Strategic Habitat Selection

For the reintroduction of the endangered Thick-billed parrot to U.S. National Parks

Can We Save The Parrots?

History

1940s — Driven out of the US due to pet trade, habitat loss and predation

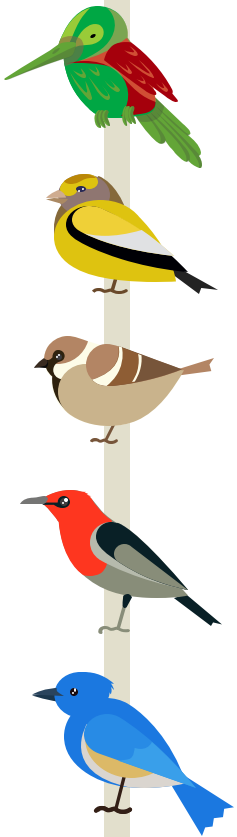
1980s — Failed reintroduction attempt in Arizona Madrean Sky Islands

Present — Endangered; <2,500 parrots mainly in northern Mexico's Sierra Madre Occidental

Only surviving parrot species native to North America

Factors to Consider

Biome	1	Temperate Forests
Temperatures	2	Doesn't mind the cold; sometimes eats snow as a water source
Food Sources	3	Mainly seeds from various pine species
Predators	4	Humans, hawks, owls, snakes
Elevation	5	4,000 to 12,000 feet to avoid predators



Challenge of Data Collection

Food Sources

46 foods that the Thick-billed parrot can feed on

Predators

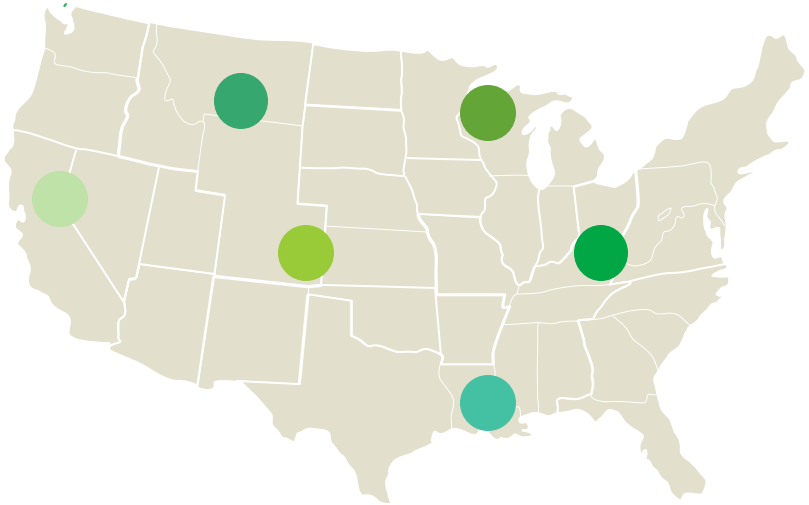
56 species that can hunt the Thick-billed parrot

Temperature

Monthly average and yearly min - max

56 US National Parks

No integrated data source



Biome

Elevation Range

Total Park Area

Integer Optimization Modelling

Maximize Habitat Suitability to Reintroduce the Thick-Billed Parrot

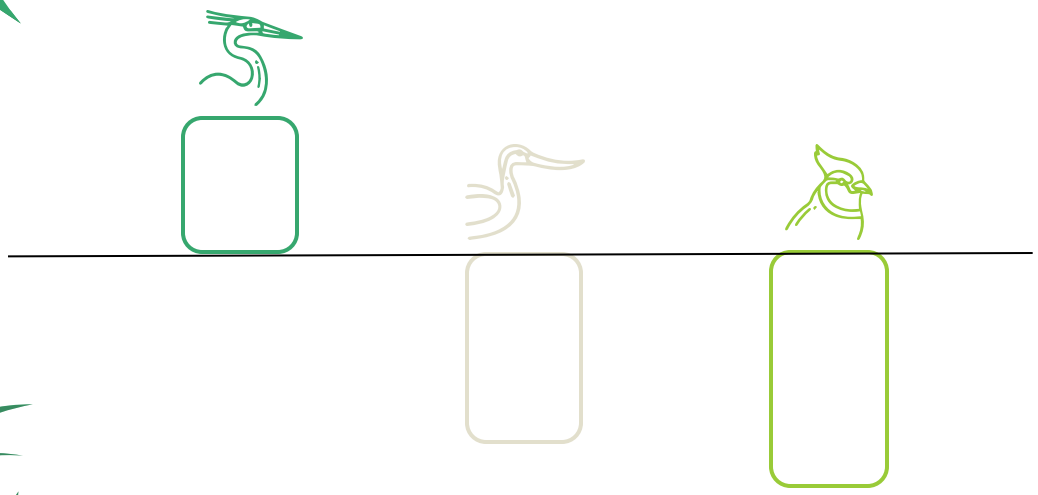
Hard Constraints
One release site
Correct biome and elevation range
Within min-max temperatures
Enough known food sources
Few known threats

Soft Constraints
Add number of food sources to reward additional sustenance
Subtract sum of predators to punish presence of threats
Subtract average monthly temperature deviation from Sierra Madre Occidental
Add location area compared to Sierra Madre Occidental

Suitability Maximization*

* Compared to current living location, the Sierra Madre Occidental

Selected Release Site vs Baselines



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Yellowstone

-8

Sierra Madre Occidental

-15

Madrean Sky Islands

Yellowstone achieves the largest feasible objective due to food prevalence, large elevation range, and predator scarcity

Sierra Madre Occidental achieves a lower objective due to imbalance of food sources and predation

Madrean Sky Islands achieve a low objective due to imbalance of food sources and predation, smaller elevation range, and smaller area

Thank you!

Any questions?

Appendix: Results against Baselines

Aspect	Yellowstone	Sierra Madre Occidental	Madrean Sky Islands
Food (#important)	23 (8)	18 (10)	12 (8)
Predators (#important)	19 (2)	26 (4)	25 (3)
Biome	Temperate Forests	Temperate Forests	Temperate Forests
Elevation Range (ft)	5250 – 11350	3900 – 10860	1500 – 7250
Area (acres)	2,219,790	55,030,368	2,000,000
Temperature Range (°F)	39 – 94	39 – 86	38 – 93

Table 2: Comparison of Yellowstone, Sierra Madre Occidental, and Madrean Sky Islands

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Yellowstone	47	52	57	62	68	74	79	77	74	66	55	47
Sierra Madre Occidental	55	59	62	67	69	69	67	67	65	62	59	56
Madrean Sky Islands	49	52	58	64	72	81	80	78	75	67	57	49

Table 3: Average Daily Temperatures (°F)