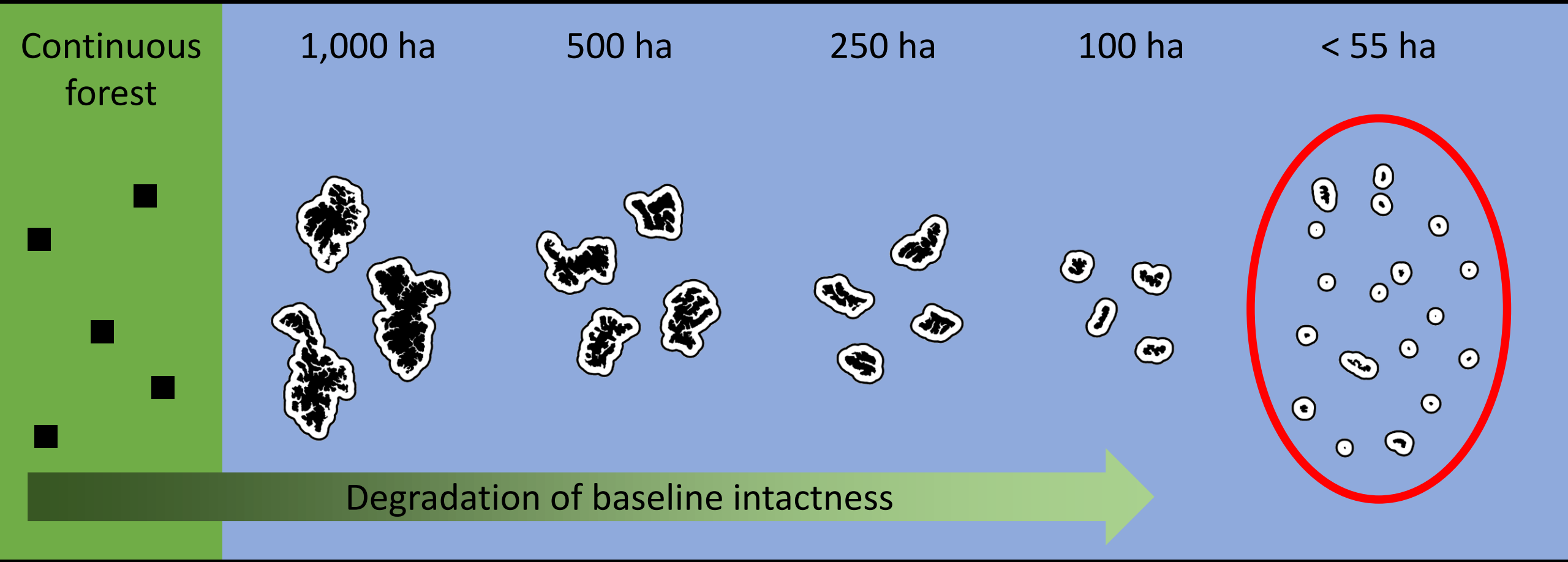
Baseline intactness

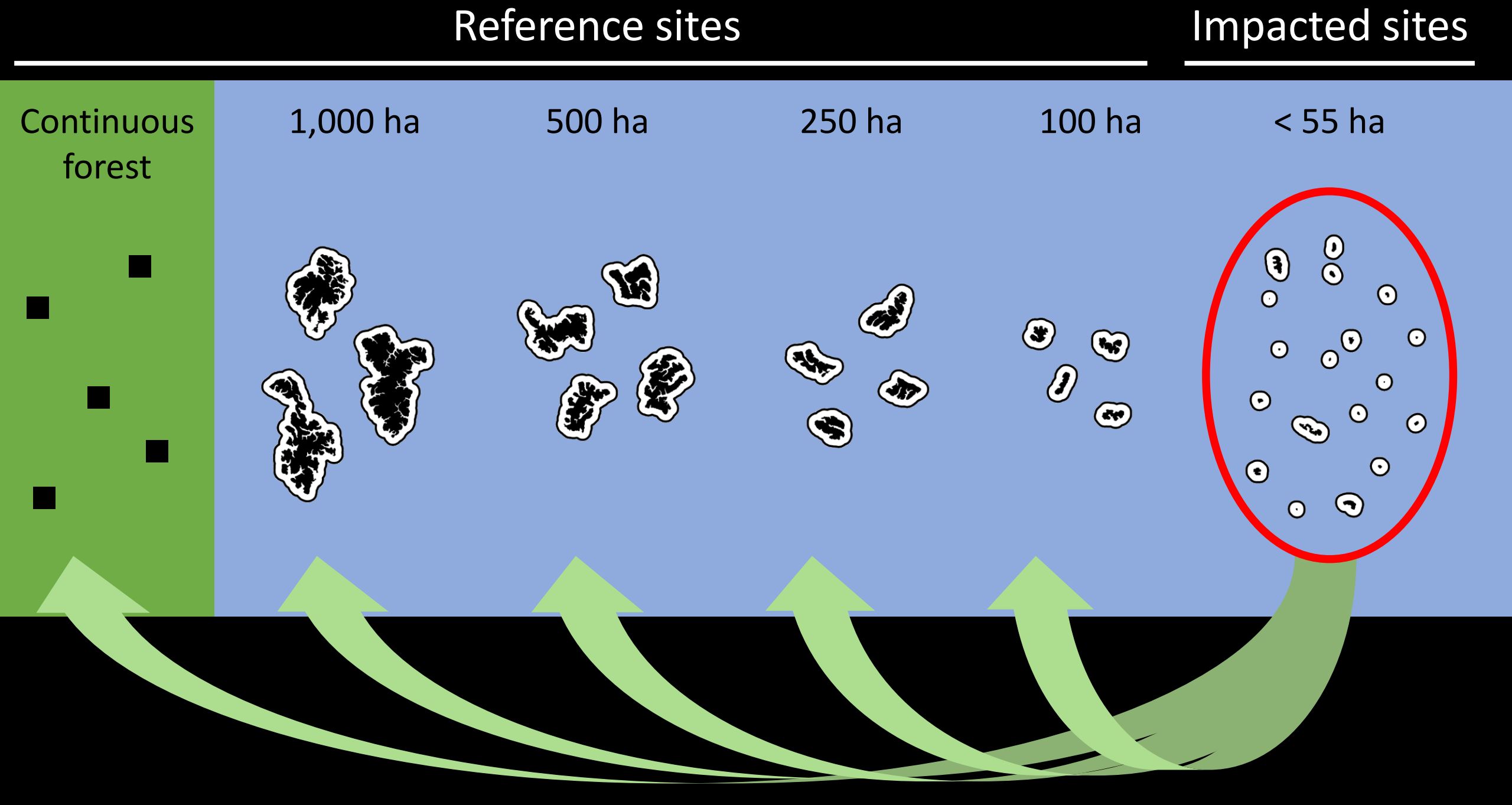


Baseline intactness

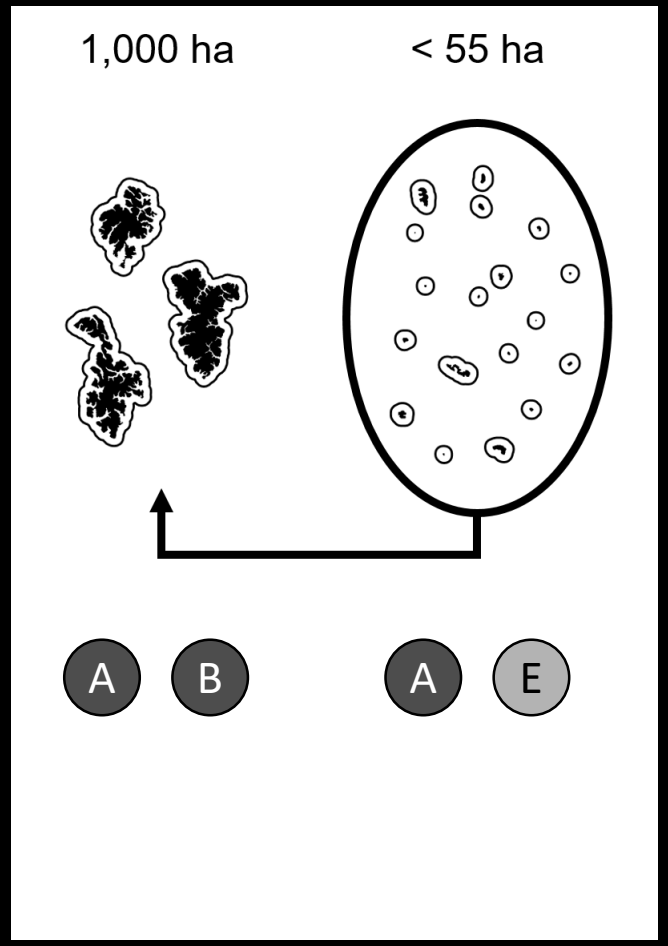


Baseline intactness

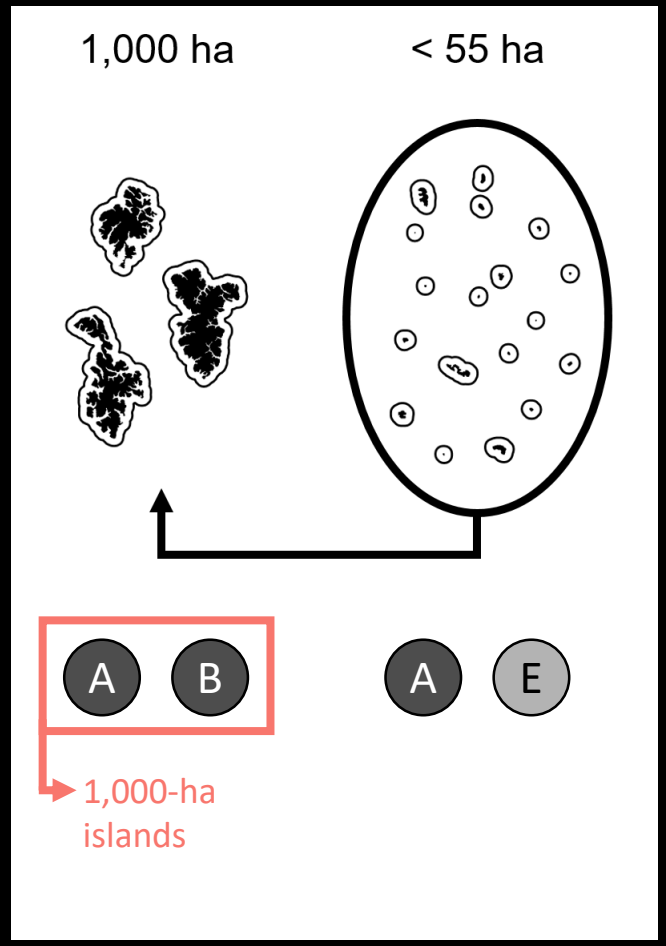



Reference sites
Impacted sites
Continuous forest
1,000 ha
500 ha
250 ha
100 ha
< 55 ha

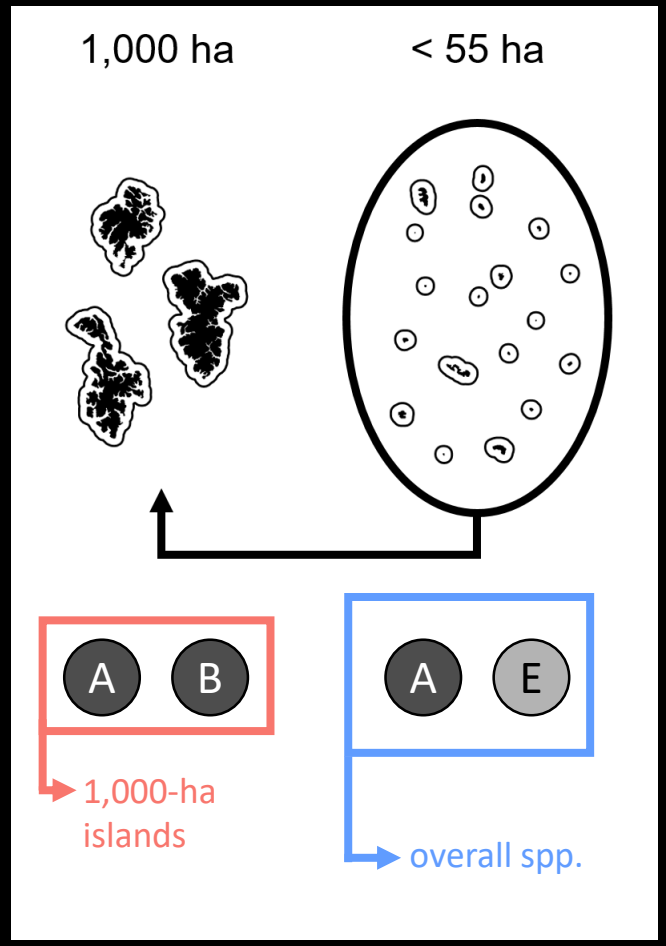
Species richness comparisons



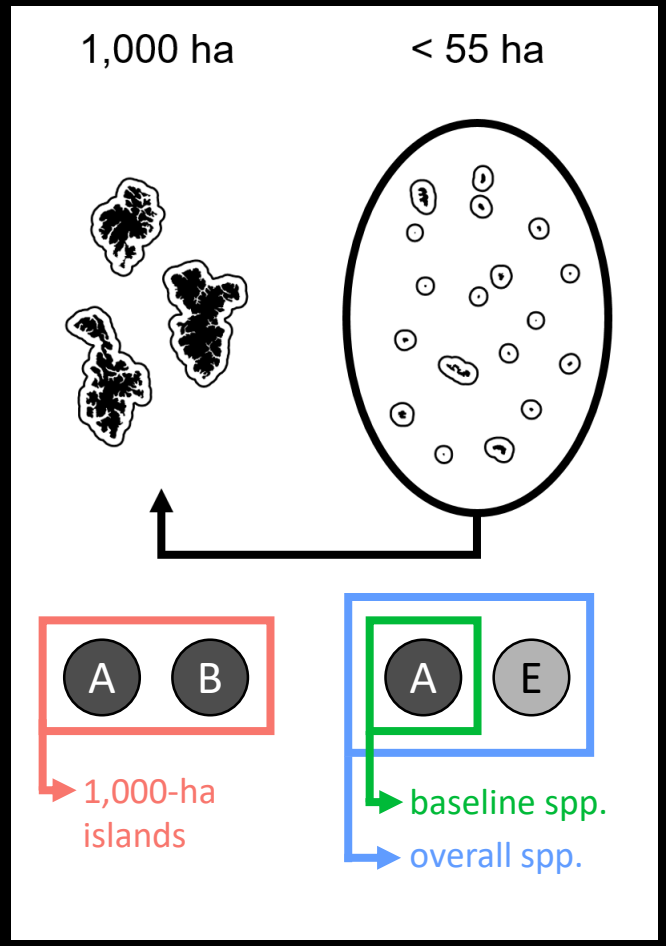
Species richness comparisons



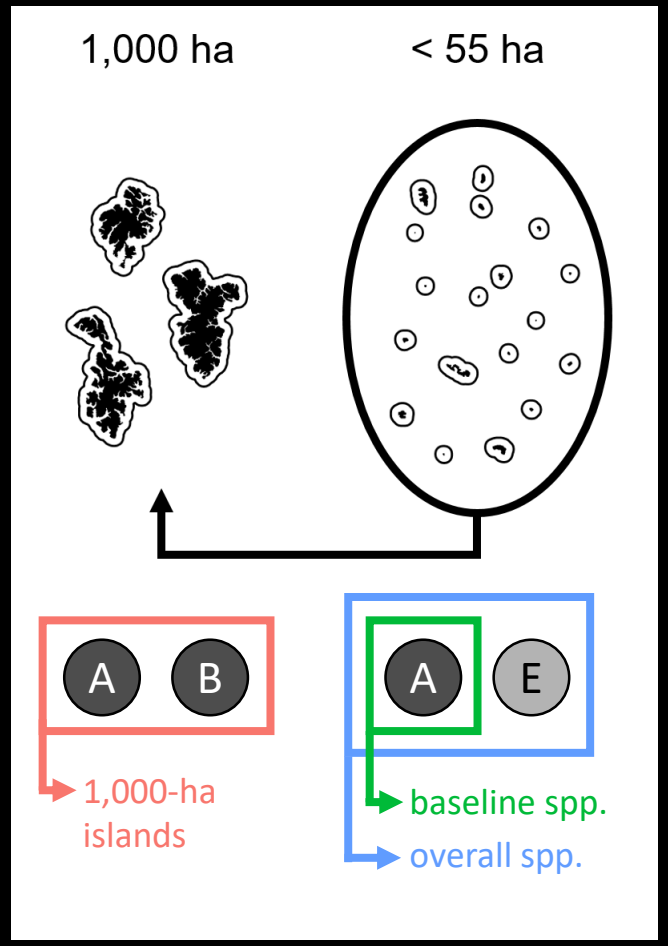
Species richness comparisons

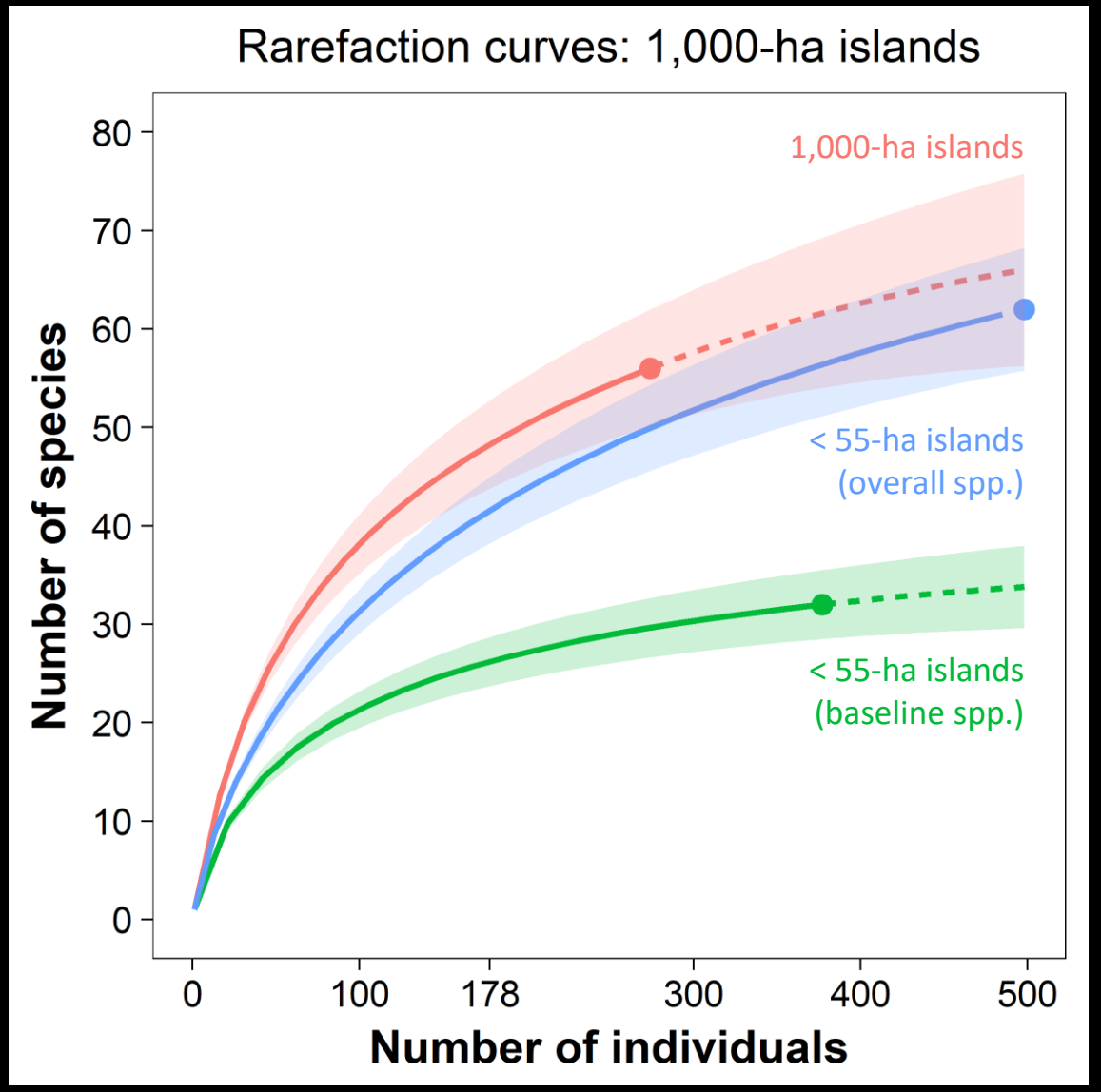


Species richness comparisons

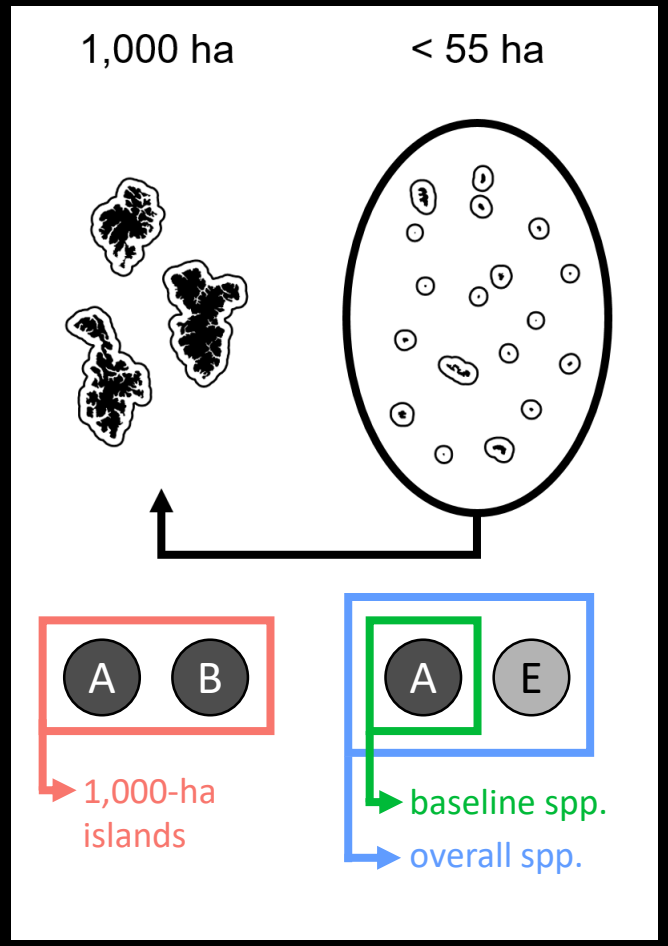


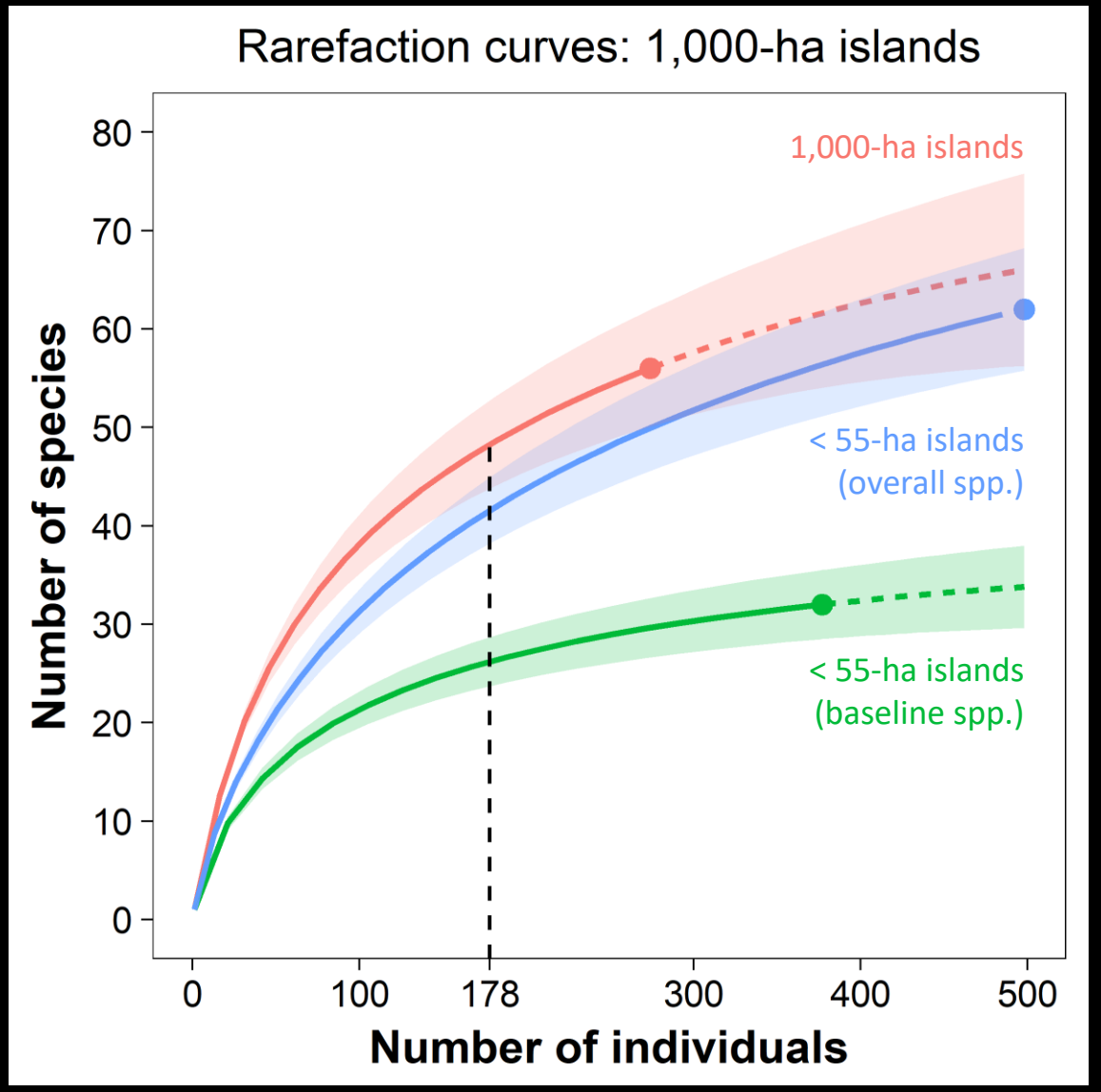
Species richness comparisons



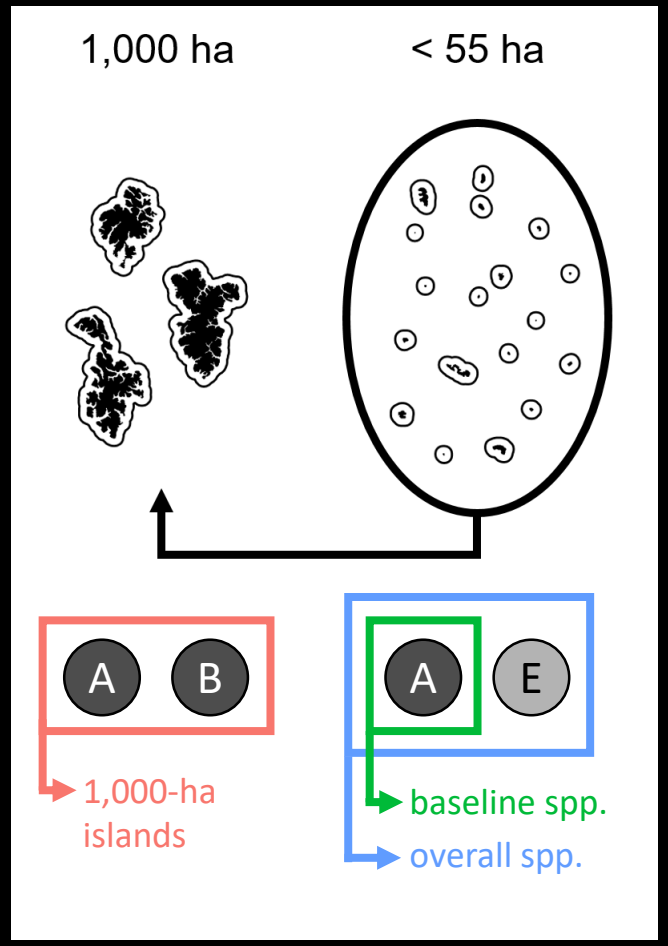


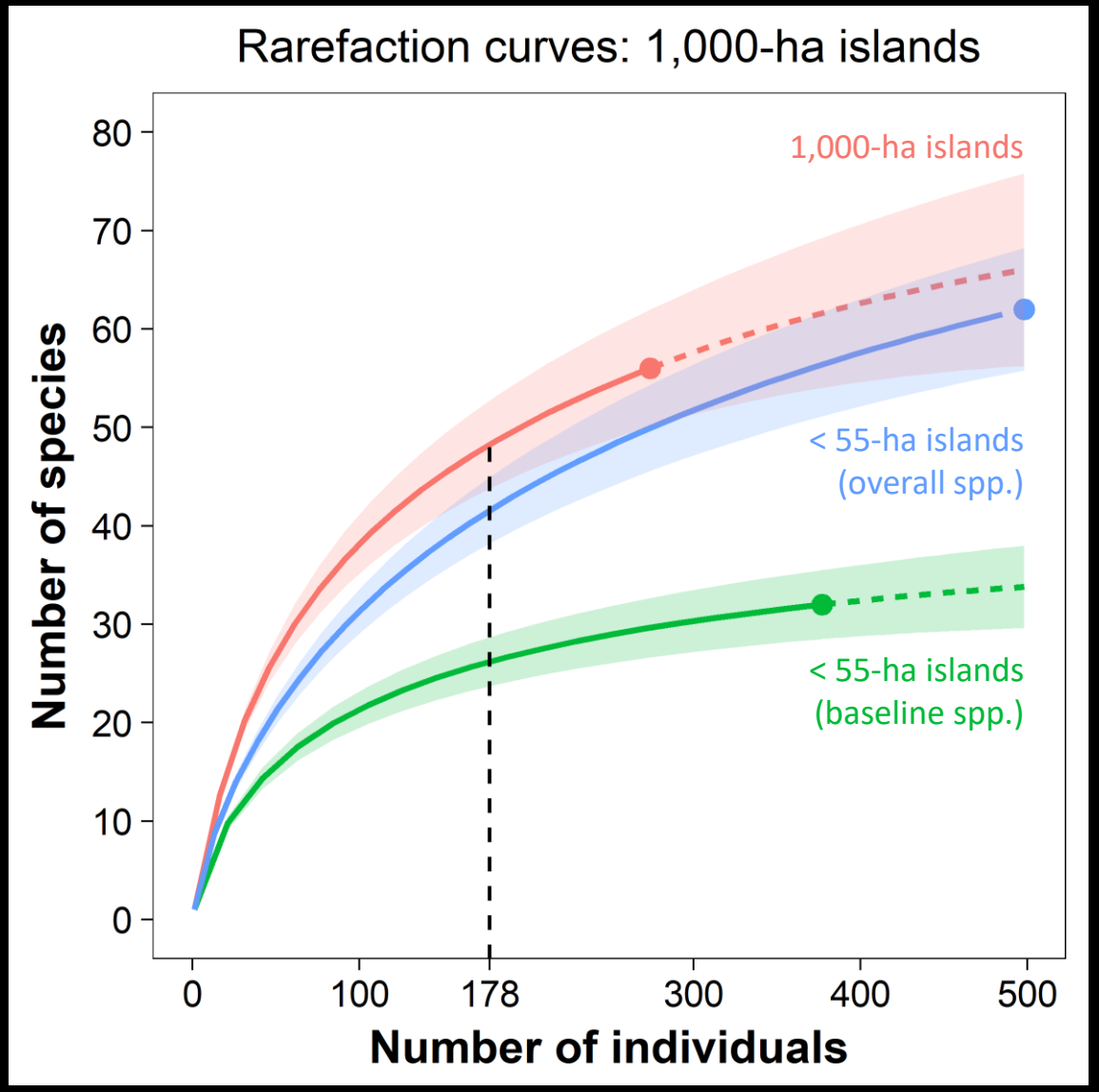
Species richness comparisons

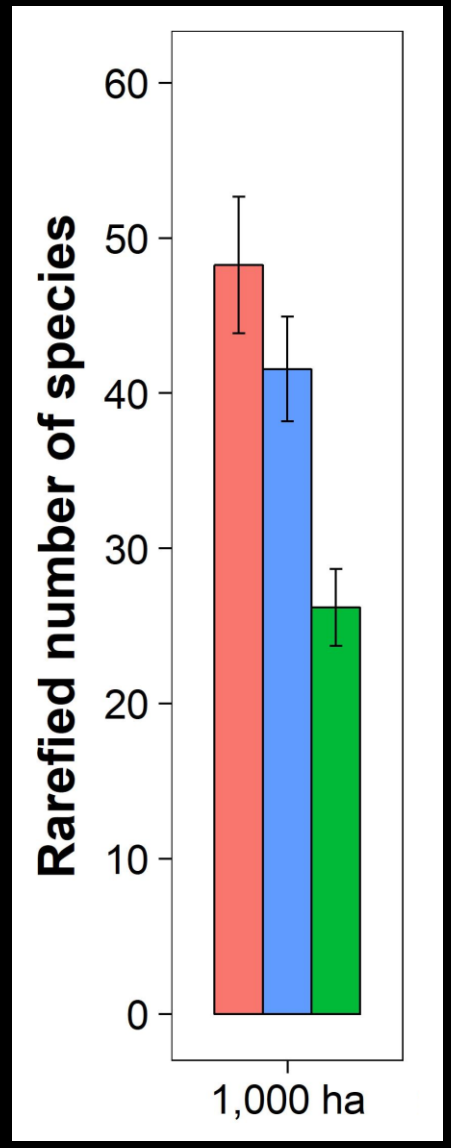




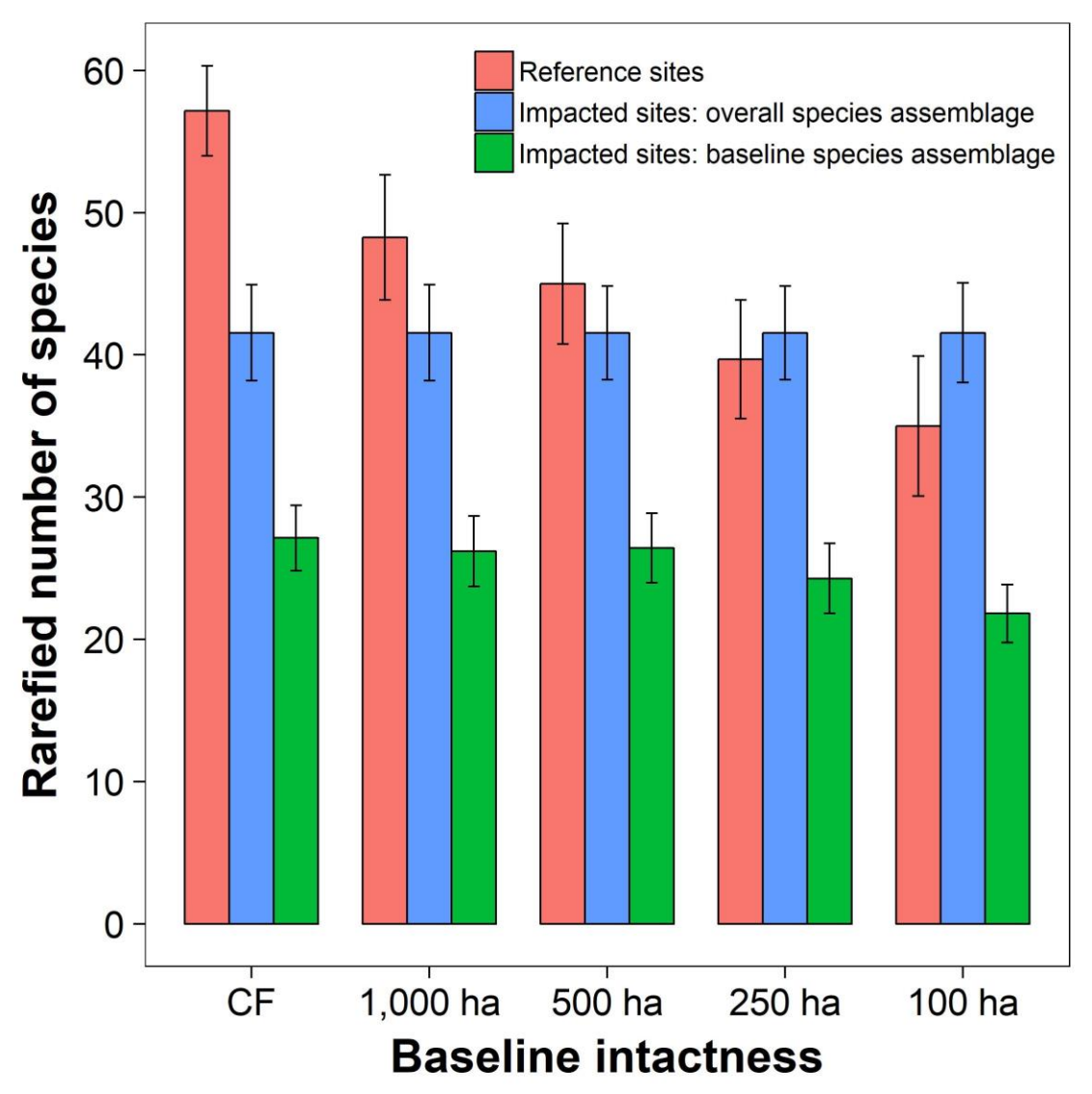
Species richness comparisons



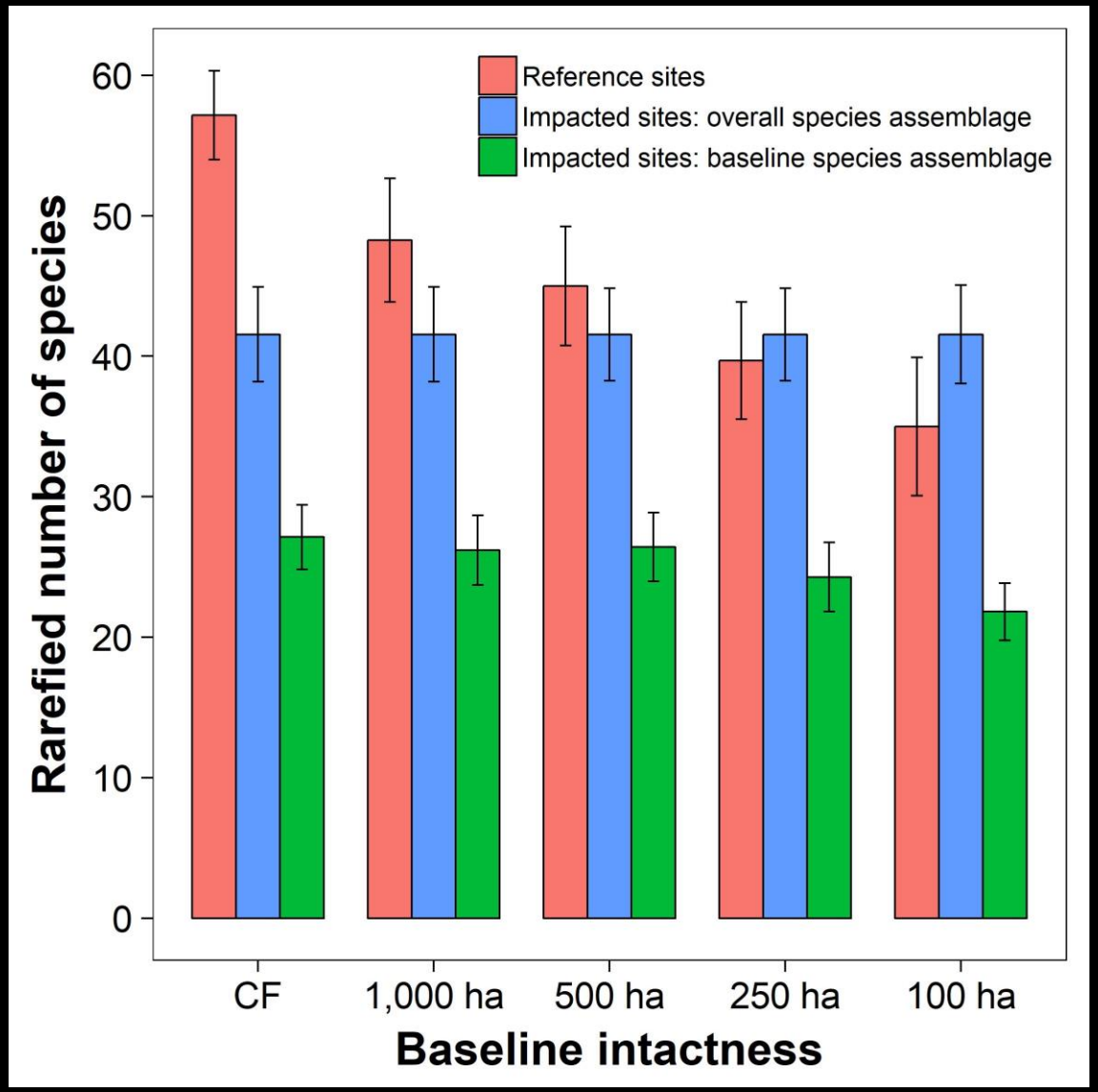


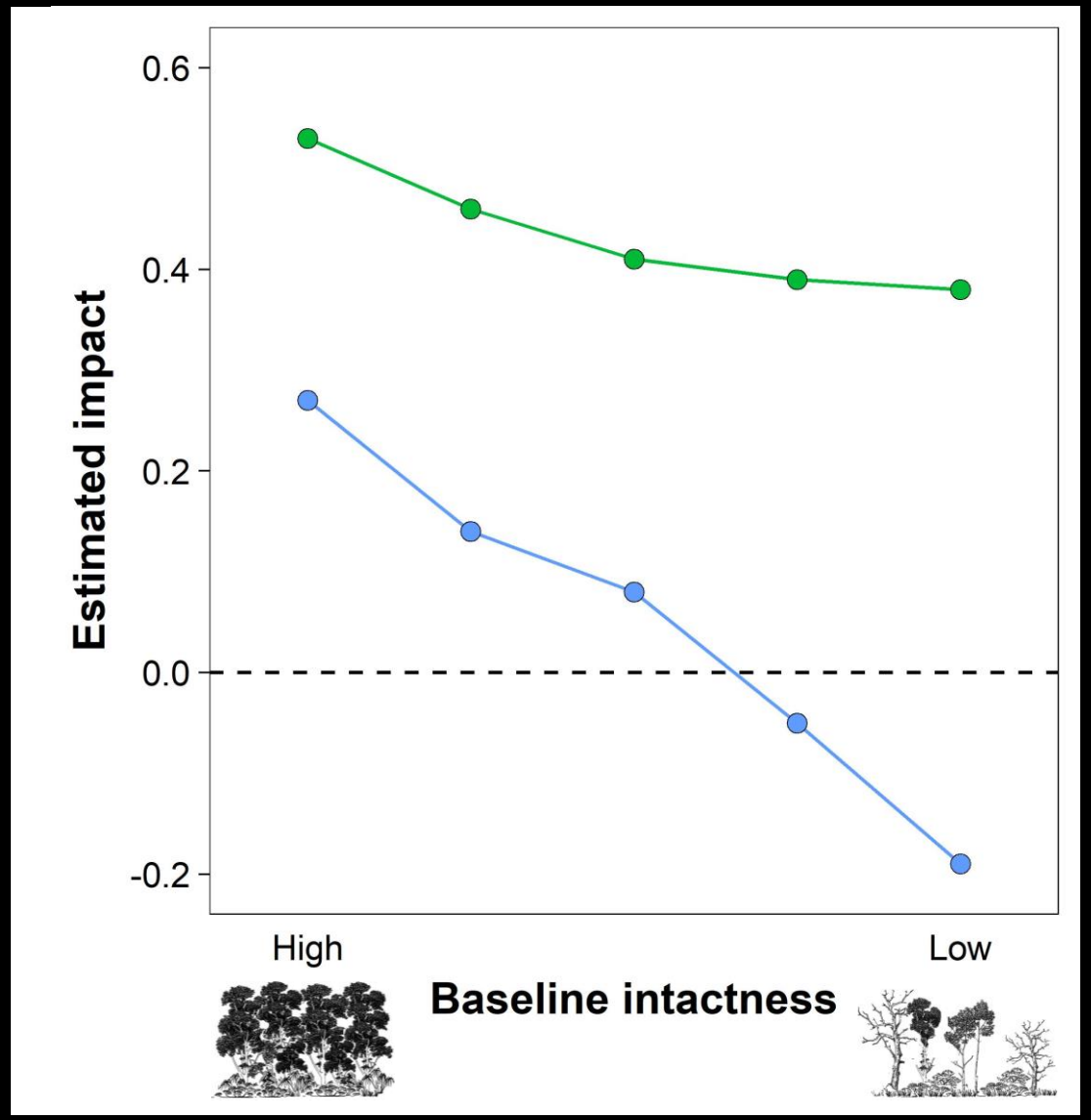


Results

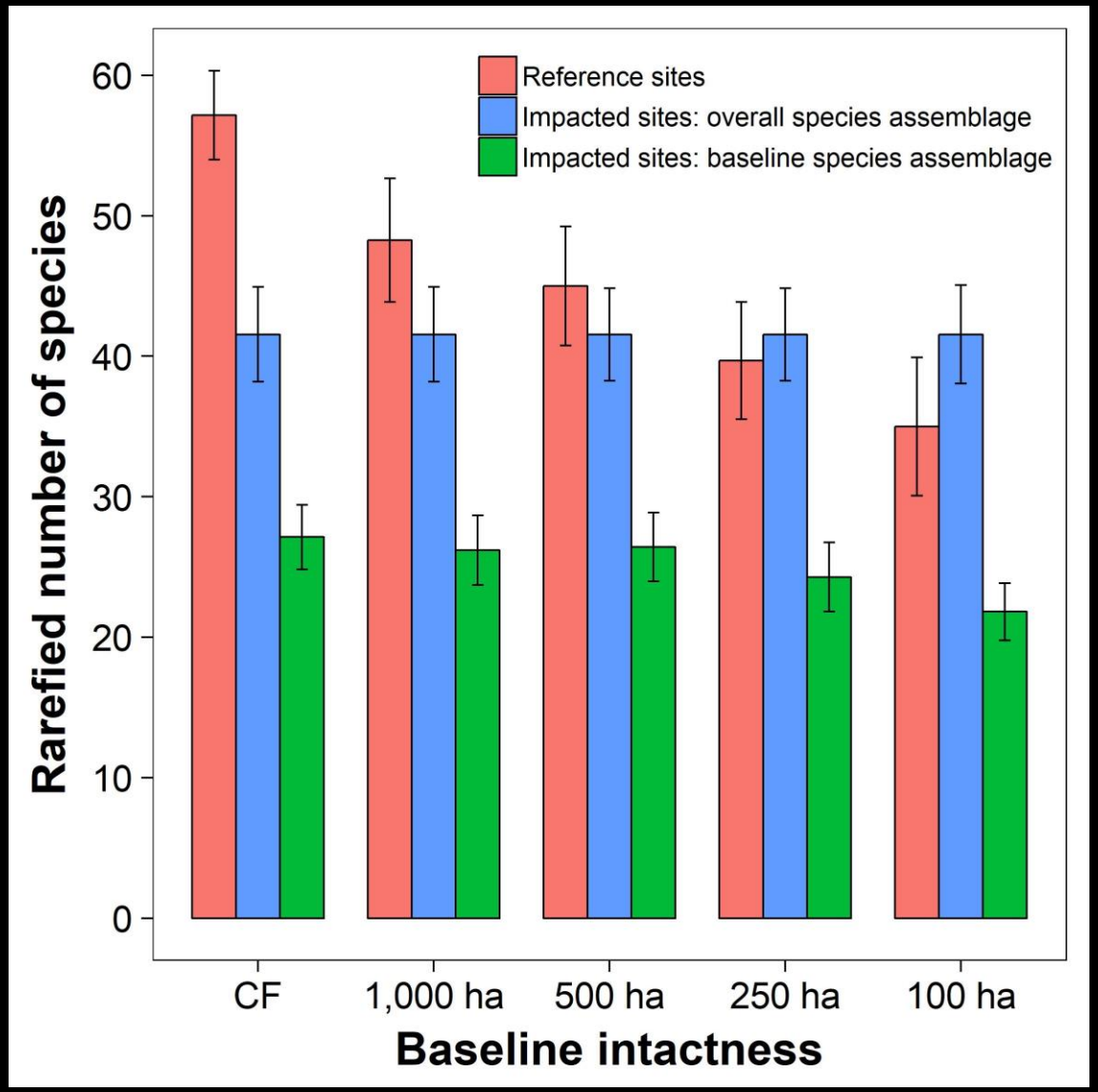

Reference sites
Impacted sites: overall species assemblage
Impacted sites: baseline species assemblage
Rarefied number of species
60
50
40
30
20
10
0
CF
1,000 ha
500 ha
250 ha
100 ha
Baseline intactness

Results


Reference sites
Impacted sites: overall species assemblage
Impacted sites: baseline species assemblage
Rarefied number of species
0
10
20
30
40
50
60
CF
1,000 ha
500 ha
250 ha
100 ha
Baseline intactness


Estimated impact
0.6
0.4
0.2
0.0
-0.2
High
Low
Baseline intactness

Results


Reference sites
Impacted sites: overall species assemblage
Impacted sites: baseline species assemblage
Rarefied number of species
60
50
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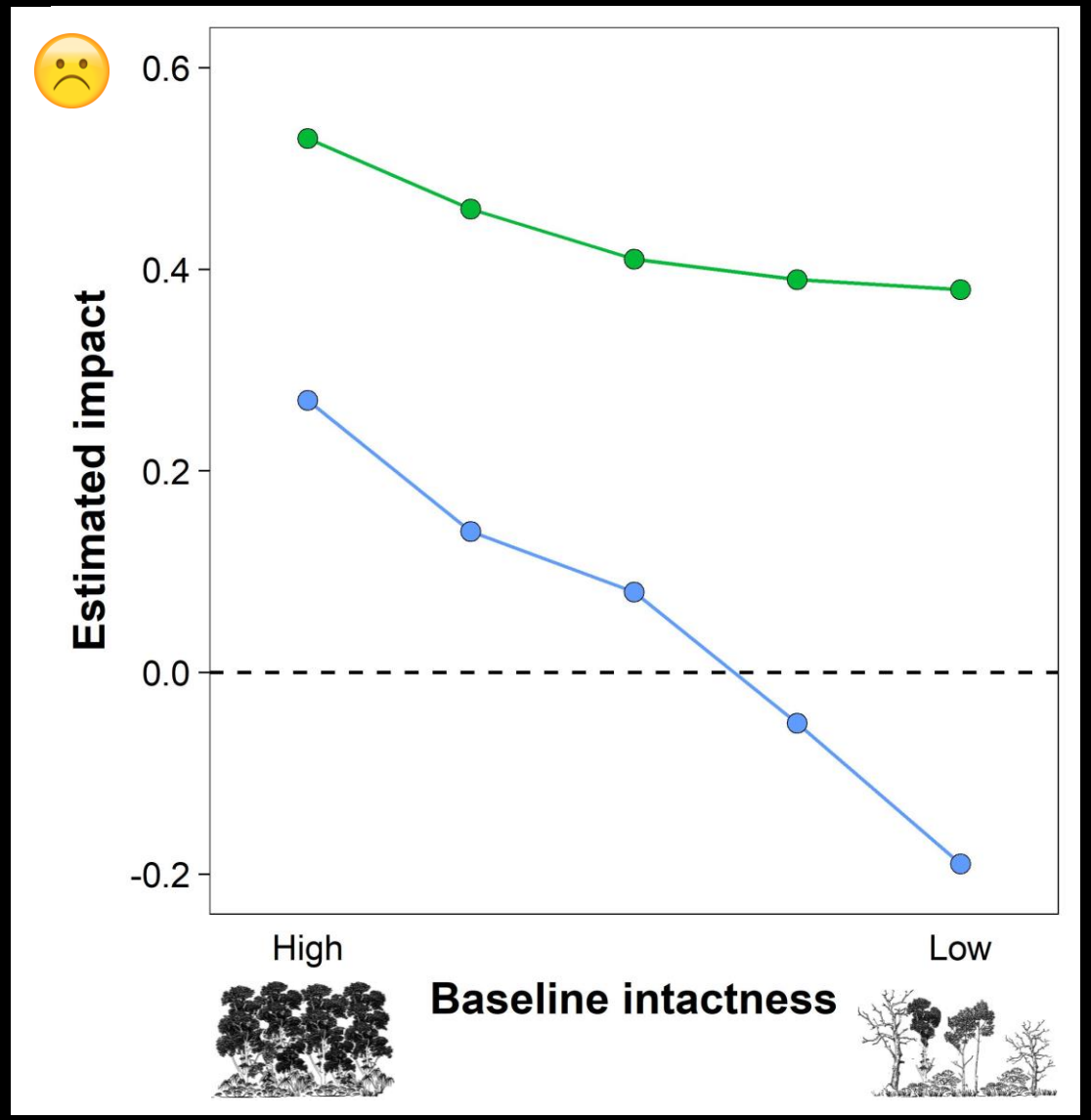
20
10
0
CF
1,000 ha
500 ha
250 ha
100 ha
Baseline intactness


Estimated impact
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0.4
0.2
0.0
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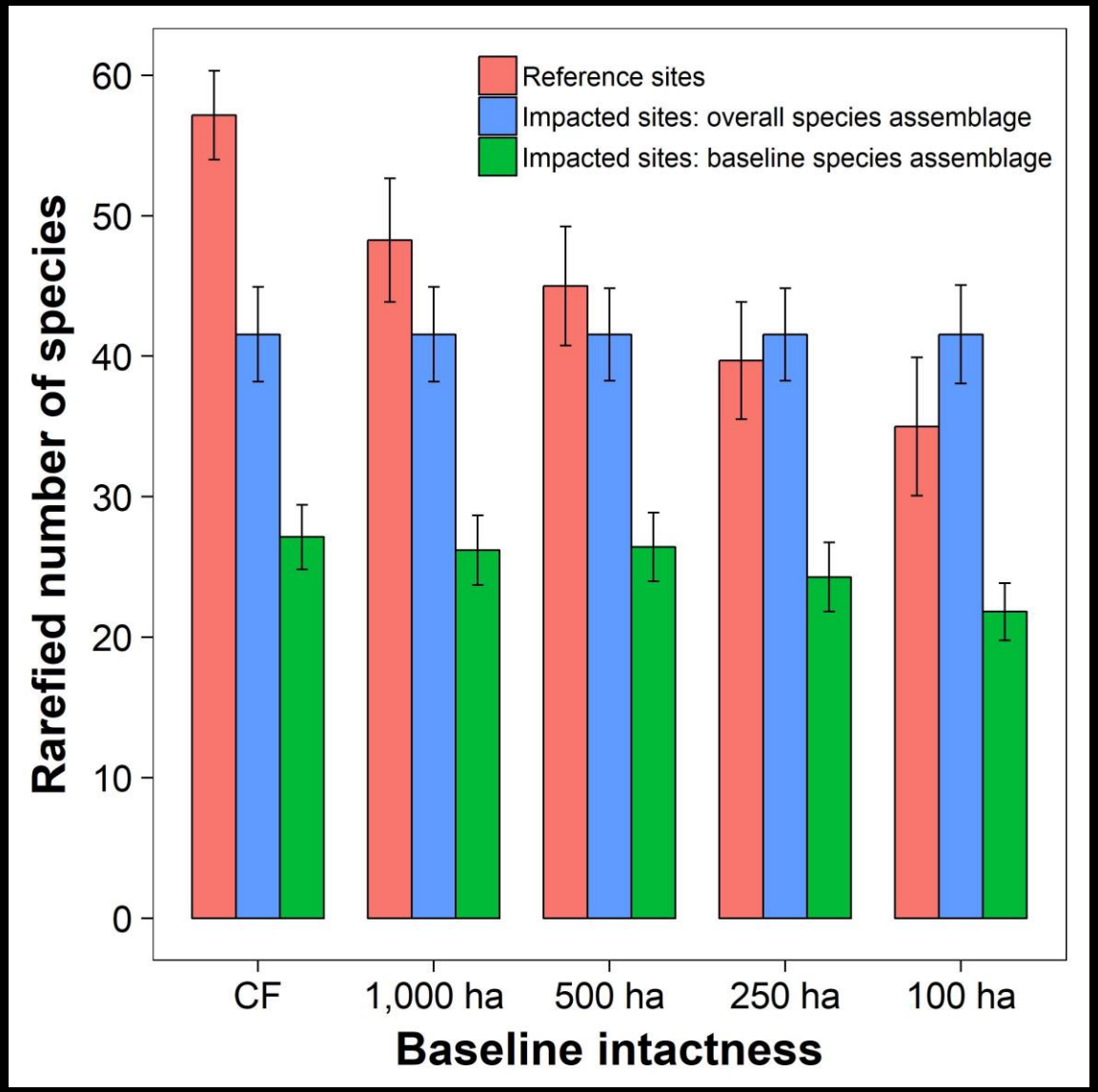
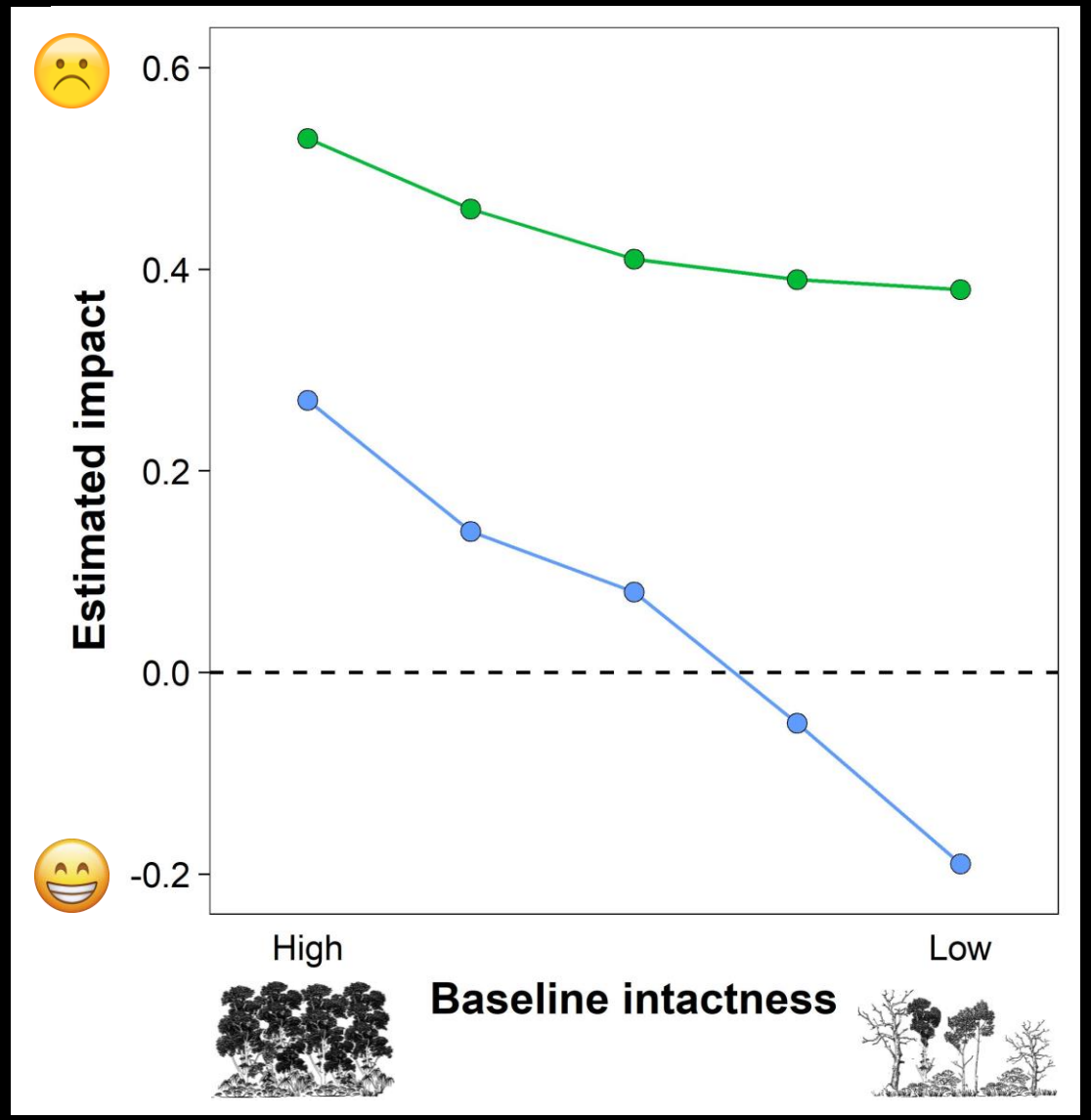
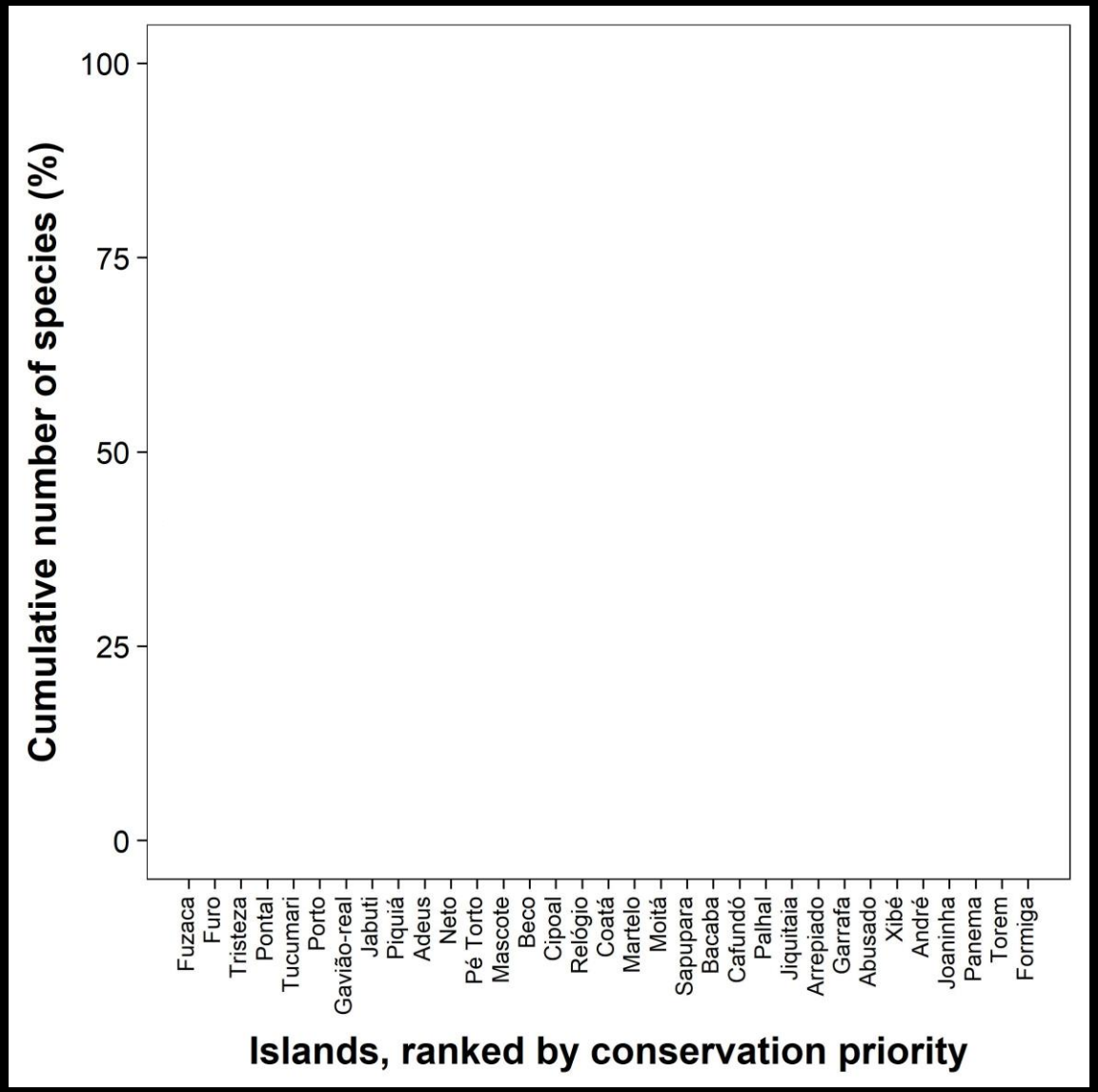
High
Low
Baseline intactness

Results

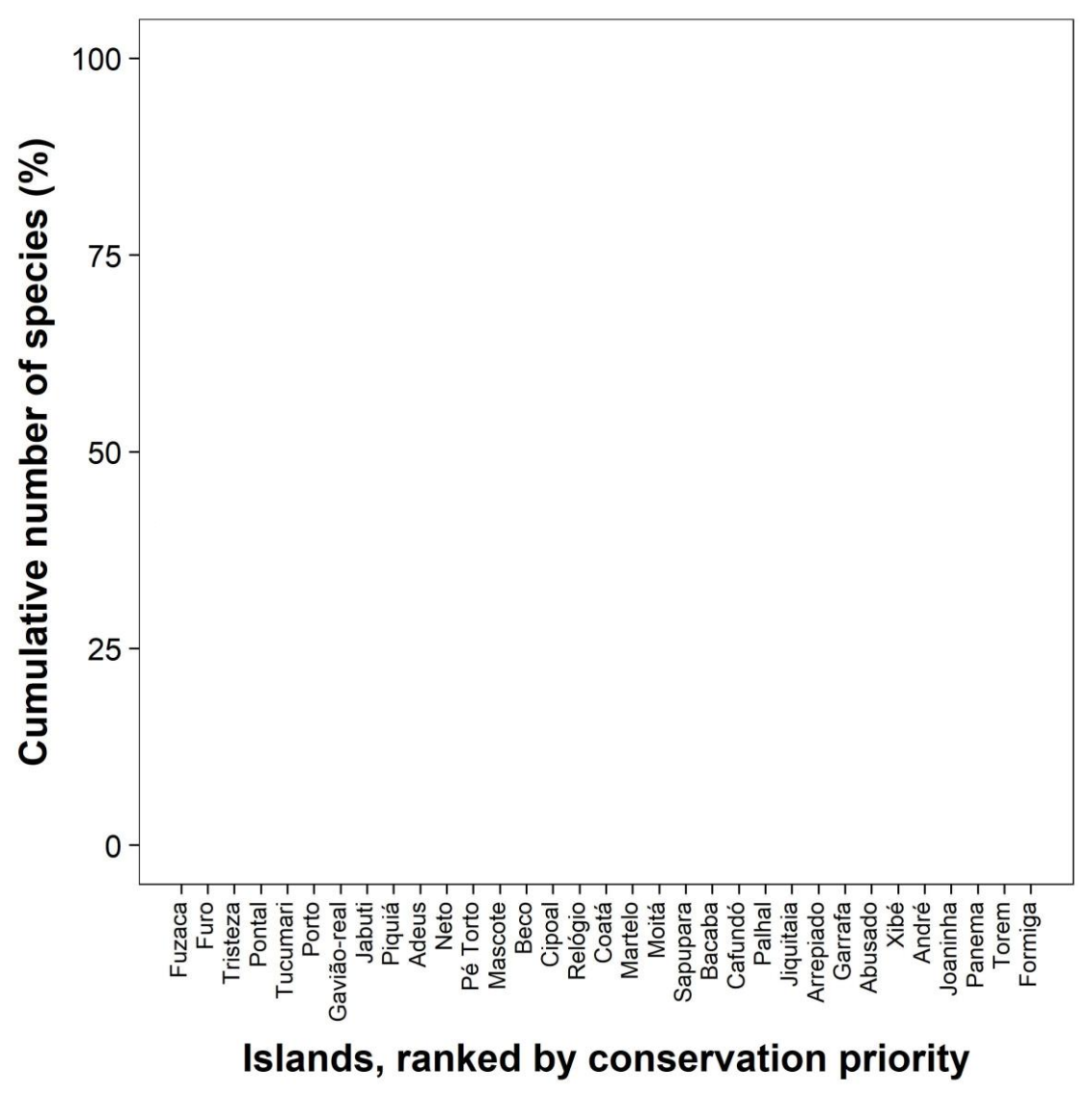

Reference sites
Impacted sites: overall species assemblage
Impacted sites: baseline species assemblage
Rarefied number of species
60
50
40
30
20
10
0
CF
1,000 ha
500 ha
250 ha
100 ha
Baseline intactness


Estimated impact
0.6
0.4
0.2
0.0
-0.2
High
Low
Baseline intactness

Results


Cumulative number of species (%)
100
75
50
25
0
Fuzaca
Furo
Tristeza
Pontal
Tucumari
Porto
Gavião-real
Jabuti
Piquiá
Adeus
Neto
Pé Torto
Mascote
Beco
Cipoal
Relógio
Coatá
Martelo
Moitá
Sapupara
Bacaba
Cafundó
Palhal
Jiquitaia
Arrepiado
Garrafa
Abusado
Xibé
André
Joaninha
Panema
Torem
Formiga
Islands, ranked by conservation priority

Results


Cumulative number of species (%)
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Fuzaca
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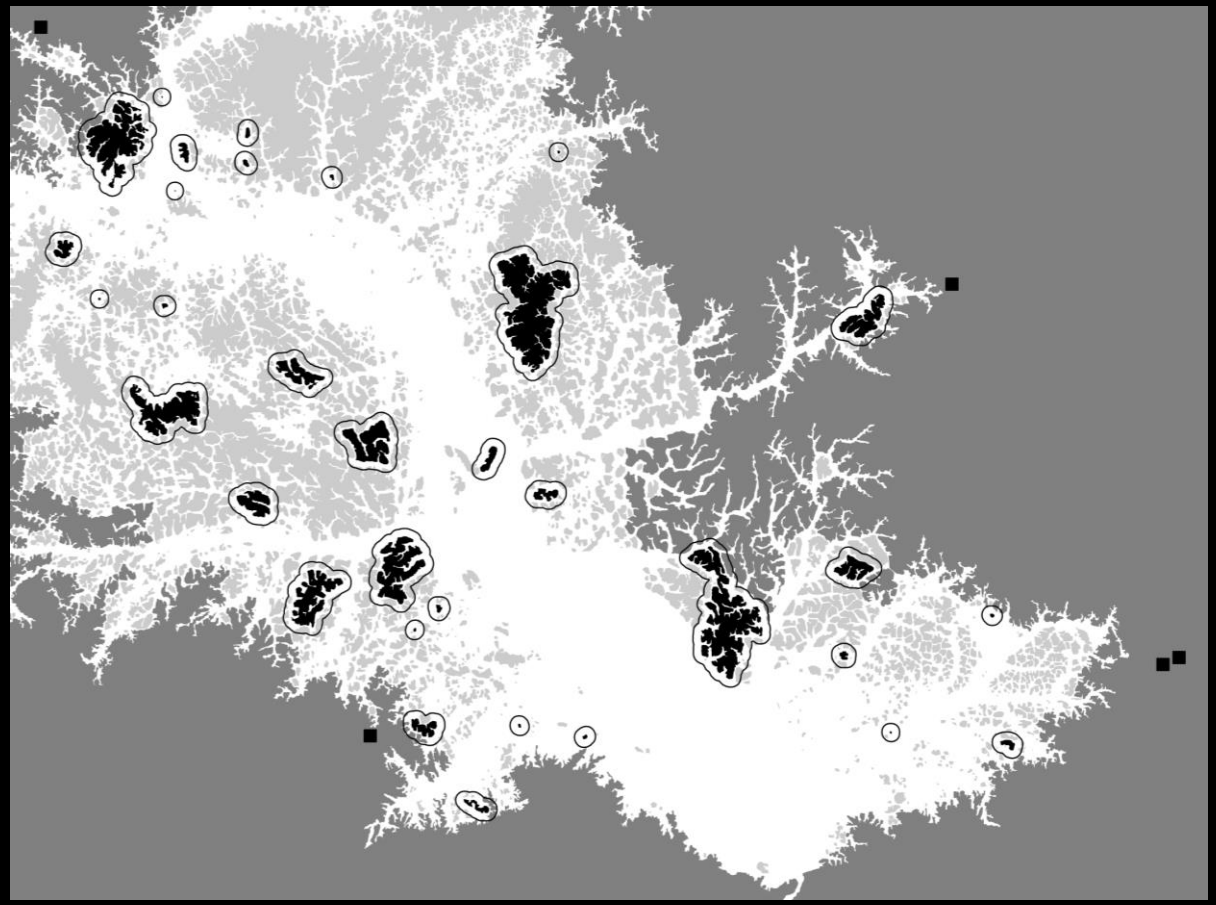
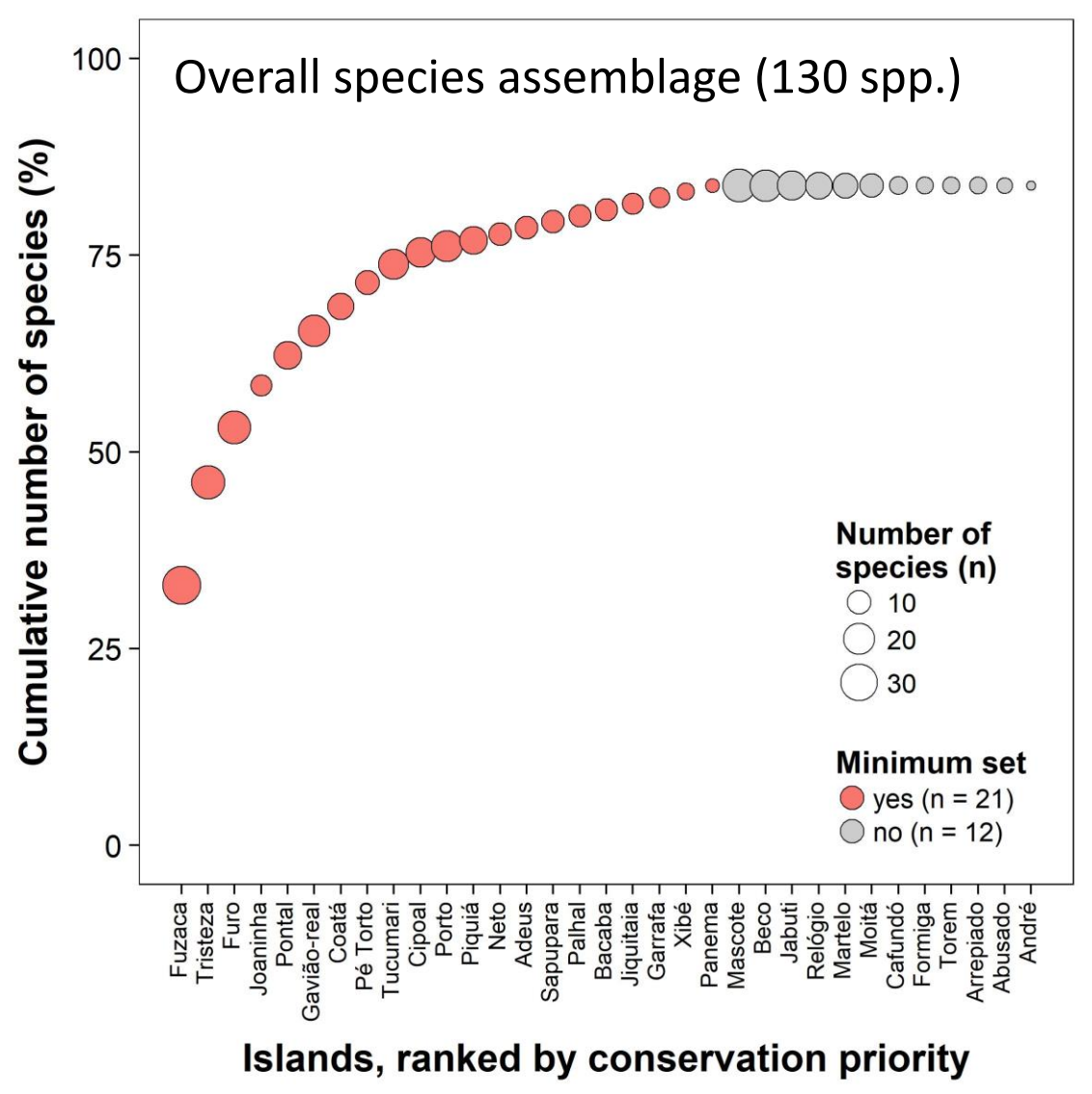
Islands, ranked by conservation priority



Results


Overall species assemblage (130 spp.)
Cumulative number of species (%)
100
75
50
25
0
Number of species (n)
10
20
30
Minimum set
yes (n = 21)
no (n = 12)
Fuzaca
Tristeza
Furo
Joaninha
Pontal
Gavião-real
Coatá
Pé Torto
Tucumari
Cipoal
Porto
Piquiá
Neto
Adeus
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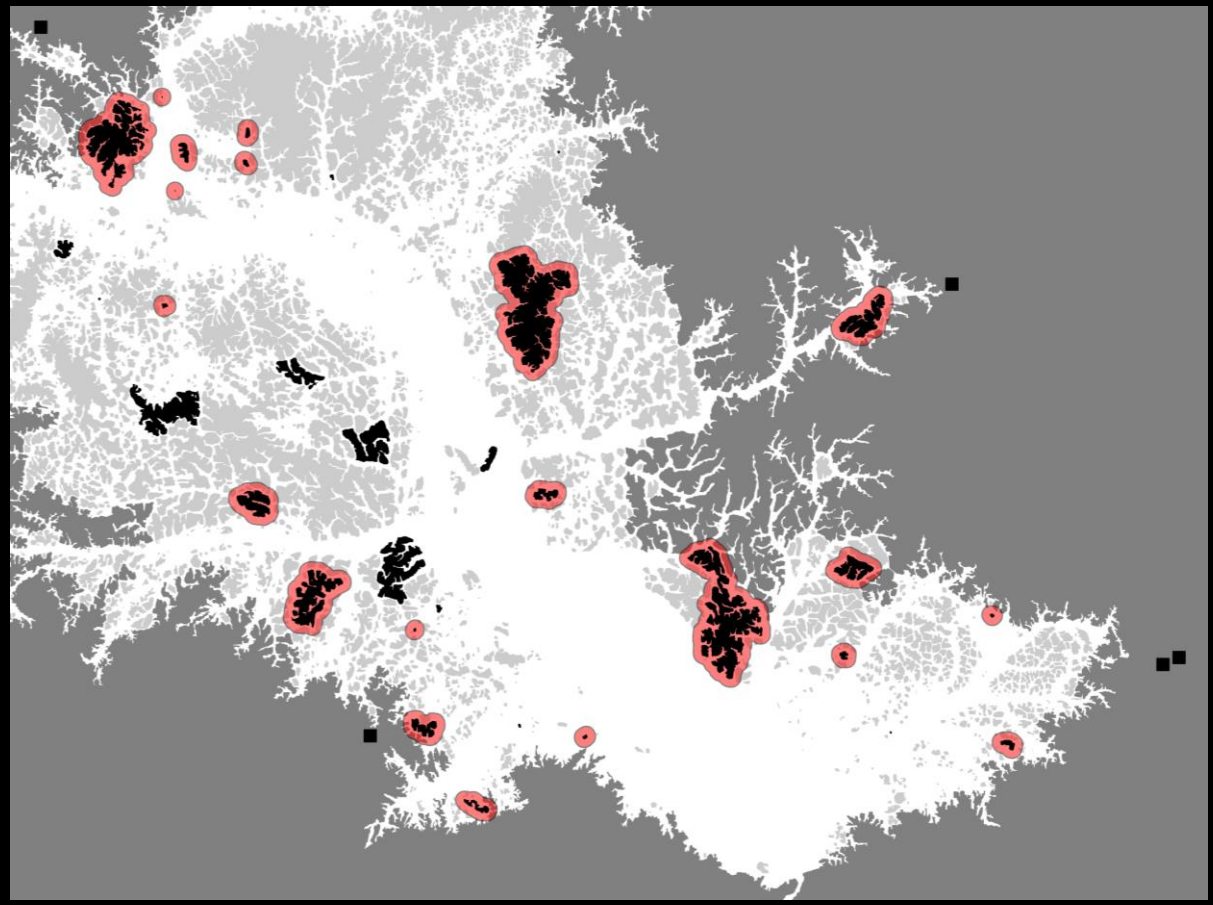
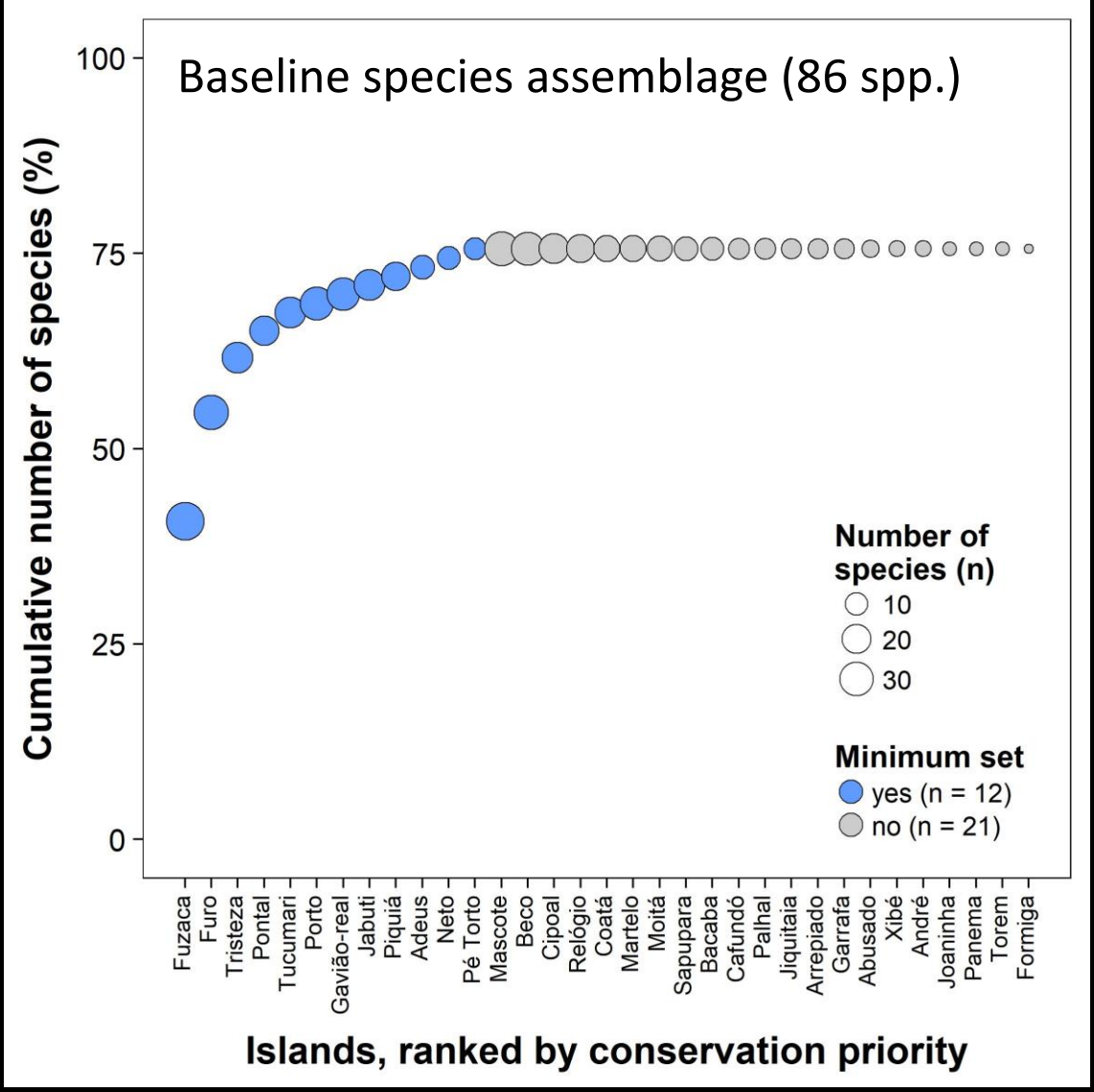
Garrafa
Xibé
Panema
Mascote
Beco
Jabuti
Relógio
Martelo
Moitá
Cafundó
Formiga
Torem
Arrepiado
Abusado
André
Islands, ranked by conservation priority



Results


Baseline species assemblage (86 spp.)
Cumulative number of species (%)
100
75
50
25
0
Number of species (n)
10
20
30
Minimum set
yes (n = 12)
no (n = 21)
Fuzaca
Furo
Tristeza
Pontal
Tucumari
Porto
Gavião-real
Jabuti
Piquiá
Adeus
Neto
Pé Torto
Mascote
Beco
Cipoal
Relógio
Coatá
Martelo
Moitá
Sapupara
Bacaba
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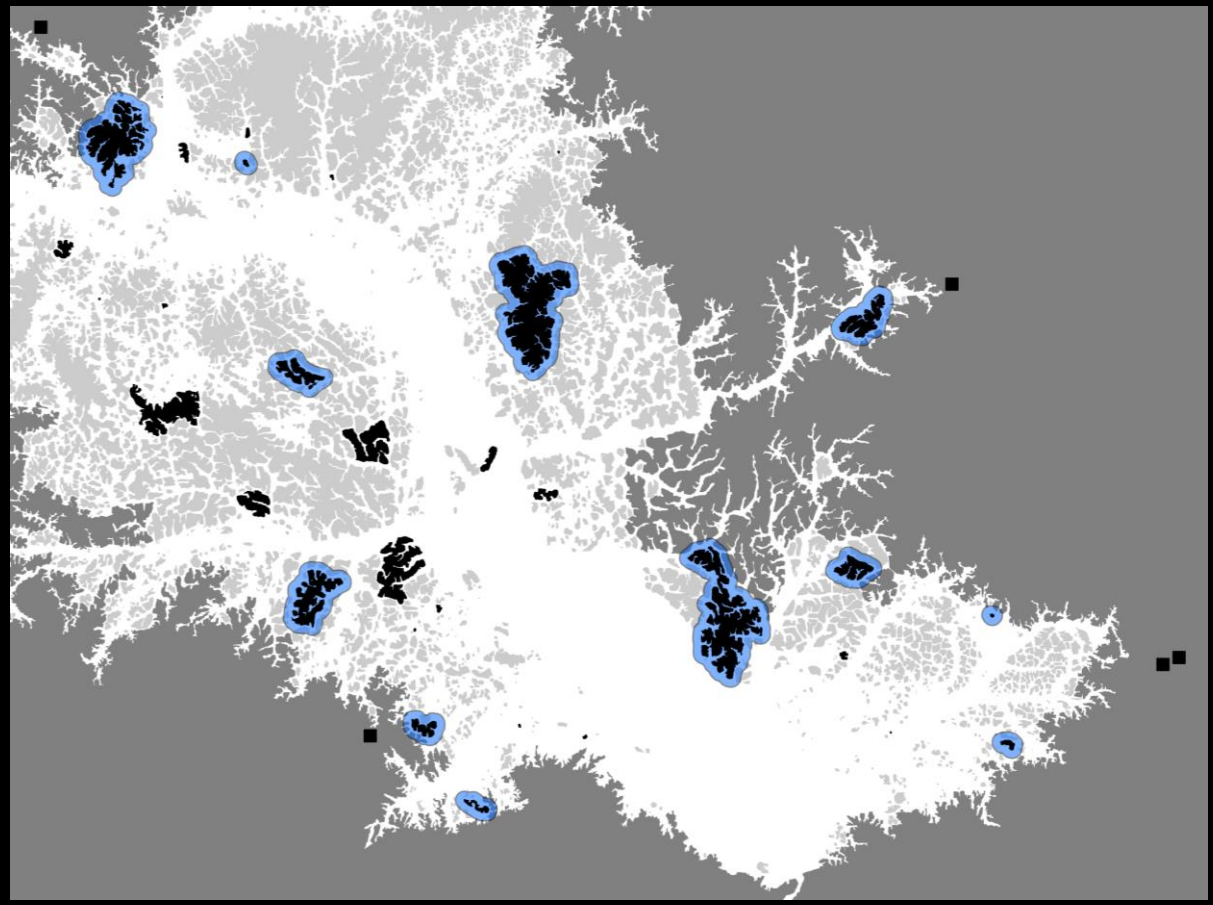
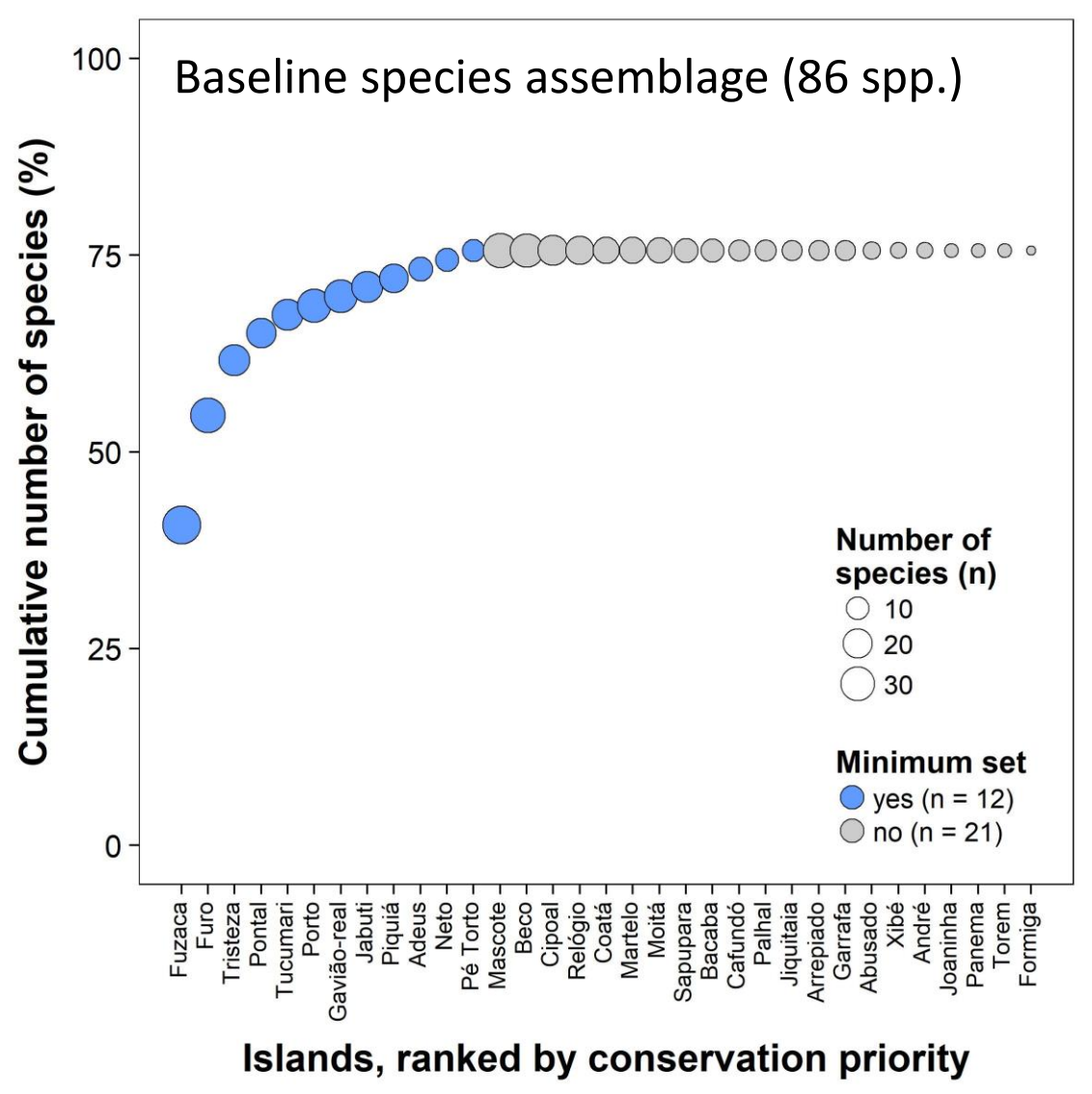
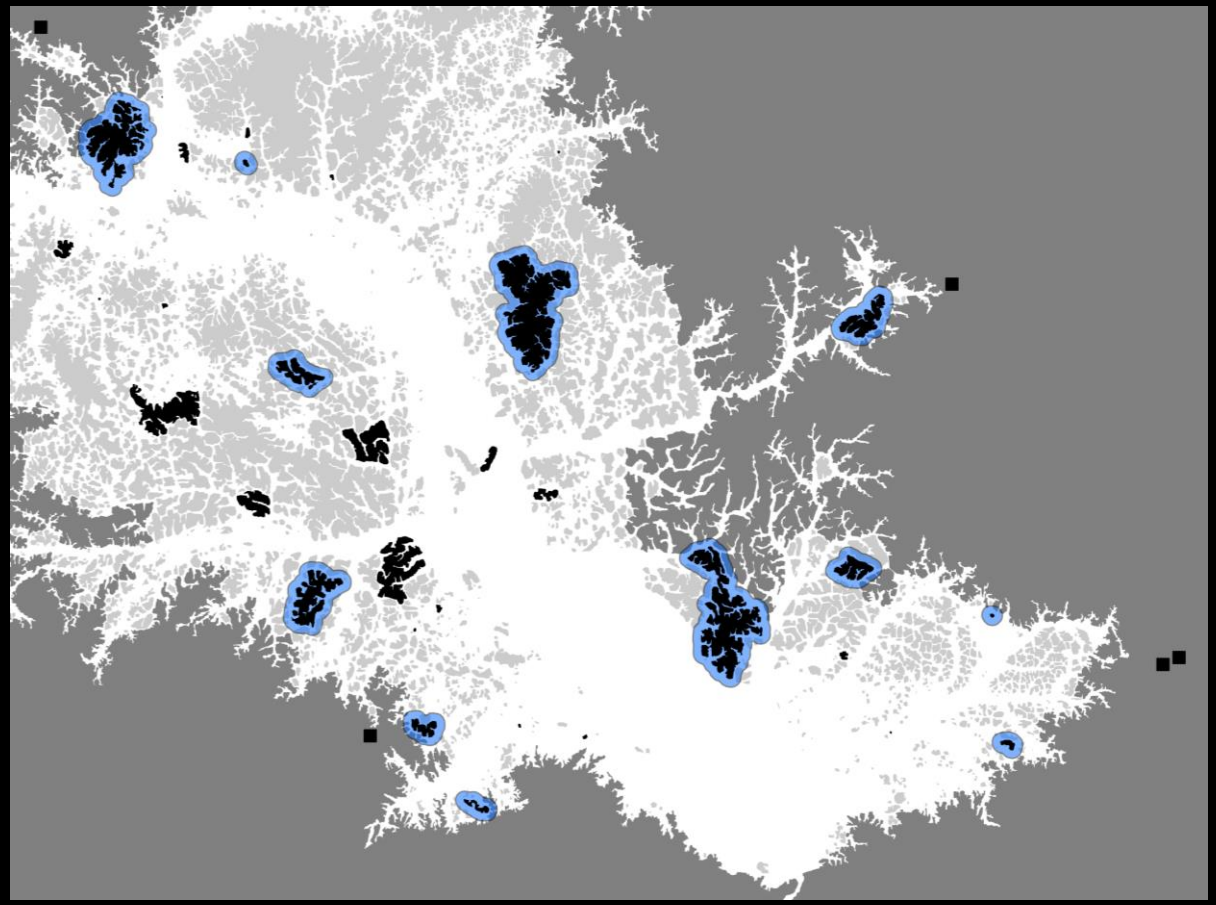
Garrafa
Abusado
Xibé
André
Joaninha
Panema
Torem
Formiga
Islands, ranked by conservation priority



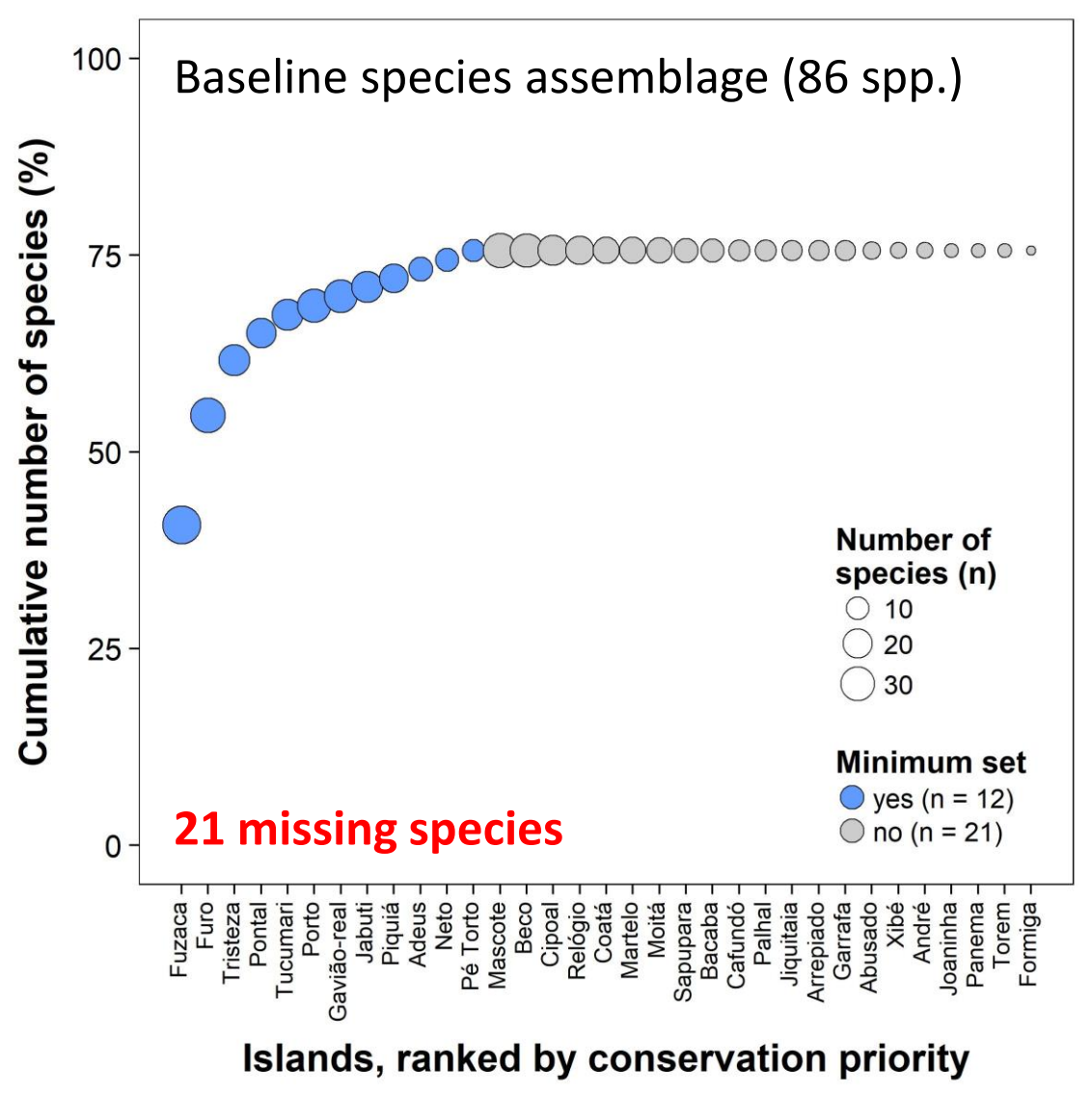
Results

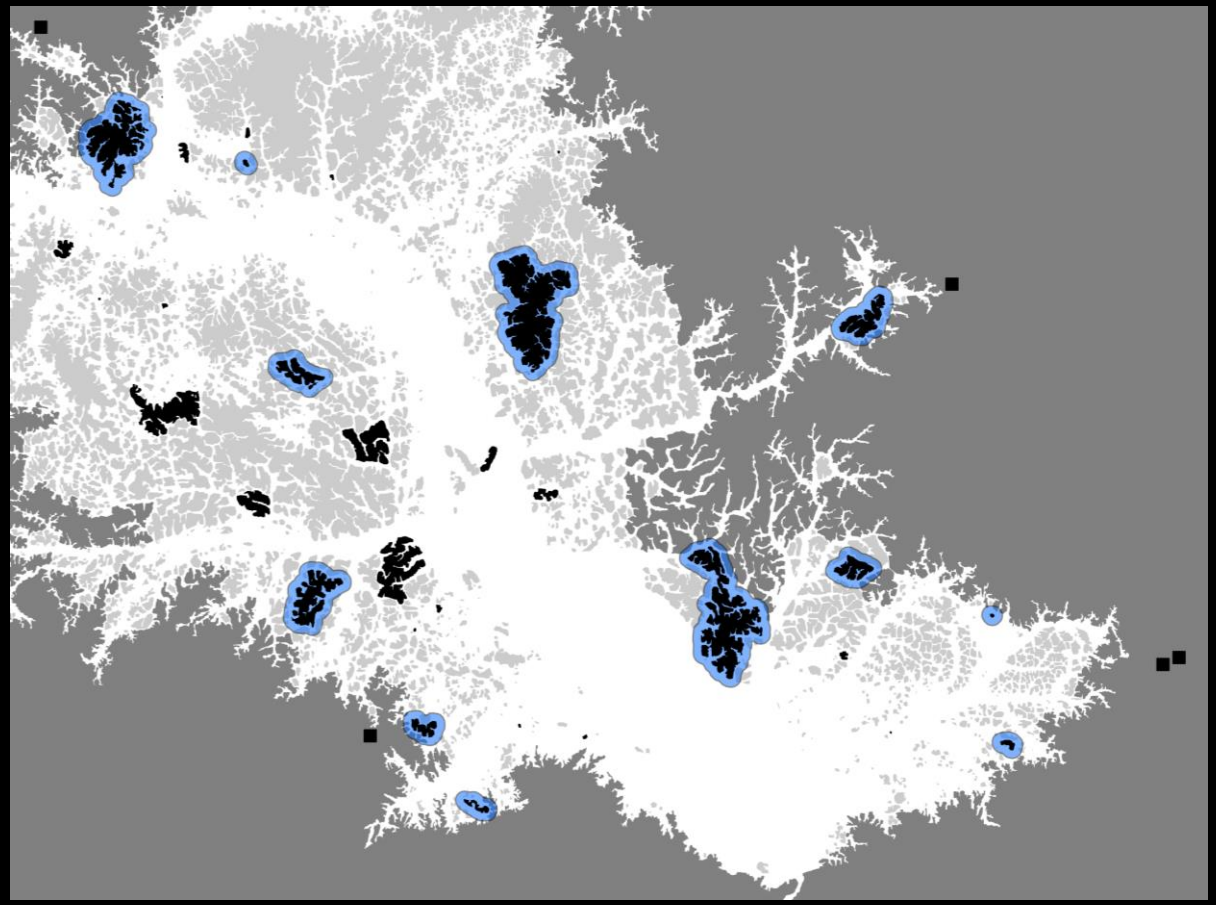




Conservation efforts would be reduced
if focused on the baseline species assemblage

Results





Conservation efforts would be reduced
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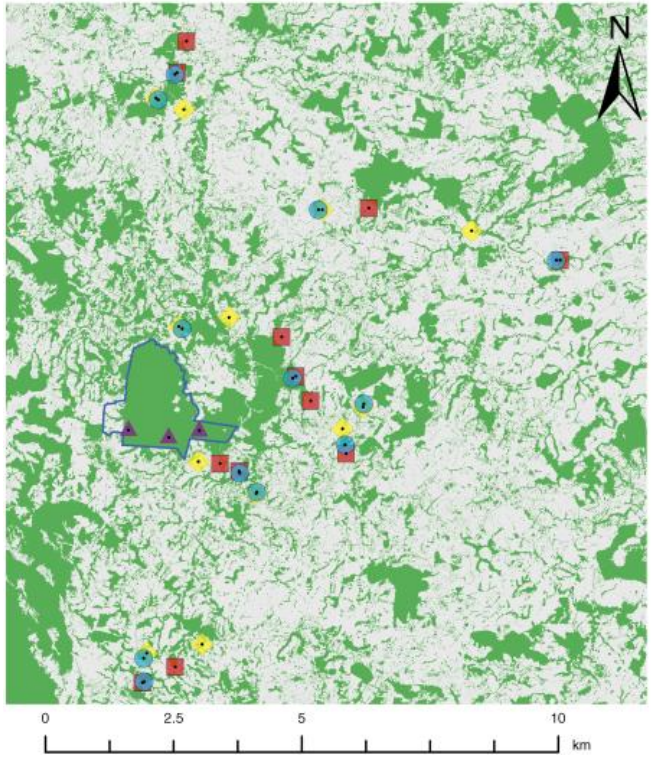
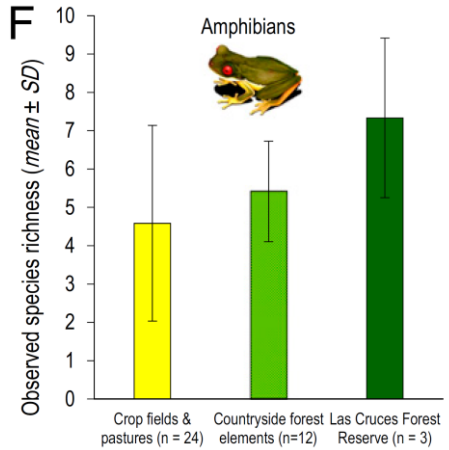
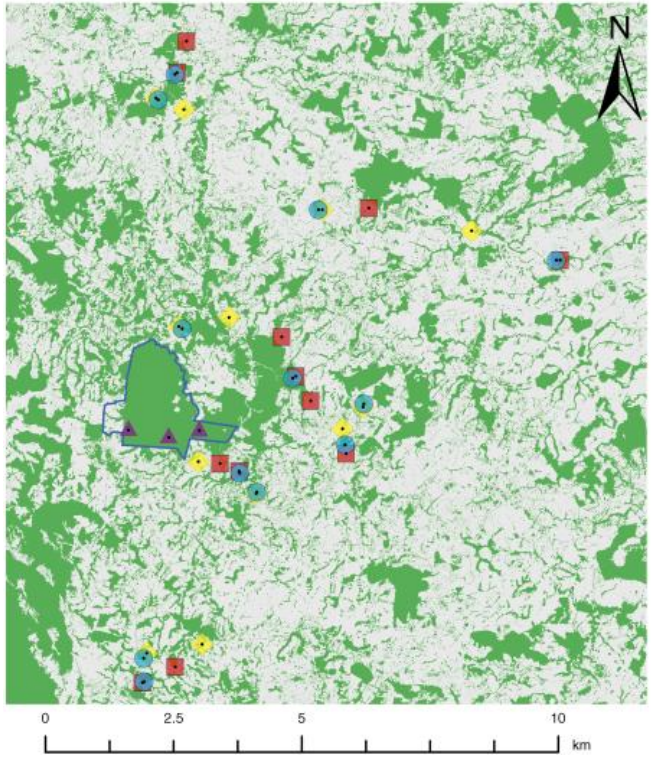
La Cruces, Costa Rica 227 ha





Mendenhall et al. 2016 – PNAS

La Cruces, Costa Rica 227 ha



Jari, Brazil

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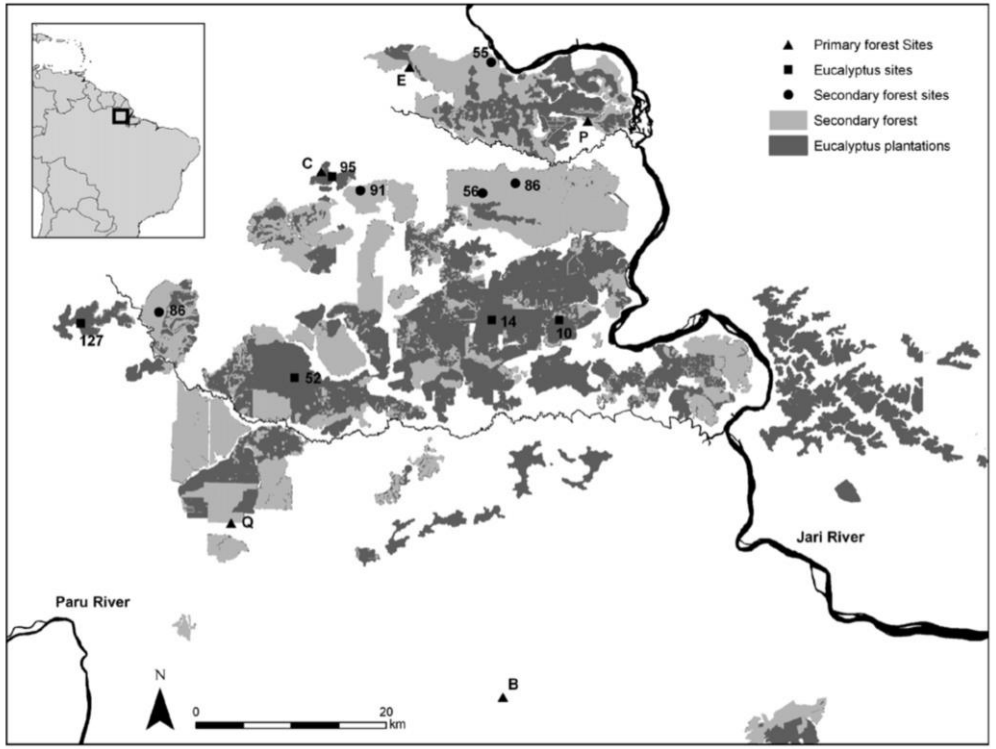

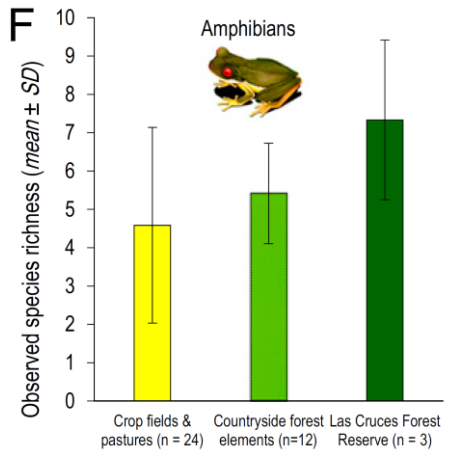

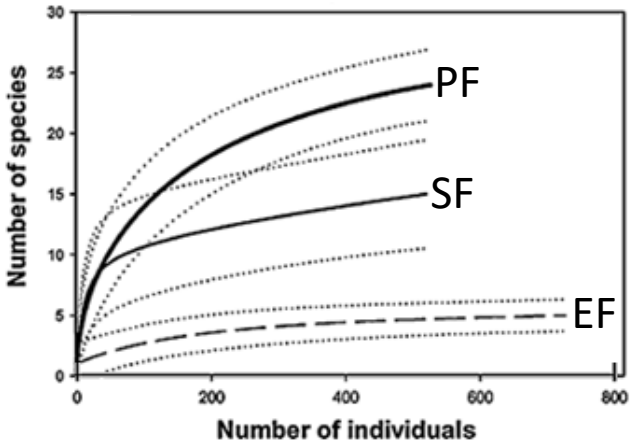

Mendenhall et al. 2016 – PNAS

Gardner et al. 2007 – Conserv. Biol.

If we want to have a sharp picture of the
impacts of land-use change on biodiversity,

we should focus on species assemblages
derived from intact baselines

University of East Anglia

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That's all Folks!