

Oystercatchers in a changing landscape: Consequences of climate-driven ecosystem change on nesting habitat in Virginia



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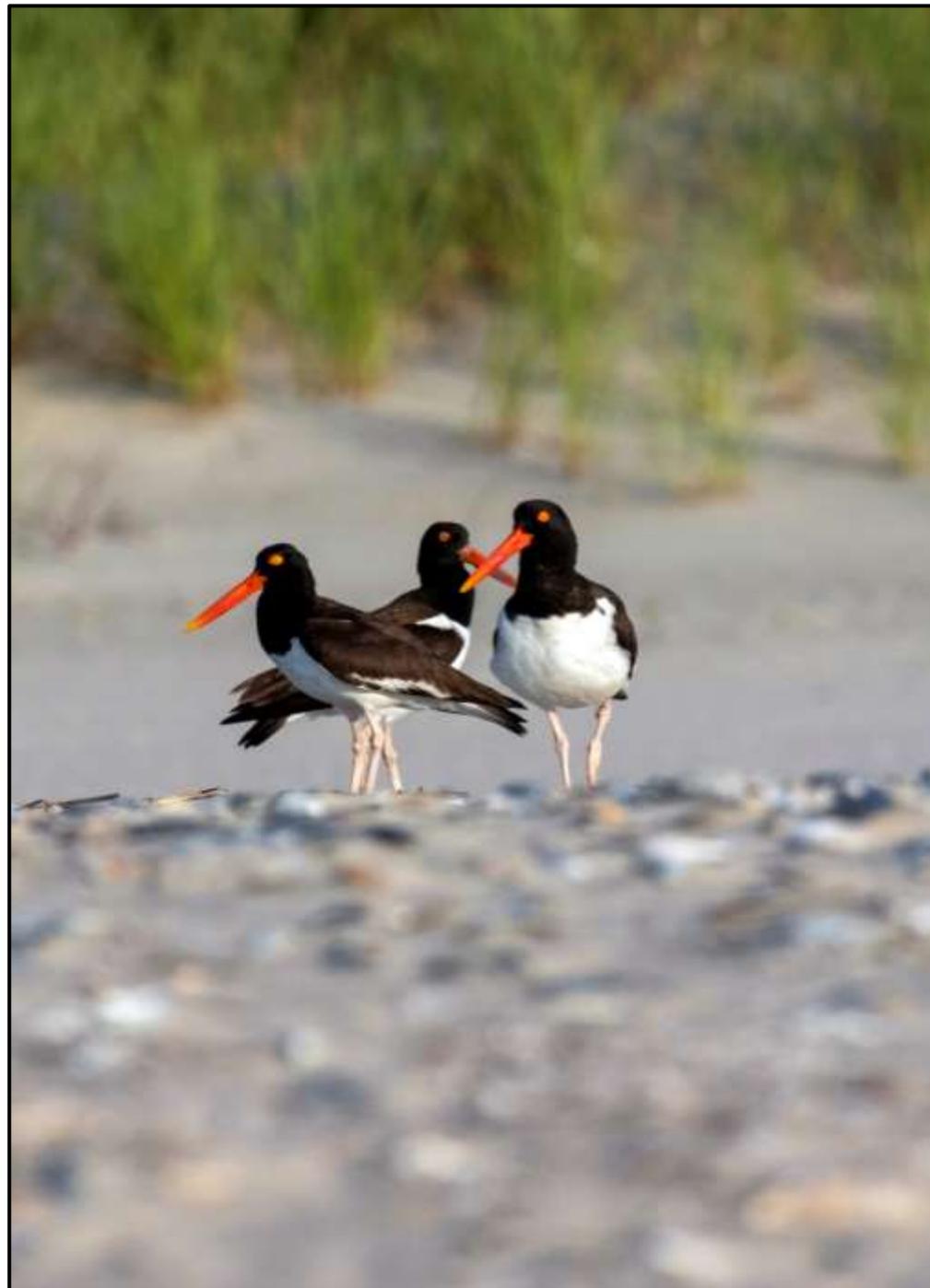
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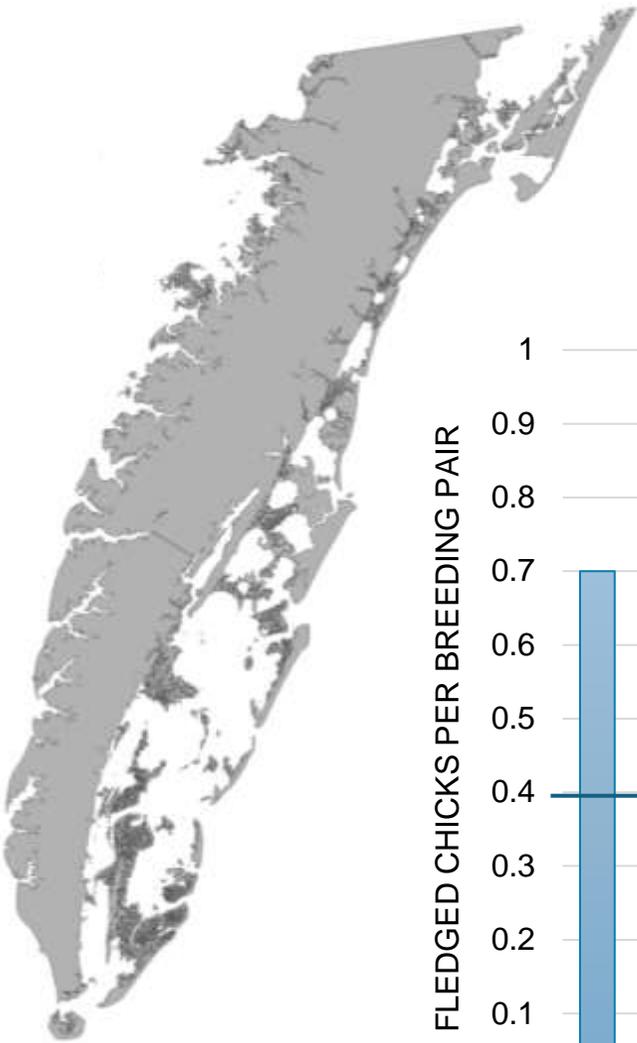
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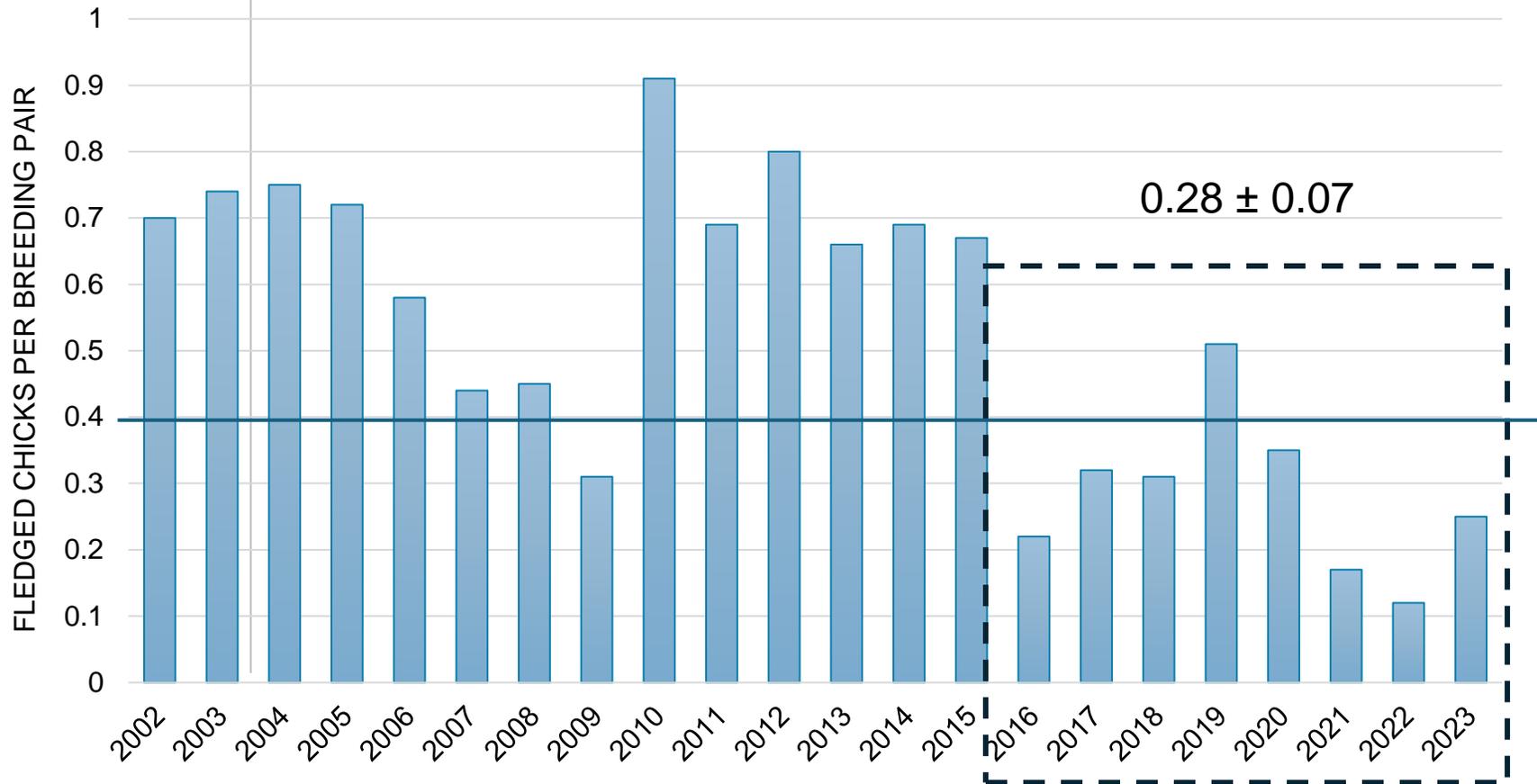
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- Virginia Tech College of Natural Resources and Environment





Oystercatcher productivity in the Virginia barrier islands



Rate for stationarity:
0.40

Research Goal: What may be causing lower-than-expected productivity and what does this mean for management?



Drivers of nest and chick survival



Top-down effects
(Altered predator pressures from human influence and climate change)



Environmental effects
(Temperature, precipitation, and storm-related impacts)

Research Goal: What may be causing lower-than-expected productivity and what does this mean for management?



Drivers of nest and chick survival



Top-down effects
(Altered predator pressures from human influence and climate change)



Environmental effects
(Temperature, precipitation, and storm-related impacts)

- **Flooding and a complex predator community drive reproductive success.**
- **Storminess in May causes birds to renest, leading to late-hatching broods and lower chick survival.**

Research Goal: What may be causing lower-than-expected productivity and what does this mean for management?



Drivers of nest and chick survival



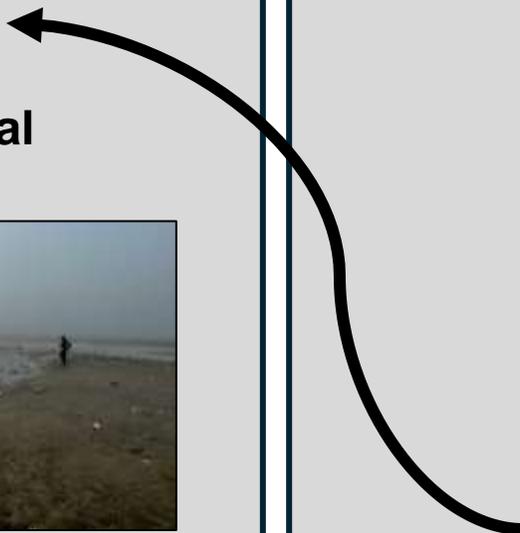
Top-down effects
(Altered predator pressures from human influence and climate change)



Environmental effects
(Temperature, precipitation, and storm-related impacts)



Habitat effects
(Changing patterns of habitat availability and habitat quality)



Globally, ecosystems are changing.



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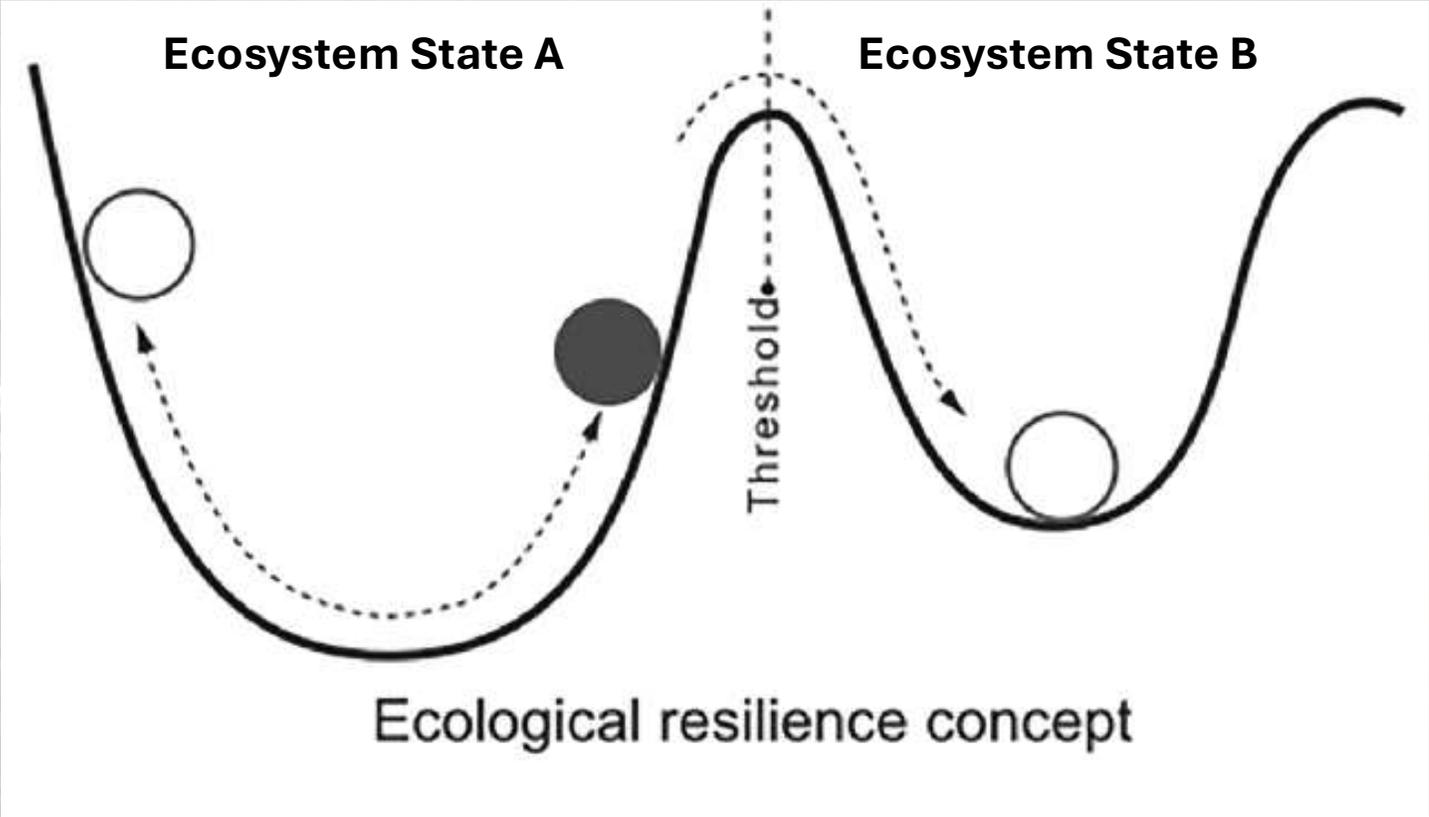


Figure from Keane et al. 2018 (Ecosphere), based on Holling 1973 (Annu. Rev. Ecol. Syst.)

Globally, ecosystems are changing.

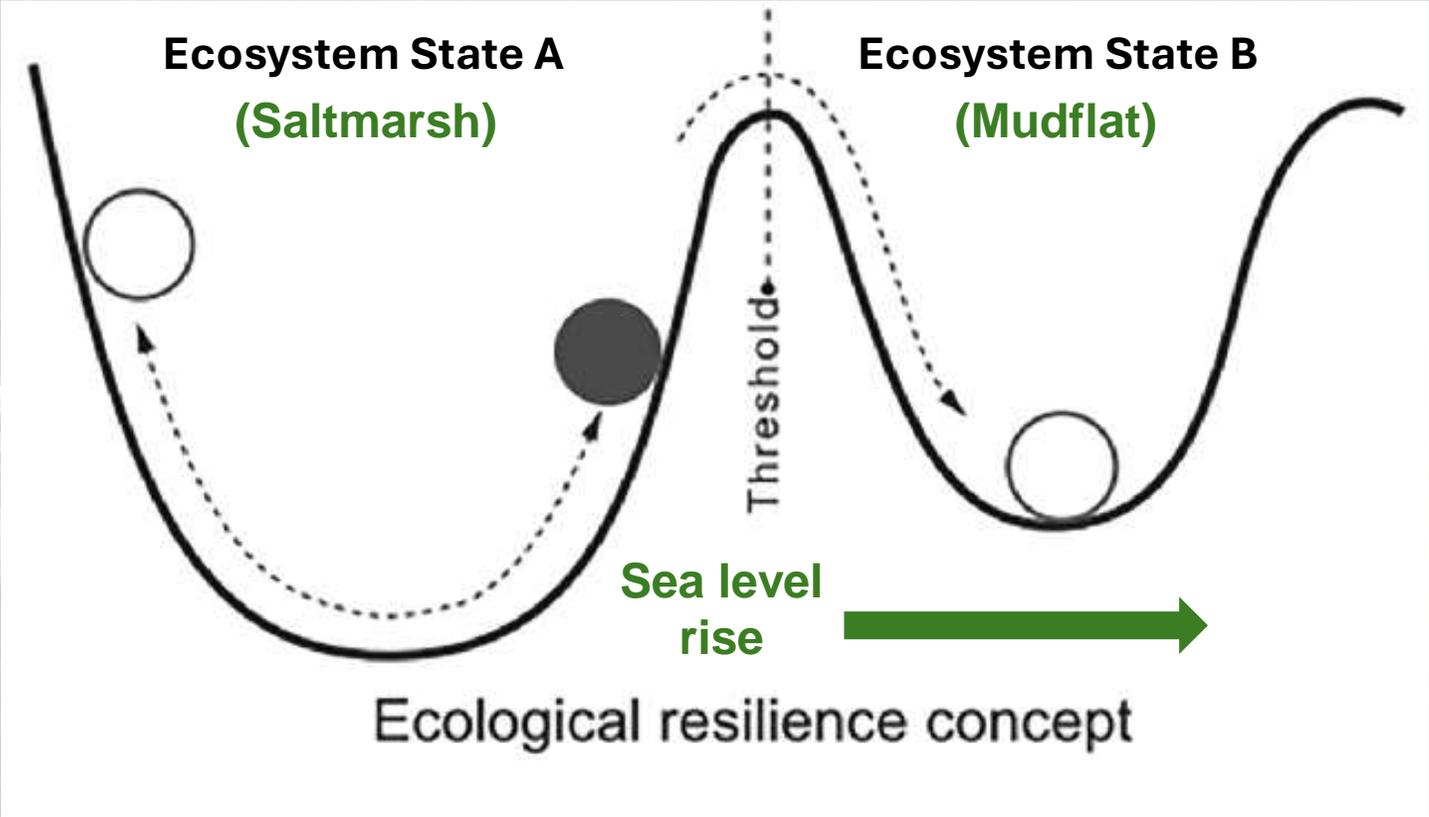
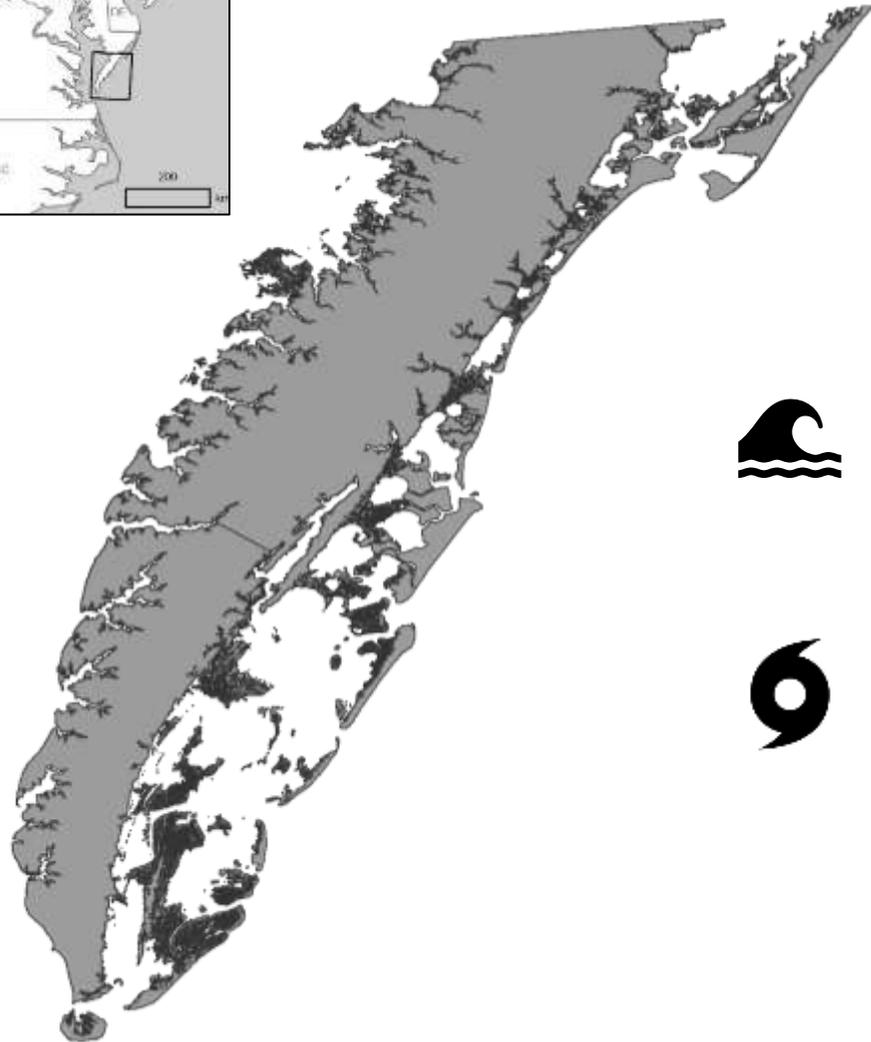
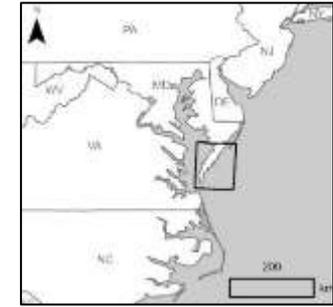


Figure from Keane et al. 2018 (Ecosphere), based on Holling 1973 (Annu. Rev. Ecol. Syst.)

Climate is a primary driver of change in



Accelerated rates of sea-level rise (5.75 ± 0.58 mm yr⁻¹)



Increased storm magnitudes and more frequent high-intensity storms





We know that the barrier islands are changing.

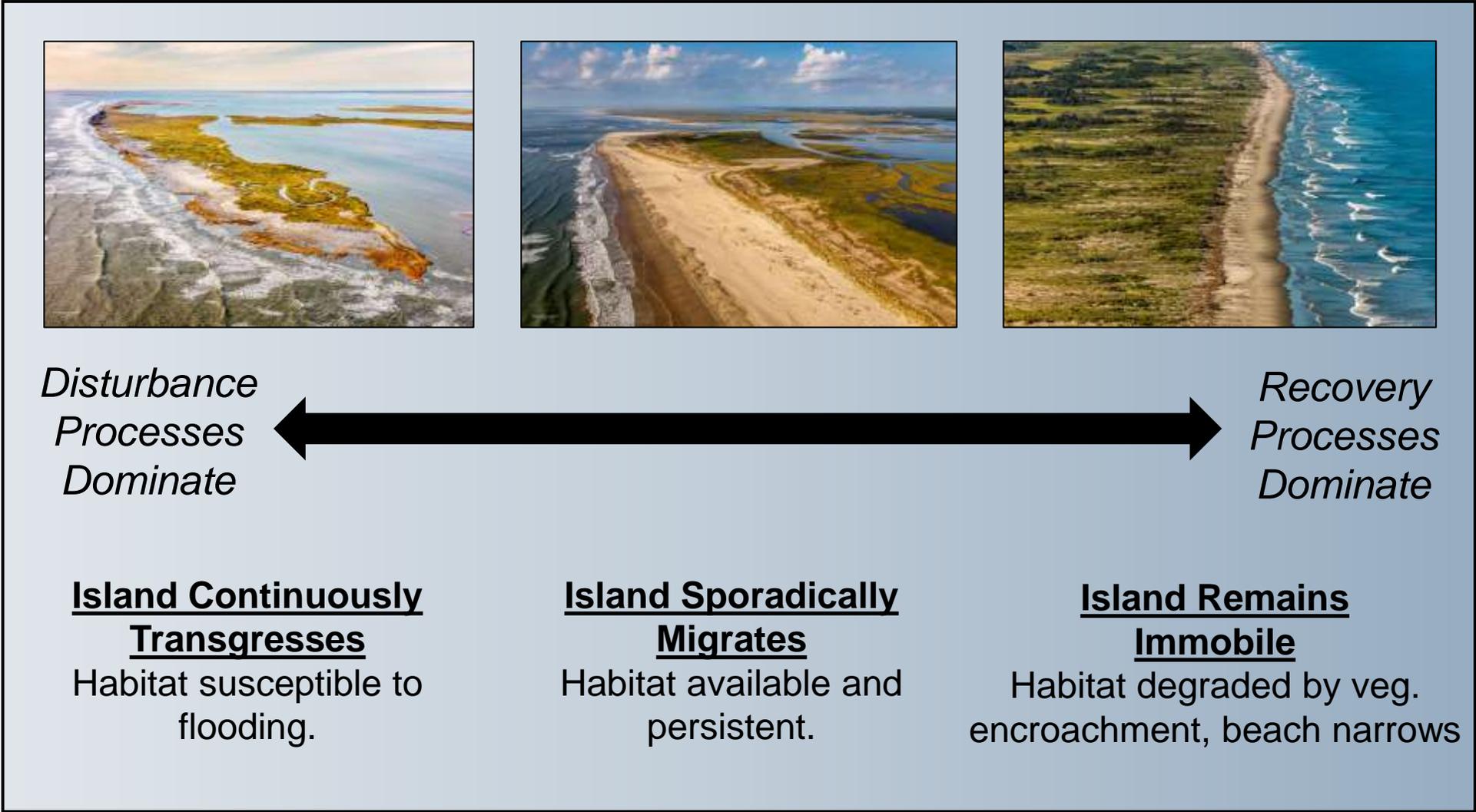
From 1940—2002, no directional change in beach area.

However,

Over the last ~ 30 yrs, there's been a 29% reduction in upland island area on some islands.

There's also been a major expansion of woody shrubs, with 40% of landcover converting from grassland to shrub thicket.

Change on the islands, means change in habitat.

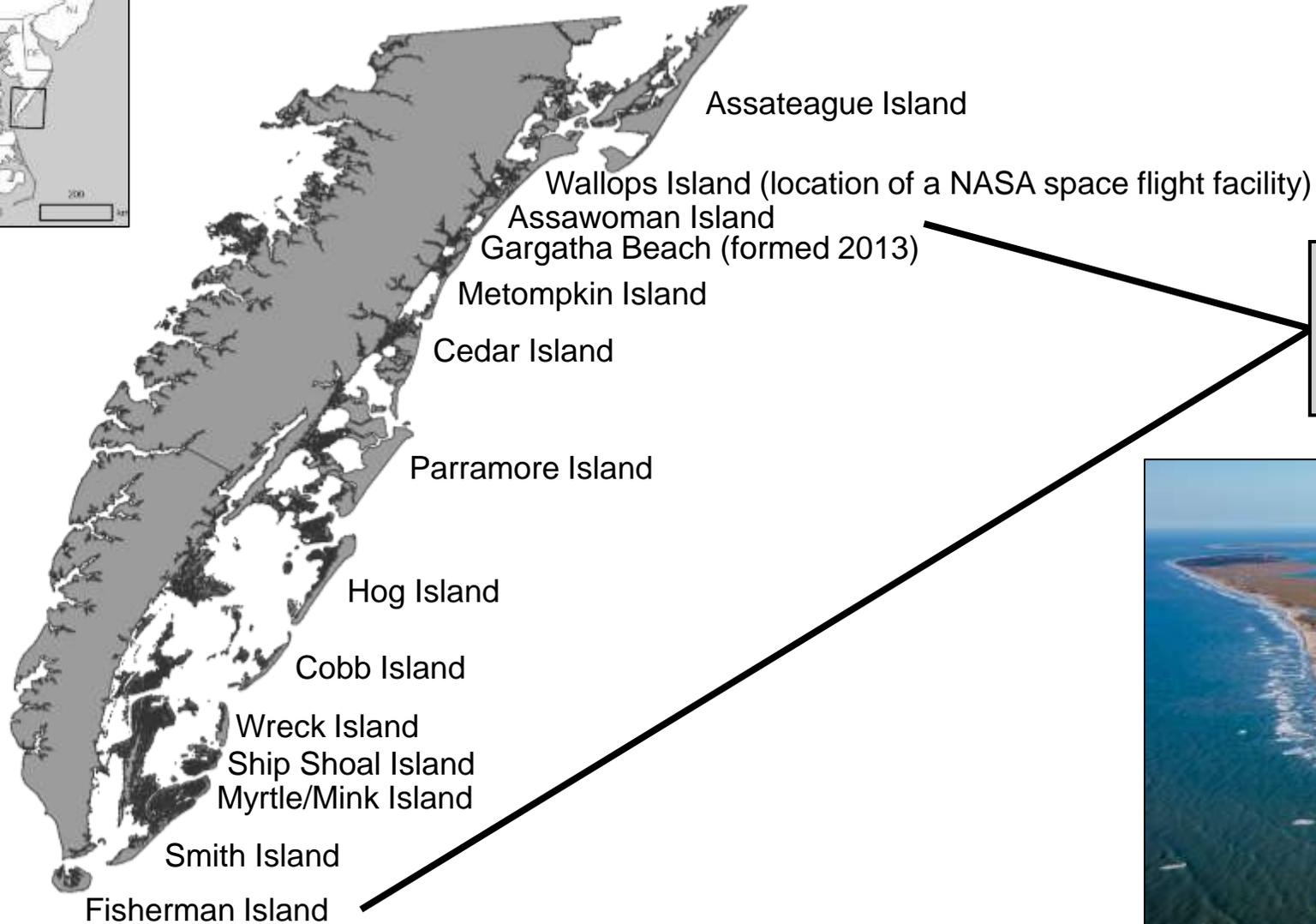
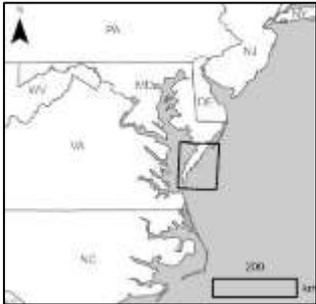


Vinent and Moore 2015 (Nat. Clim. Change); Zinnert et al. 2019 (Glob. Change Biol.); Reeves et al. 2021 (Geophys. Res. Lett.); Reeves et al. 2022 (J. Geophys. Res.: Earth Surf.)

Photos by Gordon Cambell | At Altitude Gallery

How has American oystercatcher nesting habitat changed in the Virginia barrier islands over time?



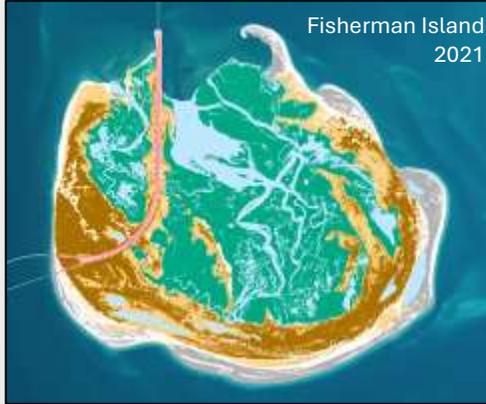


**Assawoman Island through
Fisherman Island included in this
analysis**



Photo by Gordon Cambell | At Altitude Gallery

(1) Assess spatiotemporal patterns of landcover change from 2004 to 2021 using supervised classification of aerial imagery

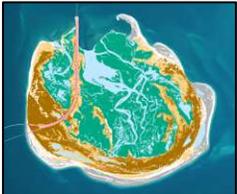


(2) Define oystercatcher nesting habitat with a second-order resource selection function.

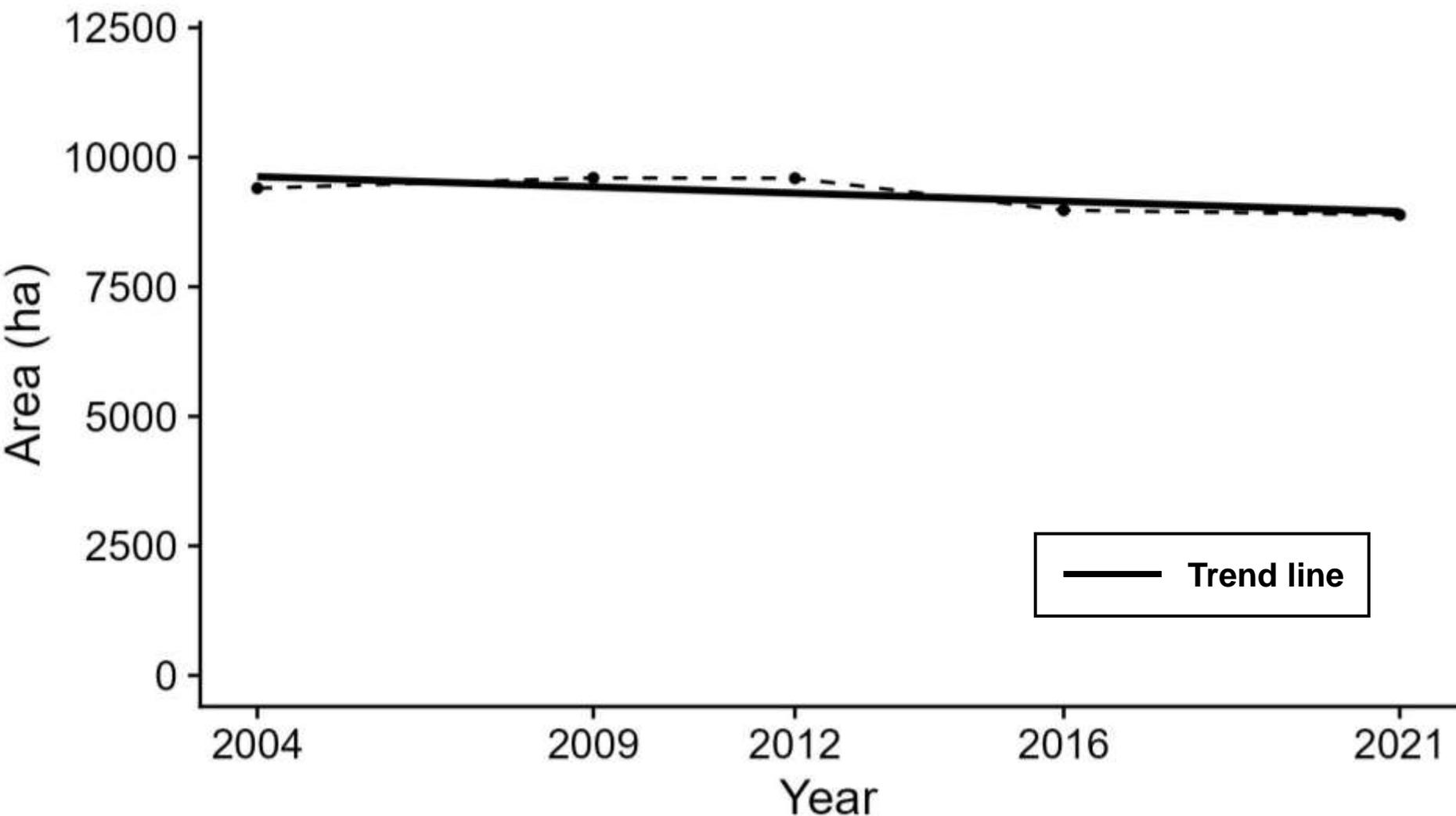


(3) Quantify patterns of availability of nesting habitat from 2004 to 2021, based on estimates from the habitat model.





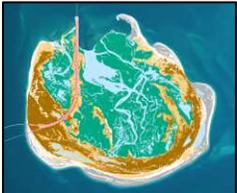
Patterns of landcover change: loss of island area



Total area of barrier island habitat minorly decreased.

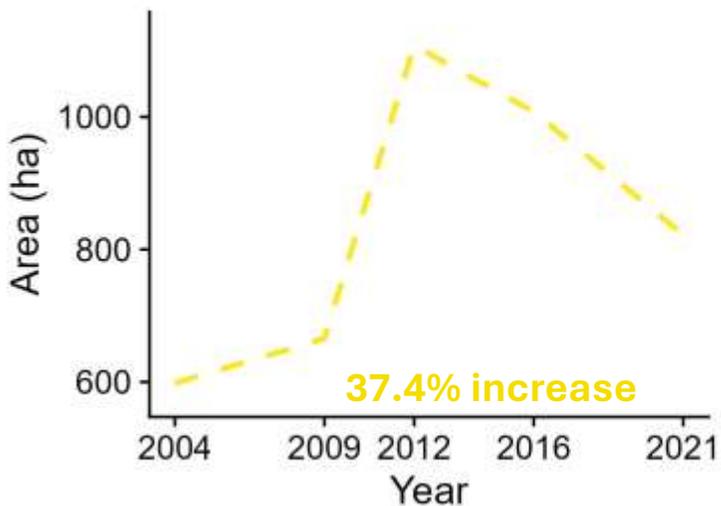
Percent change = -5.47%

— Trend line

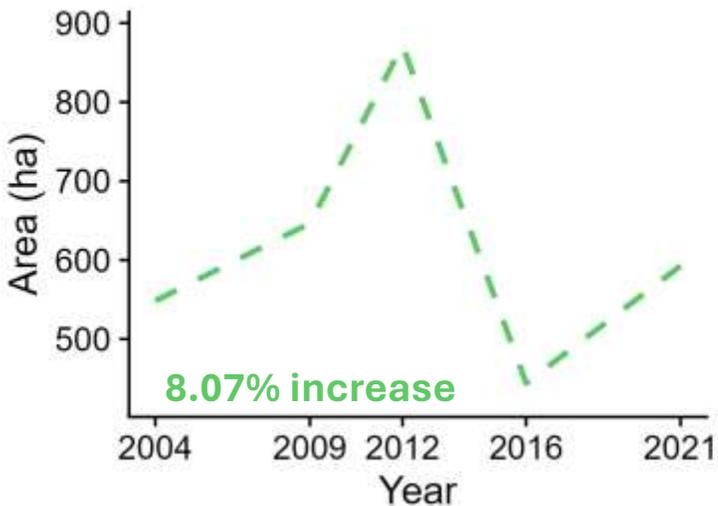


Patterns of landcover change: temporal variability

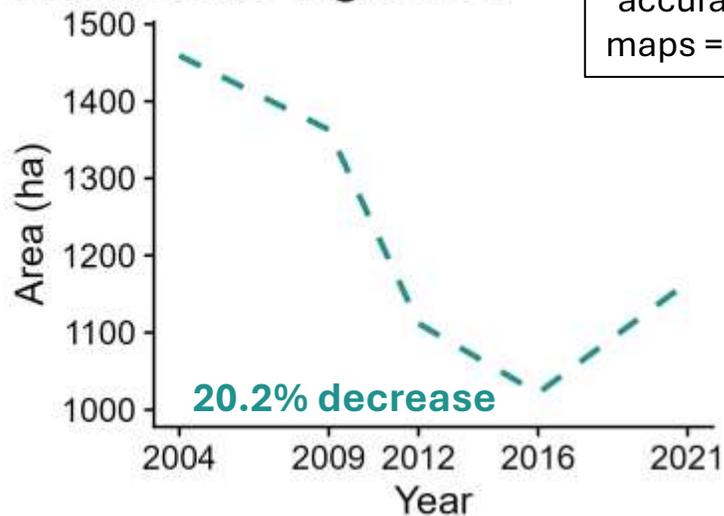
Dry sand



Wet sand

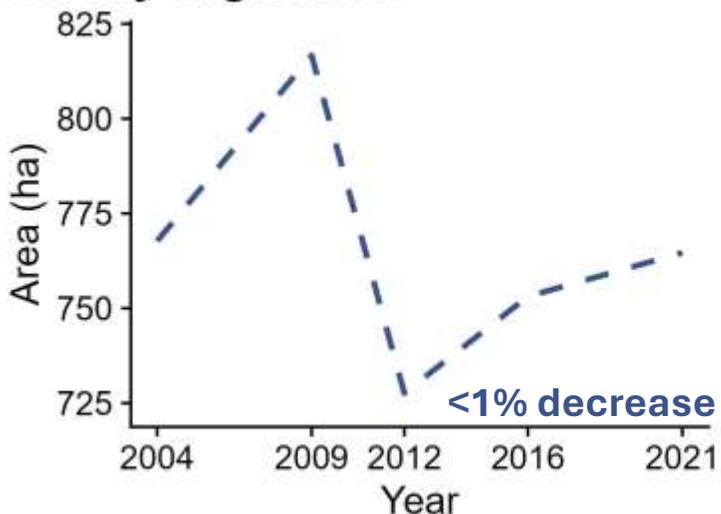


Herbaceous vegetation

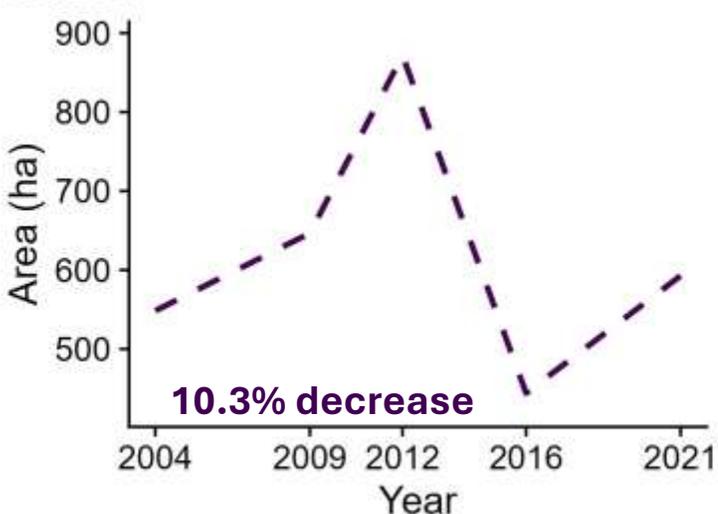


Average overall accuracy of landcover maps = 0.89 ± 0.03 (SD)

Woody vegetation

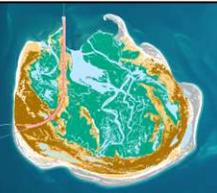


Marsh

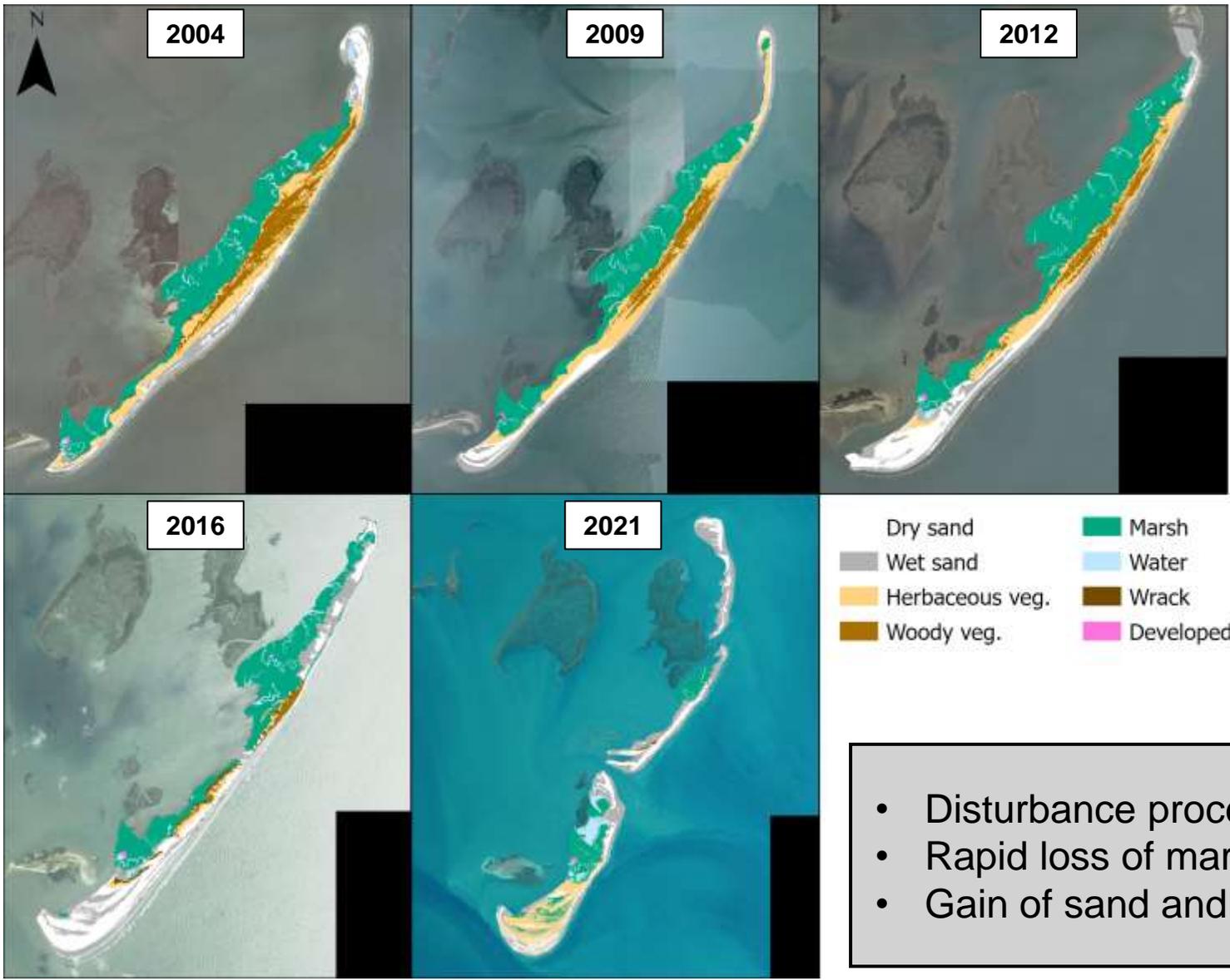


Directional change for all classes except woody vegetation, 2004-2021.

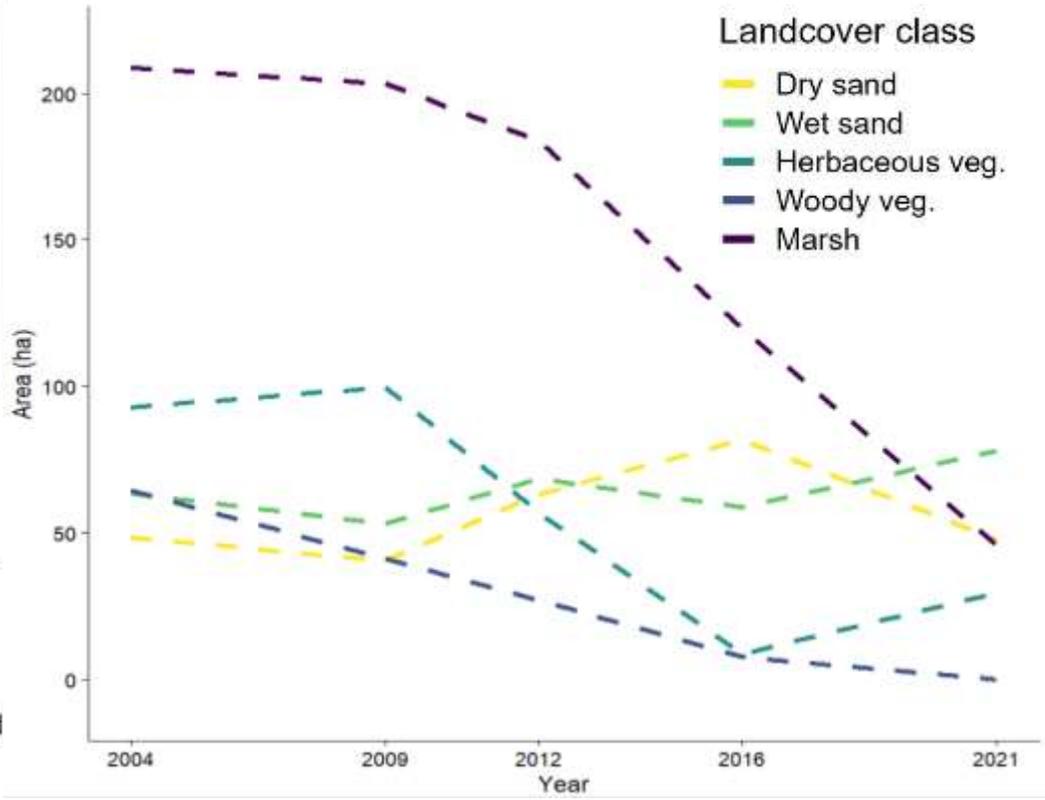
There is temporal variability (likely due to storms, especially 2009-2012).



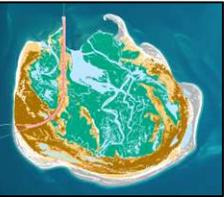
Patterns of landcover change: spatial variability



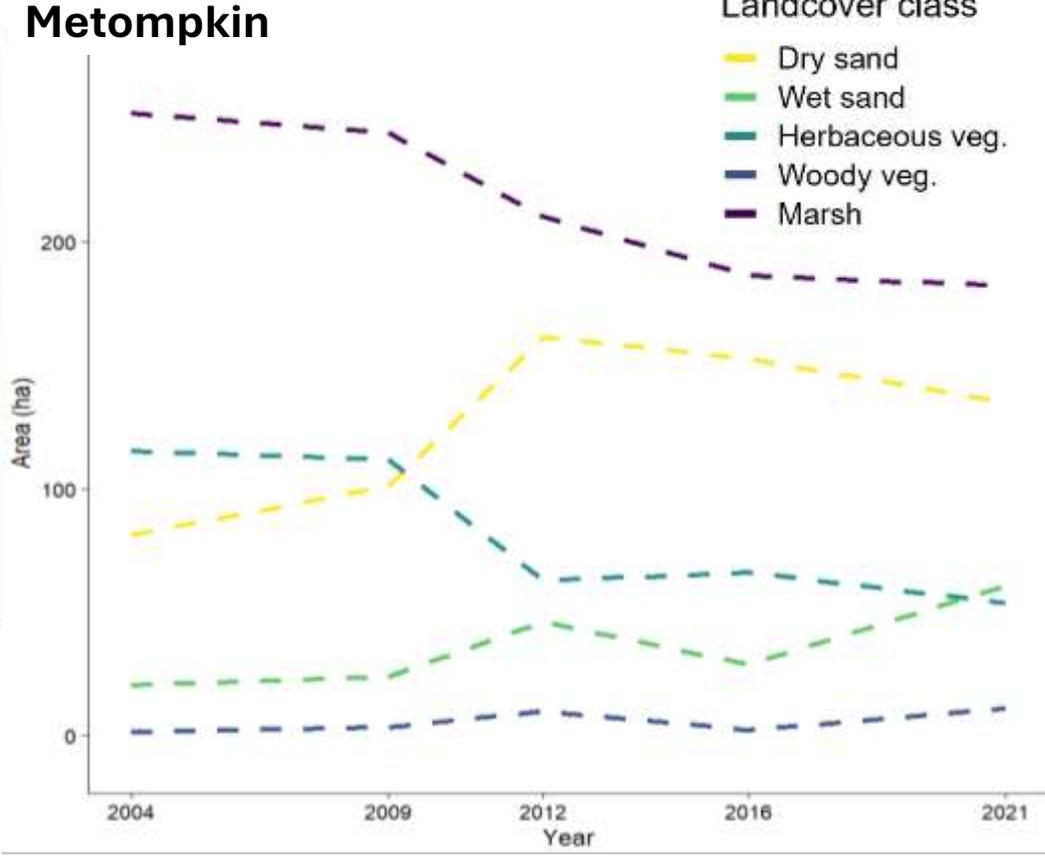
Cobb



- Disturbance processes dominate
- Rapid loss of marsh starting around 2012
- Gain of sand and loss of vegetation as island overwashes



Patterns of landcover change: spatial variability

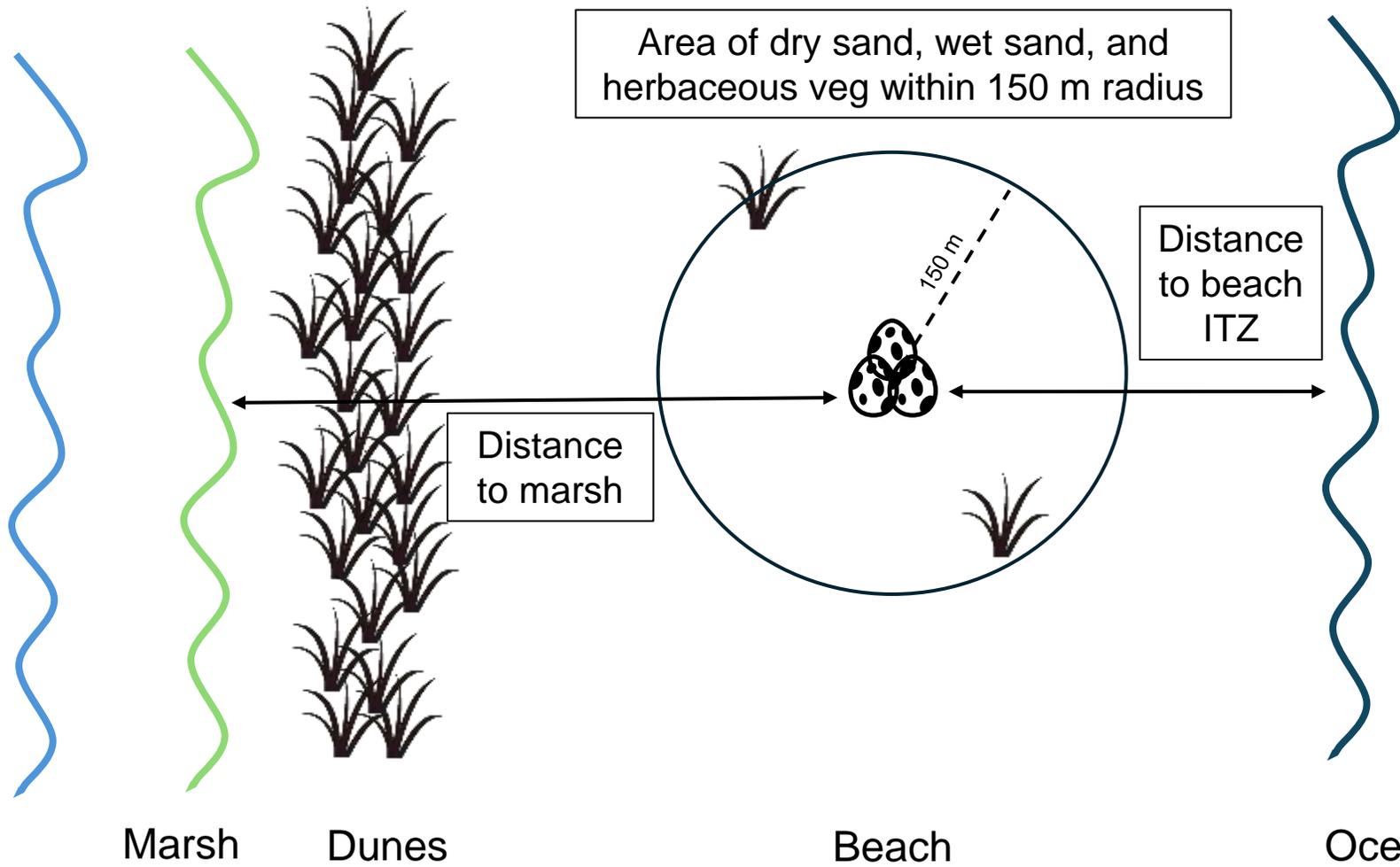


- Neither disturbance nor recovery processes dominate.
- Gain of sand and loss of marsh and herbaceous veg. following overwash.
- Climate-driven grassland to shrubland transition evident.



Oystercatcher habitat selection

Second order resource selection function (use vs. availability):



Variables selected to represent factors hypothesized as important for use, e.g., substrate, viewshed, susceptibility to flooding, and proximity to foraging habitat.

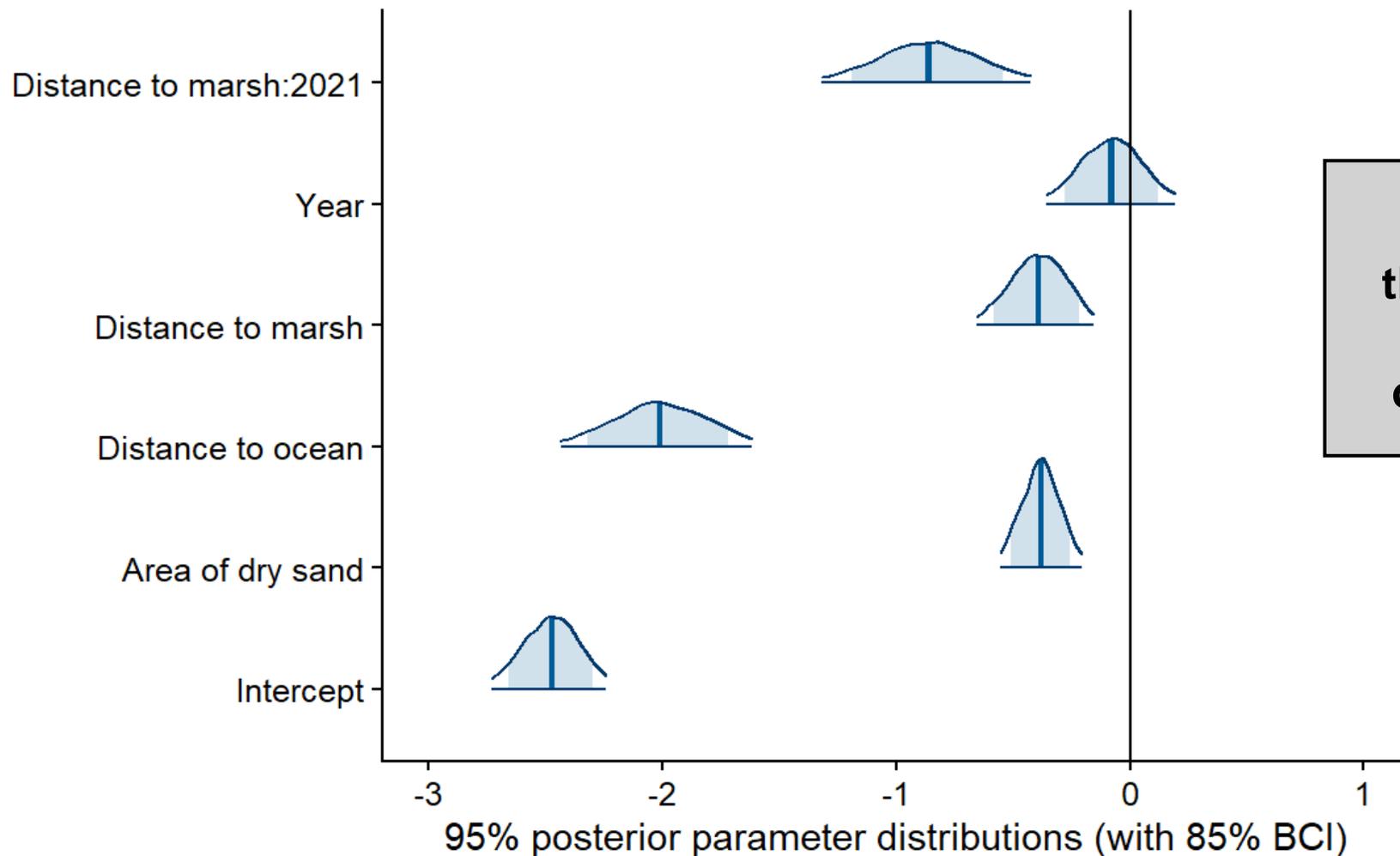
5 independent random points per nest, constrained to upland

All predictor variables interact with year.



Oystercatcher habitat selection

Results from 2004 and 2021 data
N = 444 nests, 2220 random



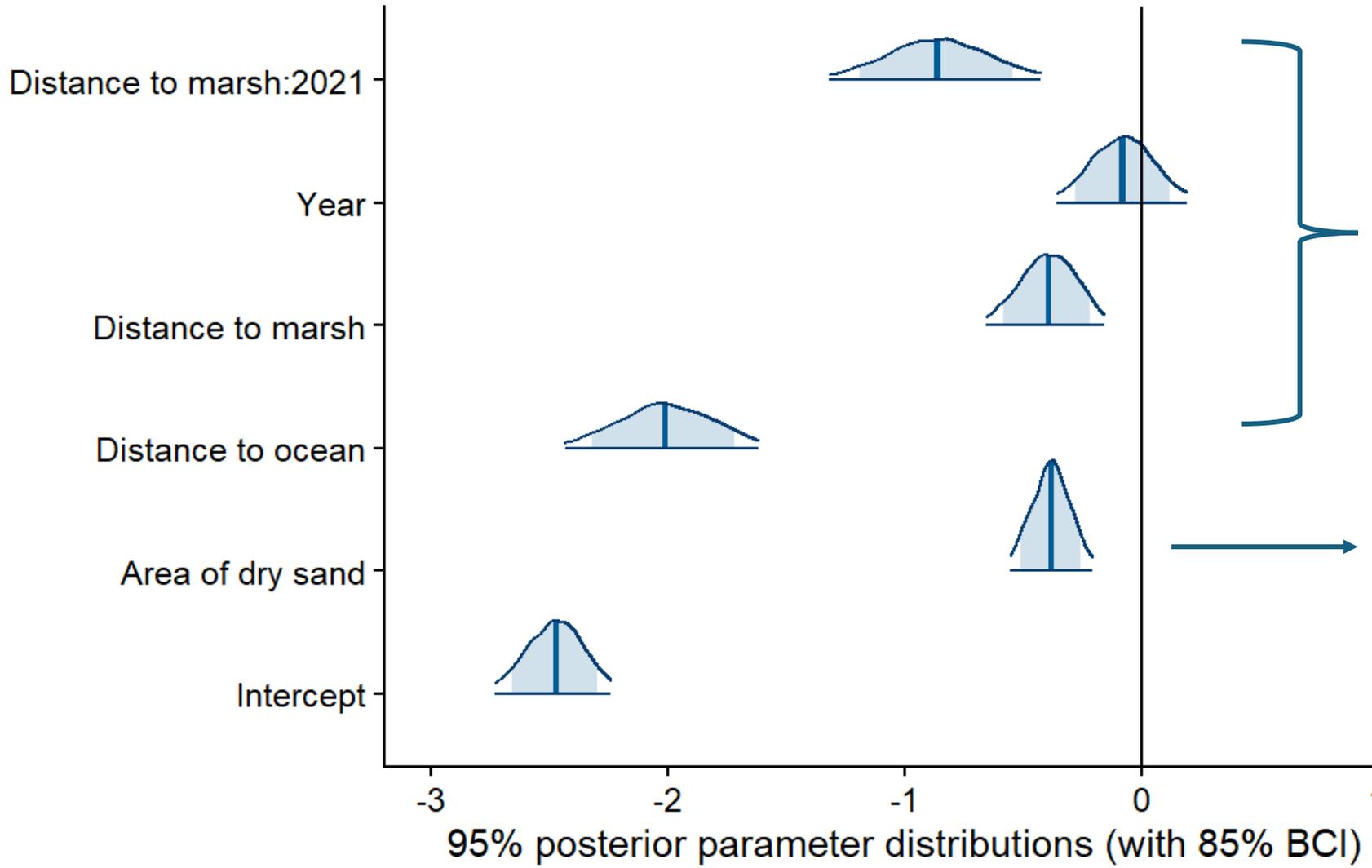
**Negative effect →
the greater the predictor value,
the less likely an
oystercatcher is to nest there.**

These are preliminary results. Results are expected to change as the model is refined. PLEASE DO NOT CITE.



Oystercatcher habitat selection

Results from 2004 and 2021 data
N = 444 nests, 2220 random



 Not nesting far from marsh. Even *less* likely to nest far from the marsh in 2021 (relative to 2004).

 Also not nesting far from the beach ITZ (this is a strong effect).

Probably nesting in a sweet spot somewhere on the beach.

 Not nesting in areas with *a lot* of dry sand.

Likely nesting near at least some vegetation?



Patterns of habitat availability

Not suitable for nesting
Somewhat suitable for nesting
Highly suitable for nesting

Metompkin Island (north end)

2004



2021



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Some things to consider...

Even if overall habitat availability stays the same, spatial distributions change.

Causes localized changes in productivity.

Not necessarily useful if there is high breeding site fidelity.



Some things to consider...

There is likely a lag in coastal response to sea-level rise.

The response observed now is due to past rates of sea-level rise (> 100 years ago), not recent rates (past decades).

Barrier island retreat in Virginia is predicted to accelerate in response to modern rates of sea-level rise and as the sediment budget runs out (Mariotti and Hein. 2022. Geosci.)



Some things to consider...

Habitat availability is not the same as habitat quality.

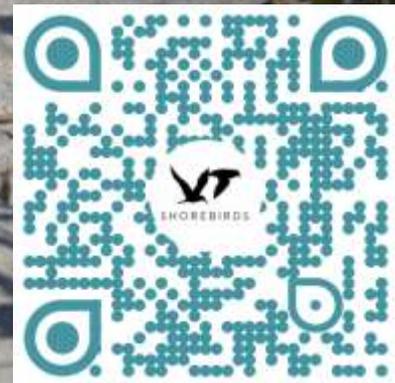
These models do not consider elevation, an important microhabitat characteristic for oystercatcher nest sites (Grand et al. 2025. Ornith. Appl.).

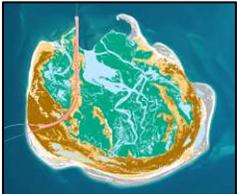
Population collapse can happen before habitat loss occurs (van de Pol et al. 2024. Nat. Clim. Change).

Questions?

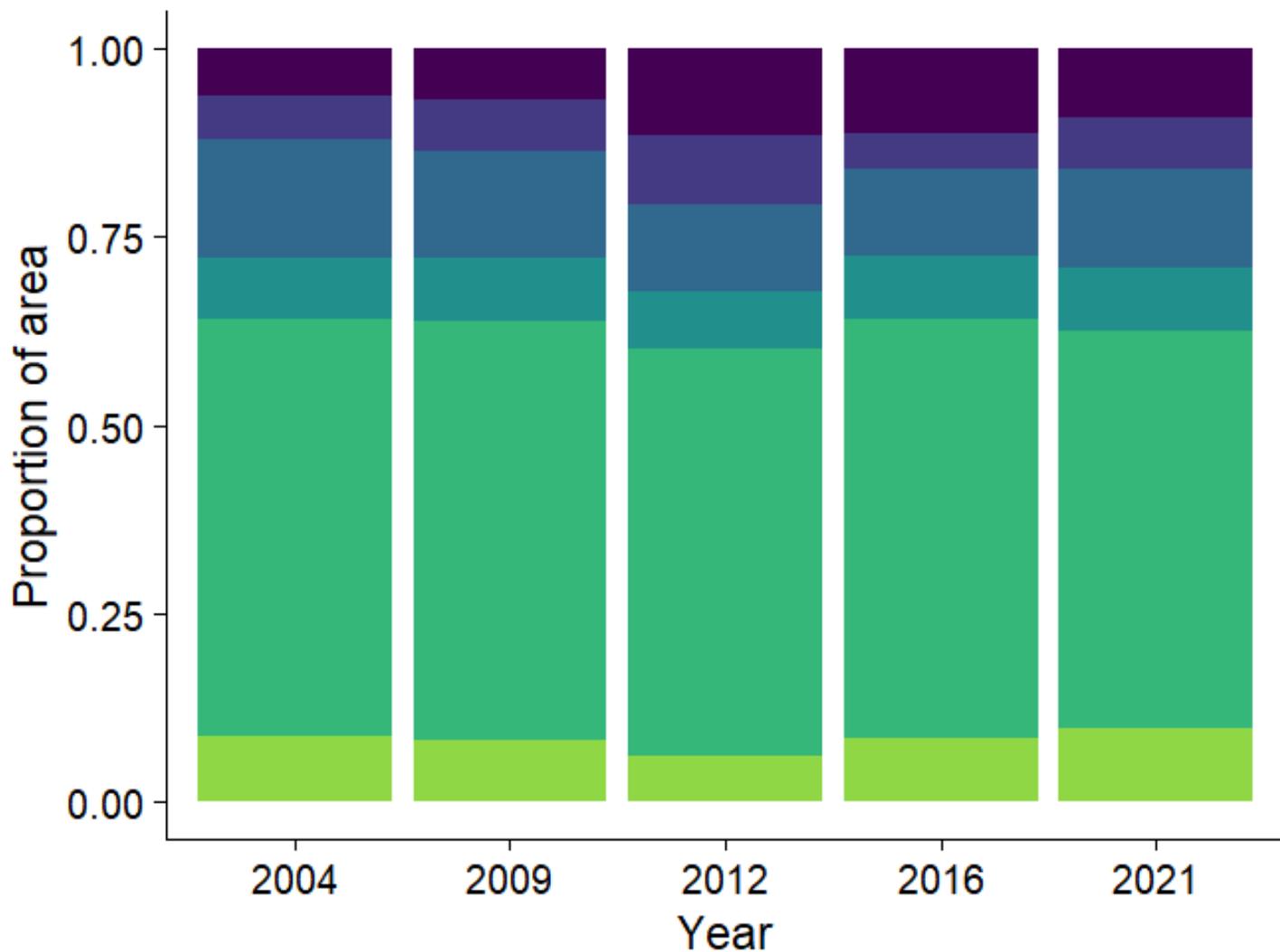


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Patterns of landcover change



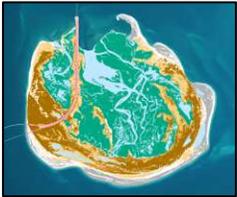
Landcover class

- Dry sand
- Wet sand
- Herbaceous veg.
- Woody veg.
- Marsh
- Water
- Developed

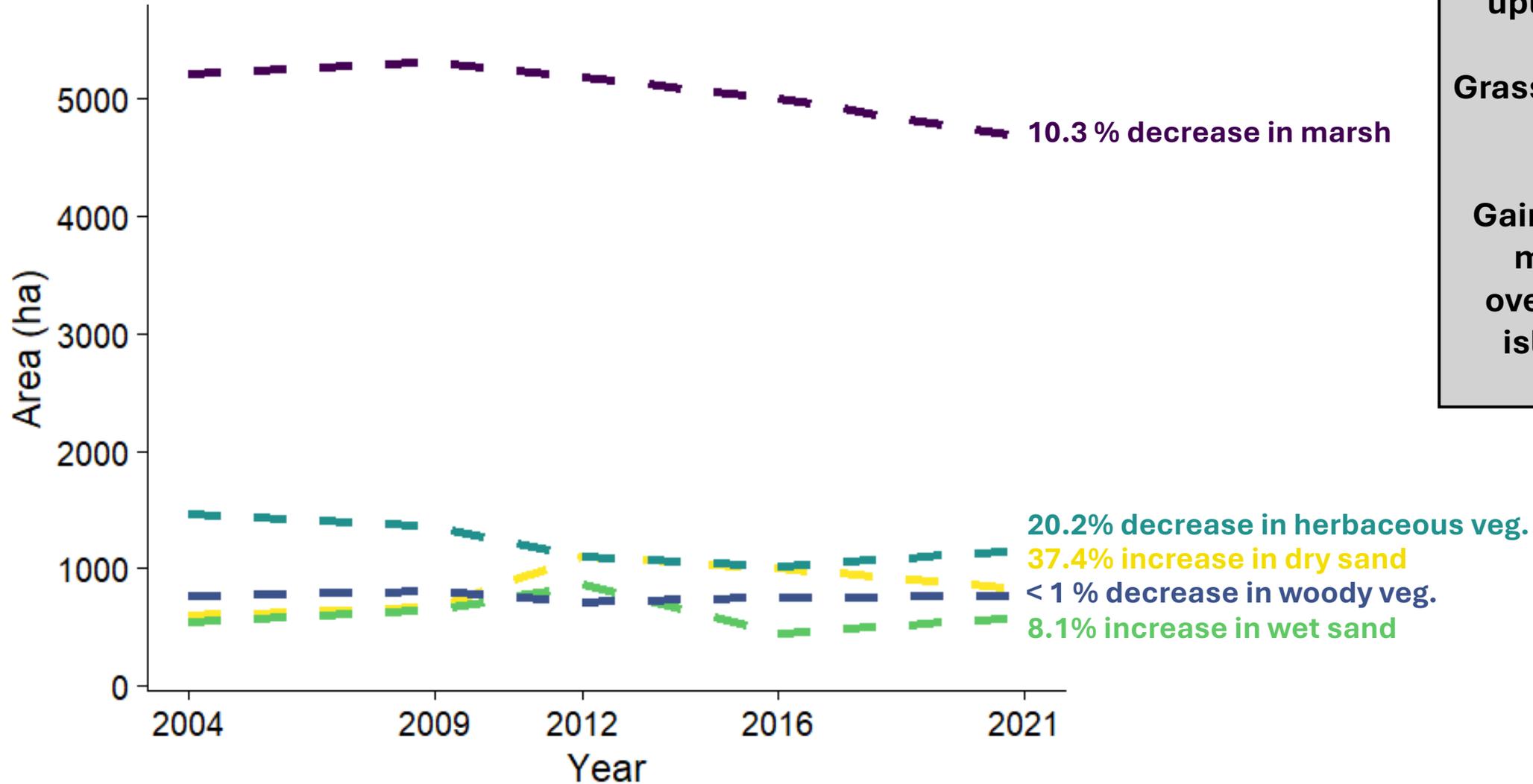
Marsh makes up the greatest area of barrier island habitat.

Upland areas include sand and herbaceous and woody veg.

Very little to no development!



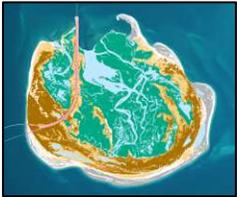
Patterns of landcover change



Marsh loss from marsh erosion and marsh-to-upland conversion.

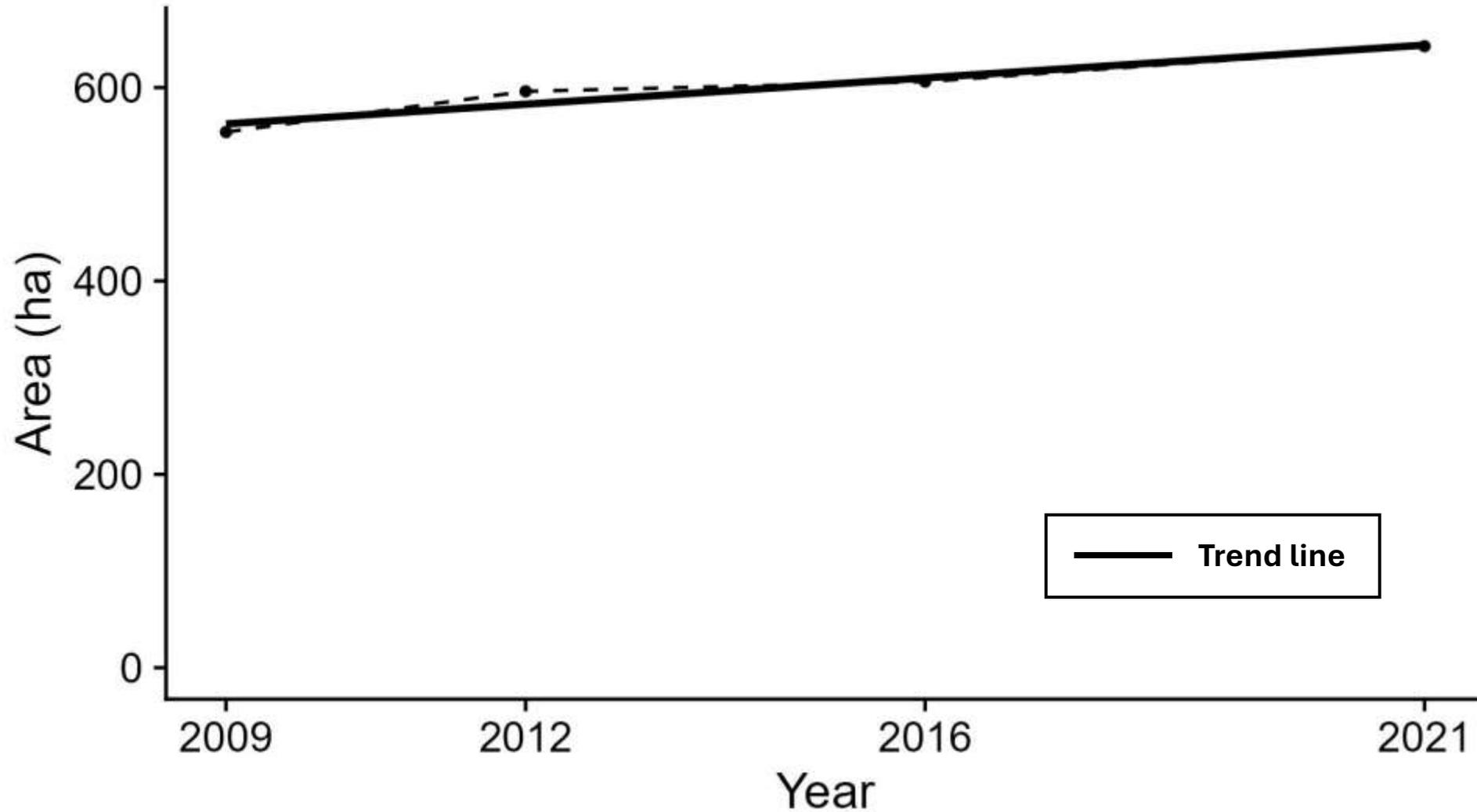
Grassland to shrubland conversion.

Gain in sandy habitat may be a sign of overwash and rapid island migration?



Patterns of landcover change

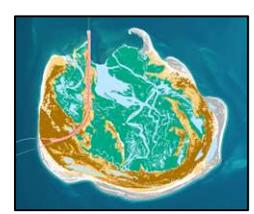
Assateague



Total area of barrier island habitat increased as hook grew.

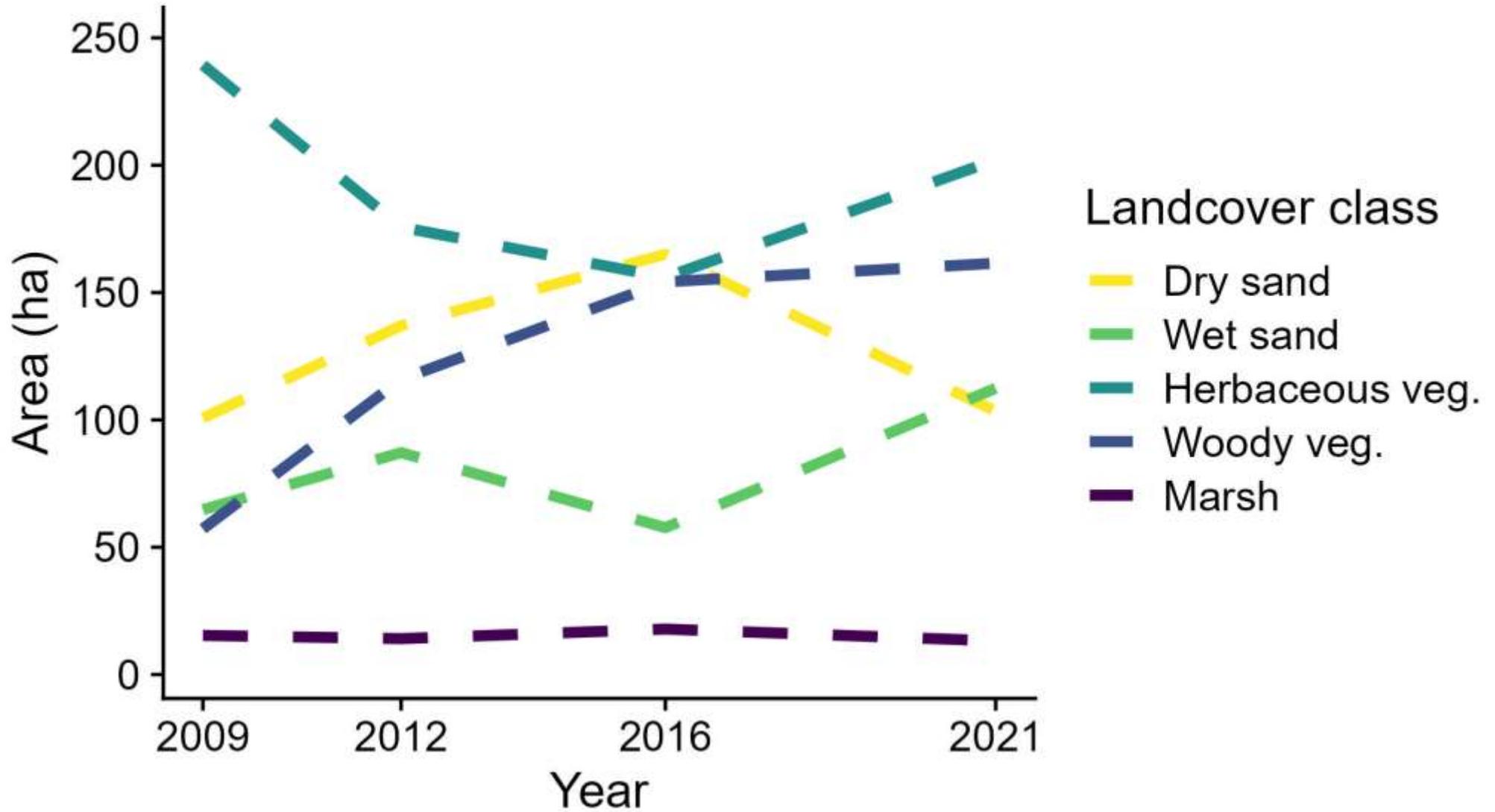
Percent change = 16.03%

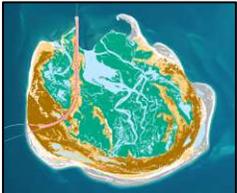
— Trend line



Patterns of landcover change

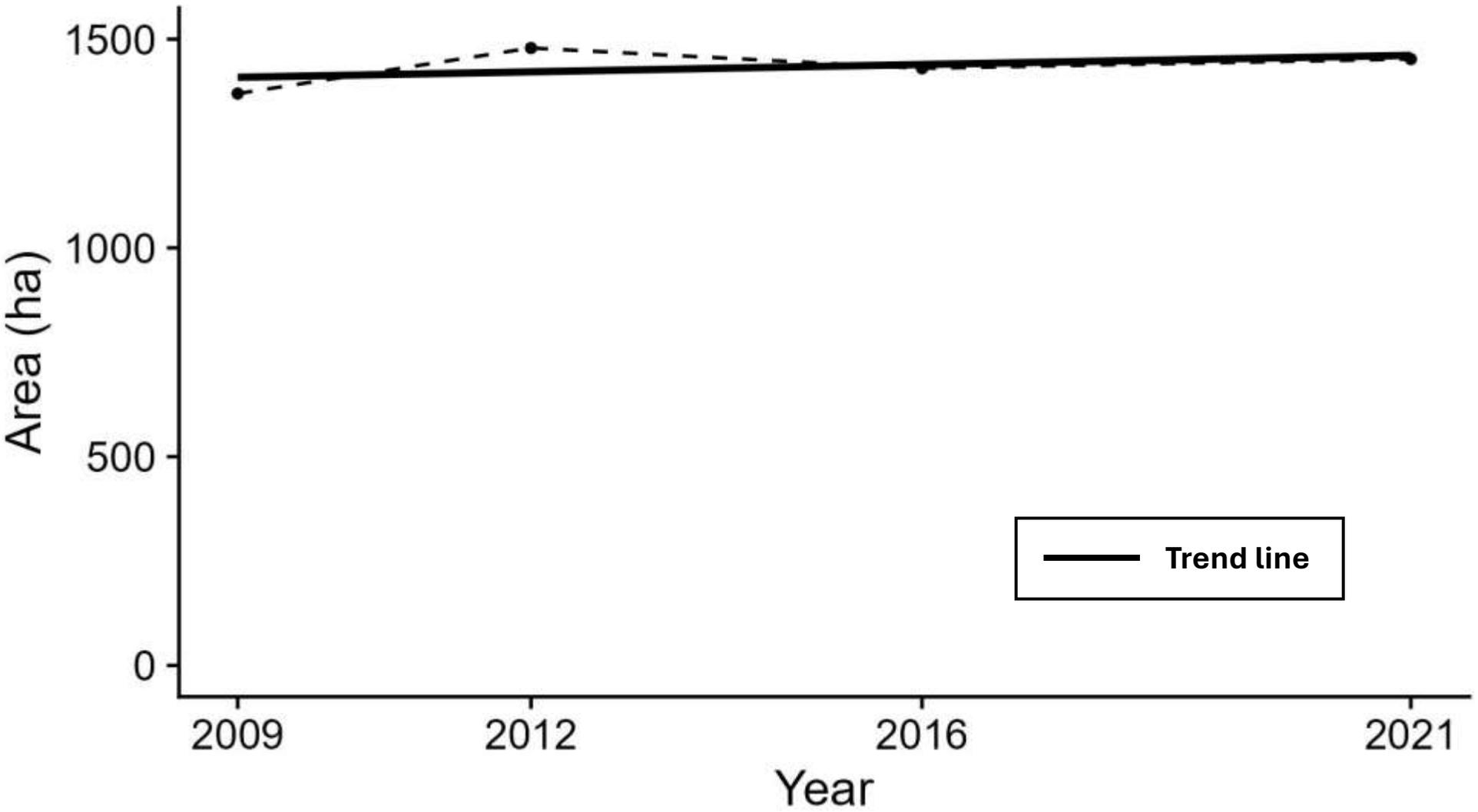
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Patterns of landcover change

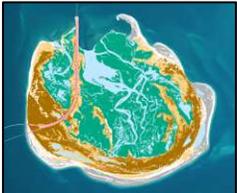
Wallops



— Trend line

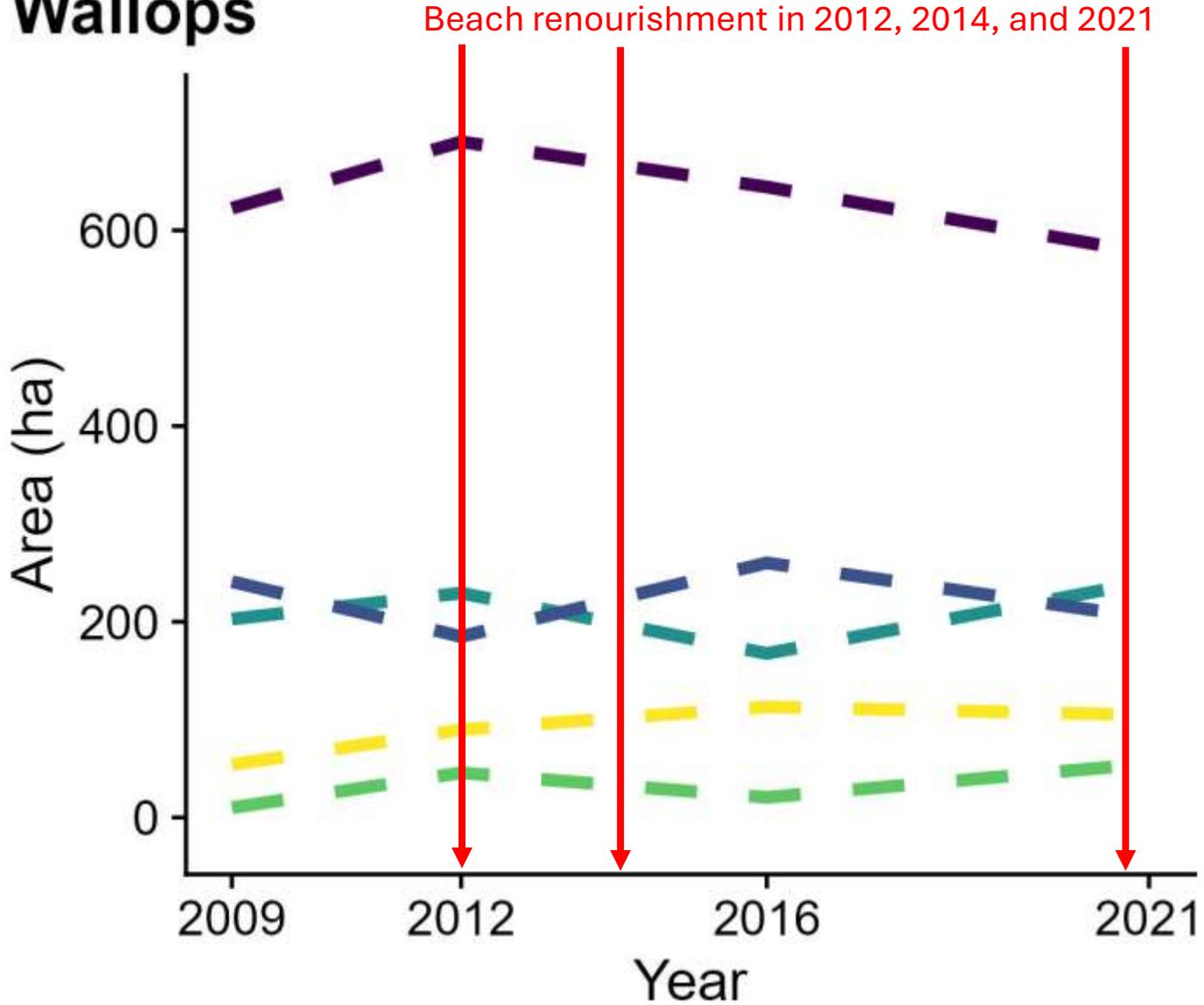
Total area of barrier island habitat minorly increased.

Percent change = 6.04%



Patterns of landcover change

Wallops

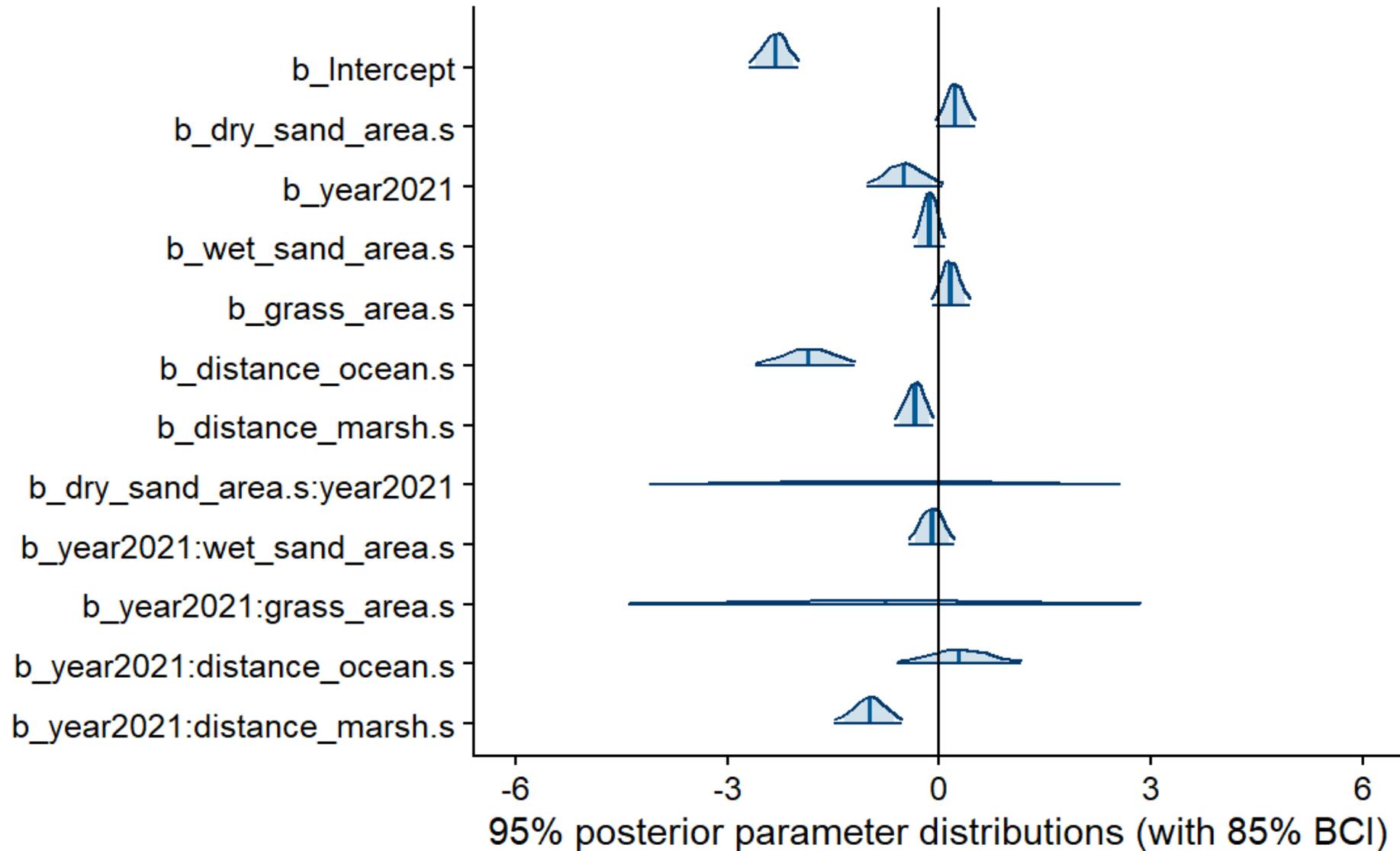


Landcover class

- Dry sand
- Wet sand
- Herbaceous veg.
- Woody veg.
- Saltmarsh

Results from 2004 and 2021 data
N = 444 nests, 2220 random

Oystercatcher habitat selection



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