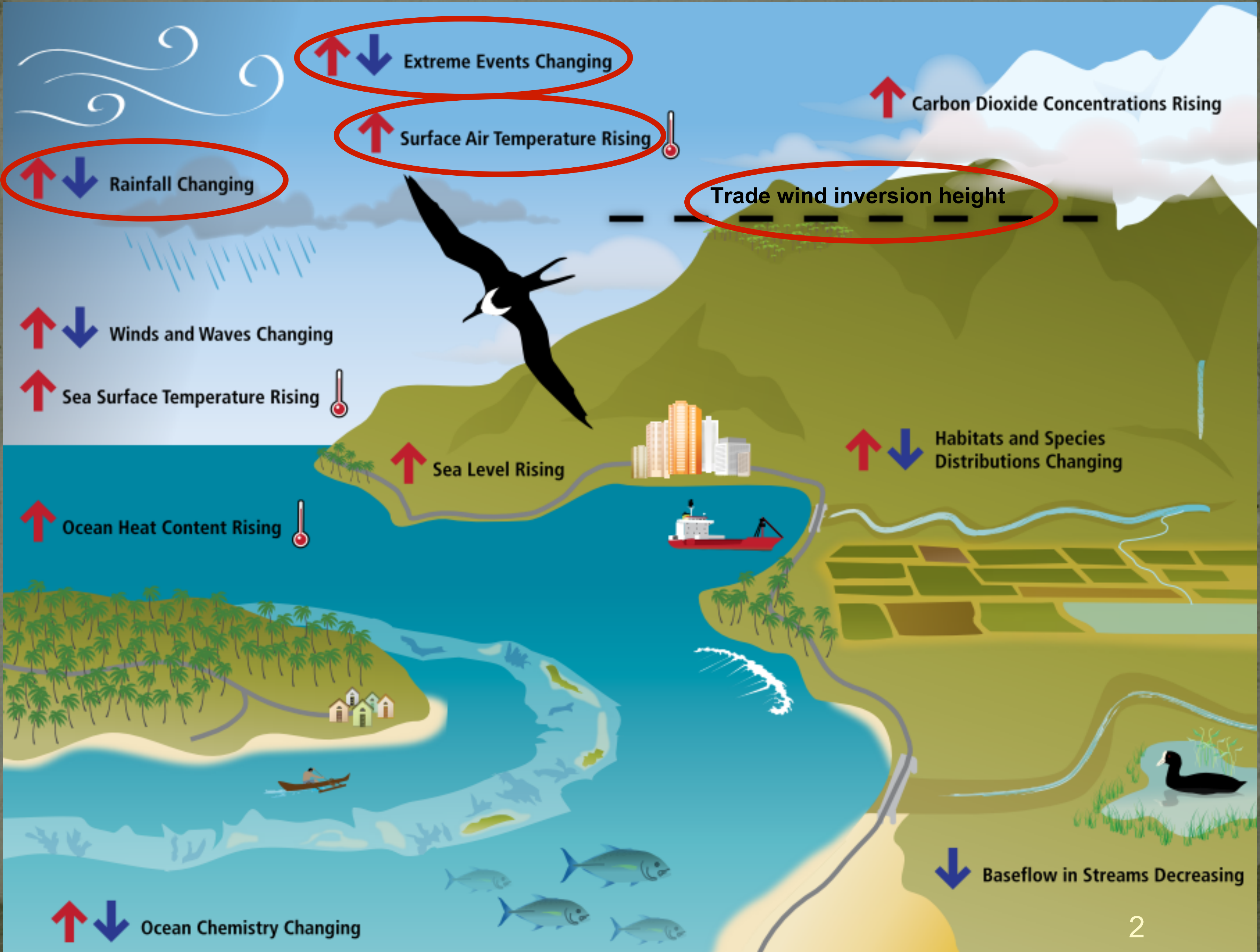
Outline

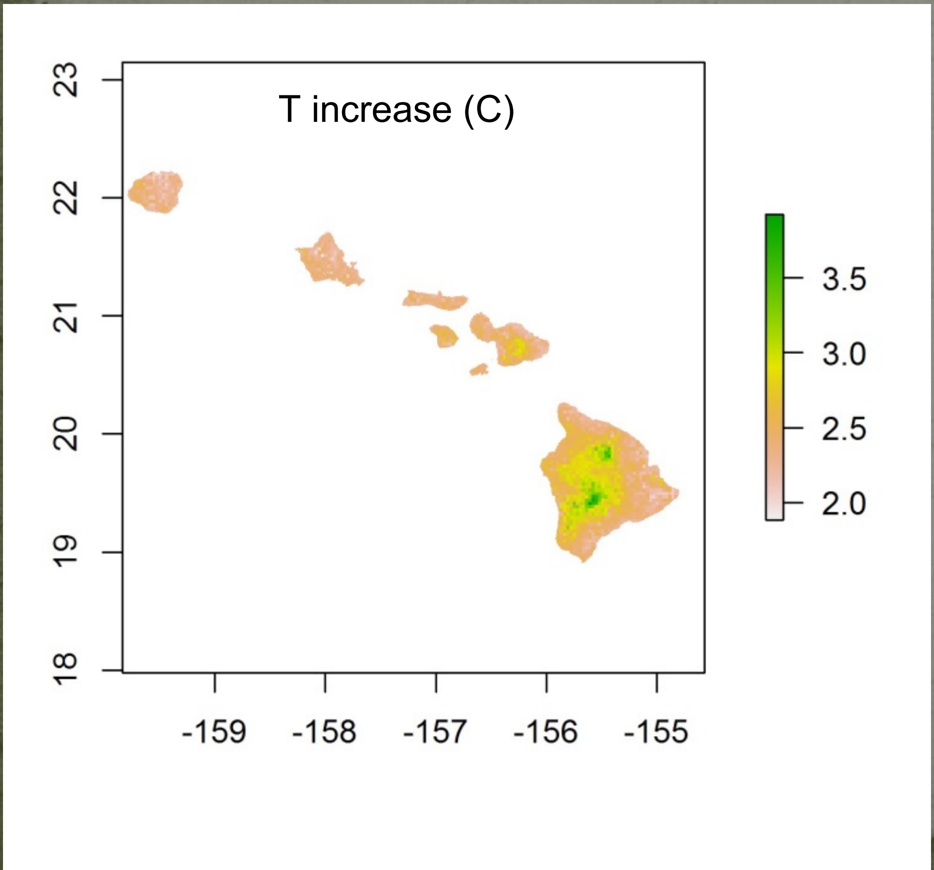
- Summary of climate change projections for Hawaii
- Overview of climate-based range projections of invasive plants in Hawaii
- Beyond range shifts: Complex interactions between invasives and climate shifts
- Conservation context: Native plant and forest bird vulnerability to climate change
- Management implications

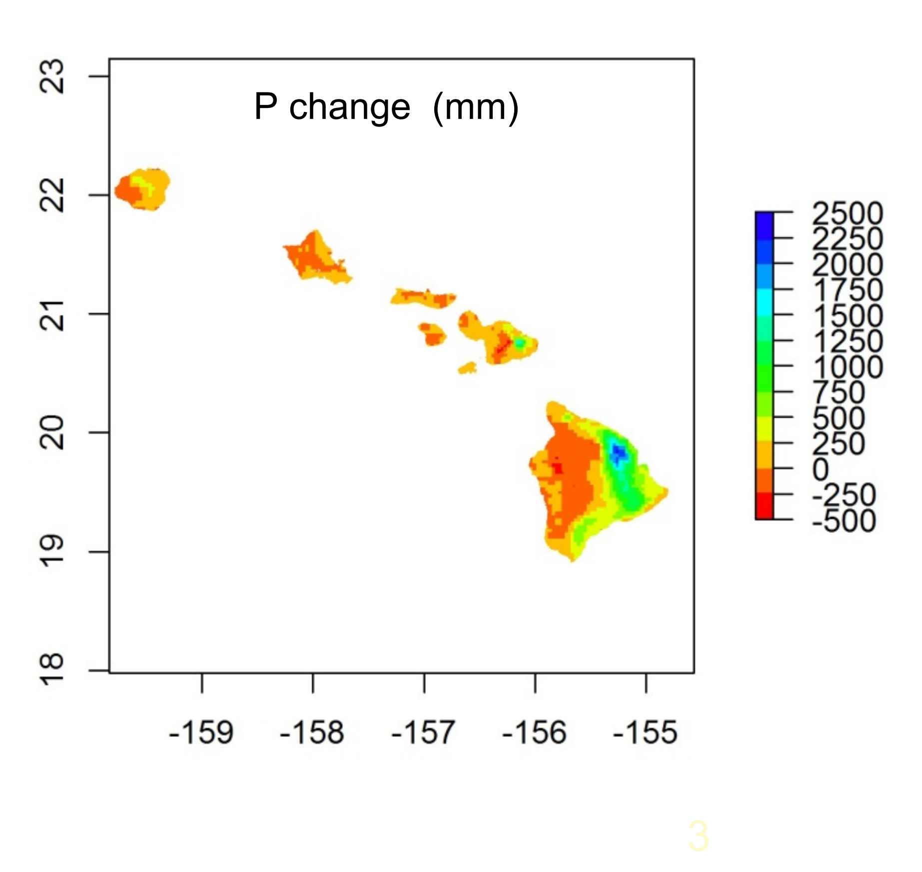
Pacific Islands Regional Climate Assessment 2012



Climate change in Hawaii by end of century

UH Manoa HRCM model projections, using mild (A1B) emission scenario





Climate change and invasives species

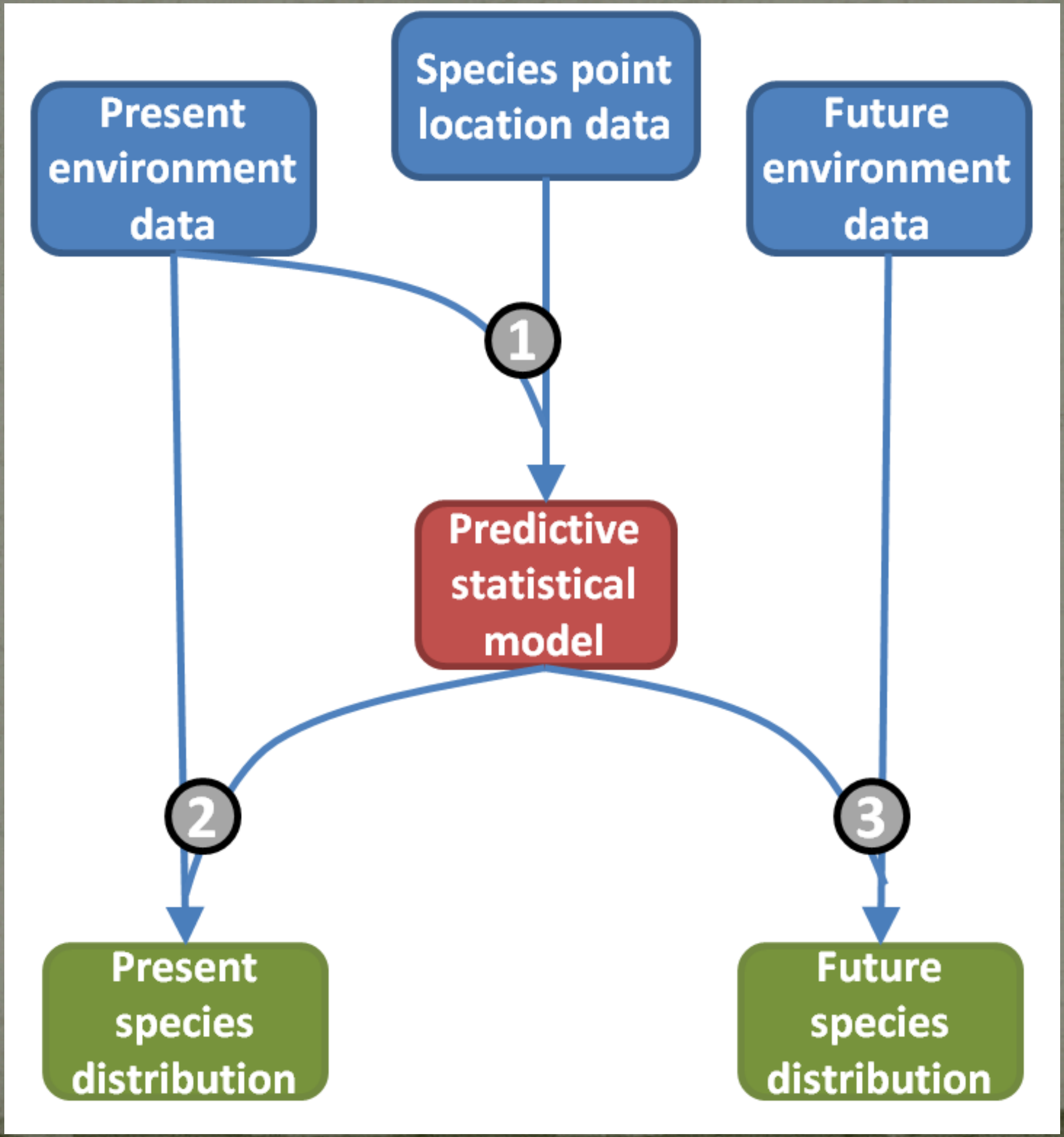
- Potential advantage of invasives under changing conditions
  - Favorable life history traits
  - In Hawaii, many tropical introduced species
- Observed impacts:
  - Correlation between invasion success and a warming climate
  - Ohlemuller et al. (2006) found non-native plants thrived in warmer and dryer forest fragments
- Projected impacts:
  - Invasive plants in the Western U.S. likely to expand their ranges (Bradley et al 2009)
  - Some losses of invasive range too, not all bad news.

Modeling Hawaiian Ecosystem Degradation due to Invasive Plants under Current and Future Climates

Adam E. Vorsino (USFWS), Lucas Fortini (USGS/PICCC), Fred Amidon (USFWS), Steve Miller (USFWS), Jim Jacobi (USGS), Jon Price (UH Hilo), Sam Gon III (TNC), Greg Koob (USFWS)

Plos One Journal, 2014

Modeling species distributions under climate change



How to SDM?
3 data sets
3 steps

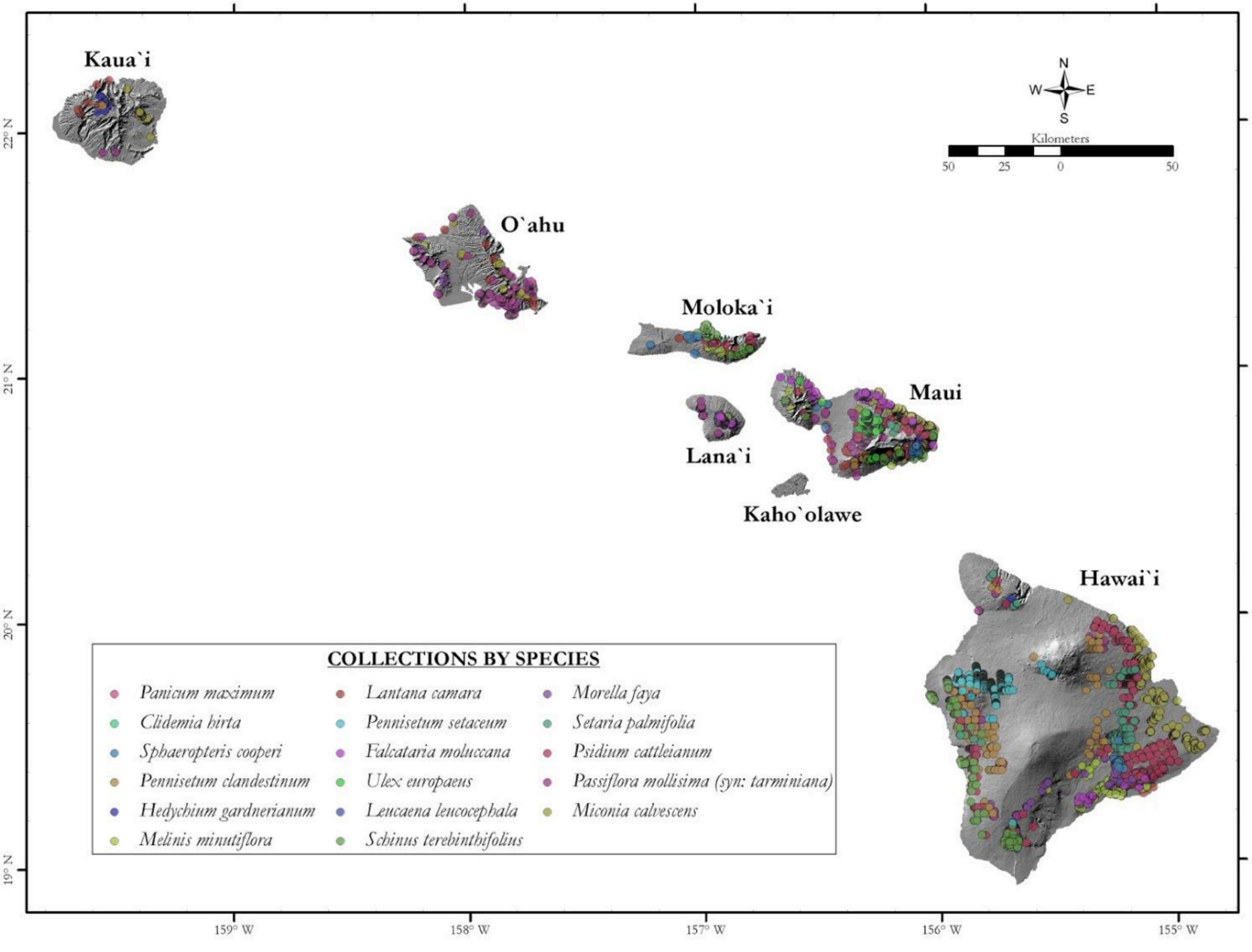
Species Selection

- Selection based on High risk assessment scores
- Selection meant to encompass broad range of invasive characteristics (e.g., habitat preferences)
- Focus on relatively early introductions (1908 mean establishment)

Species Selection

CommonName	Established in Hawaii	[2]Habitat (Price *et al*, [42])	Number of Records	[4]RA
Koster's curse	1941 (72 years)	Mesic-Wet	60	High Risk
Albizia	1920 (93 years)	Mesic	414	High Risk
Kāhili ginger	1940 (73 years)	Wet	218	High Risk
Lantana	1858 (155 years)	Dry-Mesic	307	High Risk
Koa haole, ēkoa	1837 (176 years)	Dry	502	High Risk
Molasses grass	1910 (103 years)	Mesic	298	High Risk
Miconia	~1983 (30 years)	Mesic-Wet	102,595	High Risk
Firetree	1926 (87 years)	Mesic	968	High Risk
Guinea grass	1871 (142 years)	Dry	44	High Risk
Banana poka	1926 (87 years)	Dry	5857	High Risk
Kikuyu grass	1923 (90 years)	Mesic	135	High Risk
Fountain grass	1914 (99 years)	Dry	317	High Risk
Strawberry guava	1825 (188 years)	Wet	540	High Risk
Christmas berry	1911 (102 years)	Mesic	916	High Risk
Palmgrass	1903 (110 years)	Wet	1059	High Risk
Australian tree fern	1950 (63 years)	Dry	79	High Risk
Gorse	1914 (99 years)	Mesic	473	High Risk
	~1908 (104±41 years	**SUM:**	**114,782**	**Avg. RA**

Species Selection



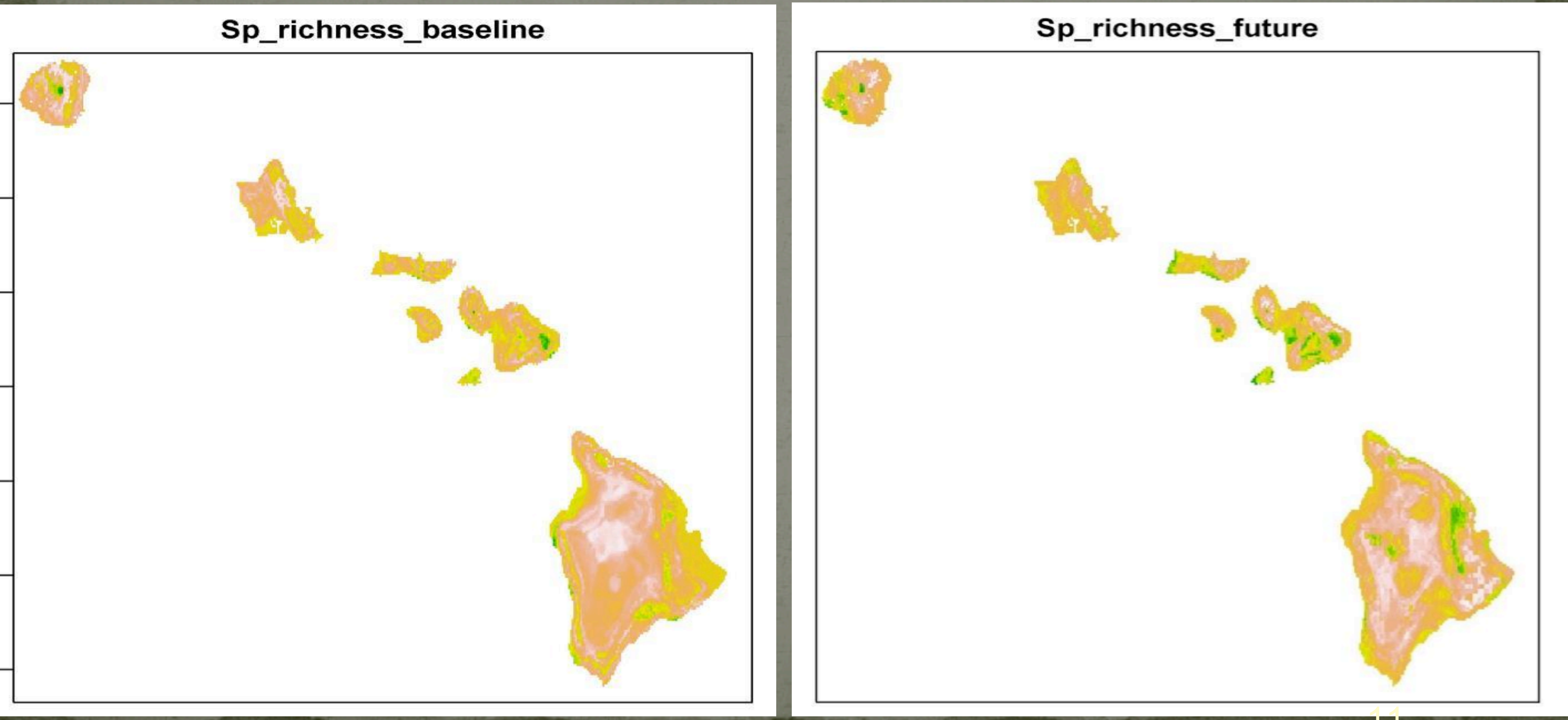
Individual species model results

- Example model with good representation of current distribution (Strawberry guava)

- Example model with poor representation of current distribution (Albizia)

Multi-species metrics

- Area available for occupation by these invasive plants may increase by 11% in 2100



Invasive range is projected to increase within valuable native habitat

- Expansion into Hawaii's upper elevation areas
- A disproportional increase within important remaining native habitat

Complexity of interaction between invasive species and climate shifts

1) Not only about spread due to changing average conditions:

- Introduction/transport: strong winds and storm surges can move species;
- Establishment: extreme events can create large disturbed areas;
- Spread: invasive species already within an area can be further spread

Complexity of interaction between invasive species and climate shifts

2) Conflicting climate change responses

- Crops for biofuel, carbon storage, and erosion control
- Choice that households make for suitable landscape plants

3) Invasives also augment climate impacts

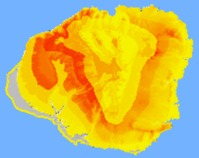
- Fire risks
- Watershed yields
- Damage from extreme events (Erosion/ canopy damage)

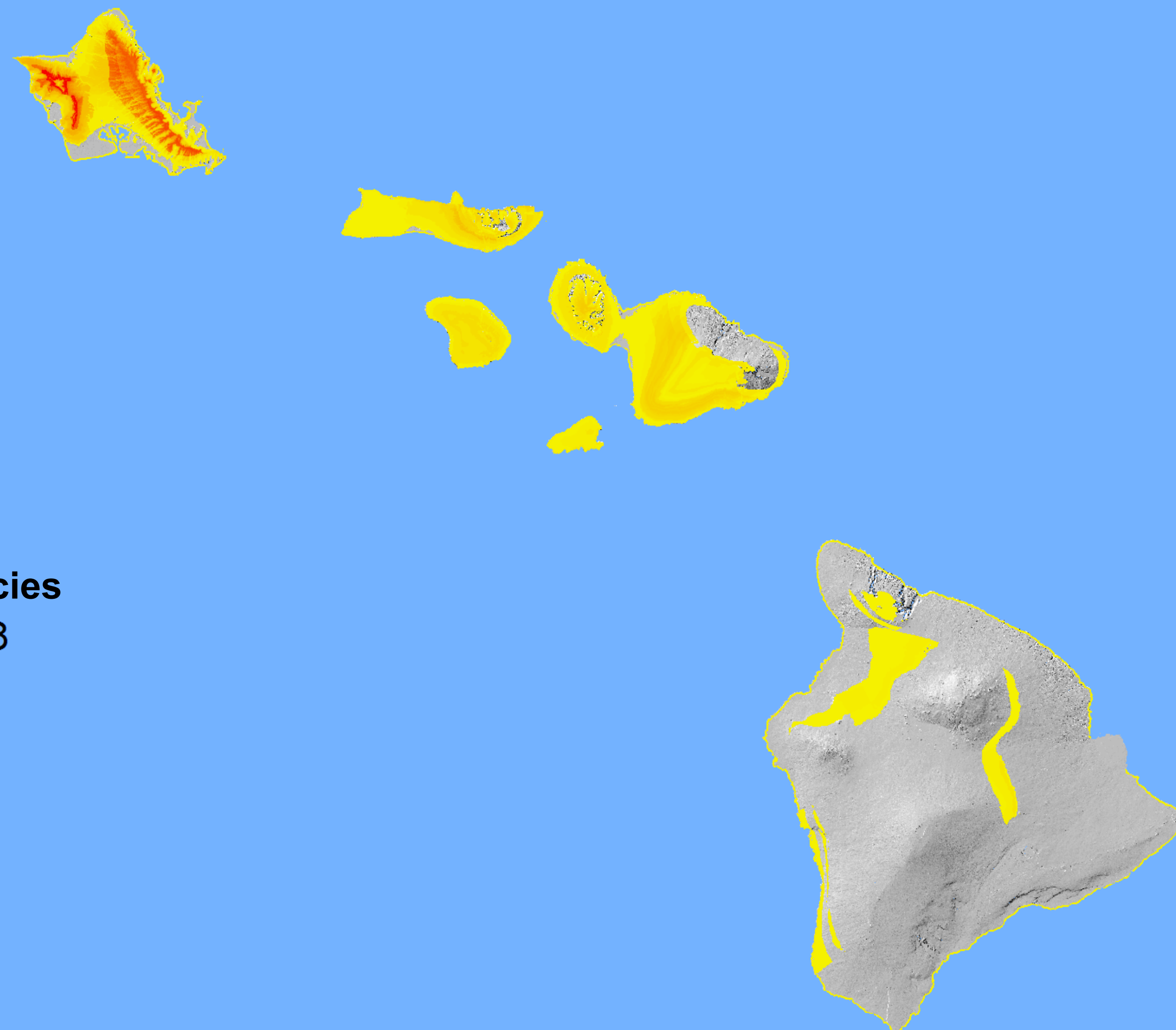
Conservation context is very important!

Native plants also respond to climate change

- Original purpose of invasive work
- Bottom line: Species currently at risk are more vulnerable to climate change
- High elevation habitat will be increasingly valuable for species persistence

Modeled current distribution of native plant species highly vulnerable to climate change



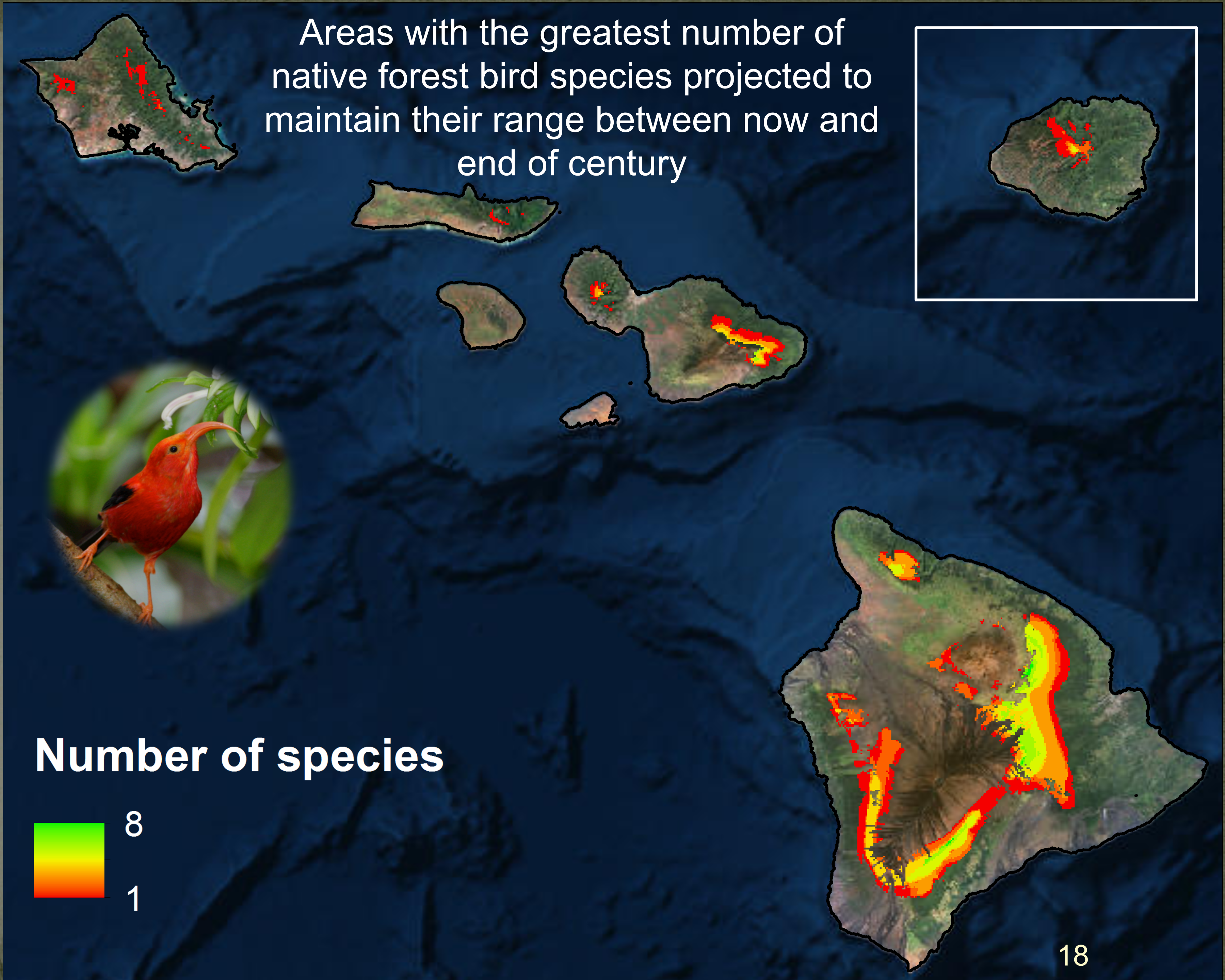


Number of species

High : 58

Low : 1

Areas with the greatest number of native forest bird species projected to maintain their range between now and end of century



Management implications

- Management for invasives is a major component of preparing for climate change
- We have an increasingly robust projections for impacts on native species
- Focus on keeping upper elevation areas
- Minimizing new introductions is critical
- Data limitations hinder more reliable projections for invasives
- Future uncertainty/ ever-changing conditions is a common aspect of invasive species management

- Questions?

- Contact:
- lucas.fortini@piccc.net