A framework for comparing landscape-scale conservation planning models and their key characteristics

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Purpose of this *endeavor*

- To standardize model review
- To better understand key differences in model designs and results and possible comparative advantages.
  - Help inform future species modeling work
  - Help align existing products with conservation needs

Purpose of this *presentation*

- Present a framework for model evaluation that may be useful for HGIT conservation planning and communication

Outline for today

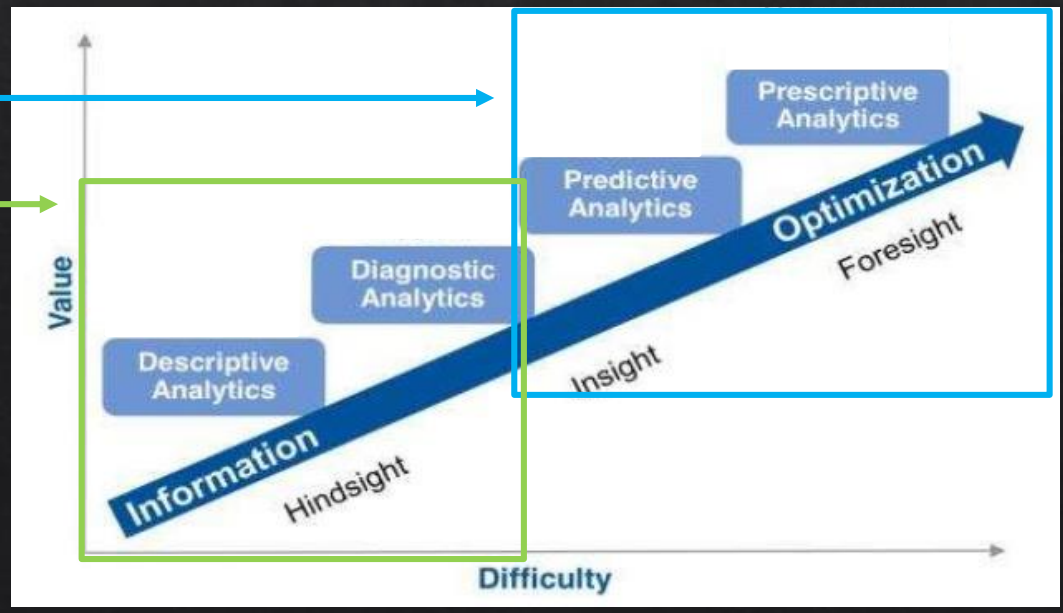
Utility of Models for Conservation Planning

Model Review Framework

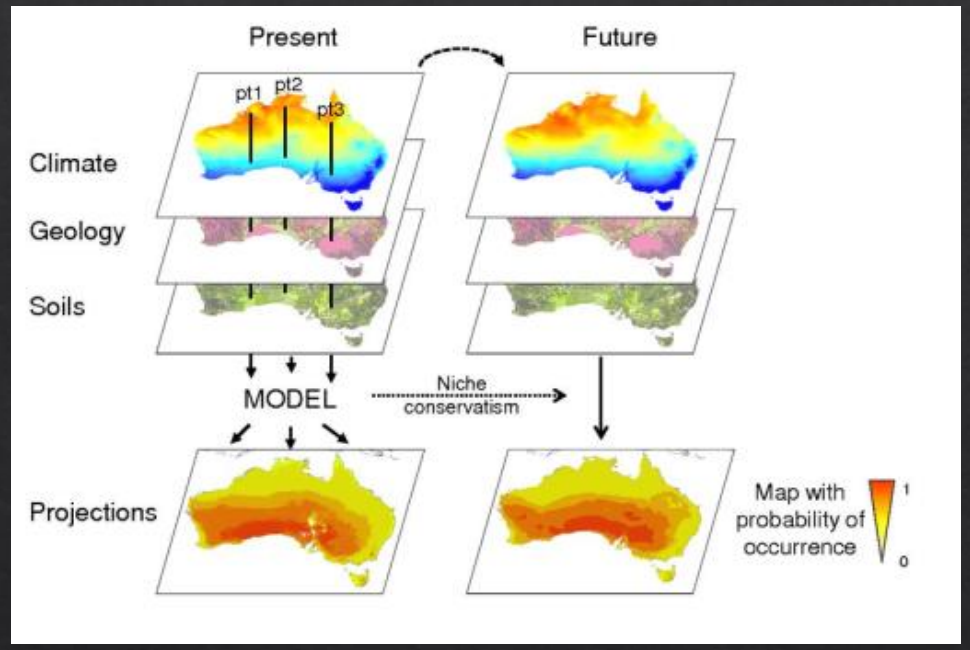
Key Characteristics for Landscape Conservation Planning Models

Utility of Species Models

- Part analysis and part design
  - Provide a better understanding (explanation)
  - Apply an understanding (prediction/projection)



Utility of Species Models



- Optimizing models (foresight)
  - What?
    - Protection, restoration, and/or enhancement
  - When?
    - Conservation for now and/or the future
  - Where and how much?
    - Identify and/or prioritize the landscape
    - Identify the amount needed to meet goals

Model Review Framework

Modeling approach	Effort	Pros/Cons
• Purpose • Type of model • Variables • Prediction/output • Validation • Supporting Layers	• Time • Money	• Key characteristics for landscape conservation planning models • Methods Critique

Model Review Framework

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• Purpose • Type of model • Variables • Prediction/output • Validation • Supporting Layers	• Time • Money	• **Key characteristics for landscape conservation planning models** • Methods Critique

Key Characteristics for Landscape Conservation Planning Models

- Spatial application
- Empirical data from rigorous sampling design
- Species-specific feature engineering
- Multi-scale associations
- High resolution data/output
- Current and future predictions
- Habitat quality predictions
- Trade-offs

Key Characteristics for Landscape Conservation Planning Models

Spatial application

Key Characteristics for Landscape Conservation Planning Models

Spatial application

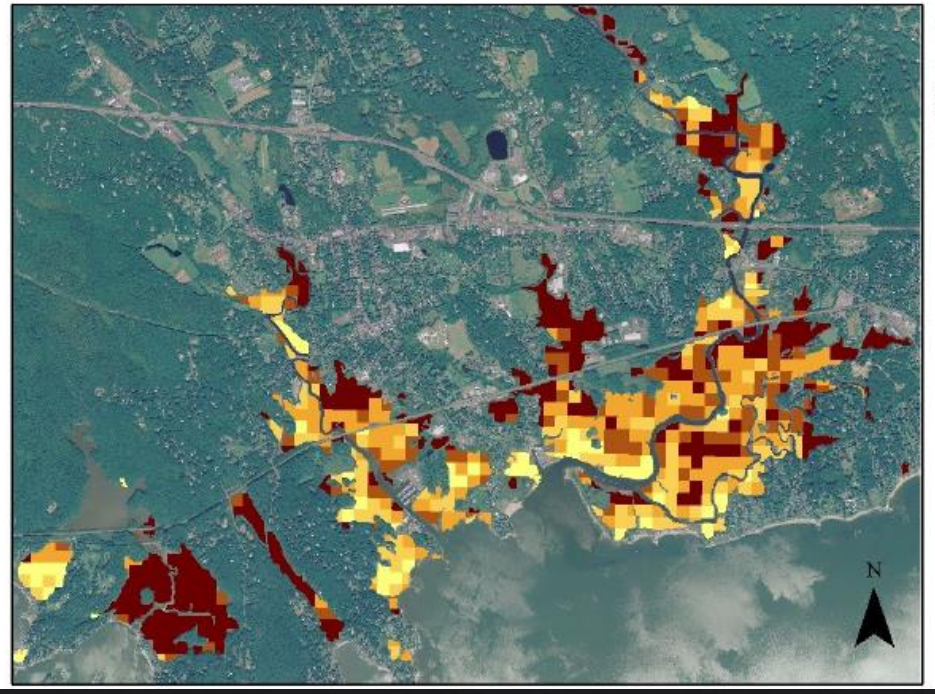
Nest model N4 (Vegetation structure, ΔDIC = 0.9)

Variable	*Parameter estimate (SD)*
Global intercept	-2.94 (1.19)
Stem density	0.15 (0.04)
Thatch height	0.25 (0.15)
Mean maximum vegetation height	-0.12 (0.05)

Nest model N9 (% High marsh, ΔDIC = 4.6)

Variable	*Parameter estimate (SD)*
Global intercept	-3.86 (1.06)
% High marsh	7.88 (2.11)

- Can not be applied outside the sampling unit



Key Characteristics for Landscape Conservation Planning Models

Empirical data from rigorous sampling design

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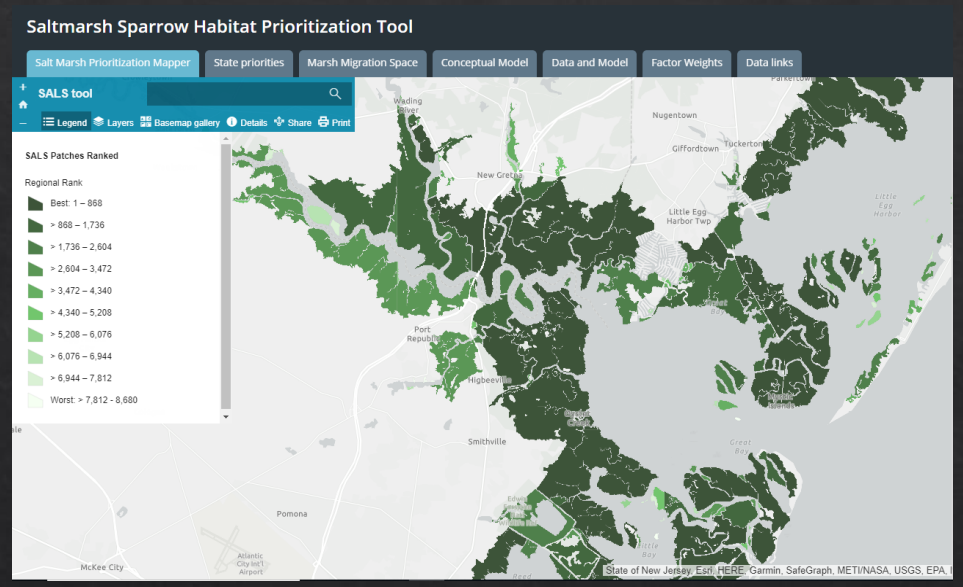
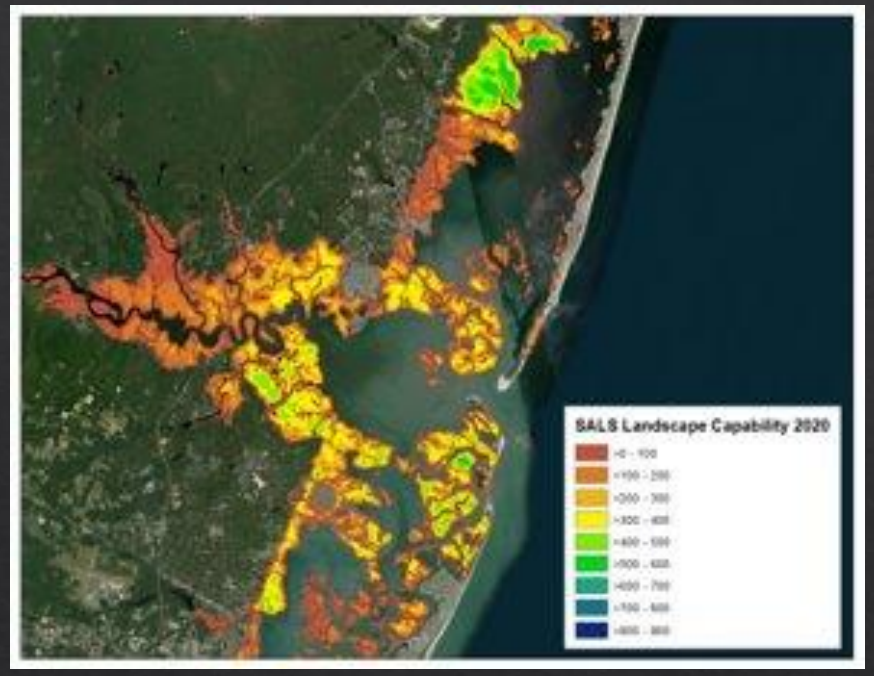
Empirical data from rigorous sampling design



- ACJV – no empirical occurrence data

Key Characteristics for Landscape Conservation Planning Models

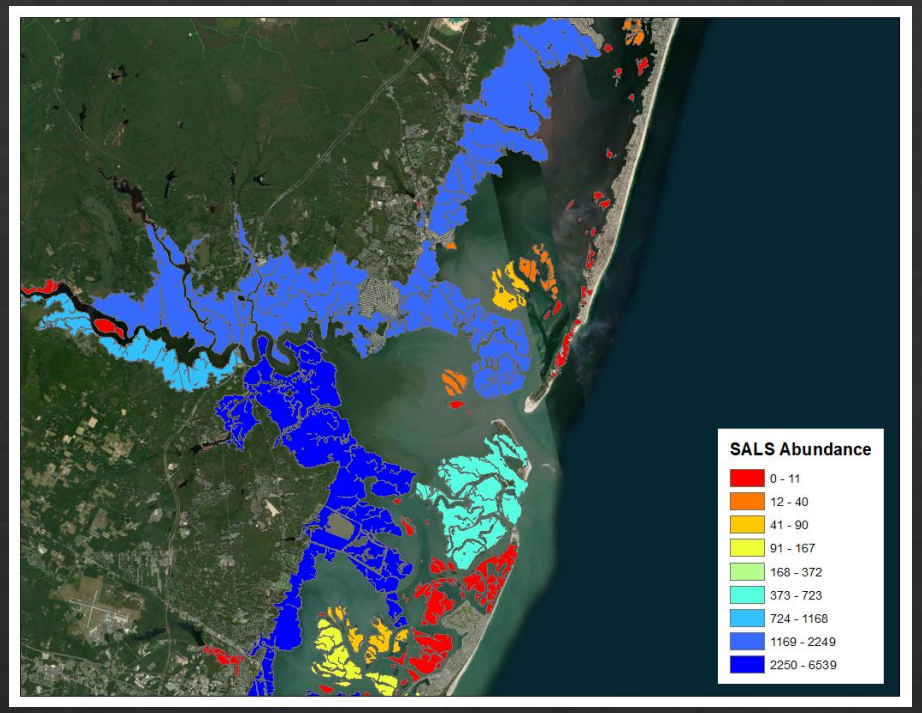
Empirical data from rigorous sampling design



- ACJV – no empirical occurrence data
- UMass – eBird occurrence data (citizen science) for portions of the model

Key Characteristics for Landscape Conservation Planning Models

Empirical data from rigorous sampling design



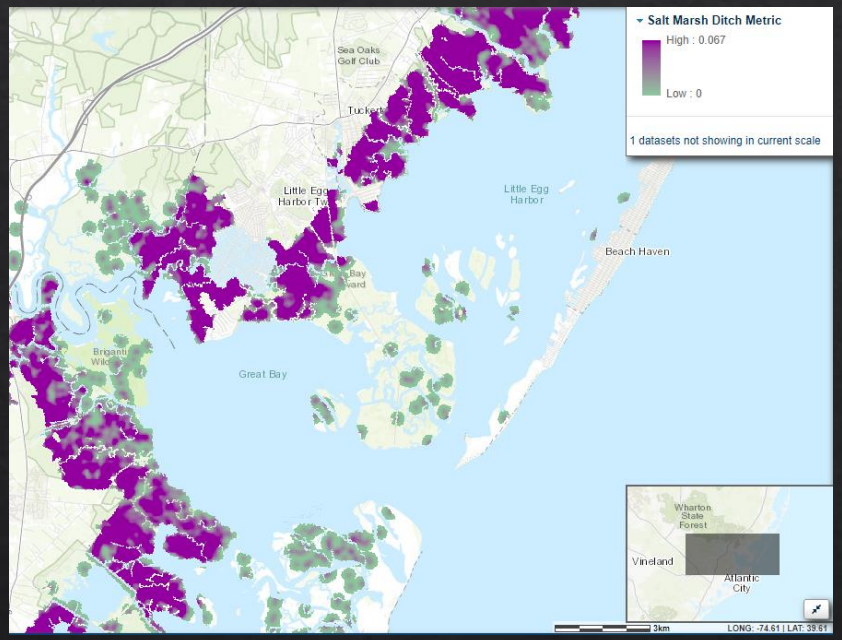
- ACJV – no empirical occurrence data
- UMass – eBird occurrence data (citizen science) for portions of the model
- SHARP – Stratified sampling design and standardized surveys

Key Characteristics for Landscape Conservation Planning Models

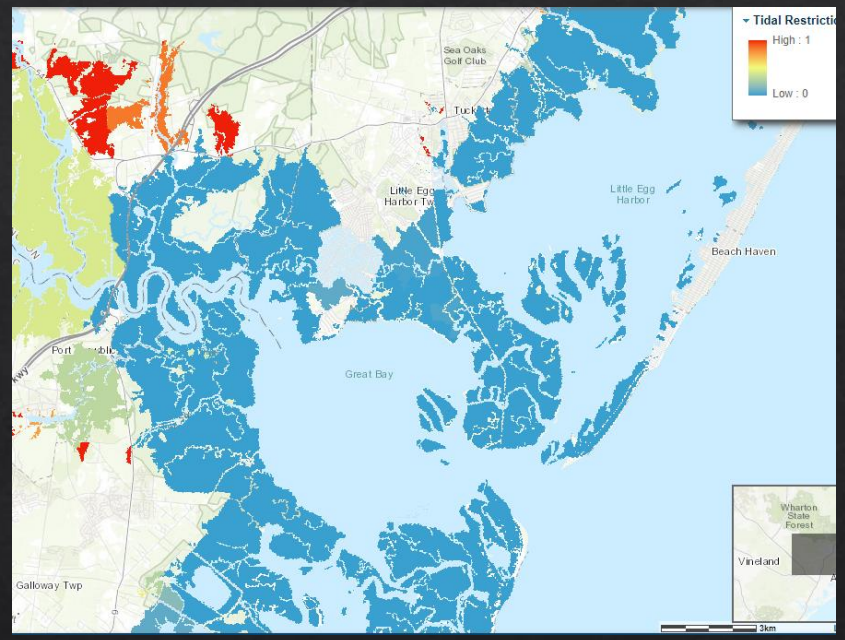
Species-specific feature engineering

Key Characteristics for Landscape Conservation Planning Models

Species-specific feature engineering



Tidal ditching



Tidal restrictions

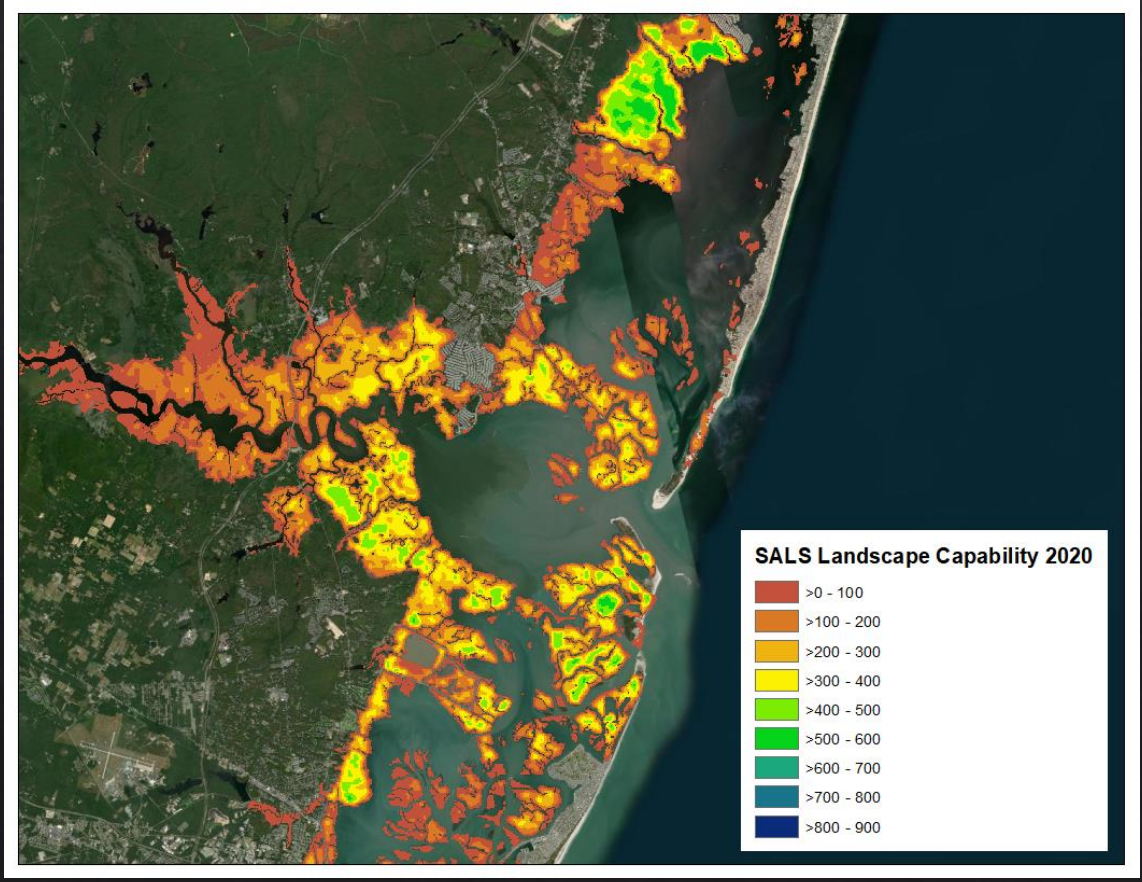
- High marsh
- Phragmites
- Coastal resiliency
- Marsh migration
- Sea-level rise

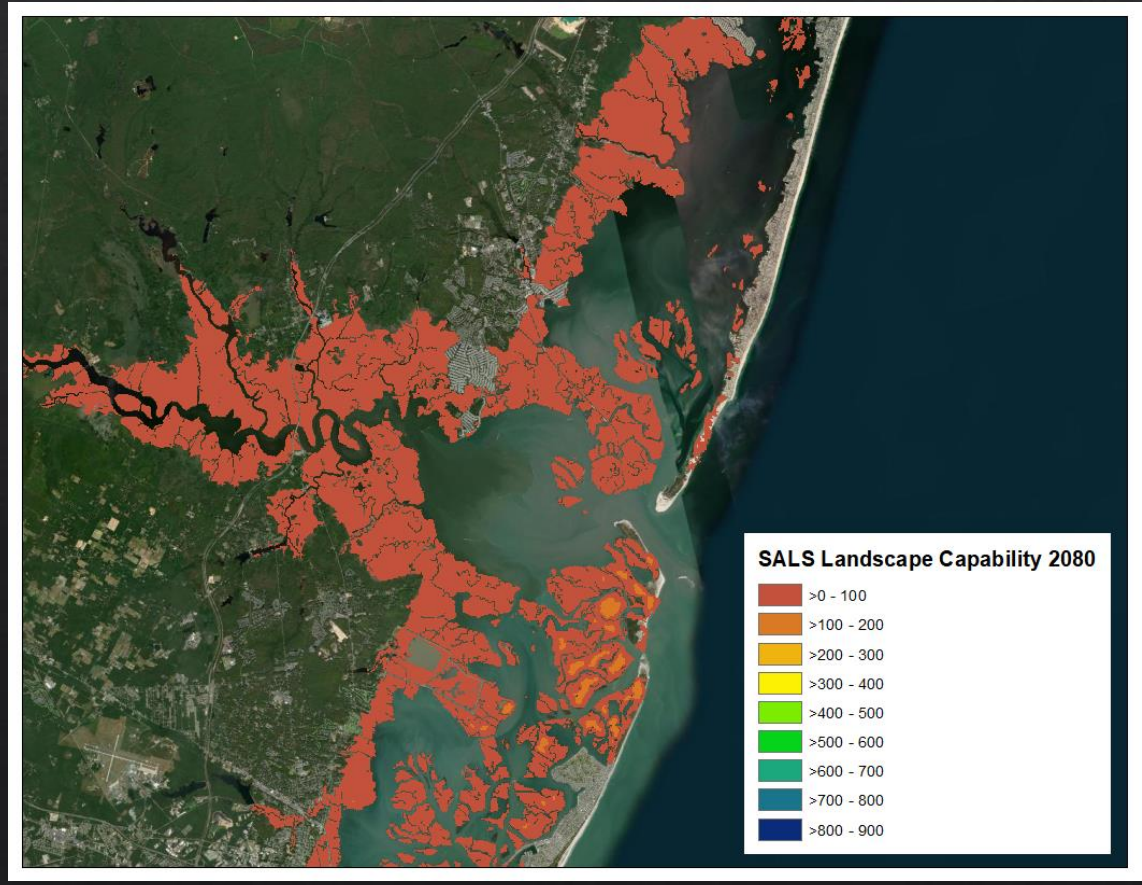
Key Characteristics for Landscape Conservation Planning Models

Current and future predictions

Key Characteristics for Landscape Conservation Planning Models

Current and future predictions





Key Characteristics for Landscape Conservation Planning Models

Multi-scale associations

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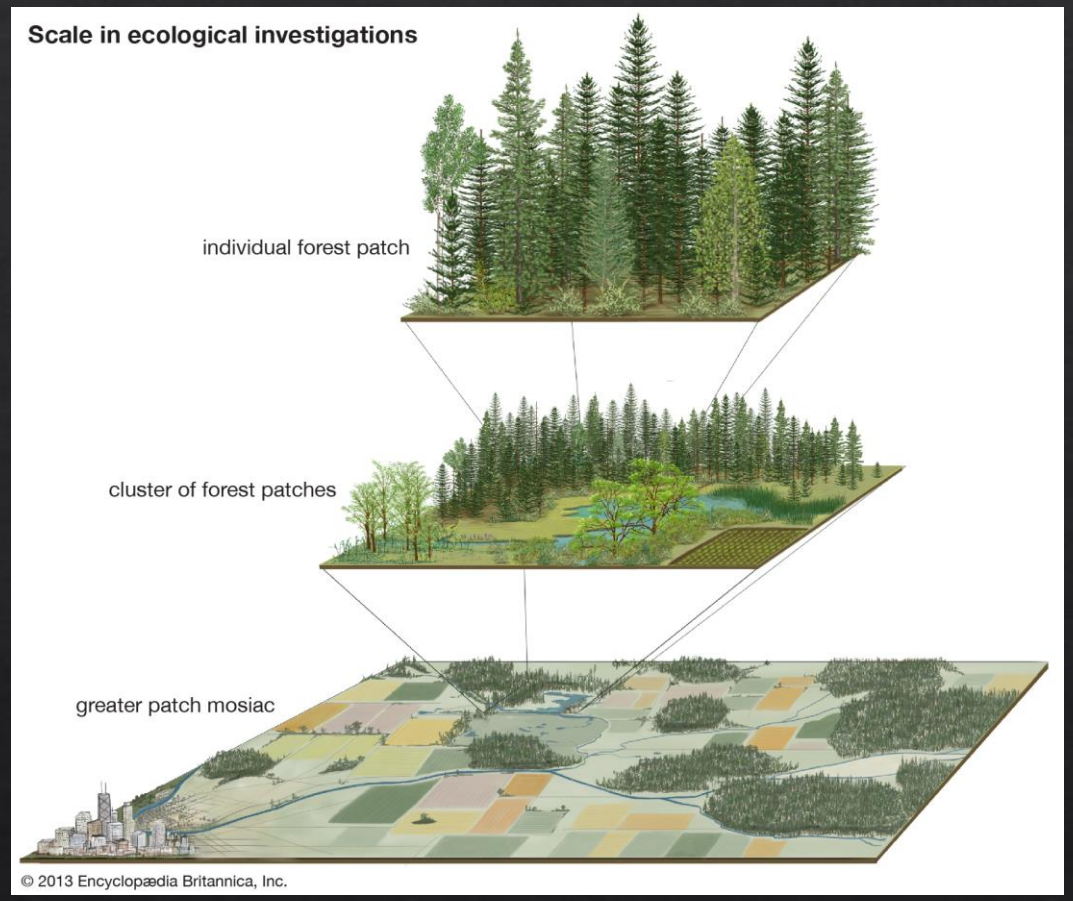
Multi-scale associations



Key Characteristics for Landscape Conservation Planning Models

High resolution data/output

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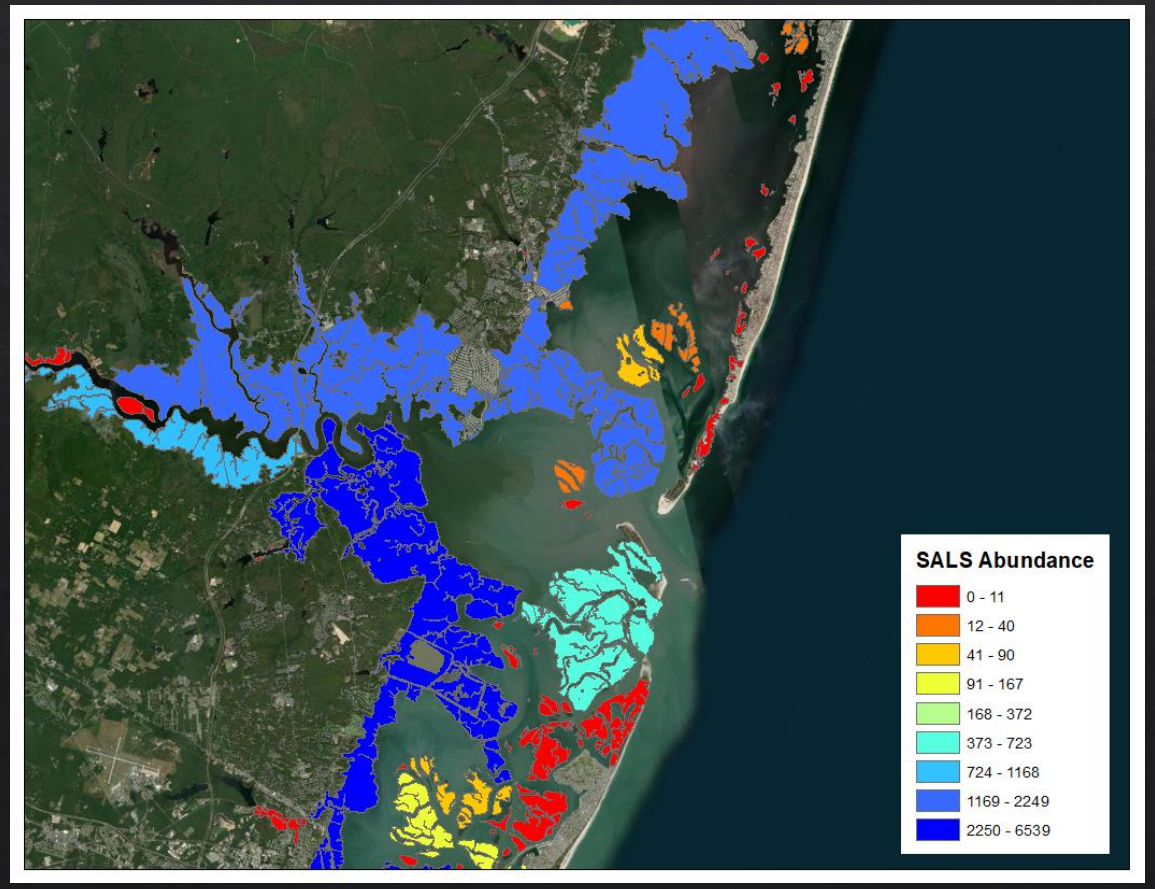
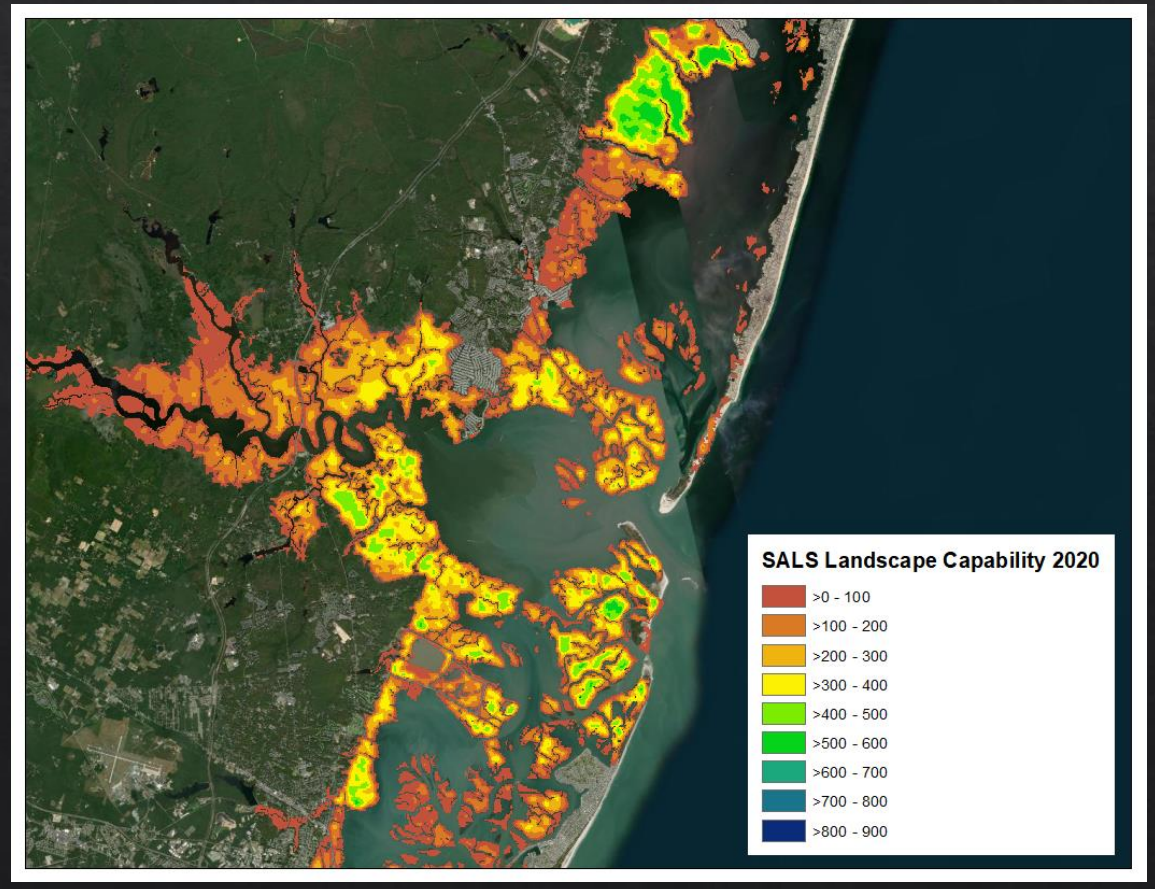
- SHARP
- Output: Tidal complex



- Umass DSL
- Output: 30 m resolution



Key Characteristics for Landscape Conservation Planning Models

Habitat quality predictions

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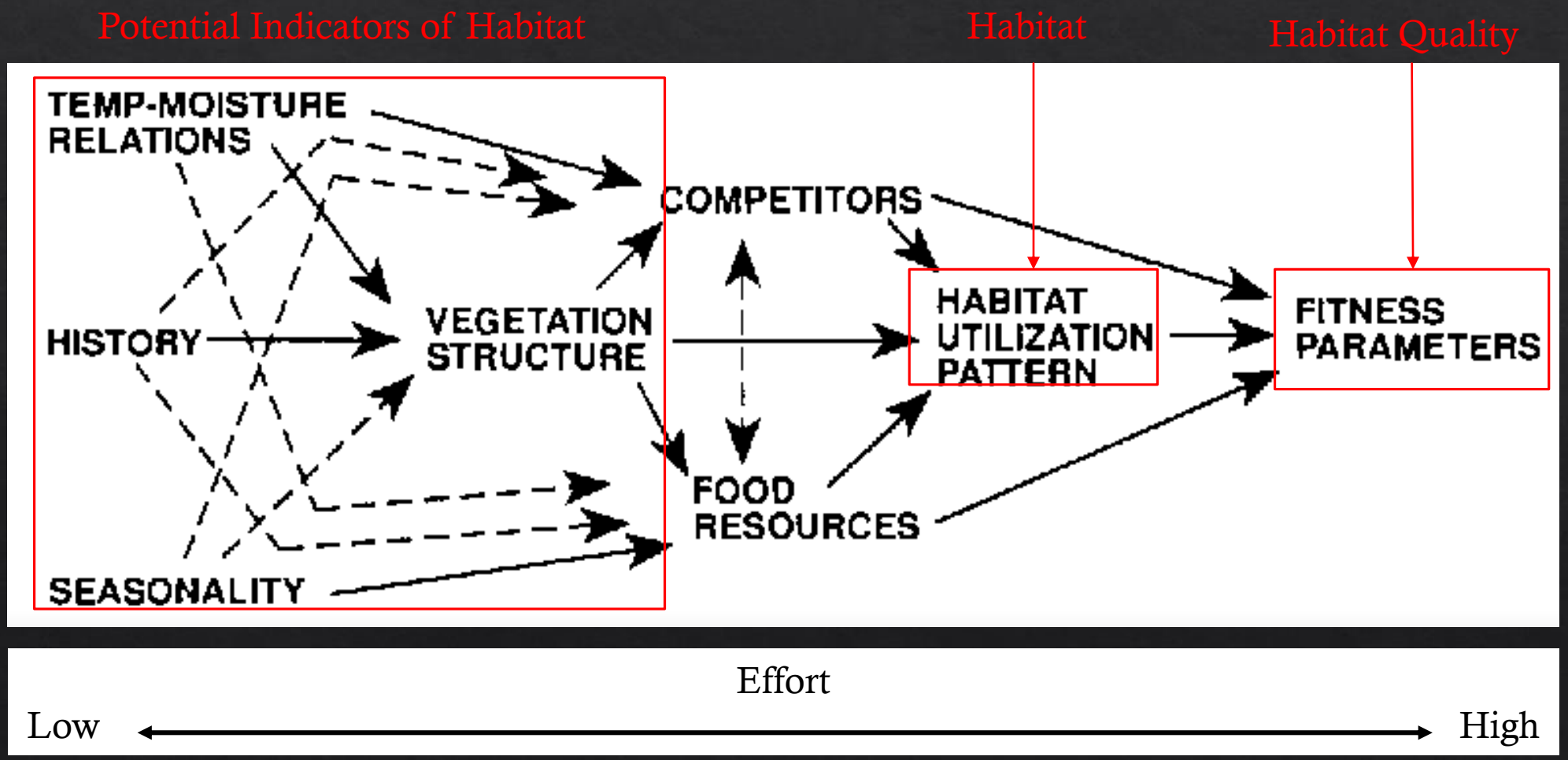
Habitat quality predictions



Key Characteristics for Landscape Conservation Planning Models

Tradeoffs

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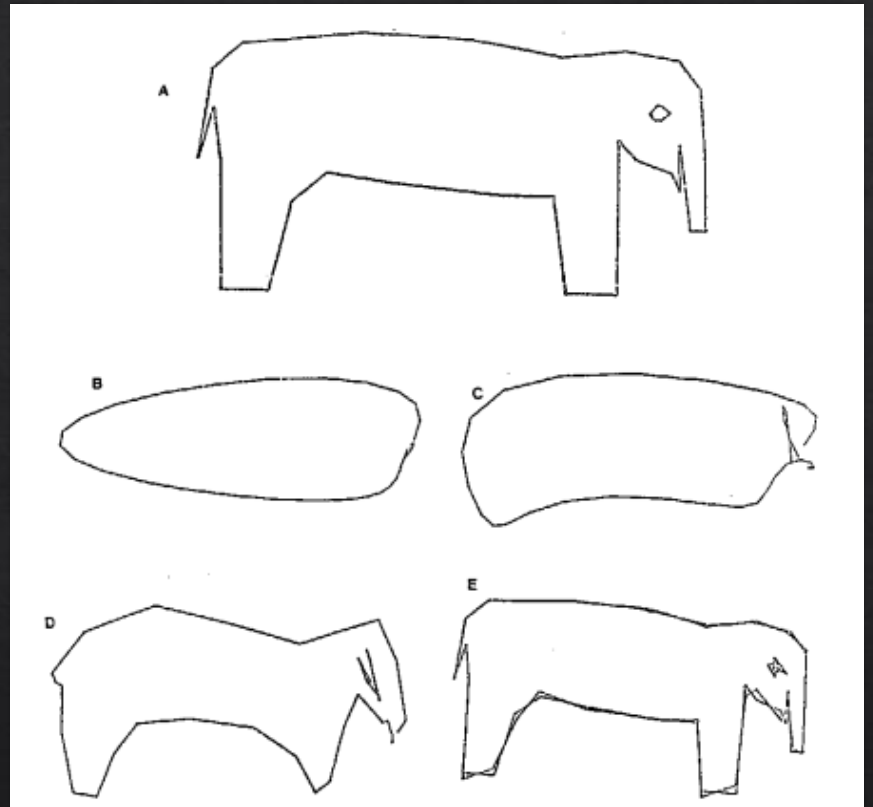
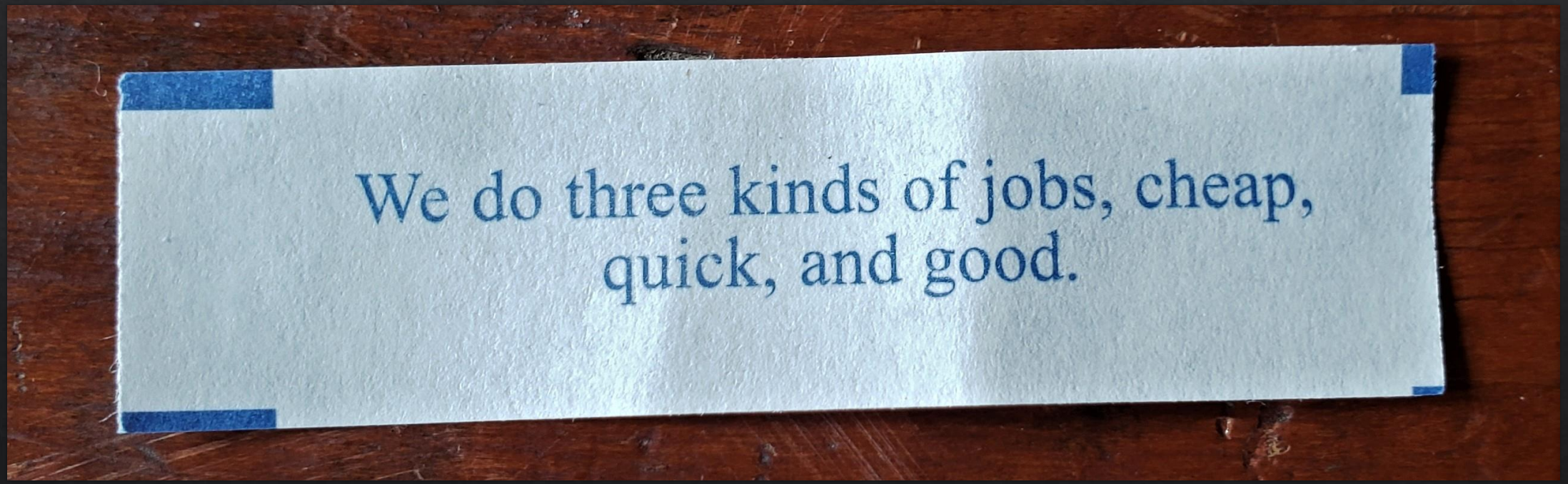
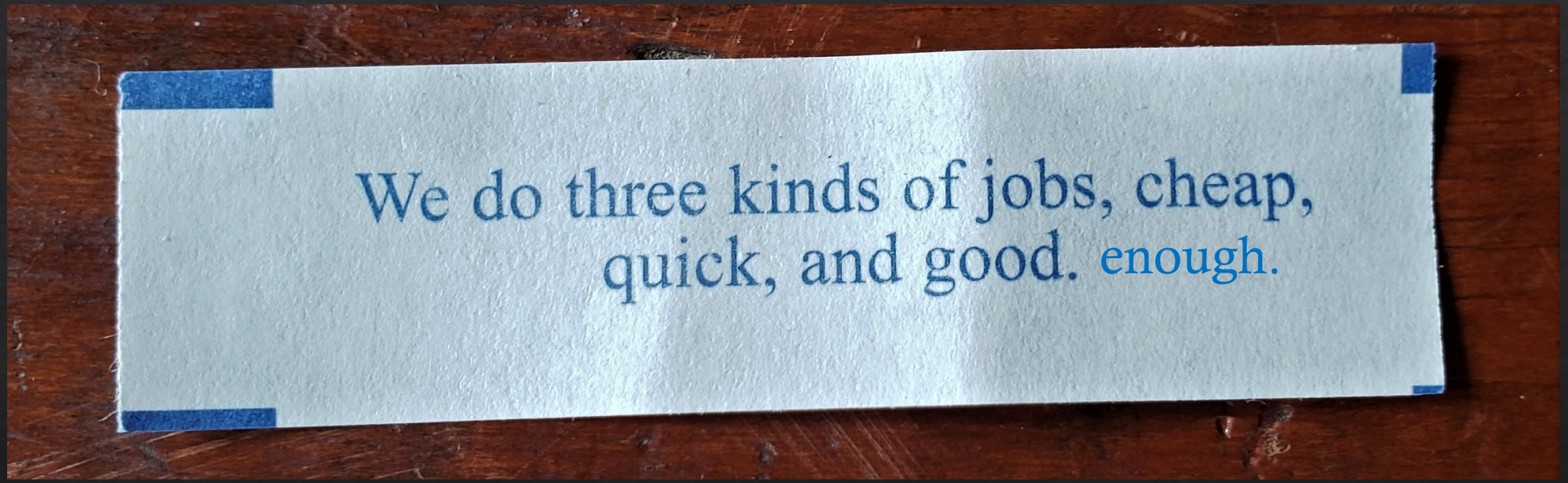


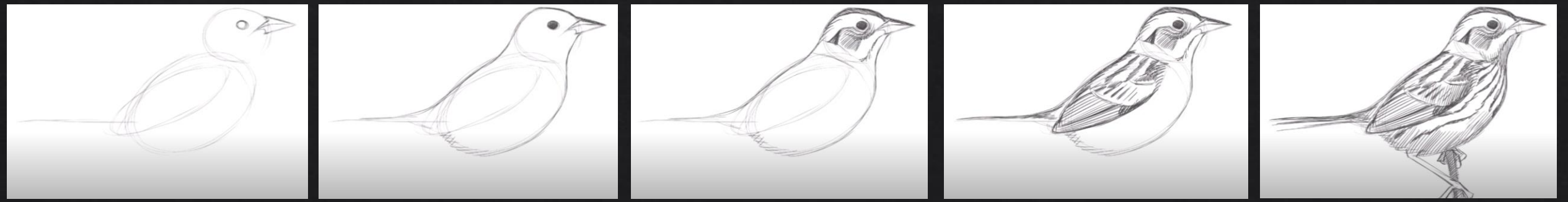
FIGURE 1.2. "How many parameters does does it take to fit an elephant?" was answered by Wel (1975). He started with an idealized drawing (A) defined by 36 points and used least squares Fourier sine series fits of the form $x(t) = \alpha_0 + \sum \alpha_i \sin(it\pi/36)$ and $y(t) = \beta_0 + \sum \beta_i \sin(it\pi/36)$ for $i = 1, \ldots, N$. He examined fits for $K = 5, 10, 20$, and 30 (shown in B–E) and stopped with the fit of a 30 term model. He concluded that the 30-term model "may not satisfy the third-grade art teacher, but would carry most chemical engineers into preliminary design."

In a perfect world…



Questions?





Model Comparison

Model	Spatially applied	Empirical data/Robust sampling	Species-specific feature engineering	Multi-scale associations	High-resolution output	Current and future preditions	Prediction	Overfit	Interpret-ability	Effort
DSL	Yes	Yes/No	Yes	Patch/ local/ landscape	30 m	Yes	Index; no validation	No	Yes/No	Med
ACJV	Yes	No	Yes	Patch /local /landscape	Patch	Yes/No	Index; no validation	No	Yes	Low
SHARP	Yes	Yes	Yes/No	Patch /local /landscape /regional	Multi-patch	No	Occurrence /Density/ Validation	Maybe	Yes/No	High