Seasonal variations in larval connectivity of *Crassostrea virginica* in Apalachicola Bay, FL

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Crassostrea virginica

The eastern oyster
- Estuarine species

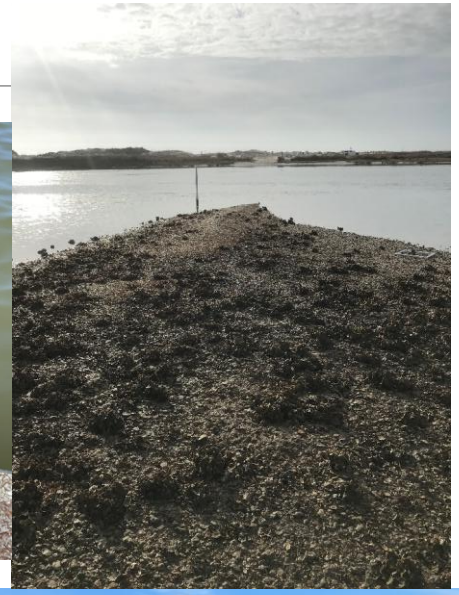
Important reef builder
- Atlantic Coast
- Gulf of Mexico

Stabilize coastlines, improve water quality

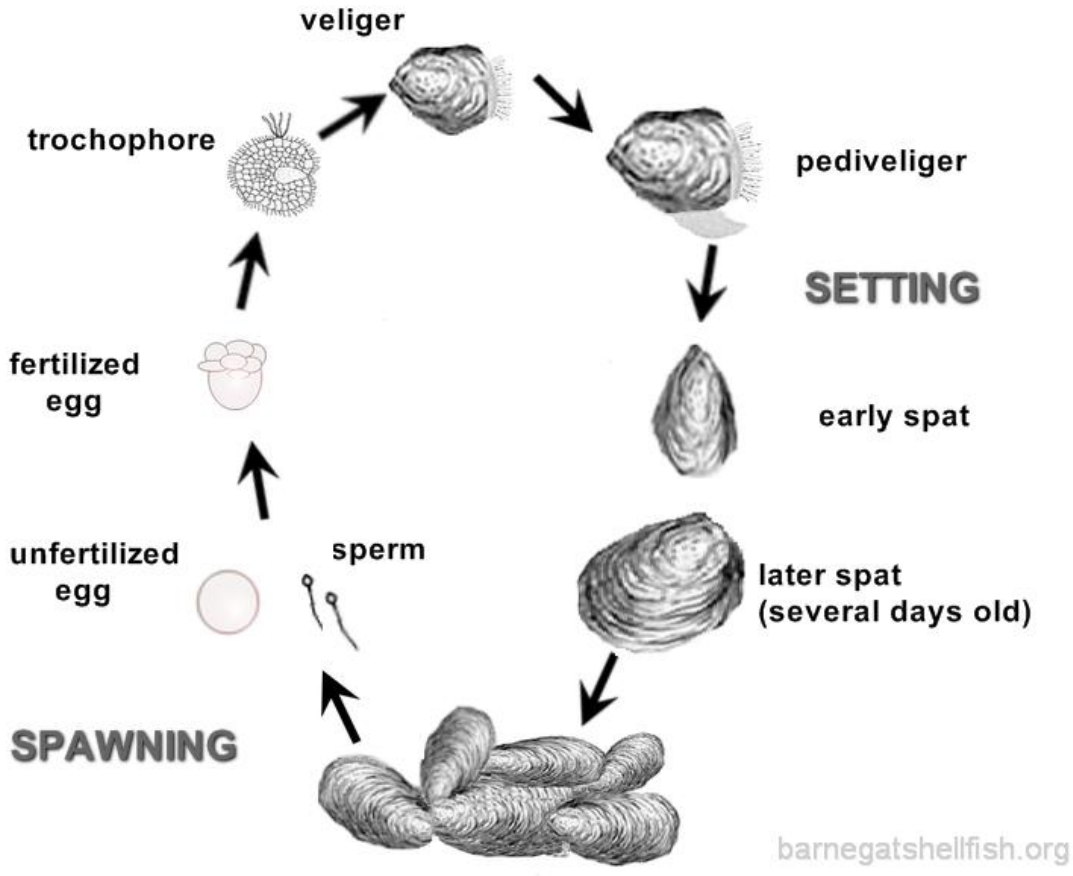
Historical food source & fishery
- One of seven commercially harvested oyster species
- Wild Harvest
- Aquaculture

Complex life cycle

Declining throughout range 85-90%



Larval Dispersal & Distribution



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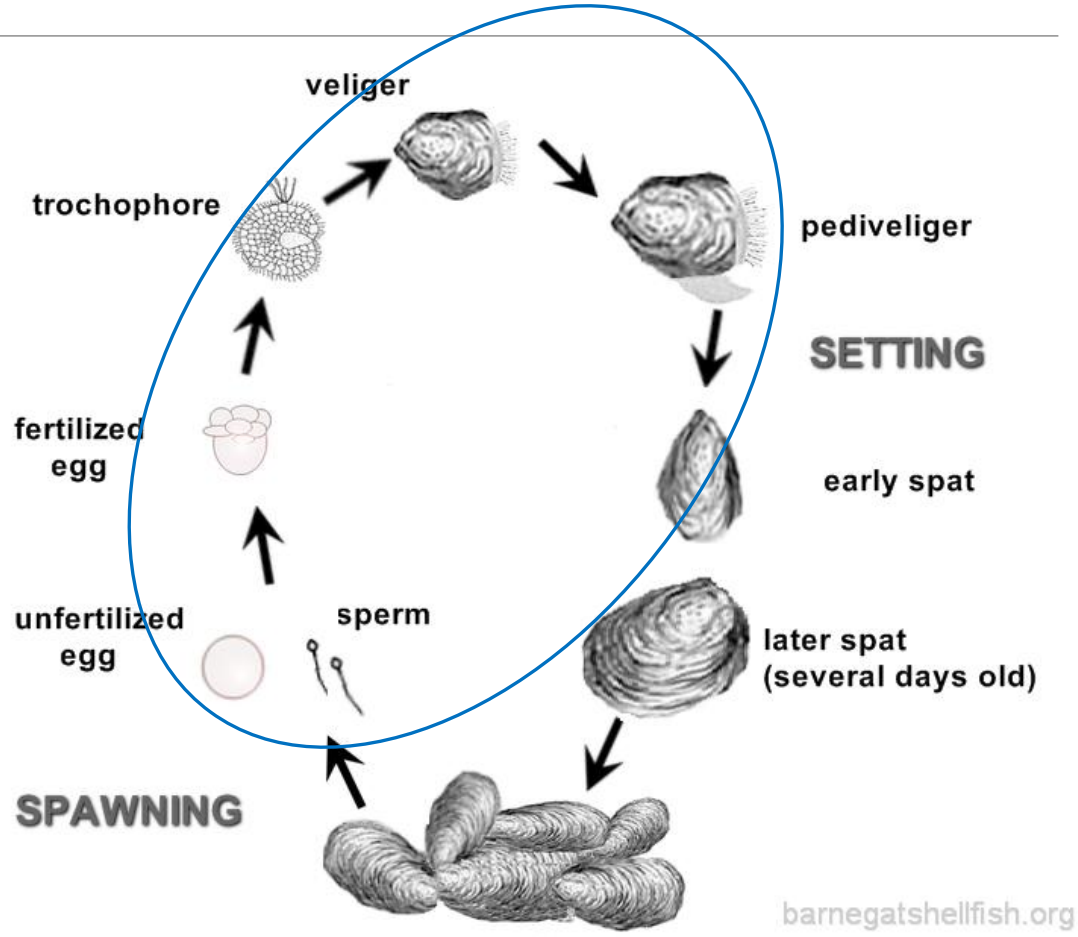


Larval Dispersal & Distribution

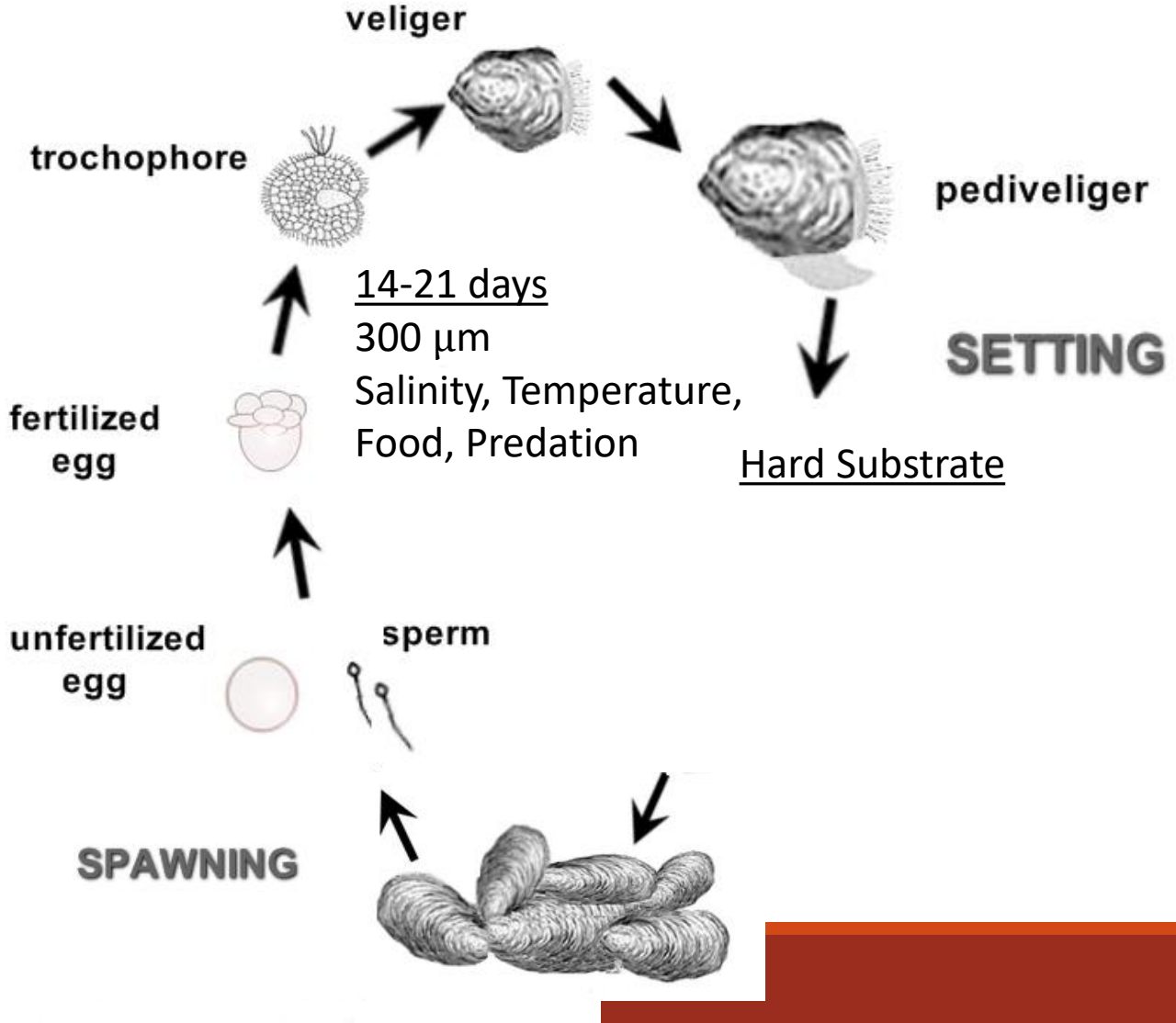
Most mobile, most vulnerable

Spawning behavior

- Broadcast spawn
- Correlated with temperature, changes in seasons

Dispersal

- Planktonic – limited swimming, goes where the water takes it
- Growth and mortality varies with S,T
- Survival requires hard substrate



Larval Dispersal & Distribution

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- Broadcast Spawn
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Dispersal

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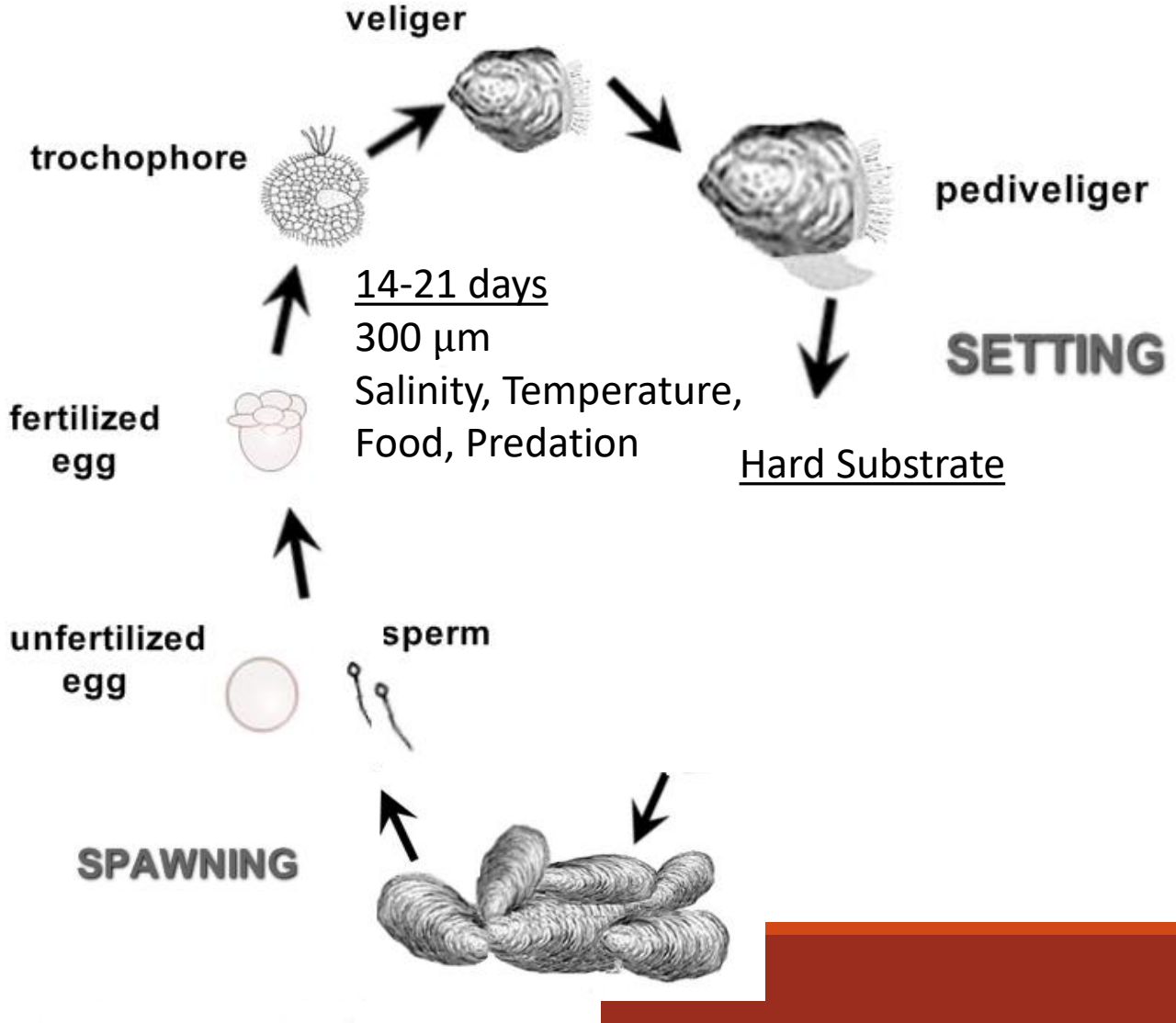
<u>Environment influences larval growth and survival</u>

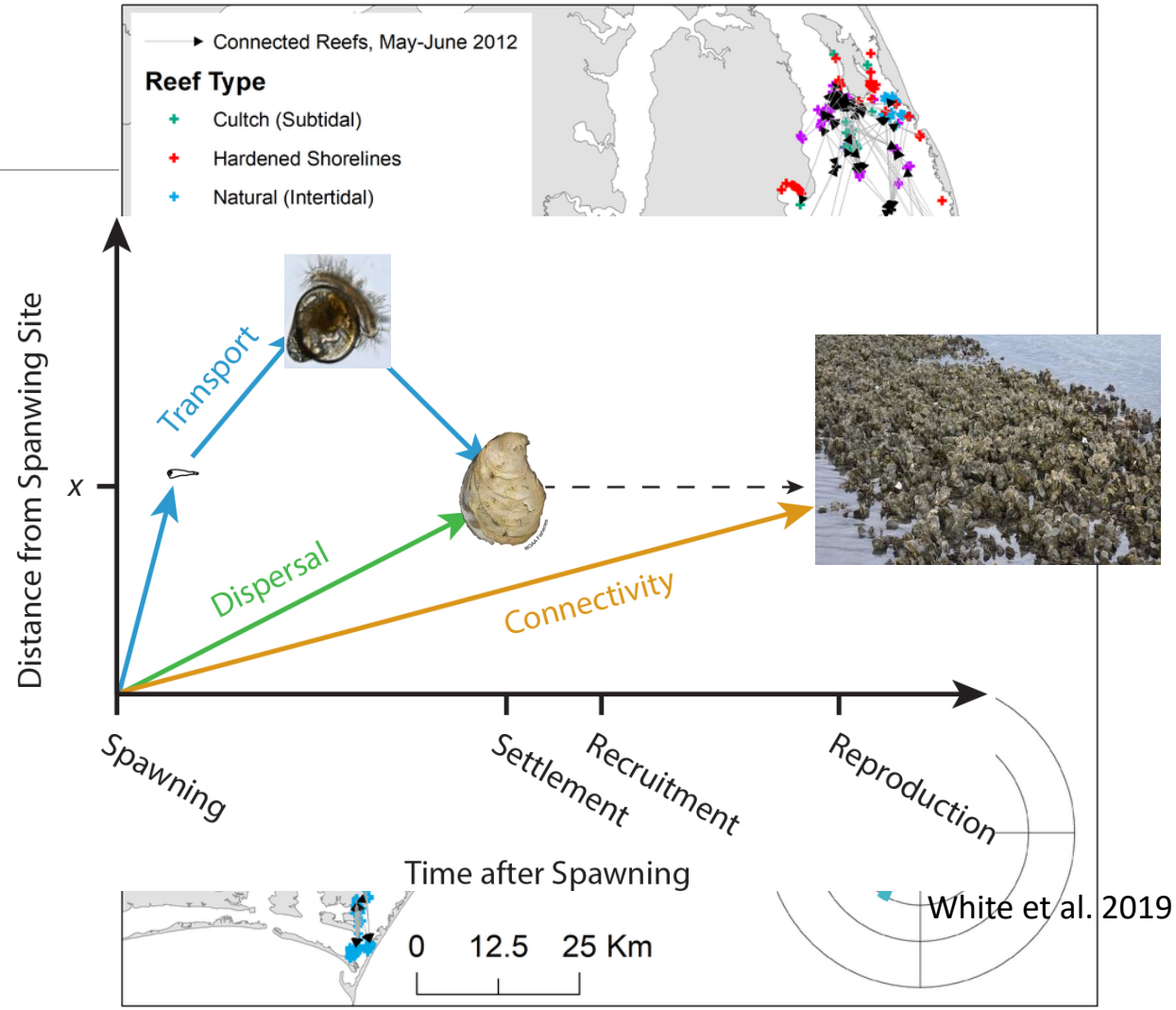


Larval Dynamics

Recruitment dynamics
- Larval Supply – Who survived?
- Source – Produced more than settled
- Sink - Settled more than made

Connectivity
- Did they settle anywhere different?
- Impacts resilience, recovery potential

Spatial planning
- Exploration
- Identification
- Restoration
- Protection



White et al. 2019

Theuerkauf and Puckett 2021

Modeling Approach

Goal

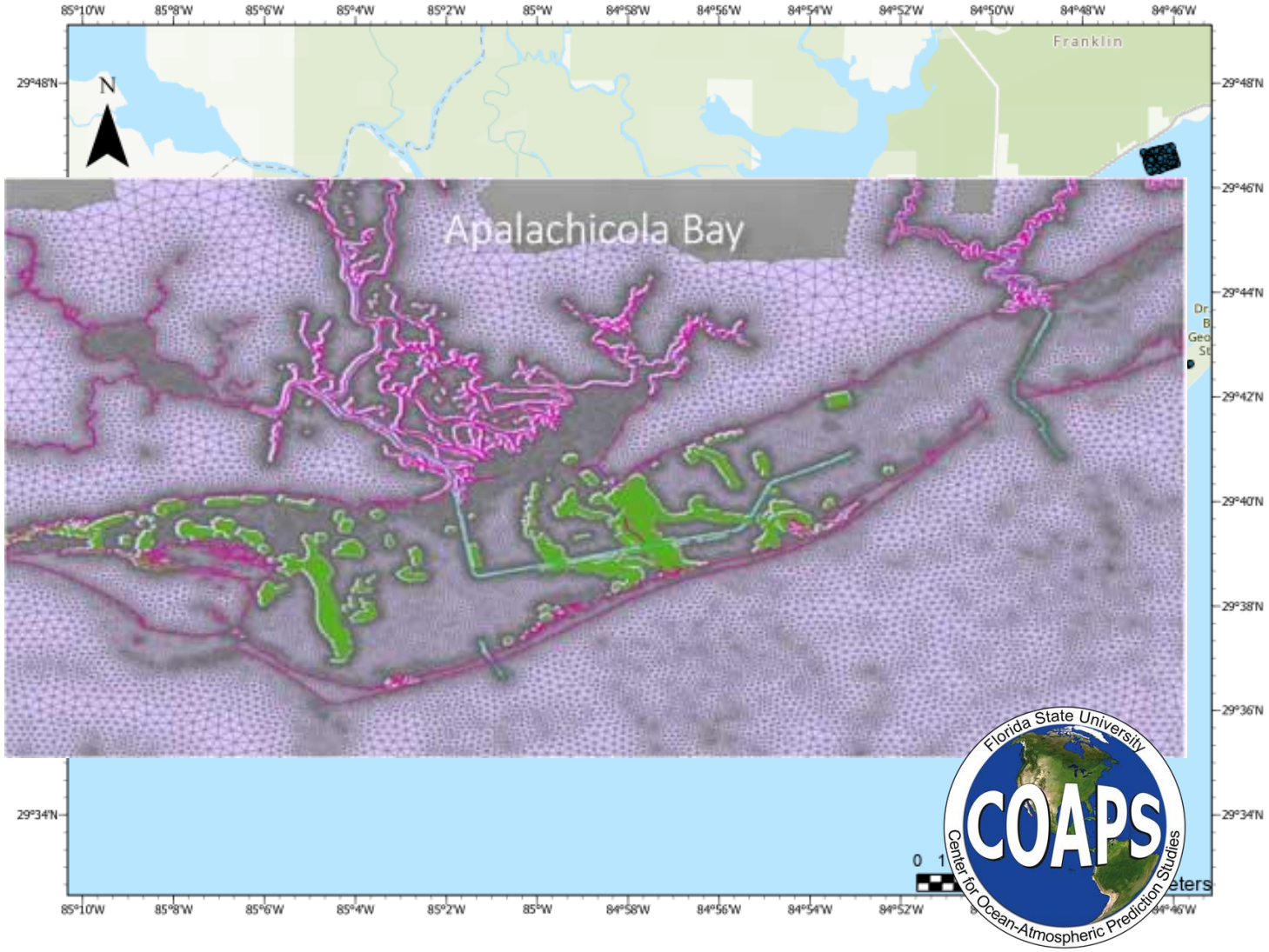
- Understand effect of environment on larval survival
- Create a coupled bio-physical model of larval growth and mortality

Methods

- Novel hydrodynamic model – COAPS
- Hatchery derived growth experiments – Fuqua and Brooke, 2025
- Modeled larval spawn

Analysis

- Calculate larval survival
- Estimate larval dispersal patterns



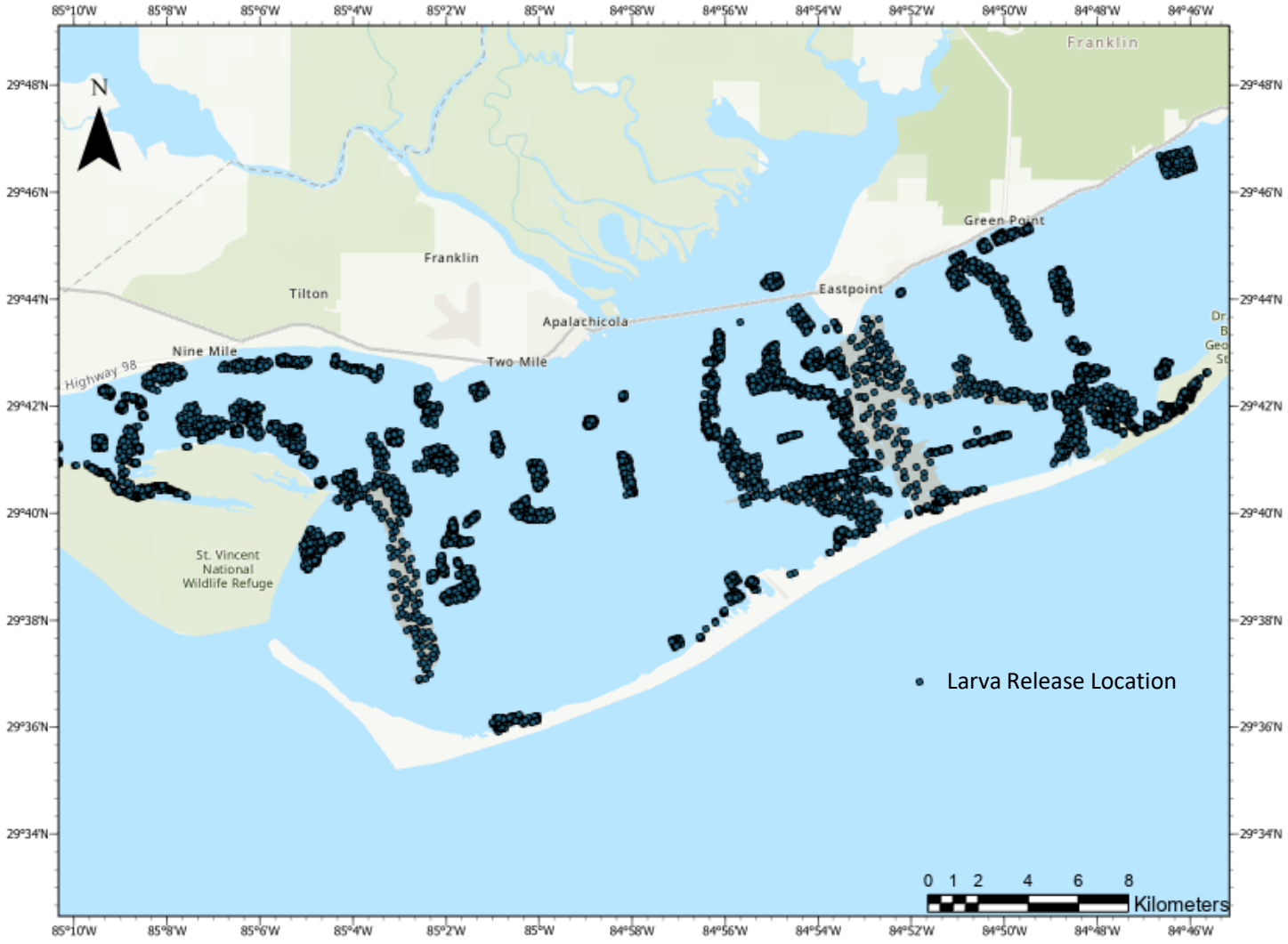
Environmental Conditions

Two major known spawns

- Spring - Early May - June
- Fall - Sept-October

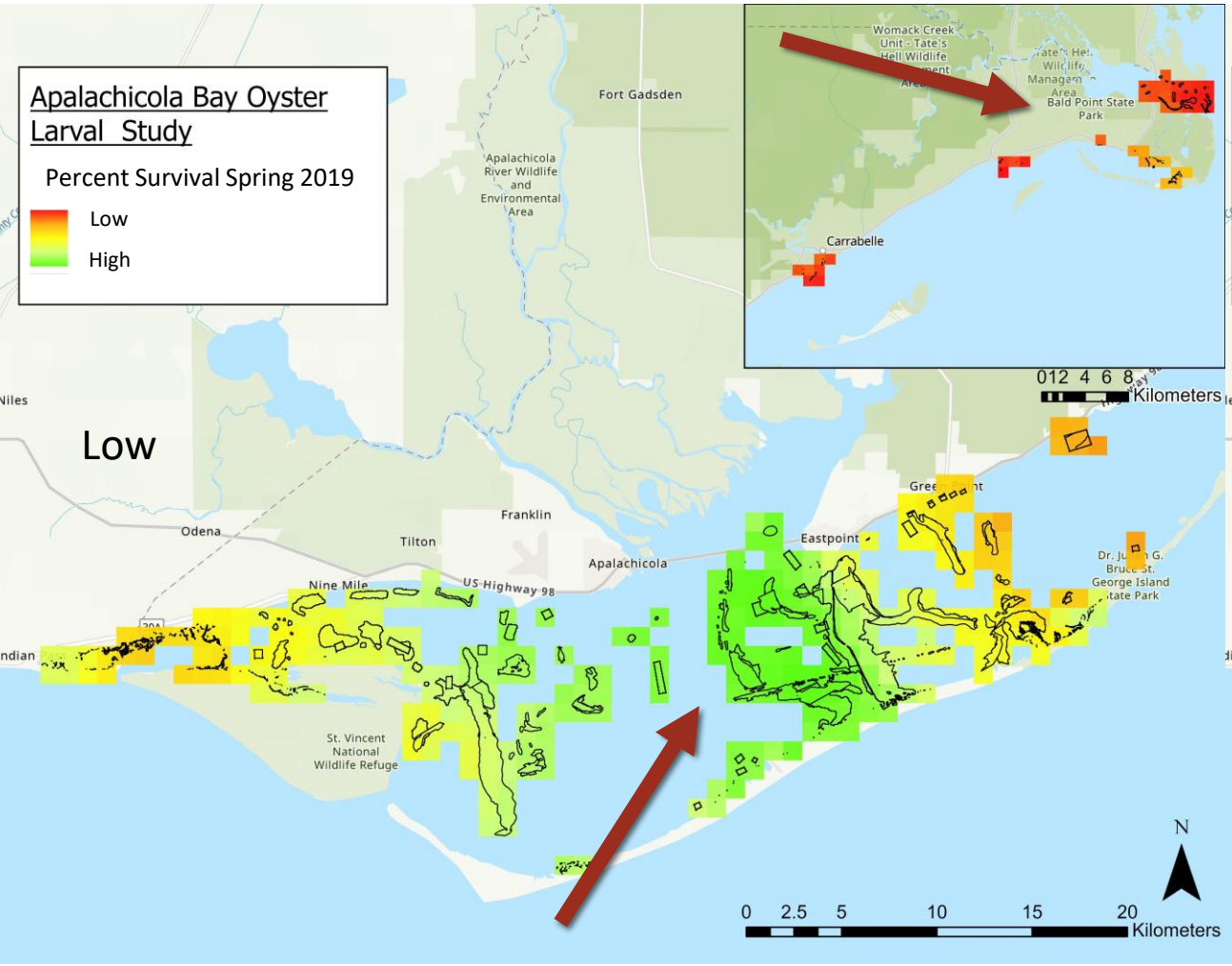
Climate scenarios

- Normal -2019
- ‘Drought’ - 2012
- ‘Flood’ – 1998

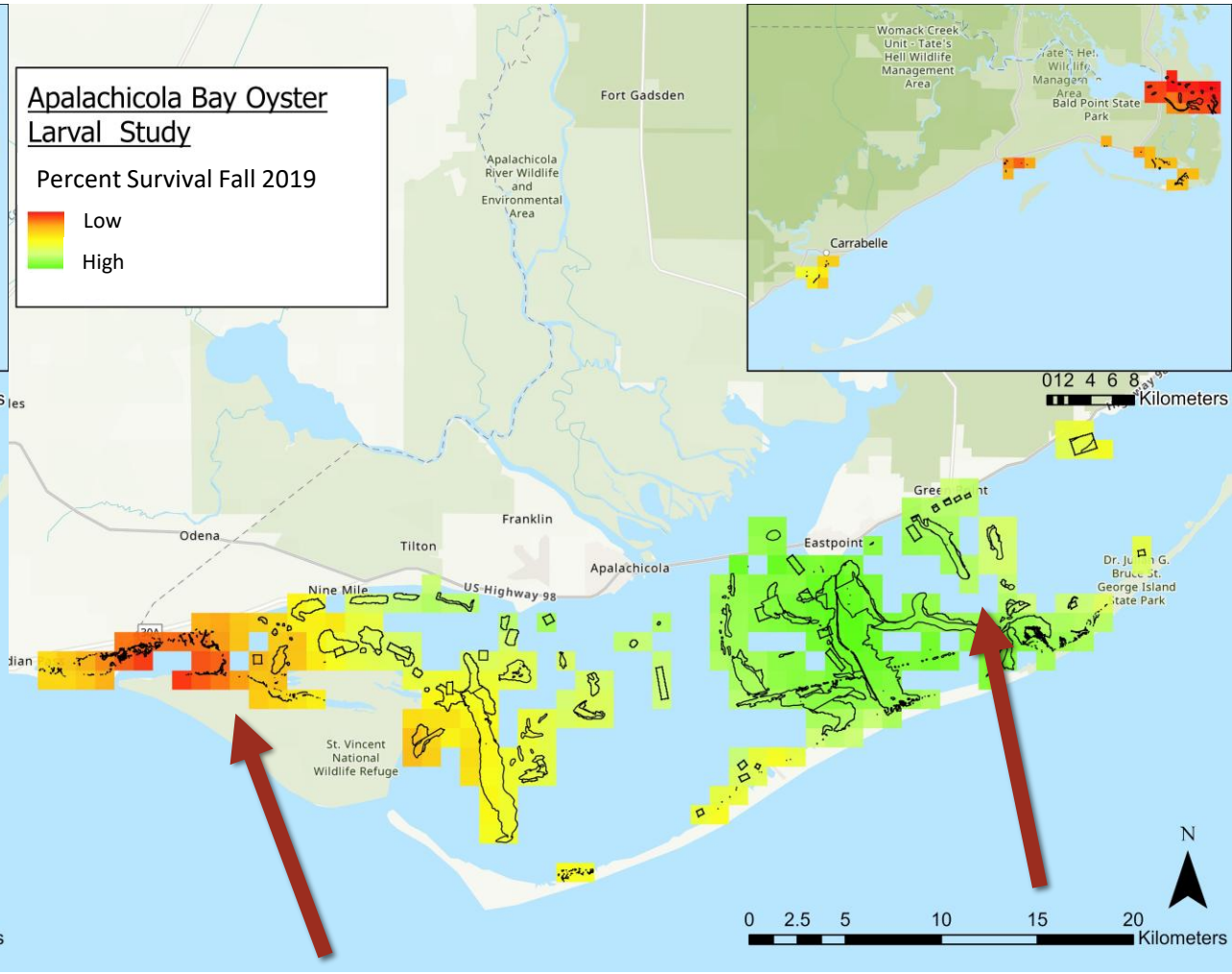


Seasonal Survival

Spring



Fall



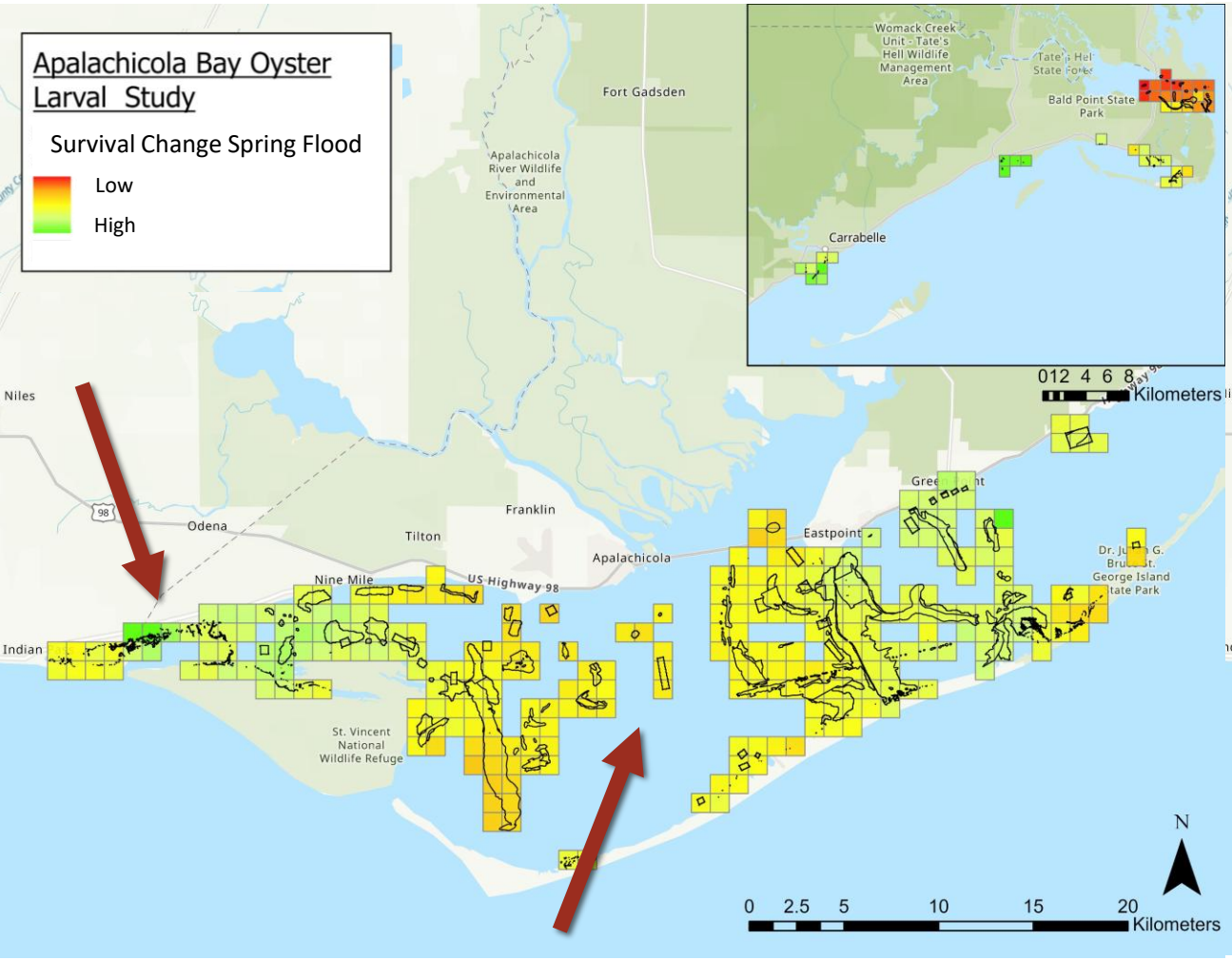
- Middle of bay high survival
- Ochlokonee low

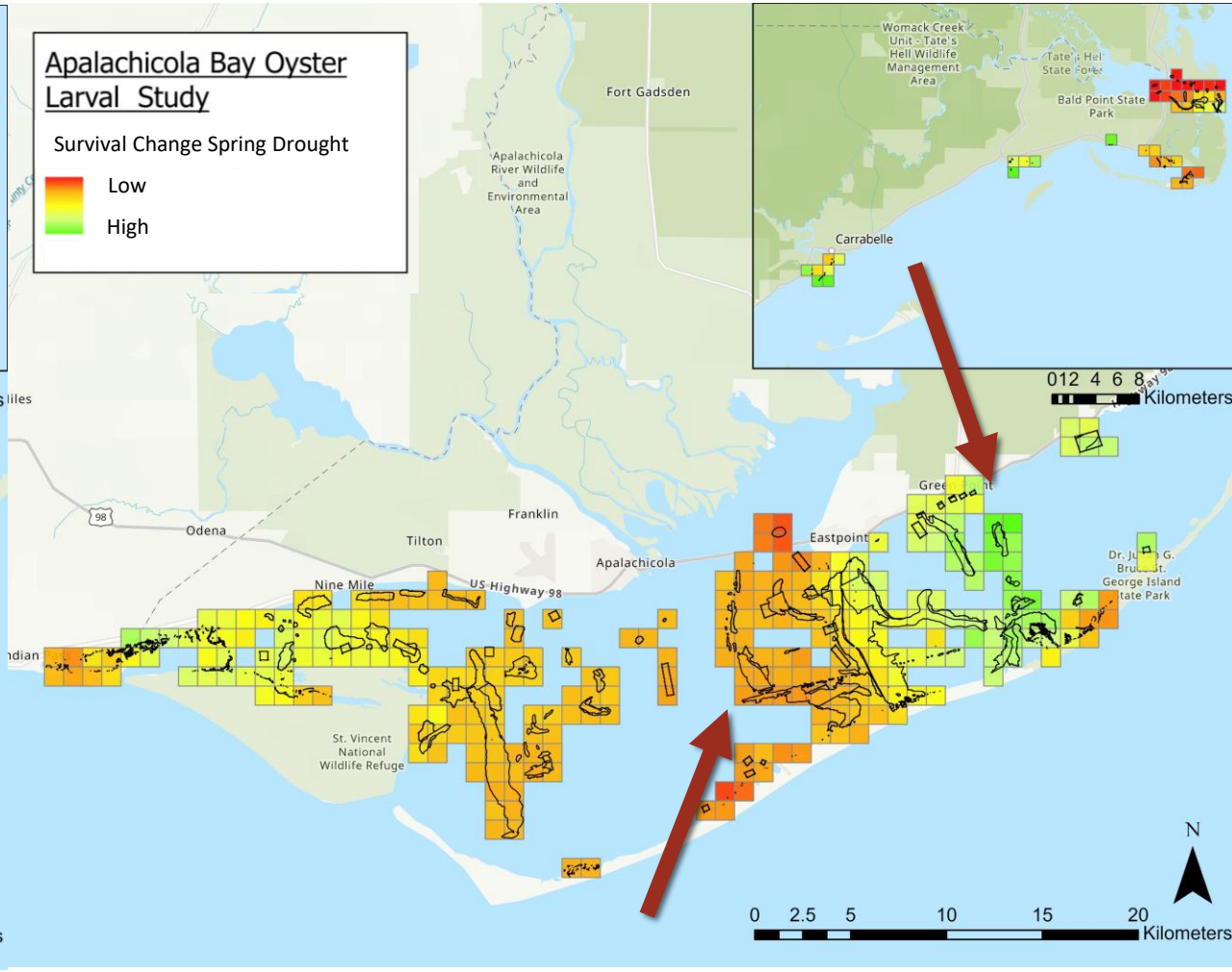
- East reefs high
- West reefs low

Flood

Spring

Drought





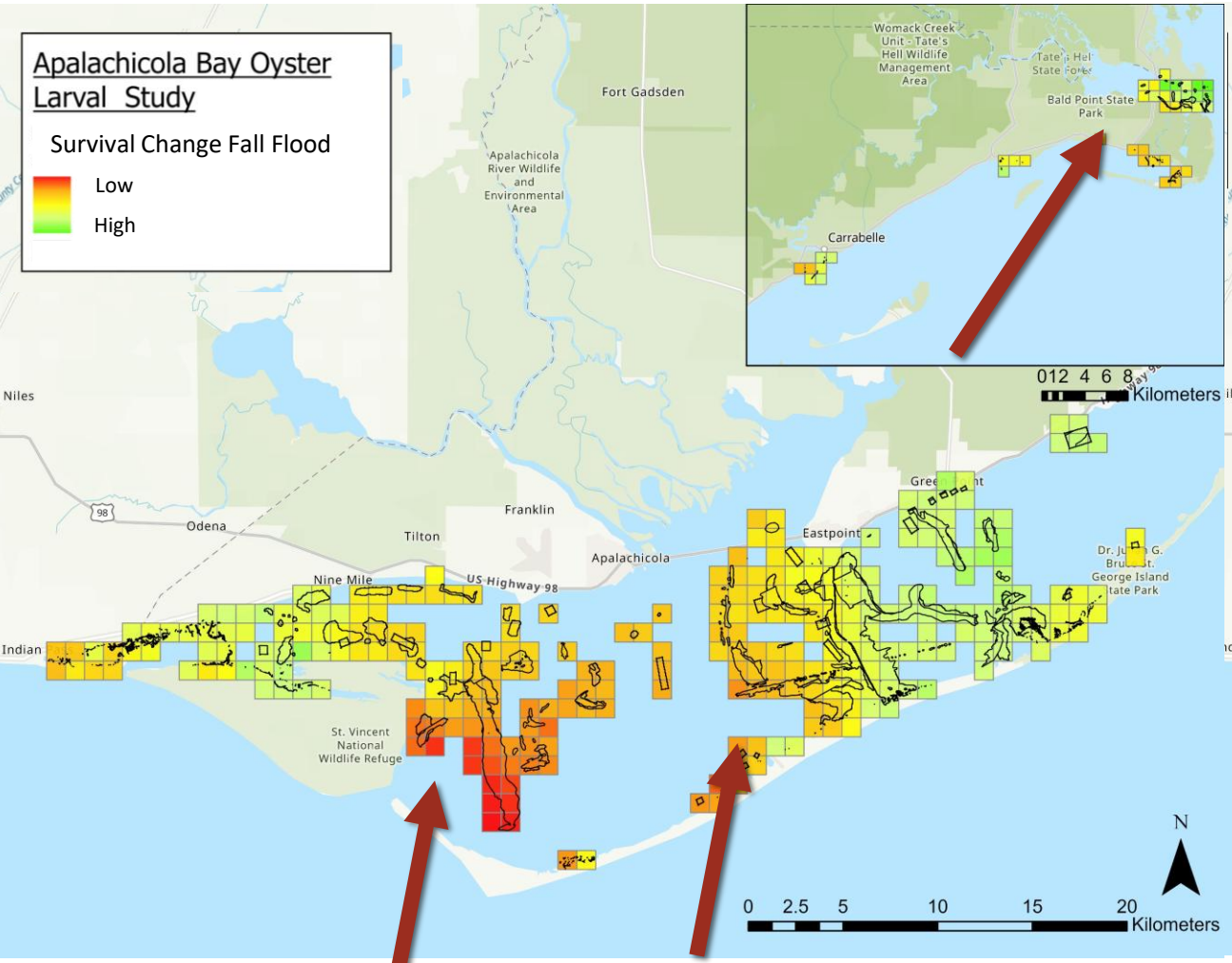
- Middle of bay low impact
- Slight increase in small area of east
- Ochlokonee loss

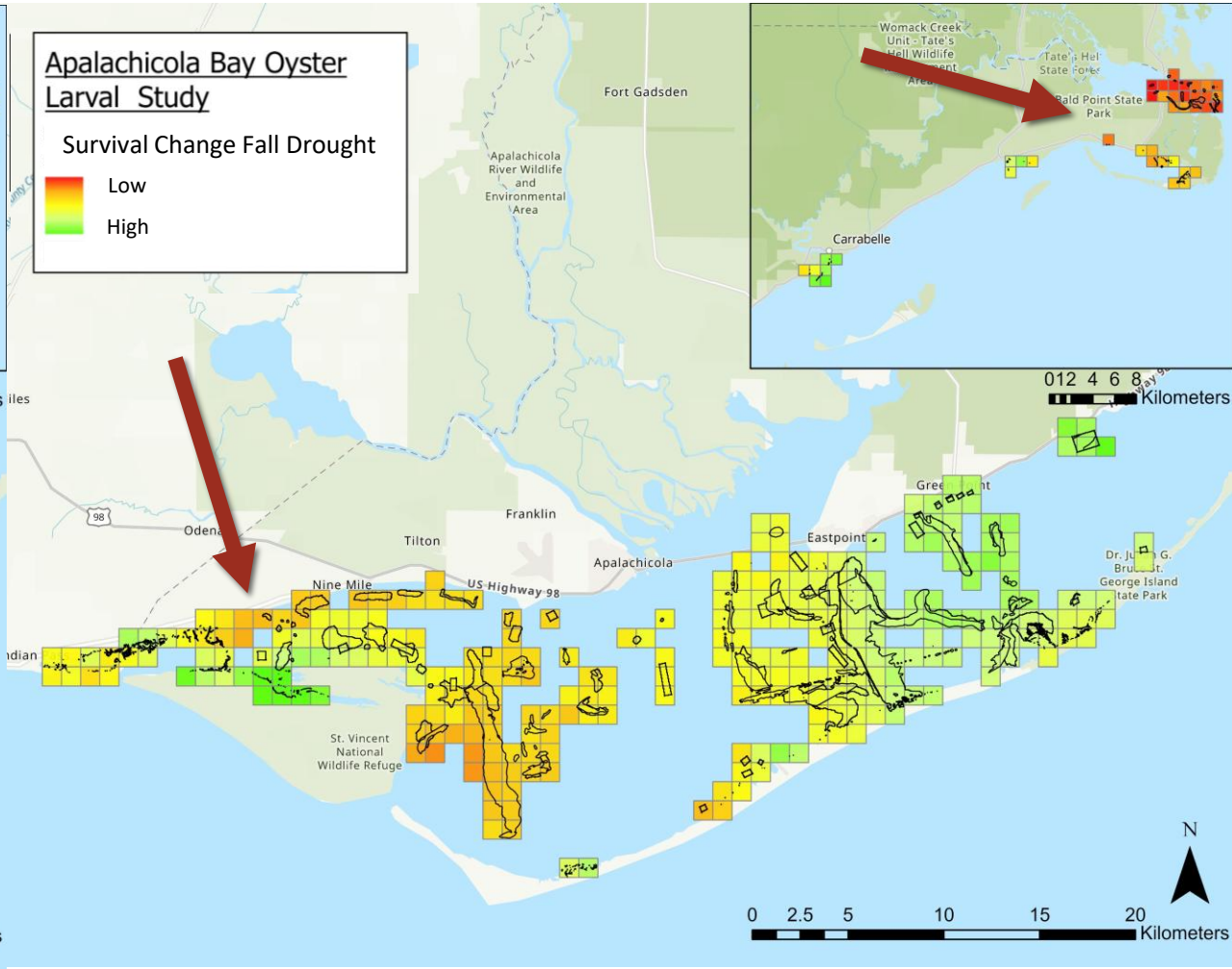
- Some east reefs increase
- Mid bay, west reefs survival loss

Flood

Fall

Drought





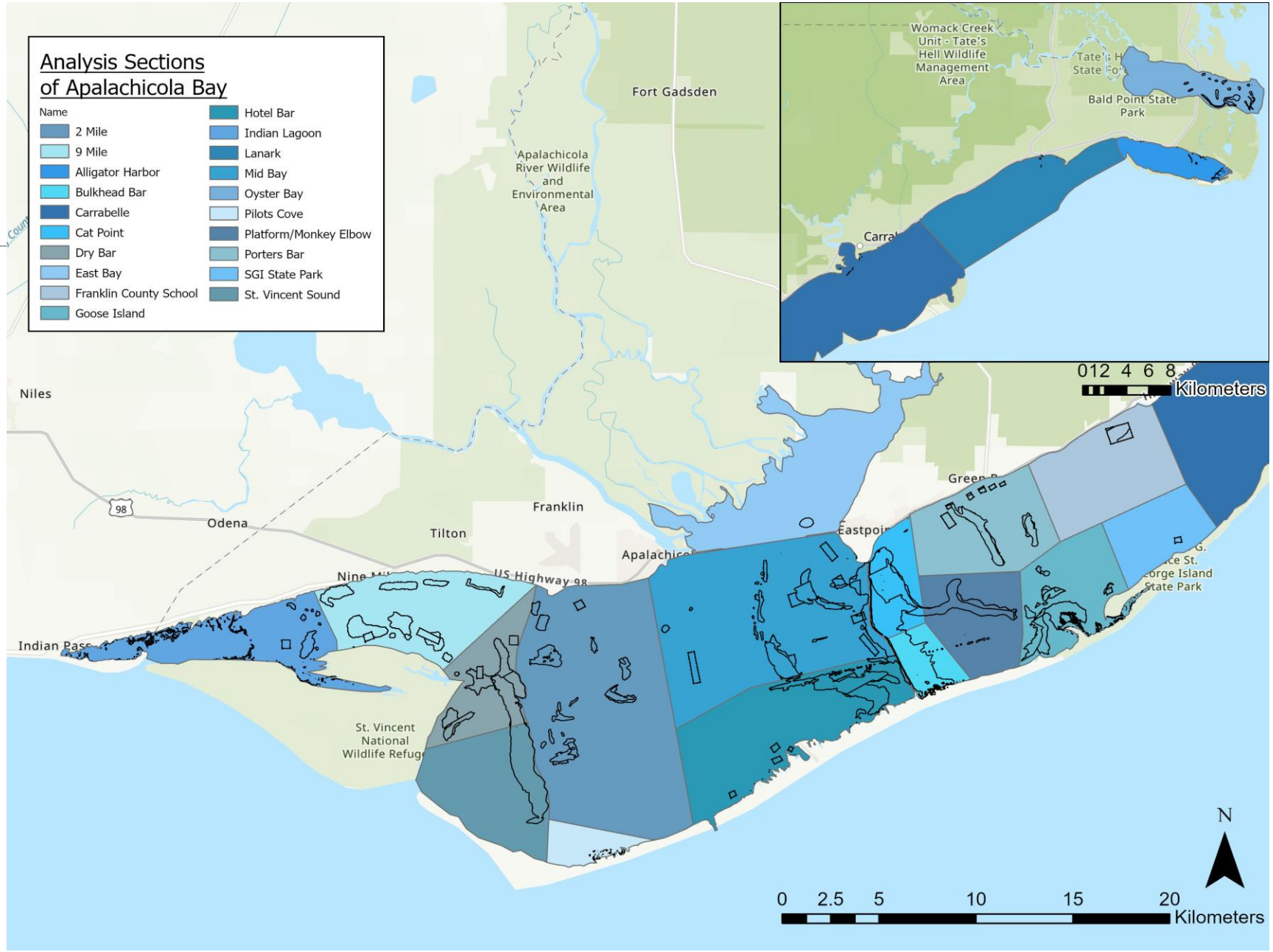
- Middle of bay survival loss
- Ochlokonee increase

- Mid bay mild decrease
- Ochlokonee decrease
- Some east reefs increase

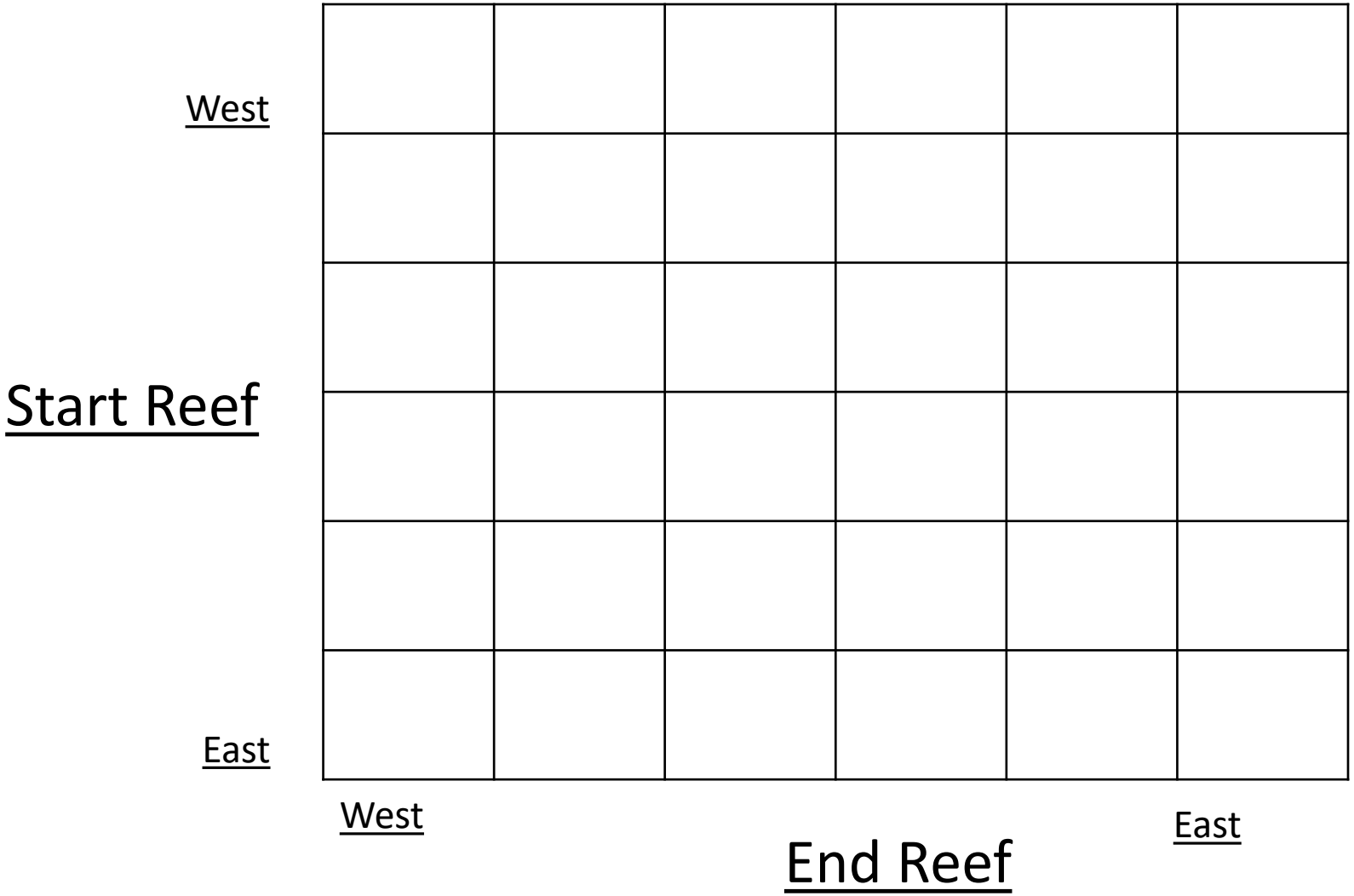
Results

Connectivity patterns

- distribution of larva across study region
- Colloquial reef complex names



Connectivity matrix



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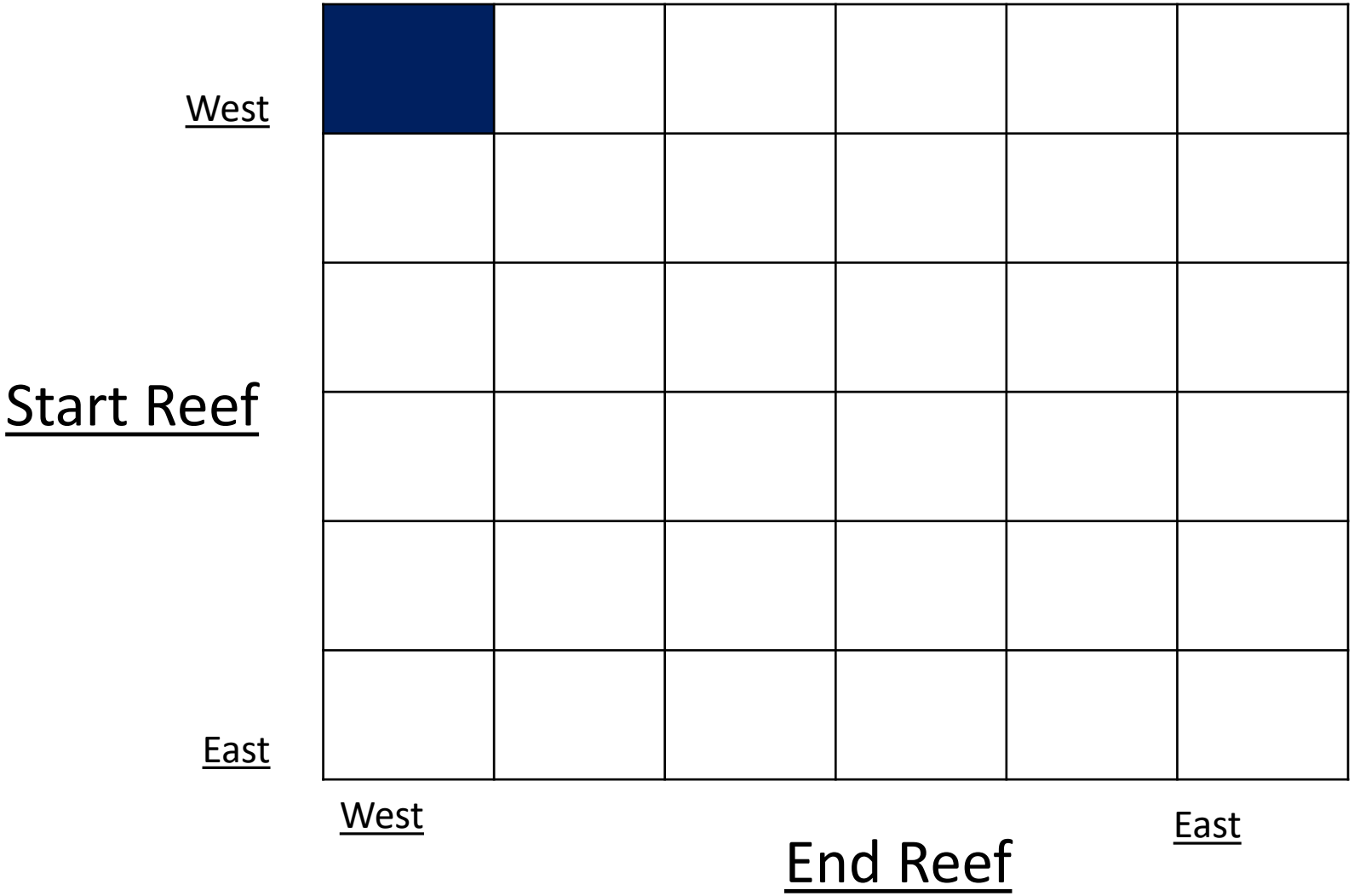

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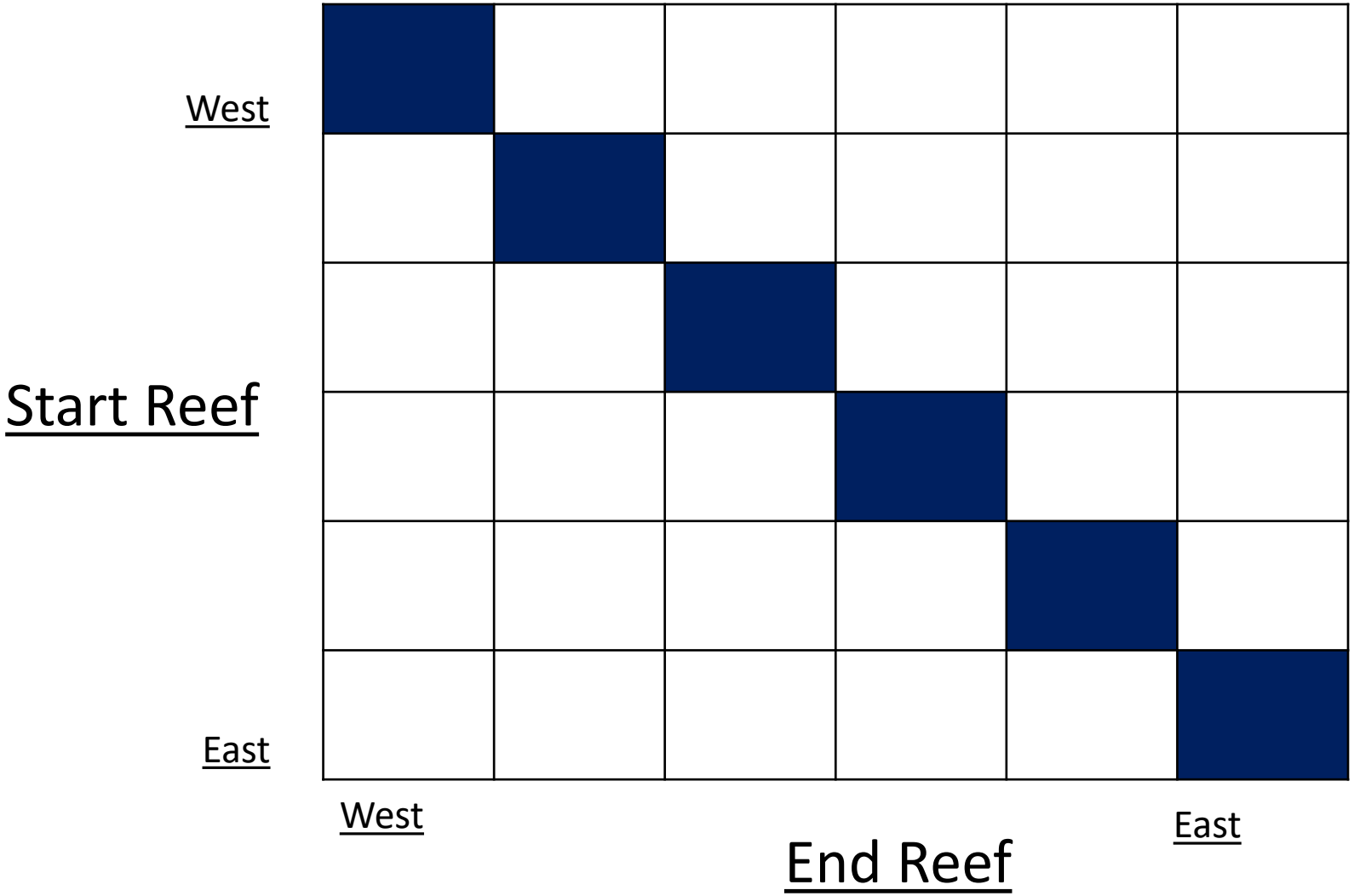

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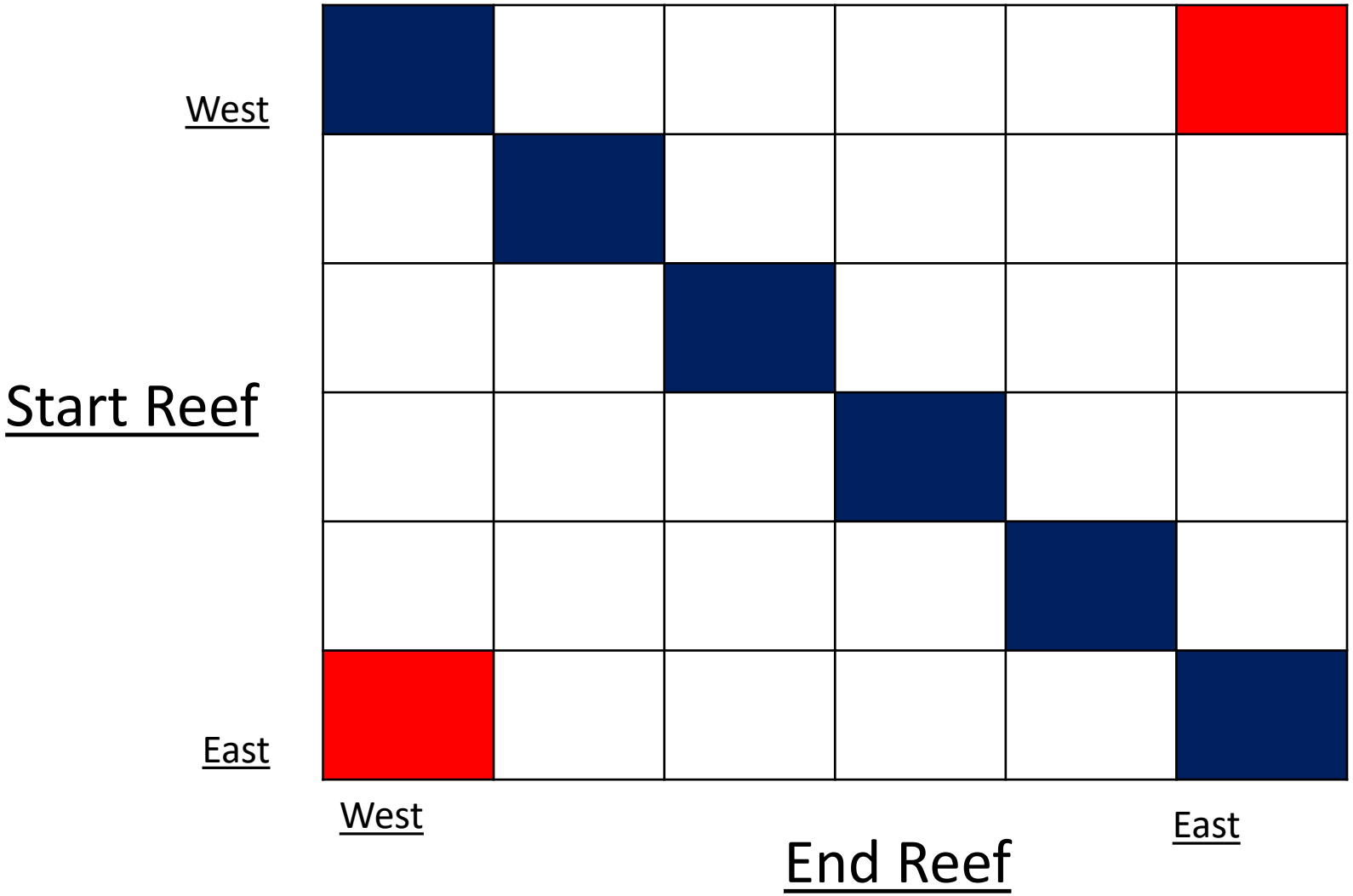

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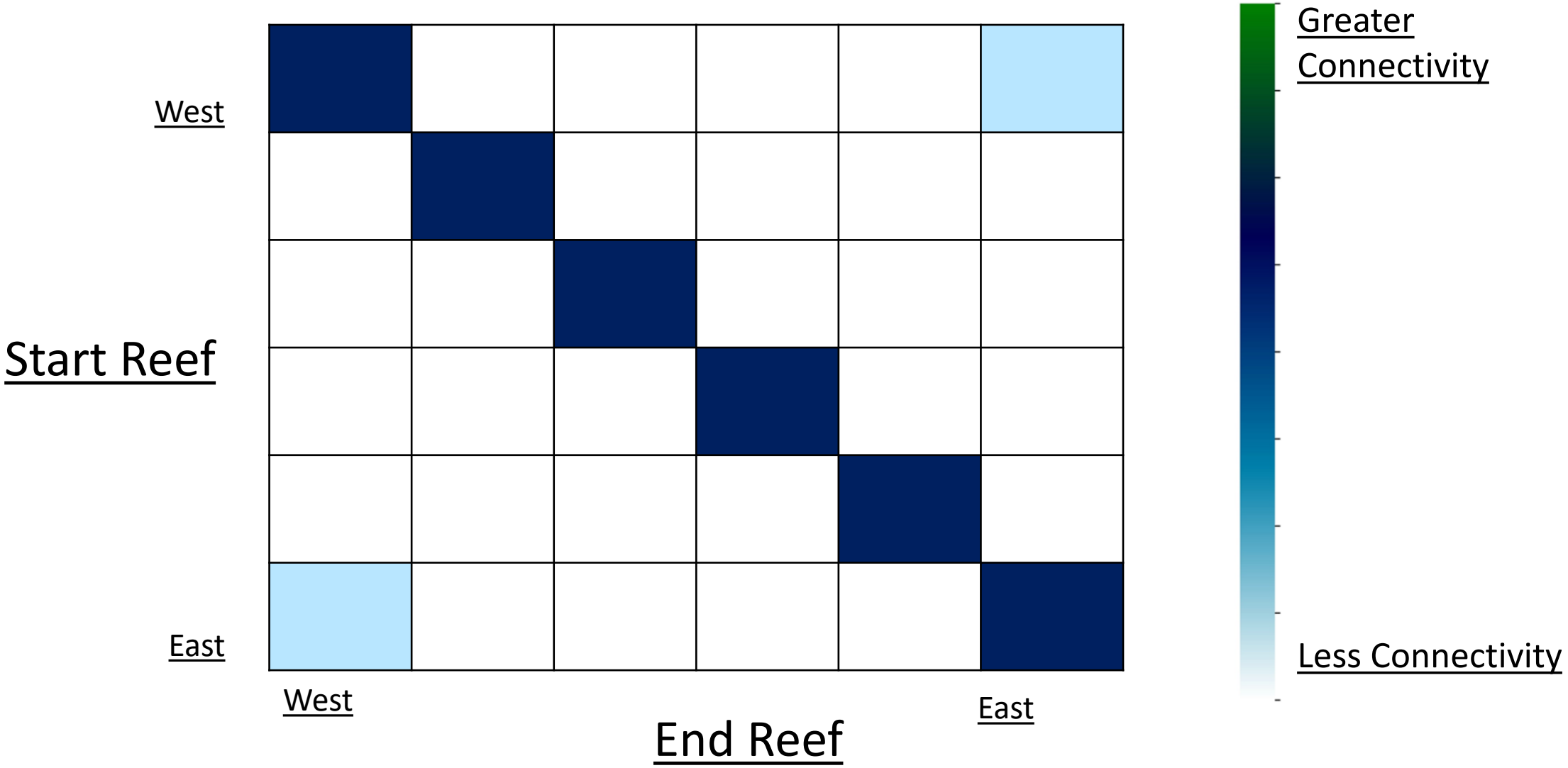
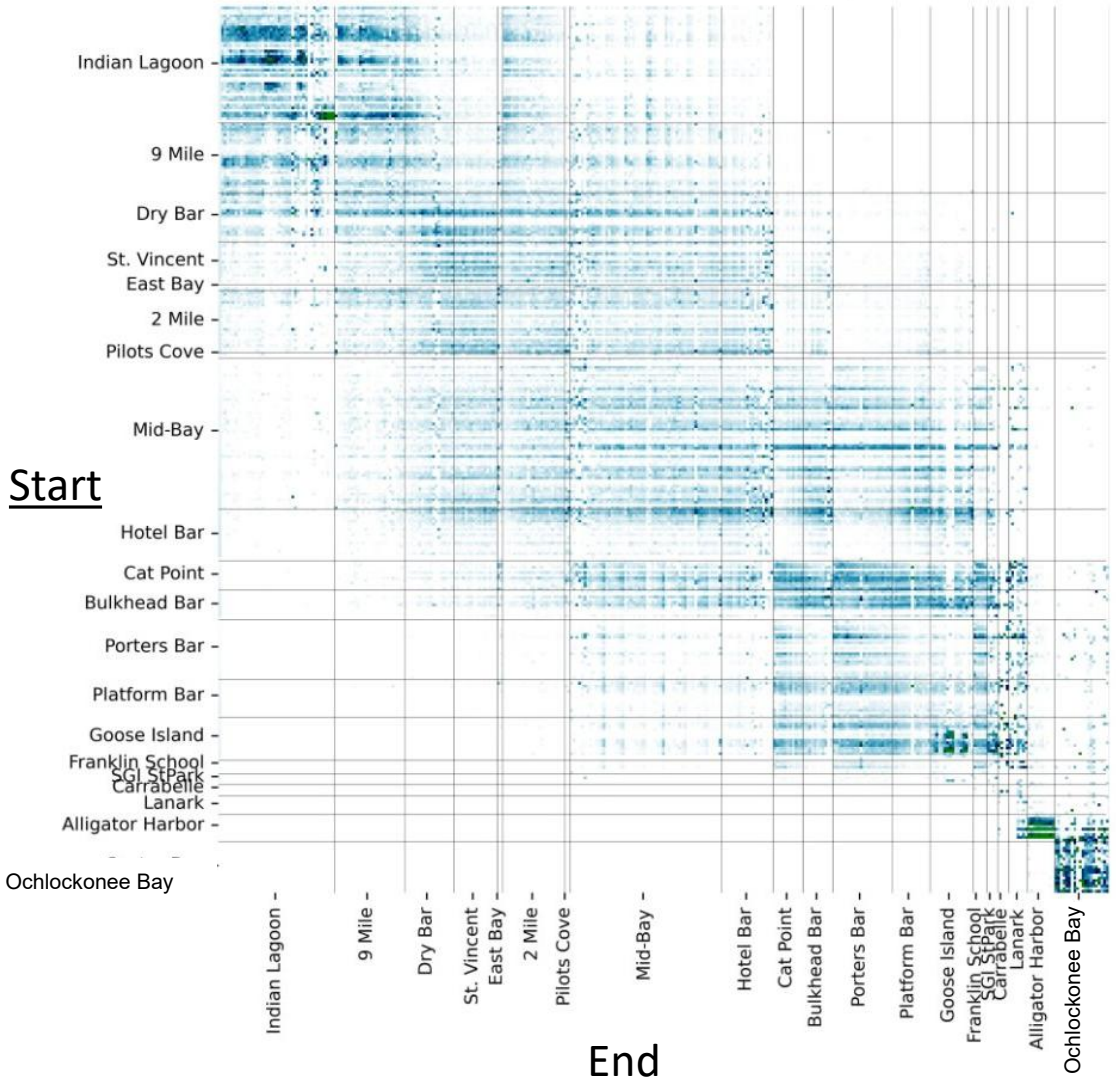
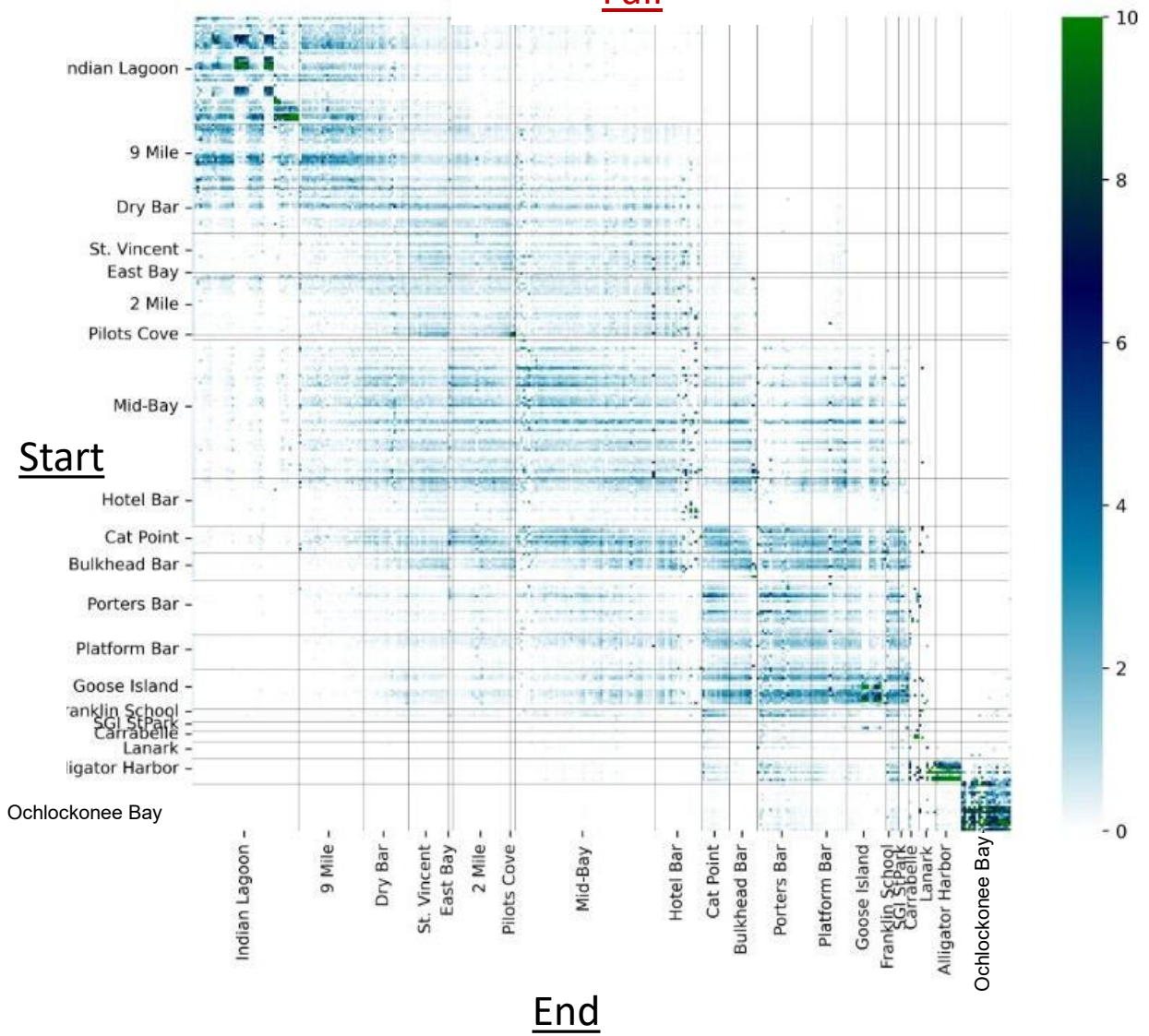


Results : Connectivity Matrices

Spring



Fall



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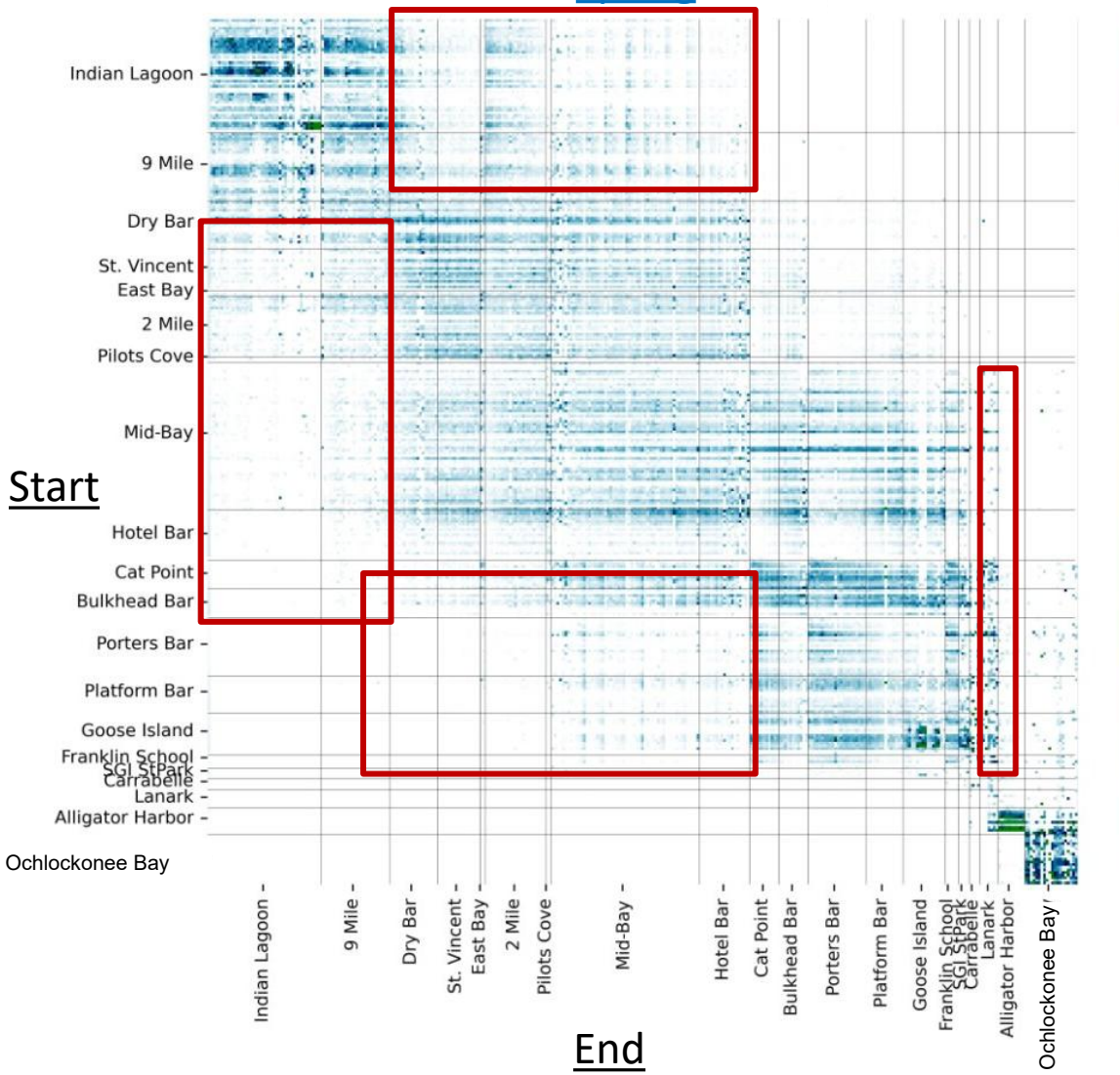
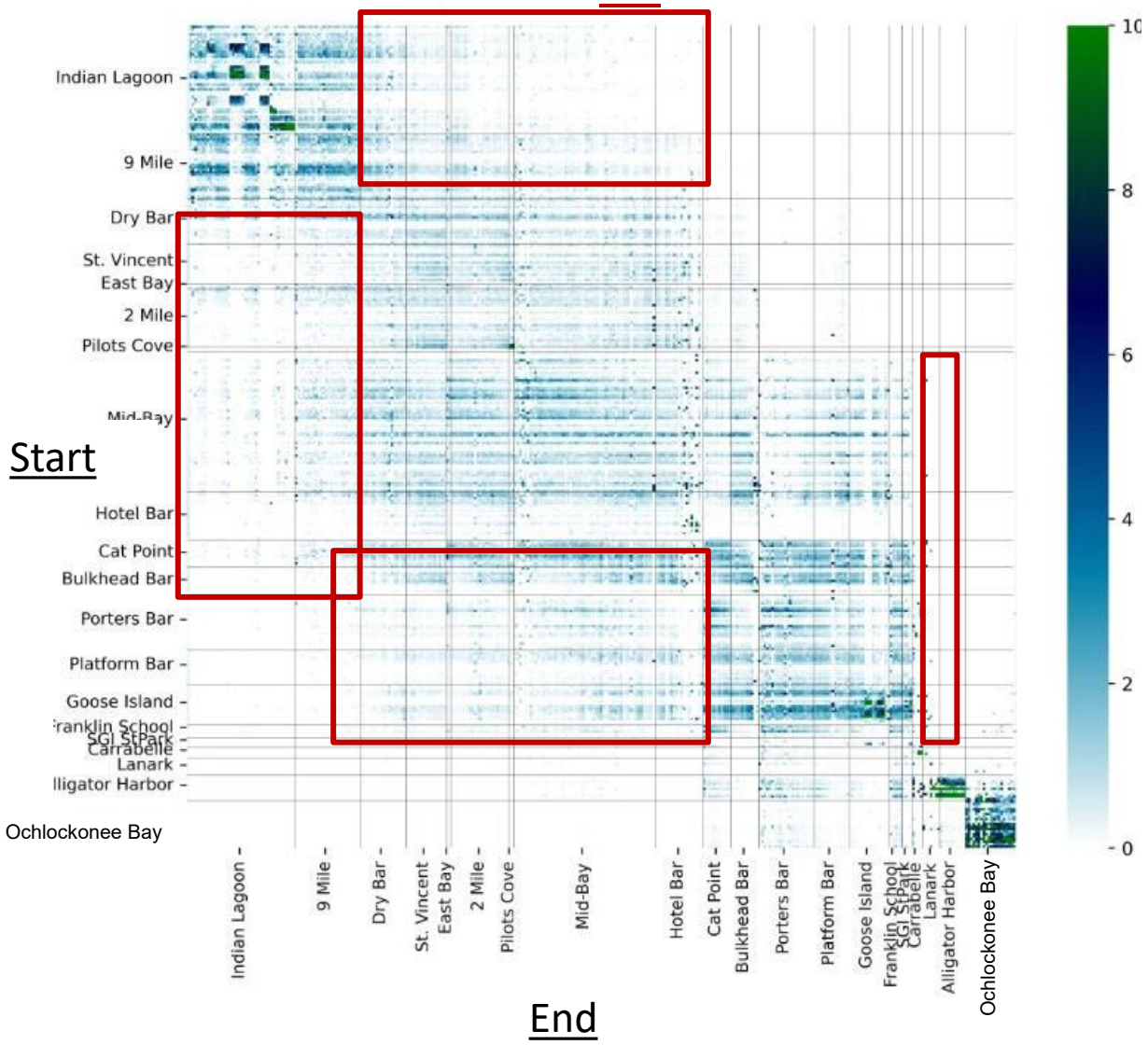
Spring



Fall



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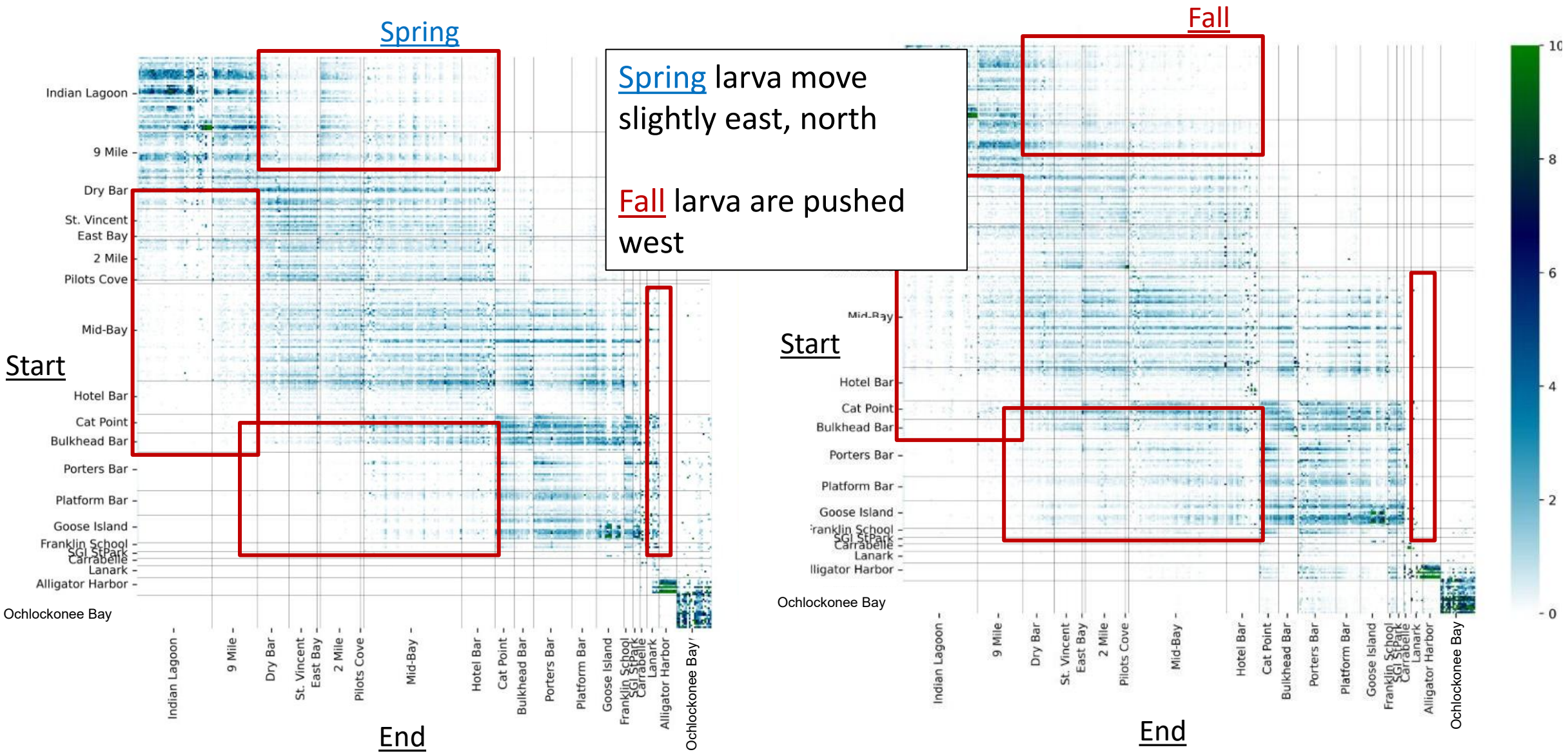
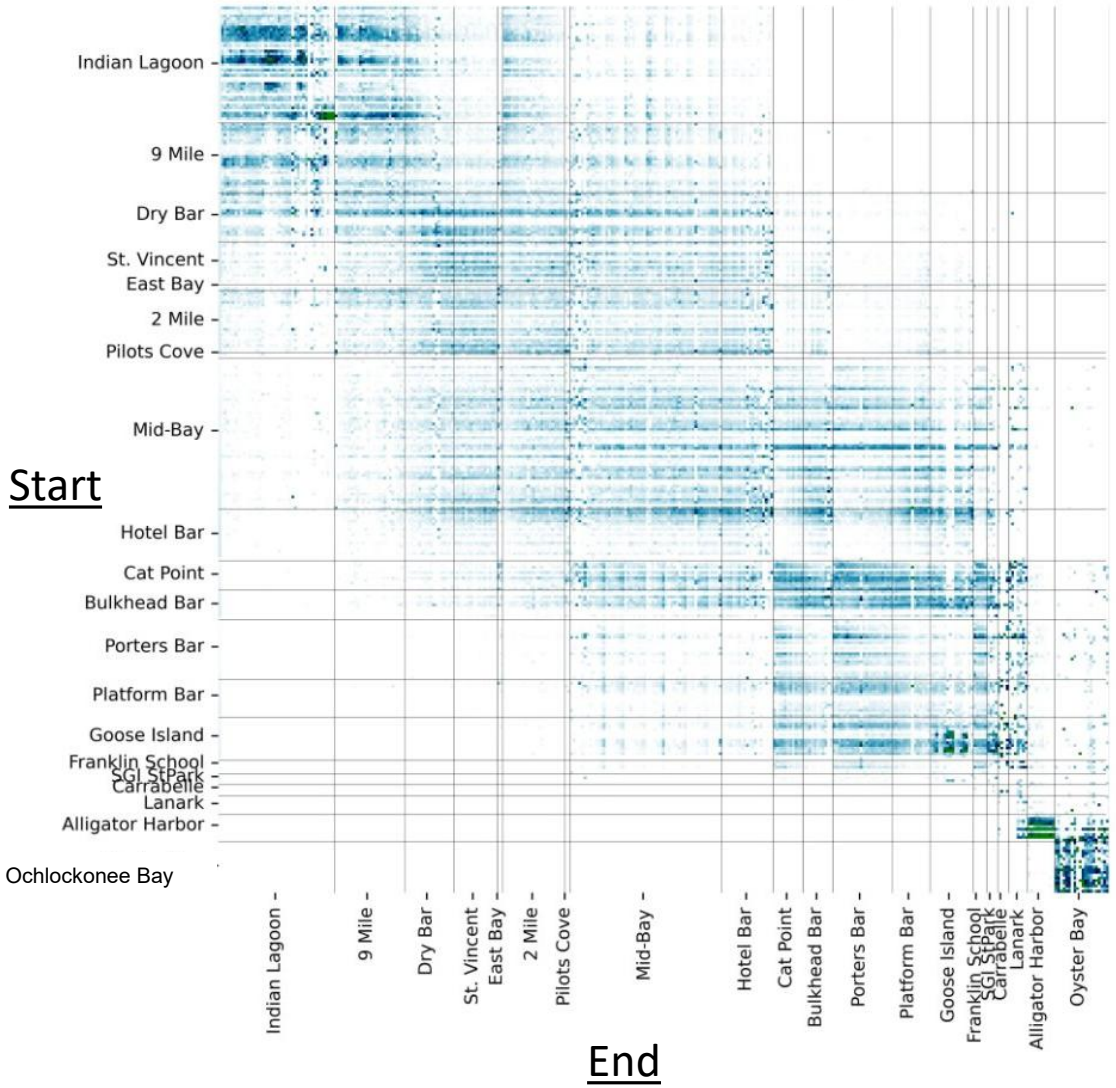


Spring larva move slightly east, north

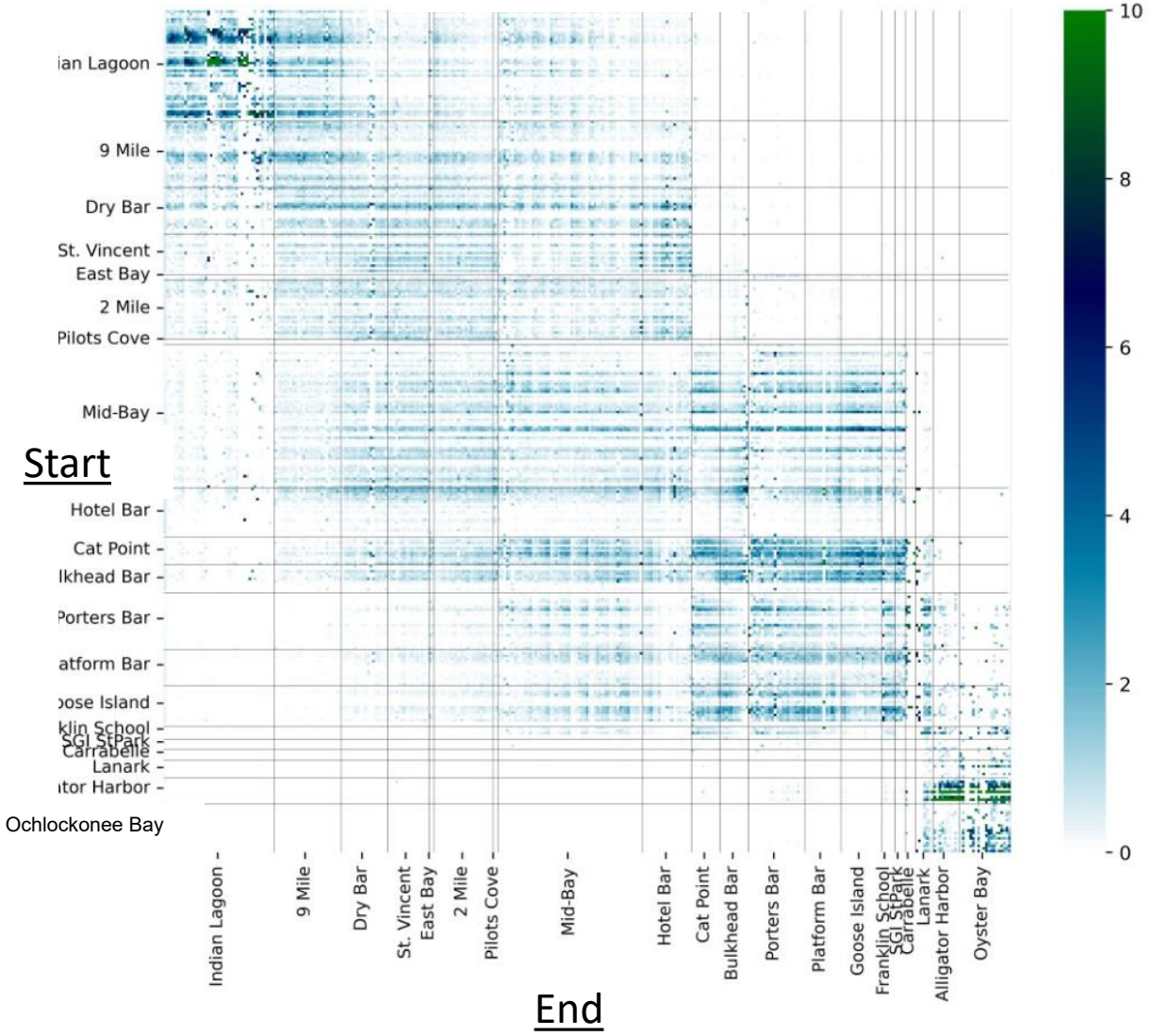
Fall larva are pushed west

Results : Connectivity Matrices - Spring ‘Drought’

Normal



Drought



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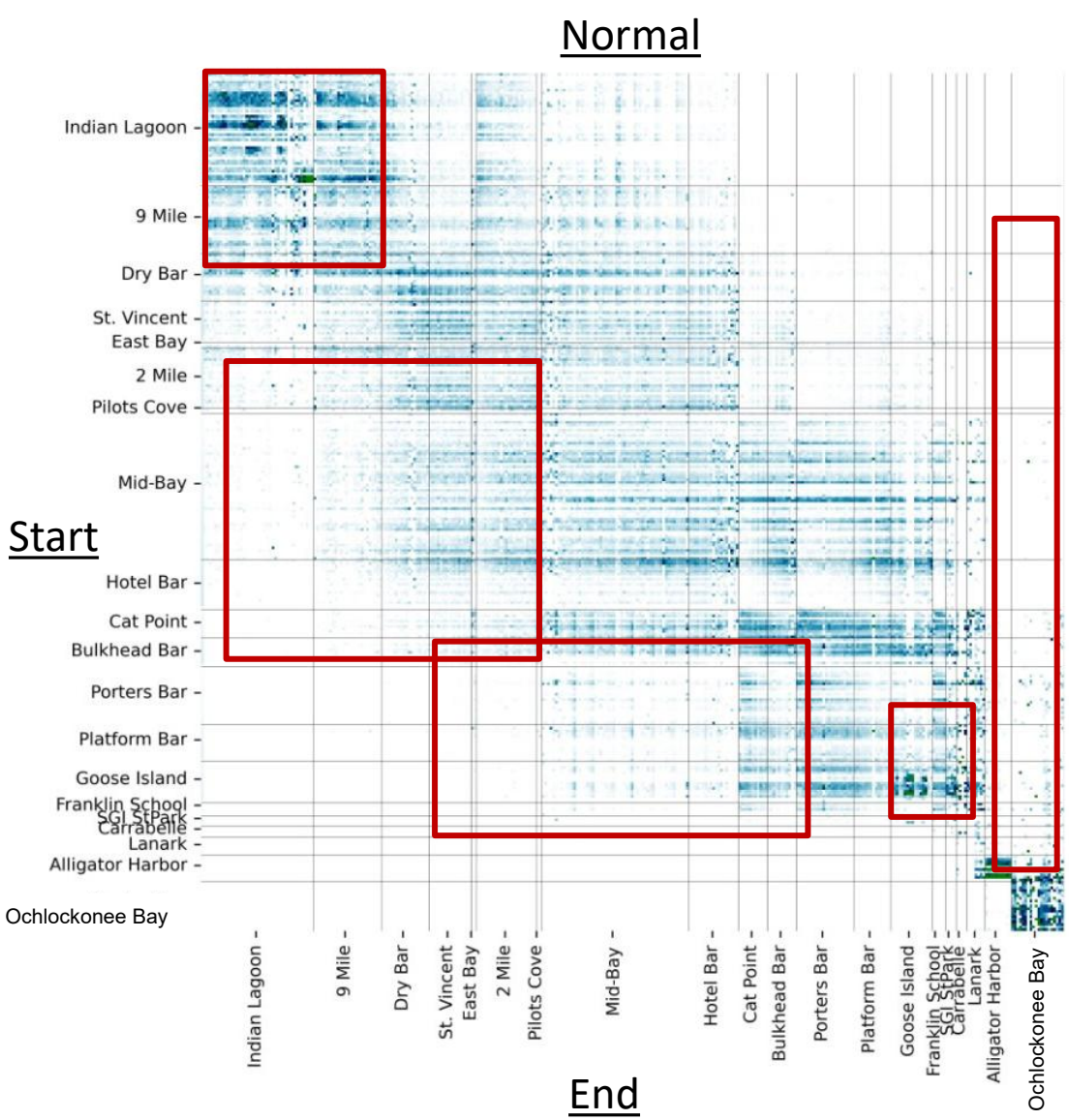

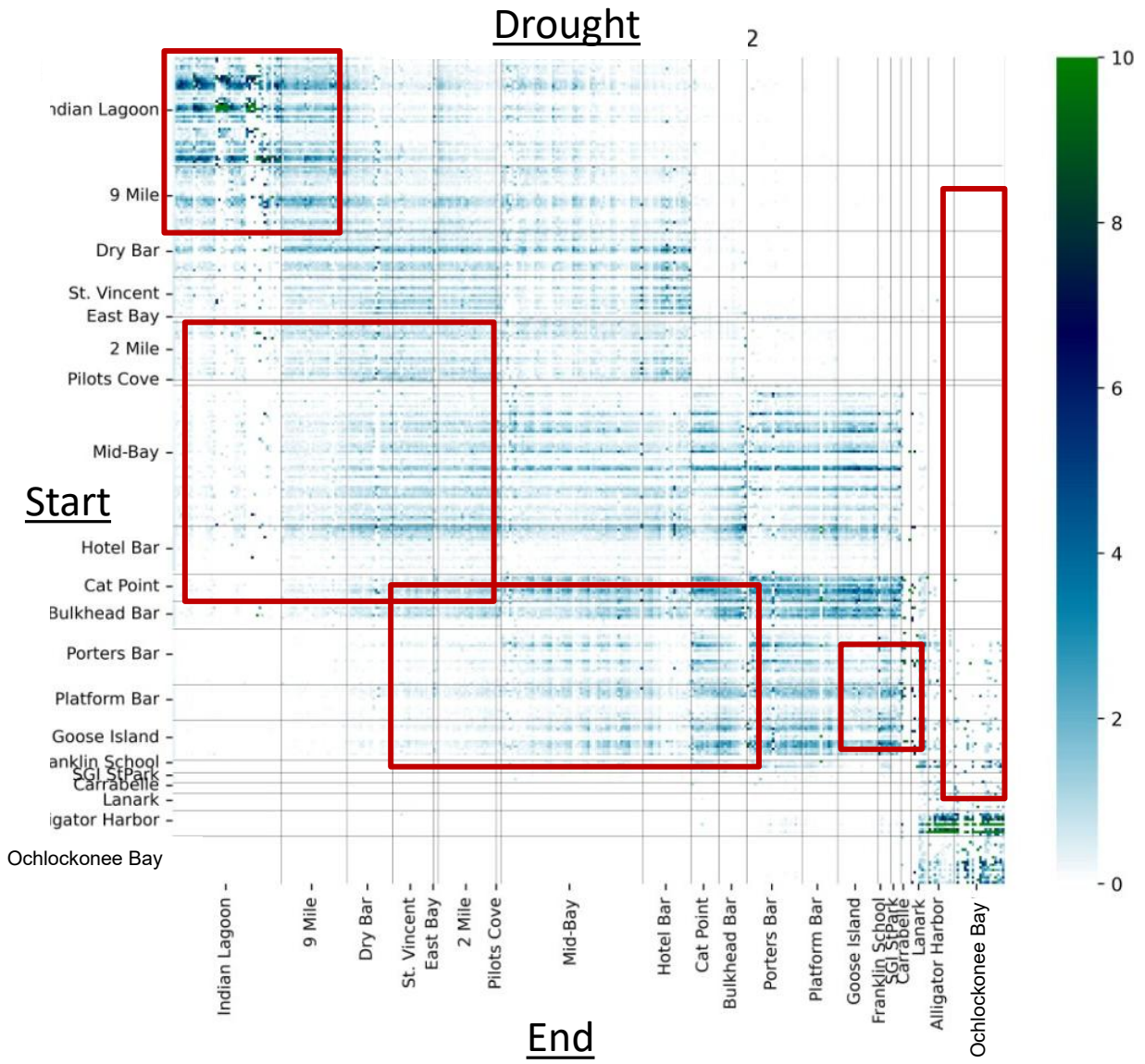

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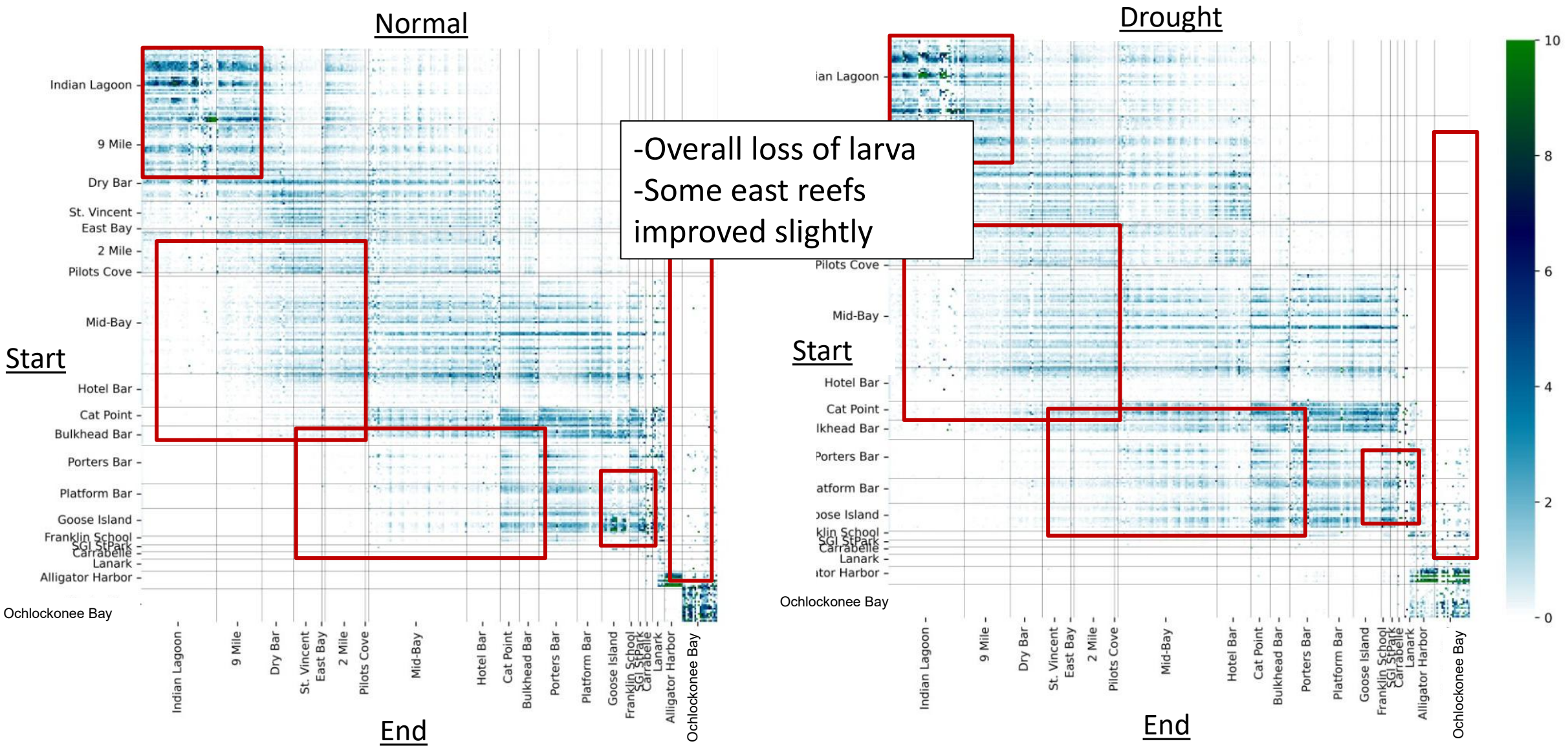
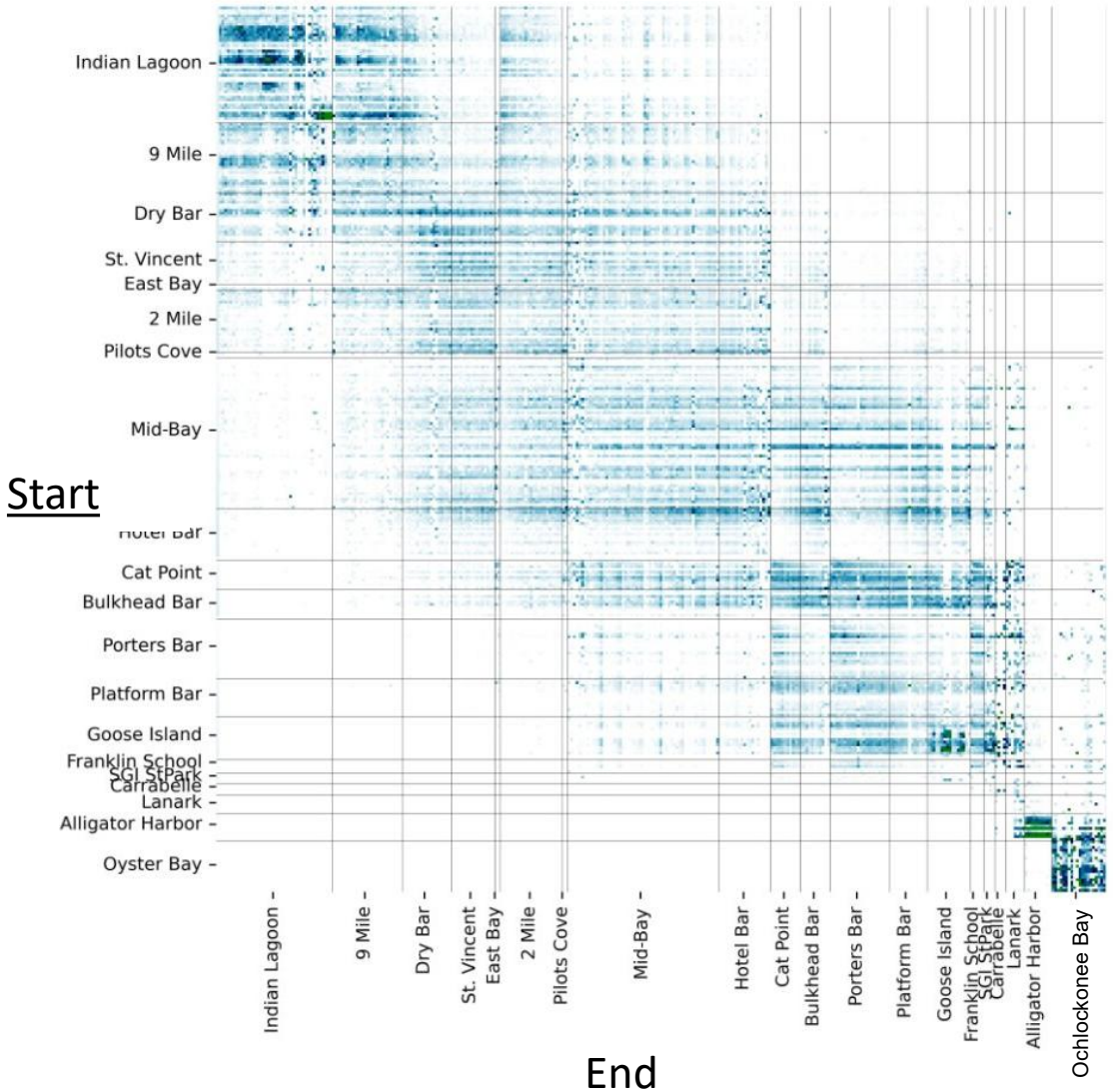
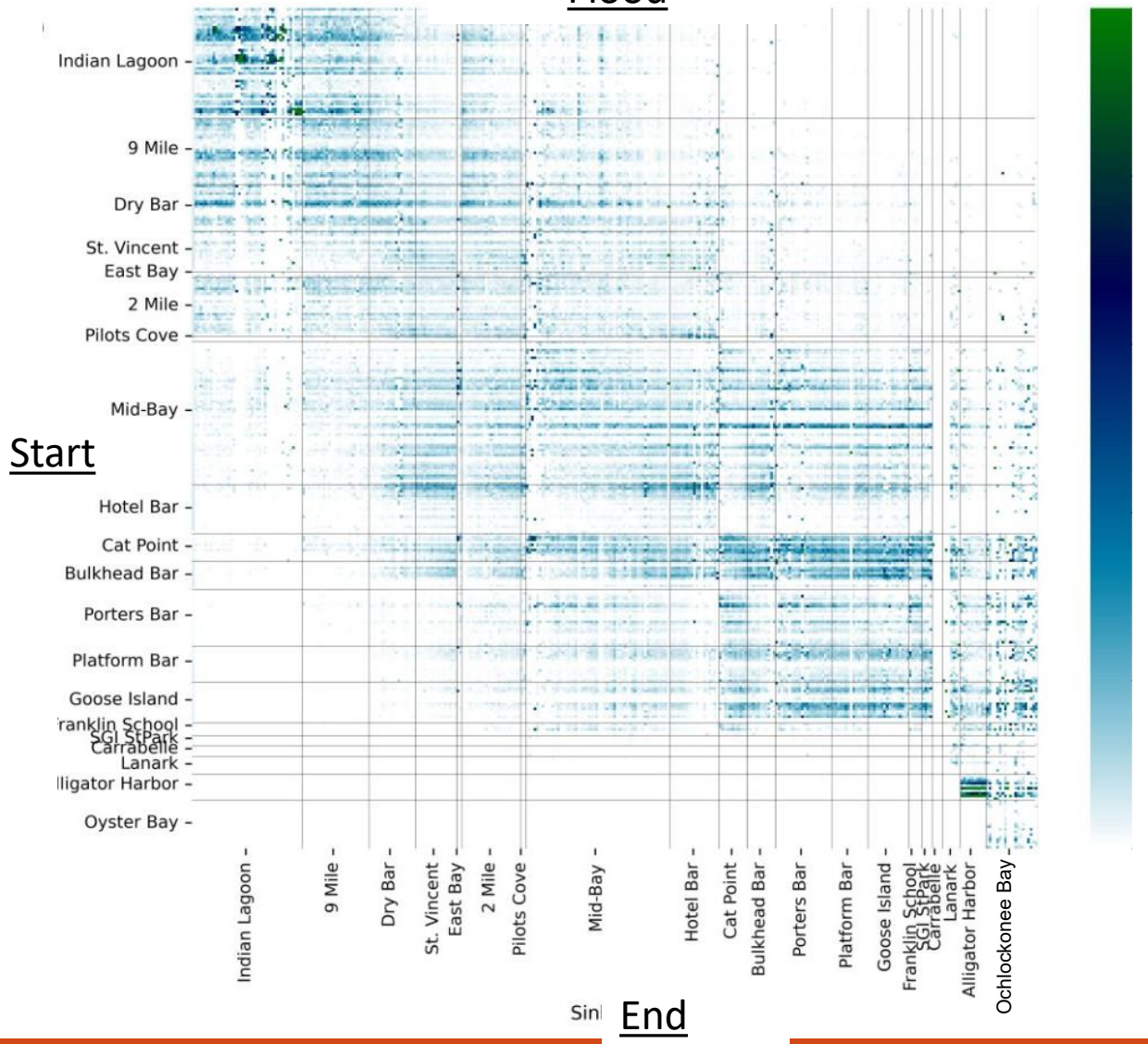


Results : Connectivity Matrices - Spring ‘Flood’

Normal



Flood



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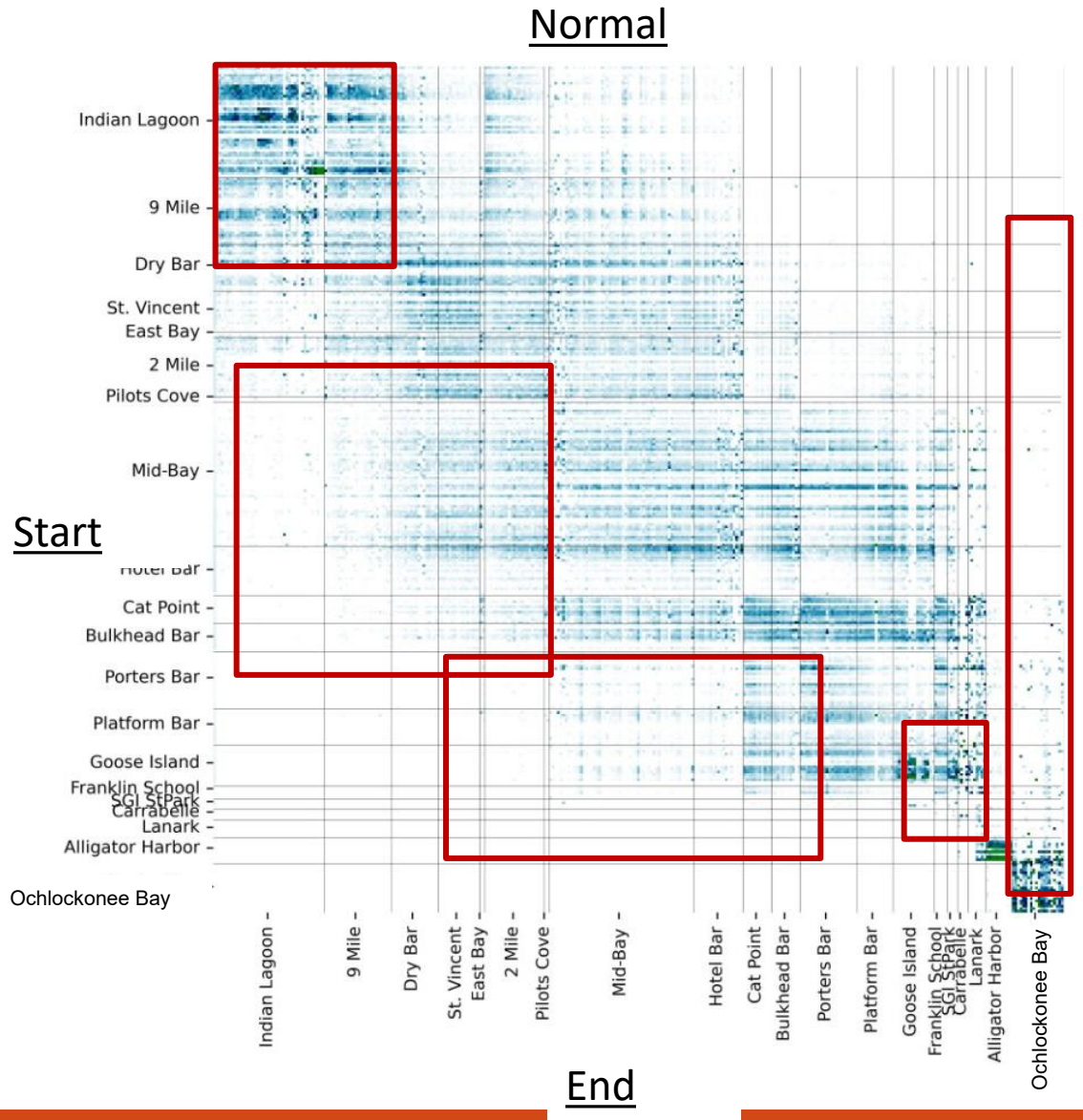

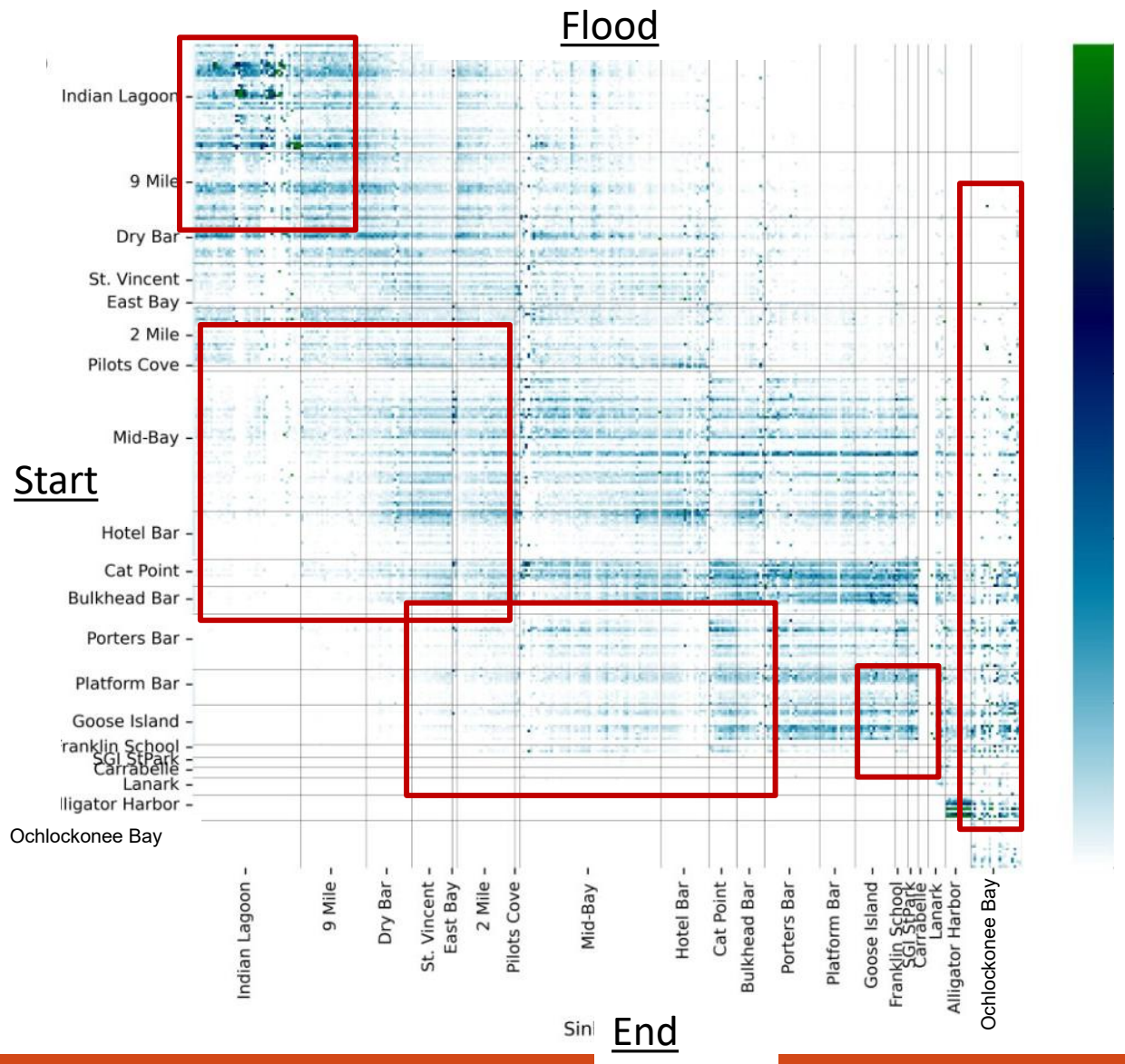

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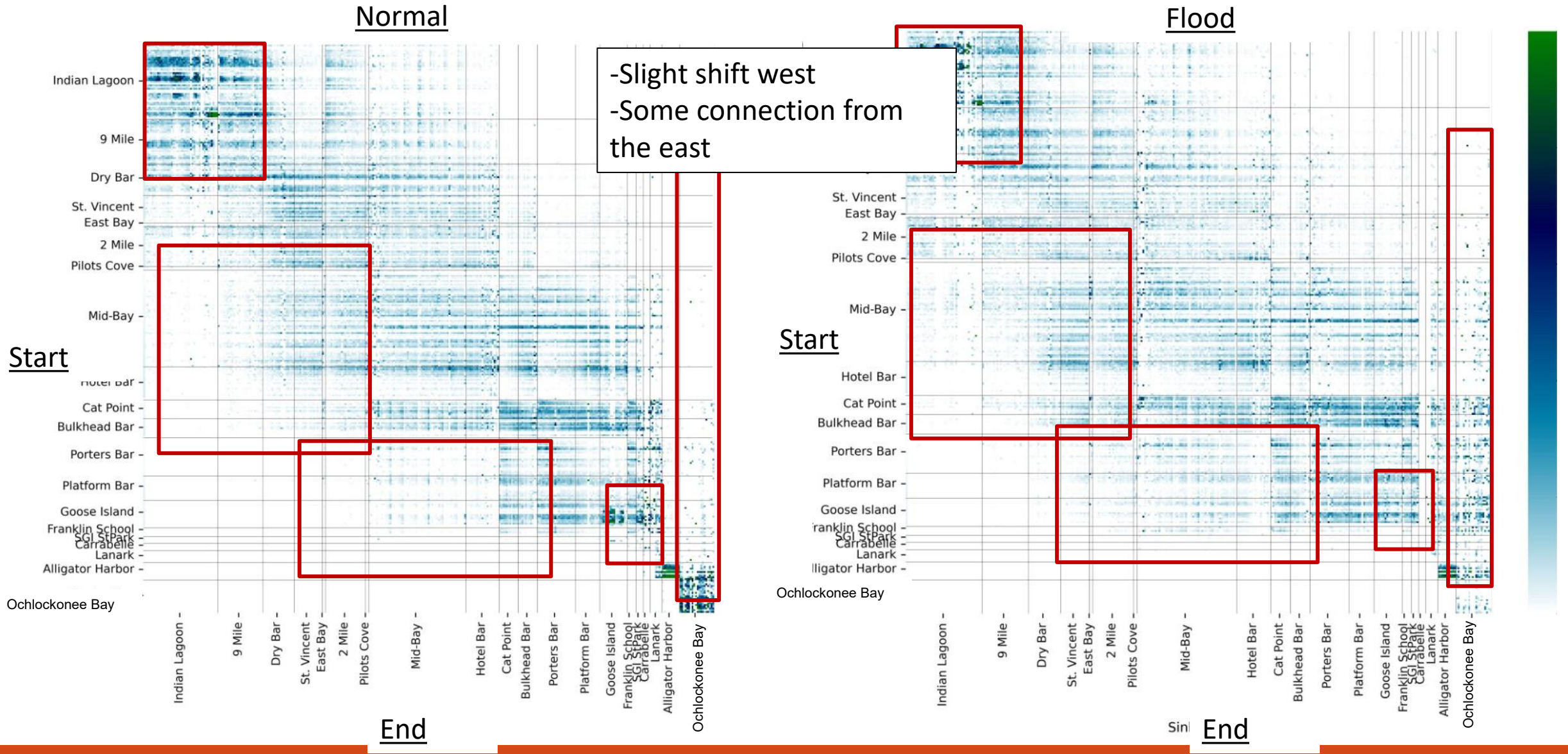
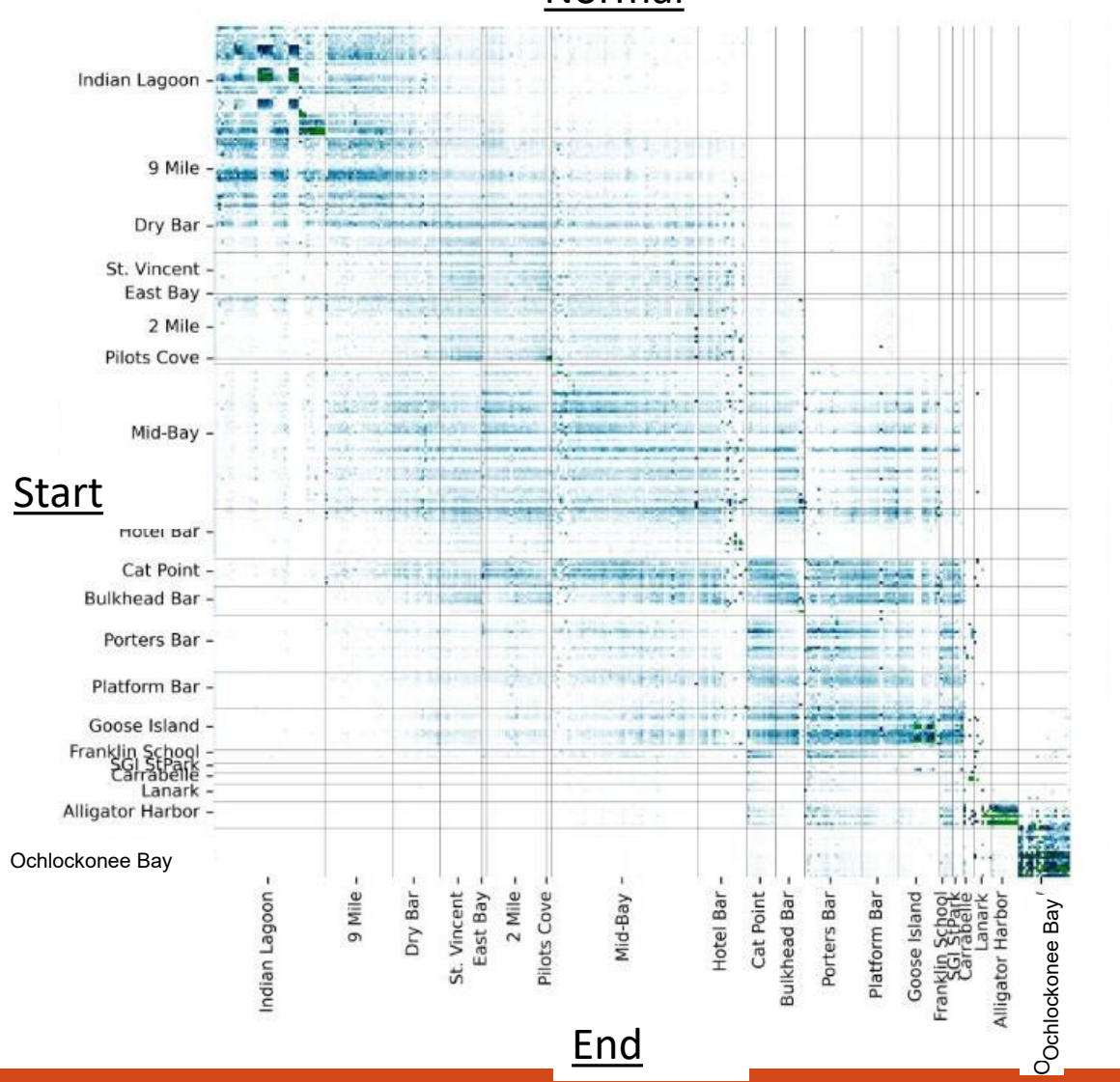
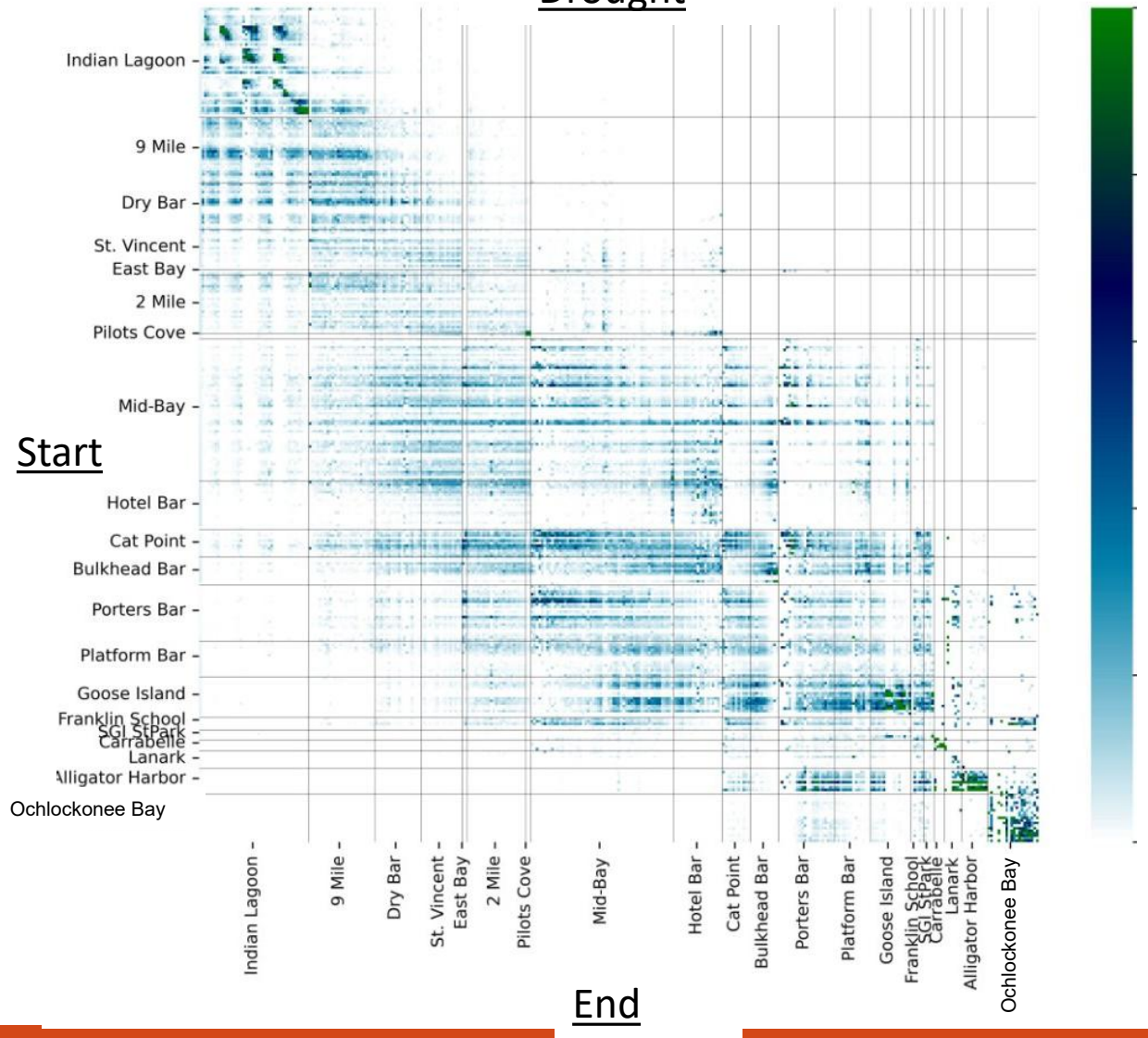


Results : Connectivity Matrices–Fall ‘Drought’

Normal



Drought



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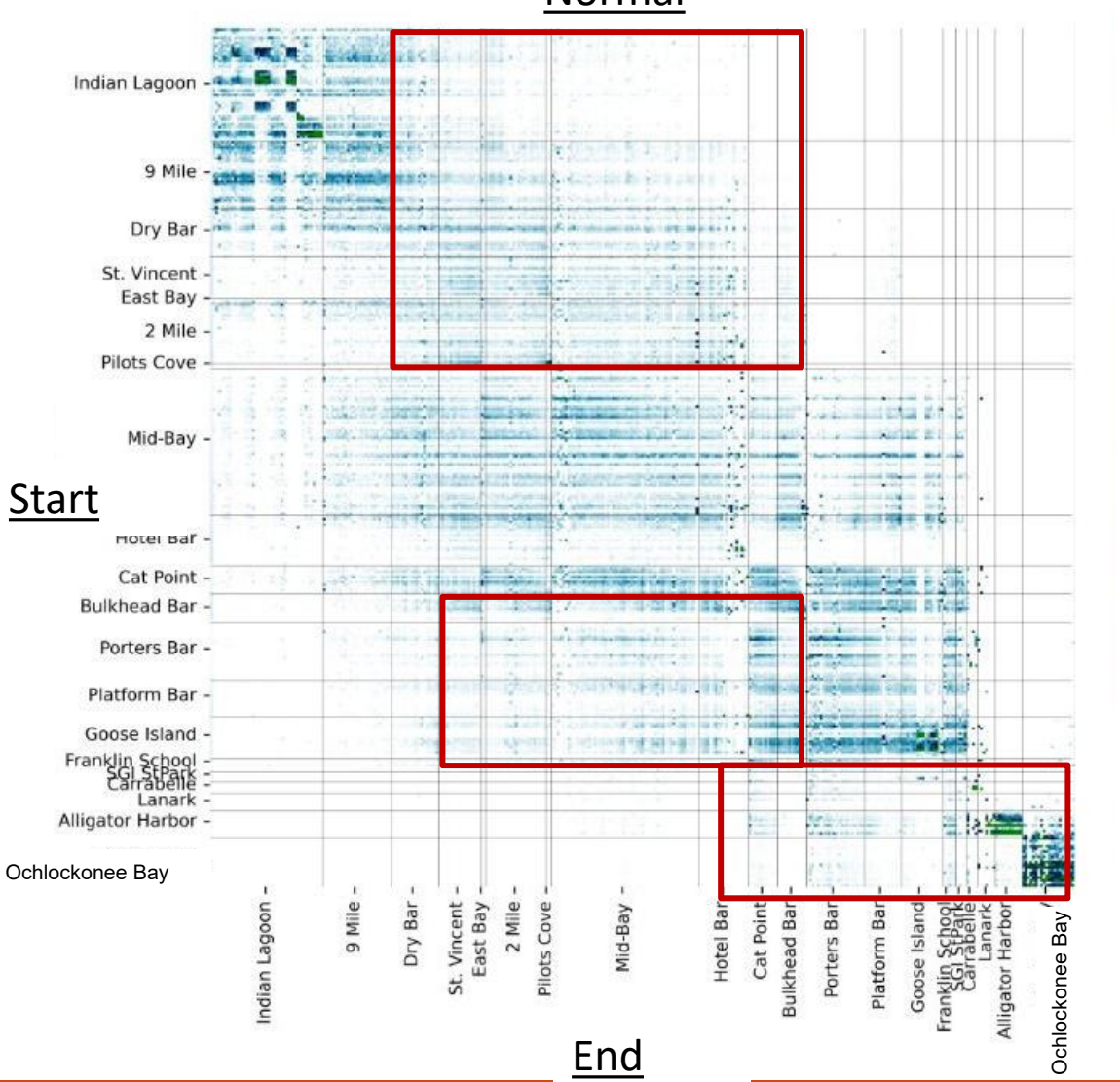
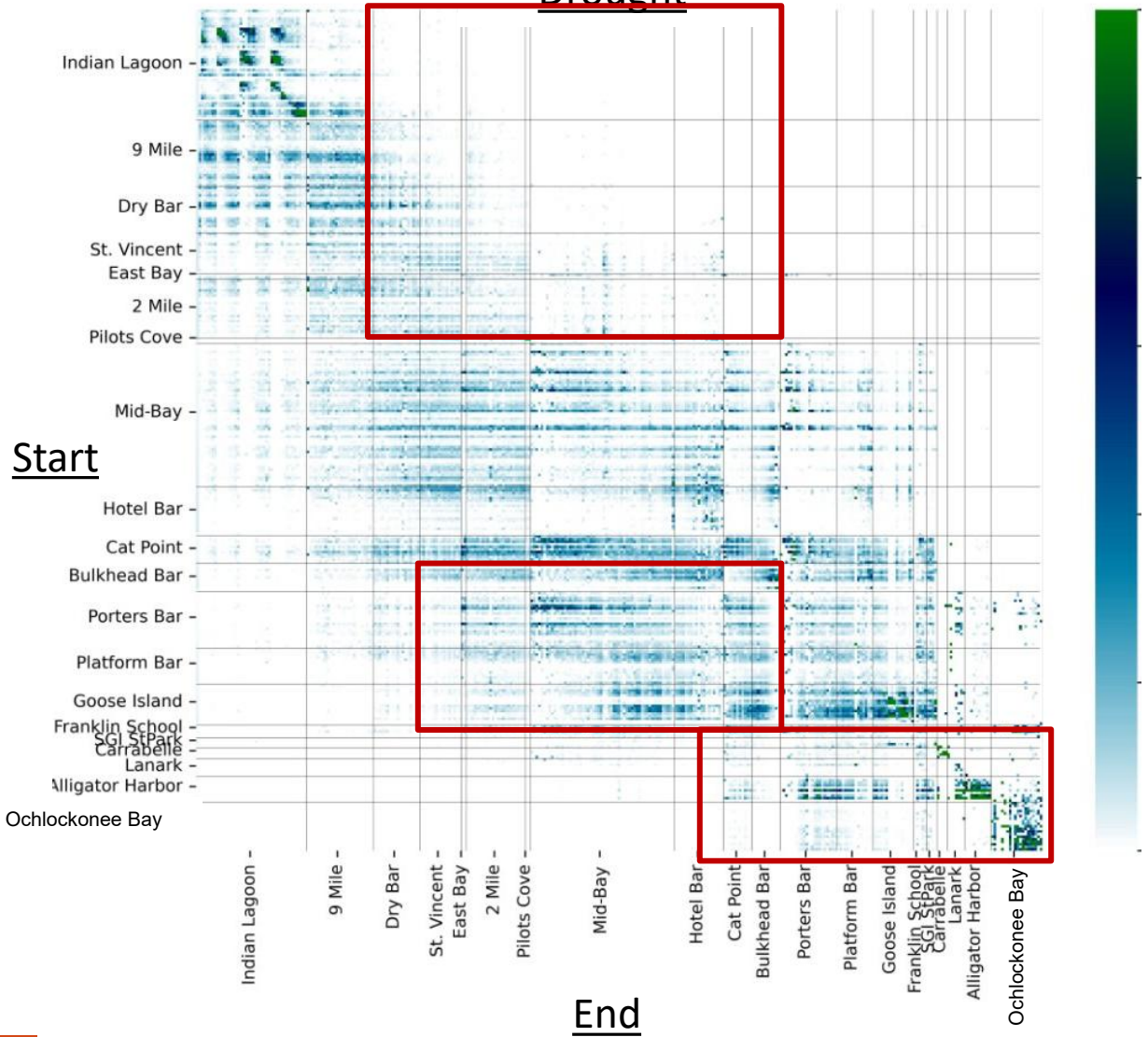


Drought



Results : Connectivity Matrices–Fall ‘Drought’

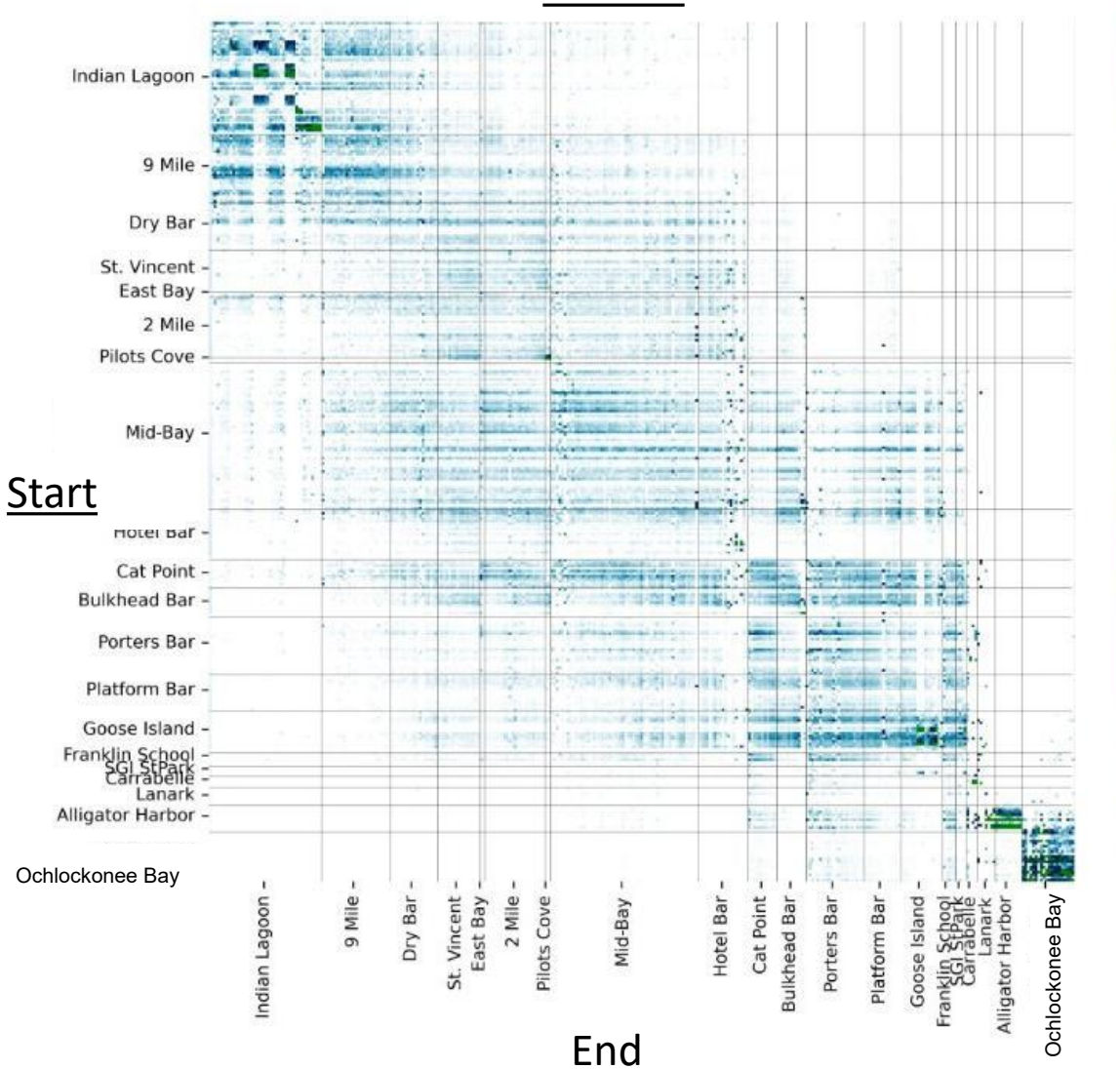
Normal

Drought

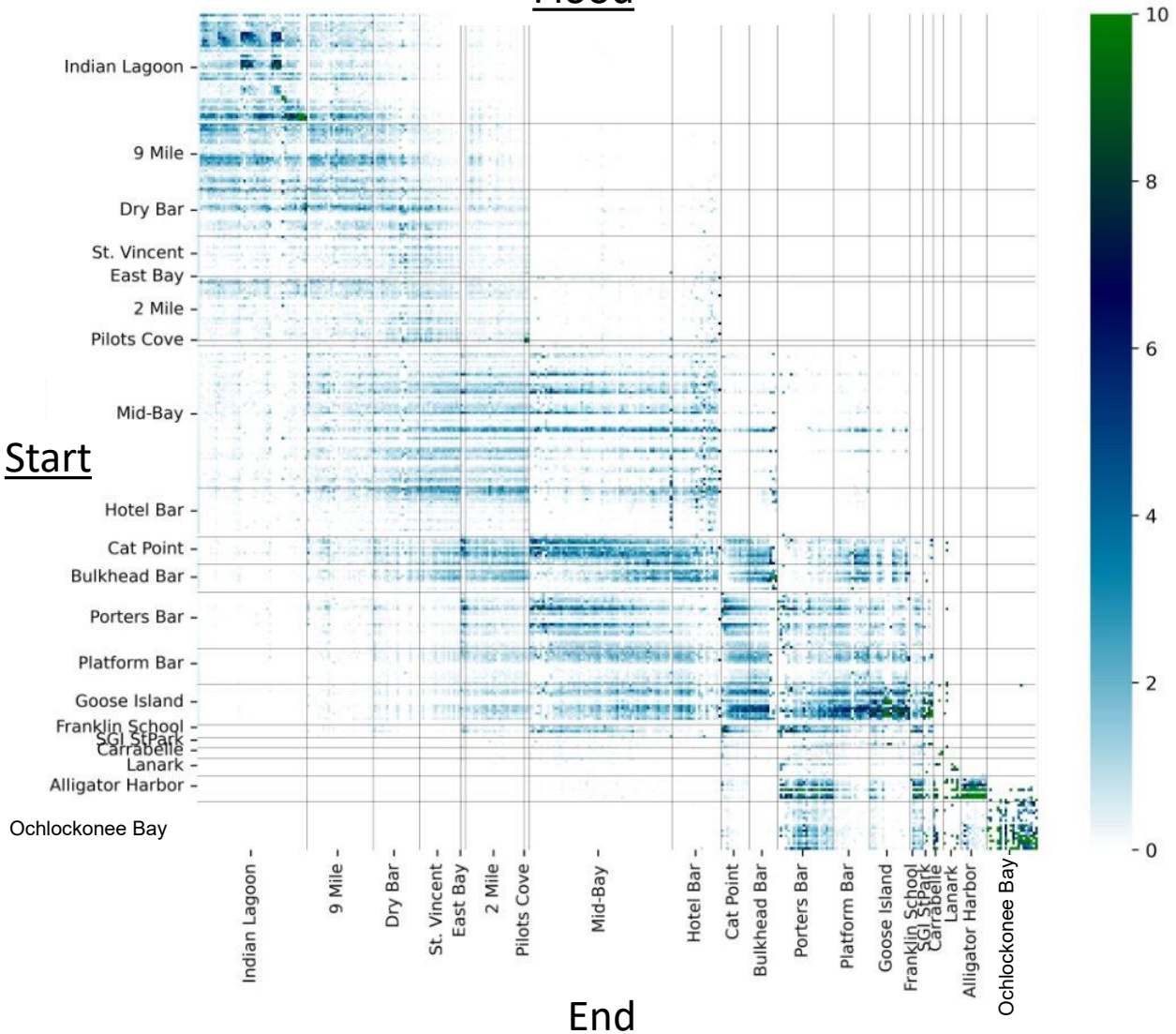
-Overall shift of larva to middle and western reefs

Results : Connectivity Matrices–Fall ‘Flood’

Normal

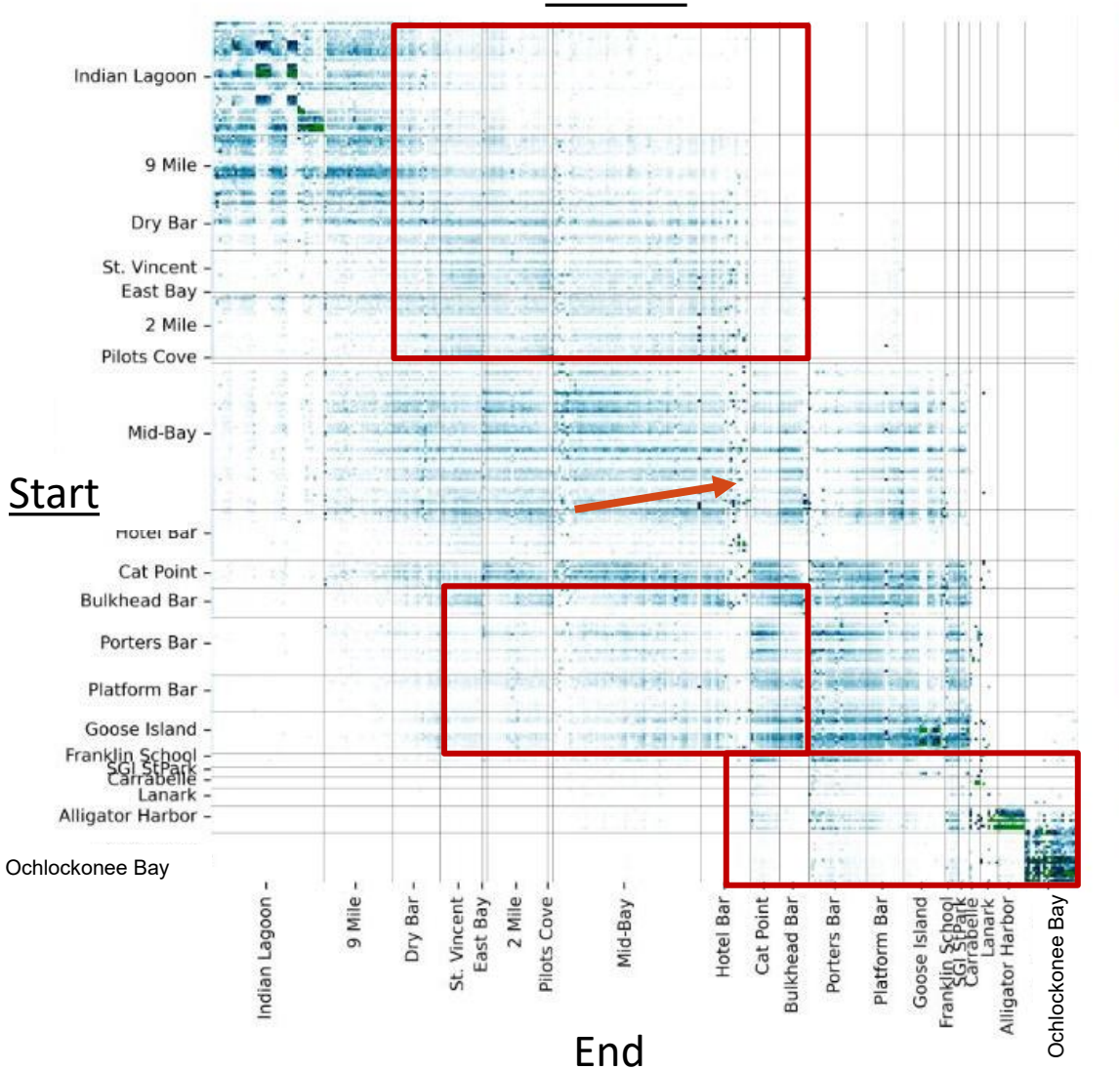


Flood

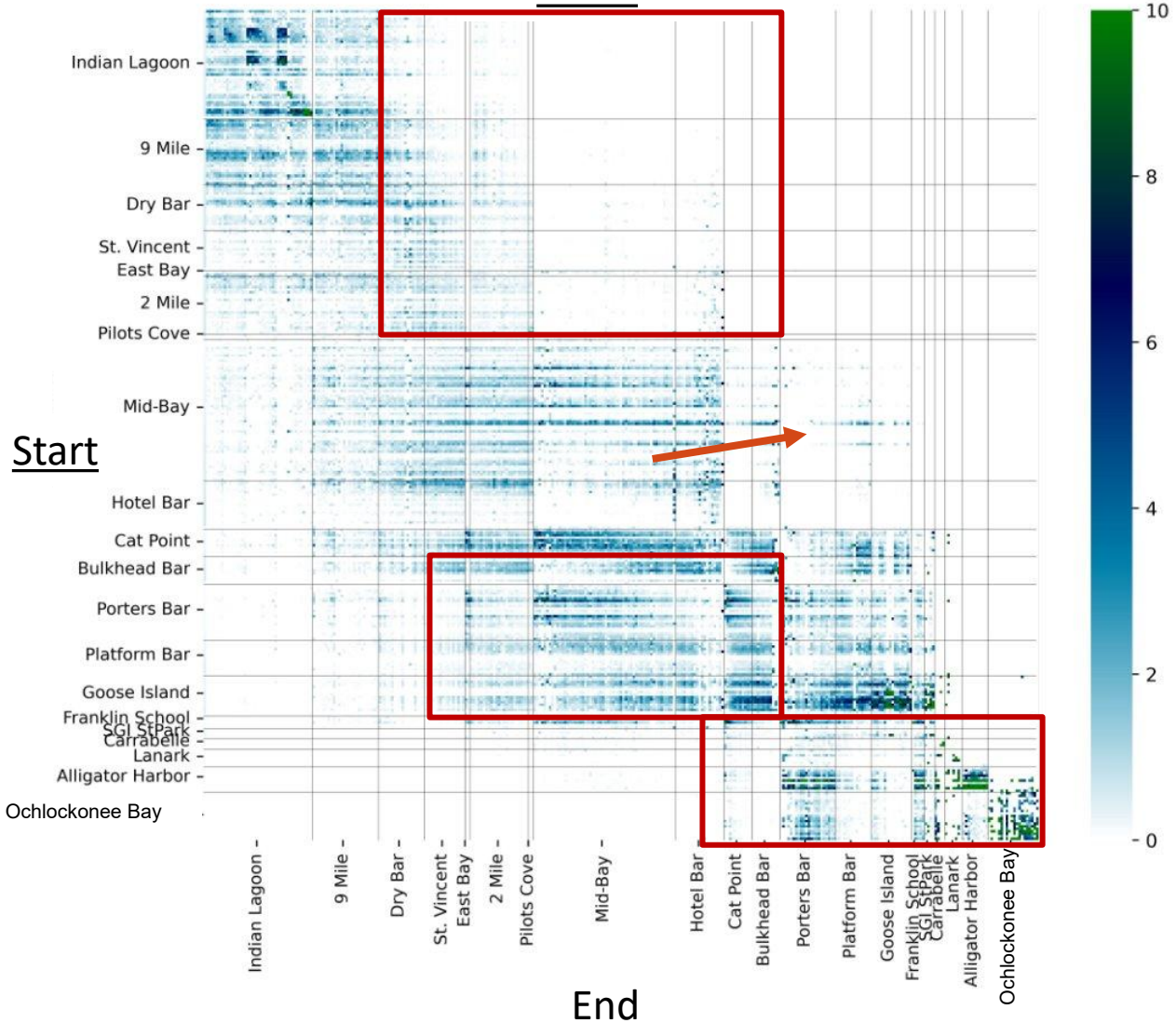


Results : Connectivity Matrices–Fall ‘Flood’

Normal



Flood



Results : Connectivity Matrices–Fall ‘Flood’

Normal

Flood

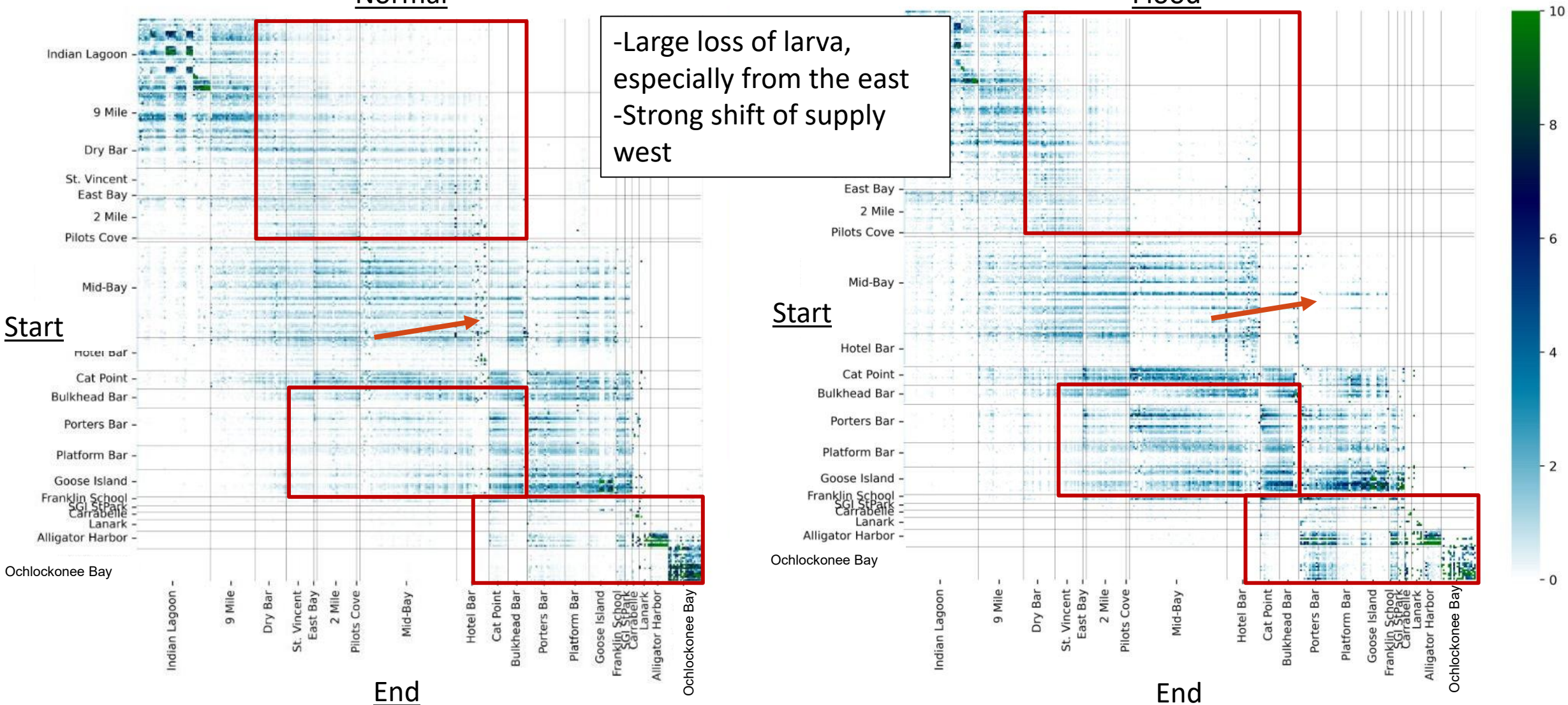
-Large loss of larva, especially from the east
-Strong shift of supply west

Start

Start

End

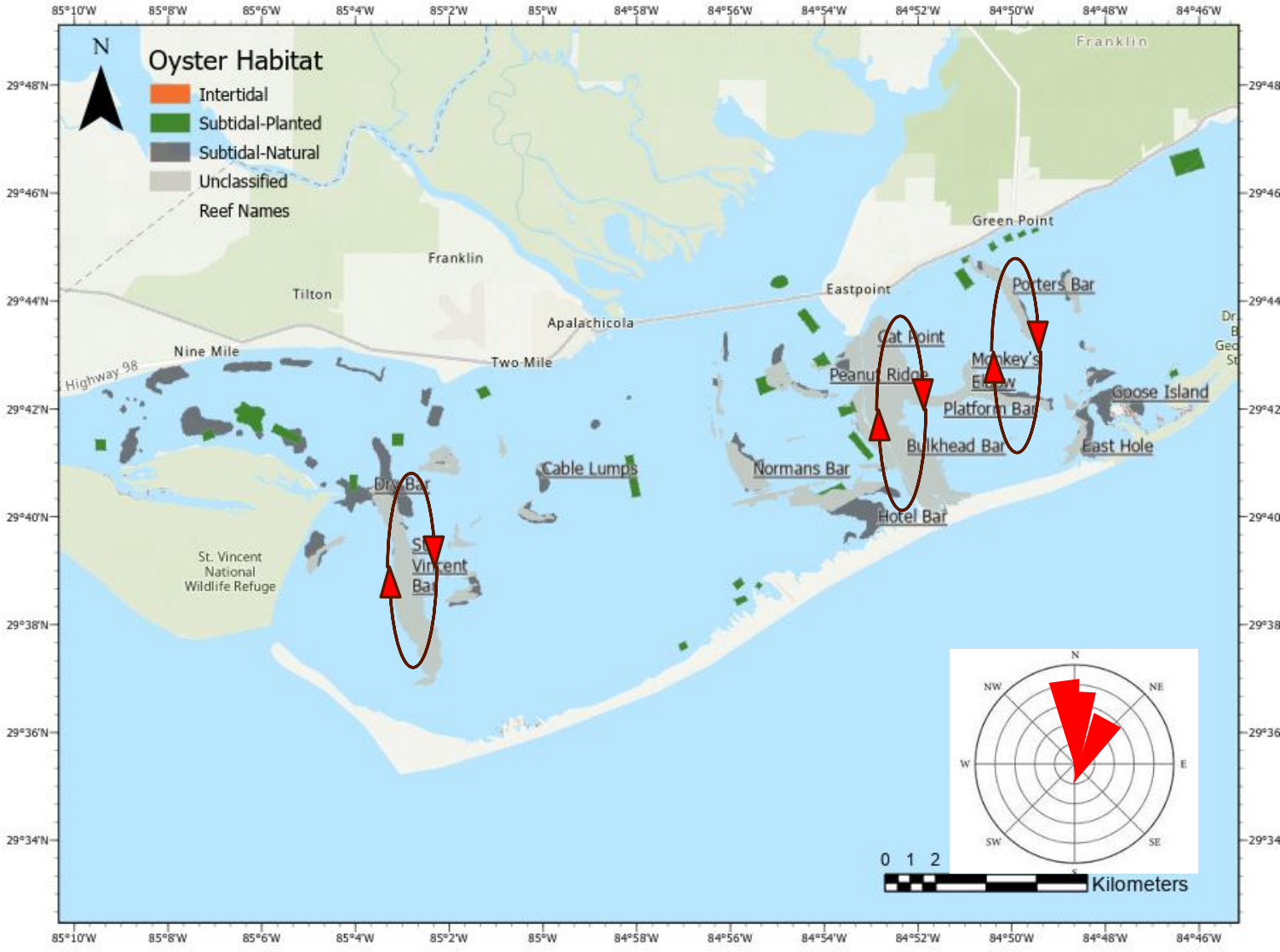
End



Implications

Spring

- Larva tend to settle on or near home reefs, connectivity across bay is limited



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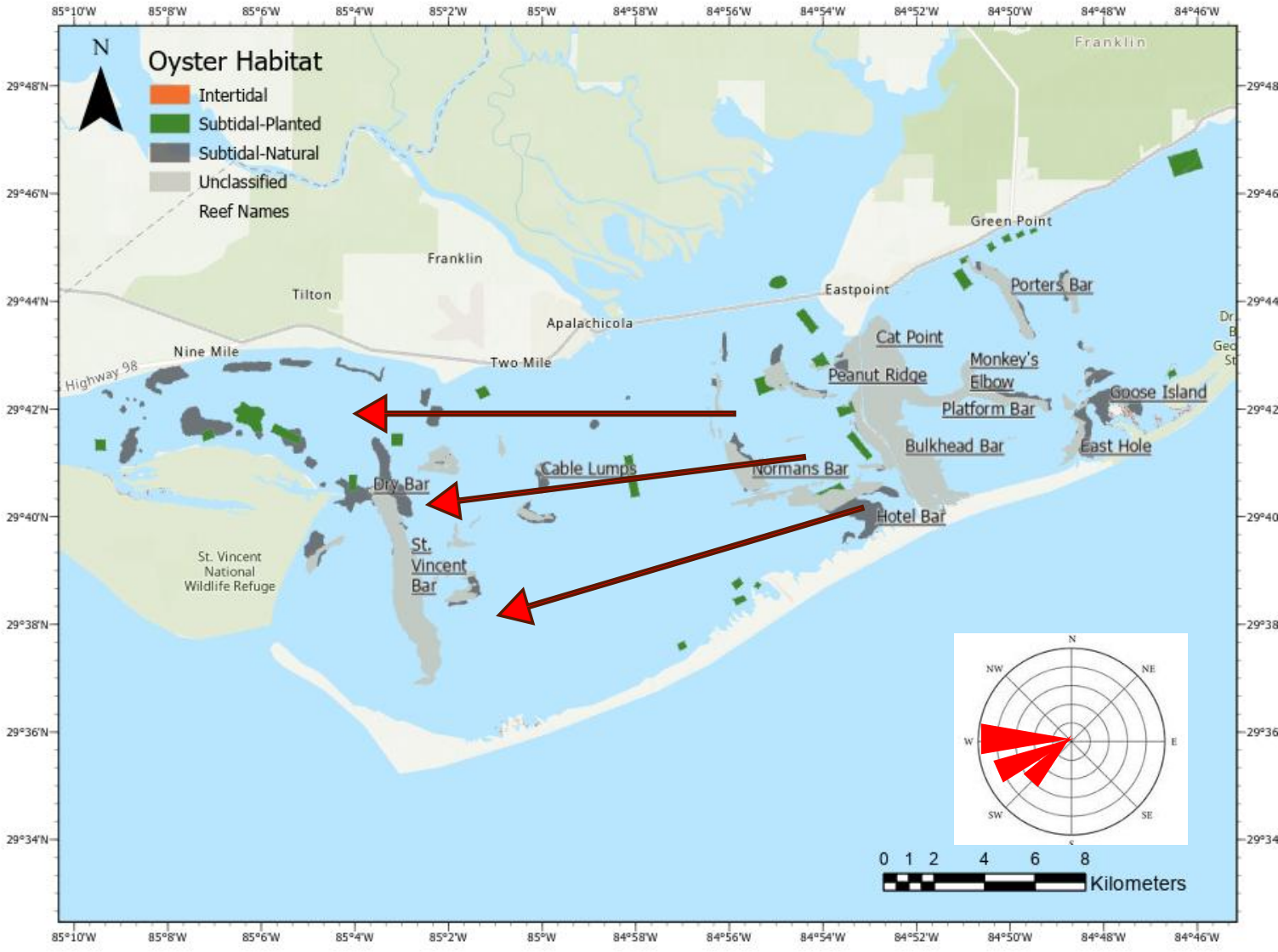
Fall

- Increased westward connectivity, flow of larval supply from east to western reefs



Implications

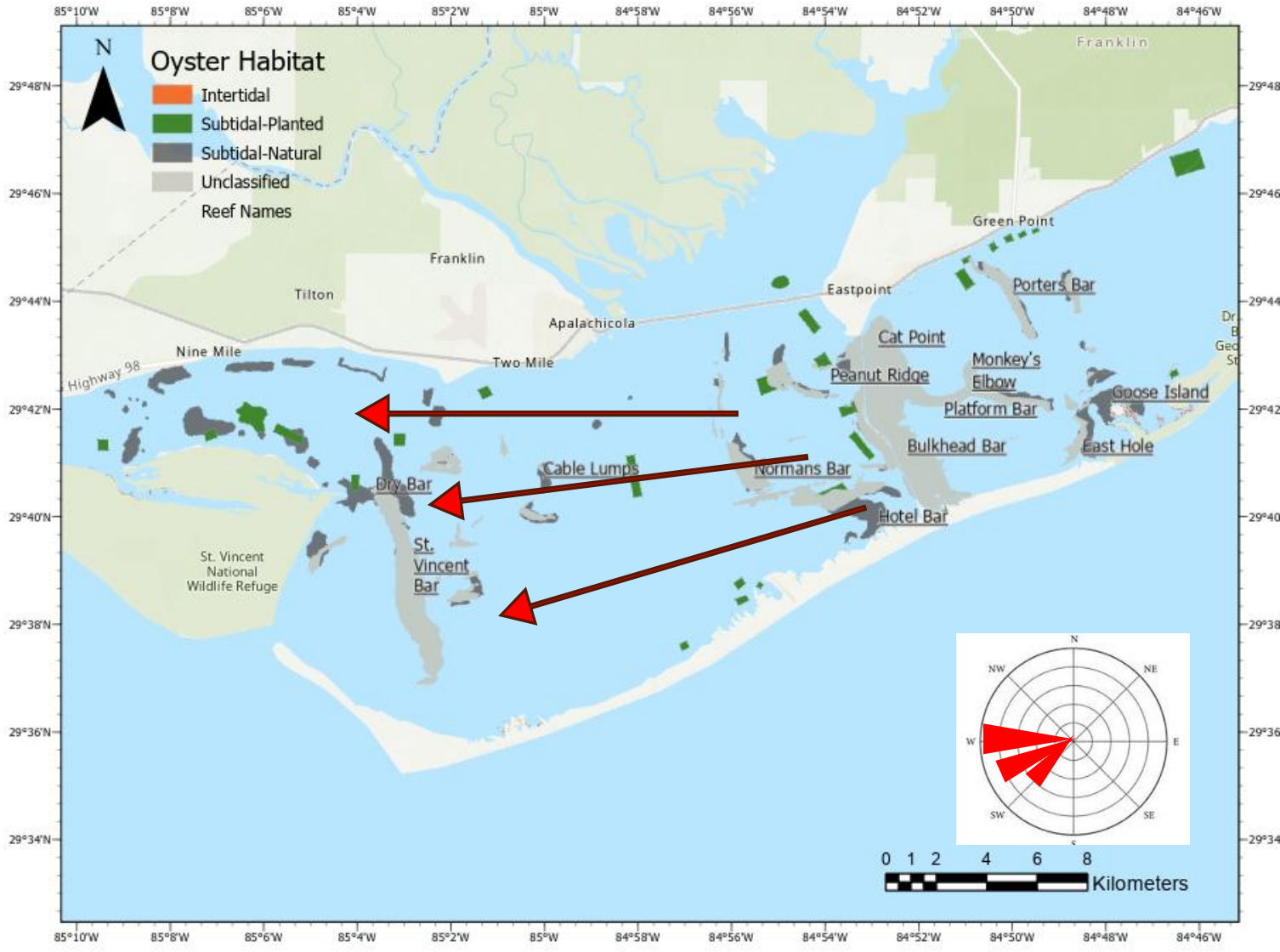
Spring
- Larva tend to settle on or near home reefs, connectivity across bay is limited

Fall
- Increased westward connectivity, flow of larval supply from east to western reefs

Flood
- Greater impacts to Fall survival, connectivity dynamics

Drought
- Greater impacts to Fall survival, connectivity dynamics

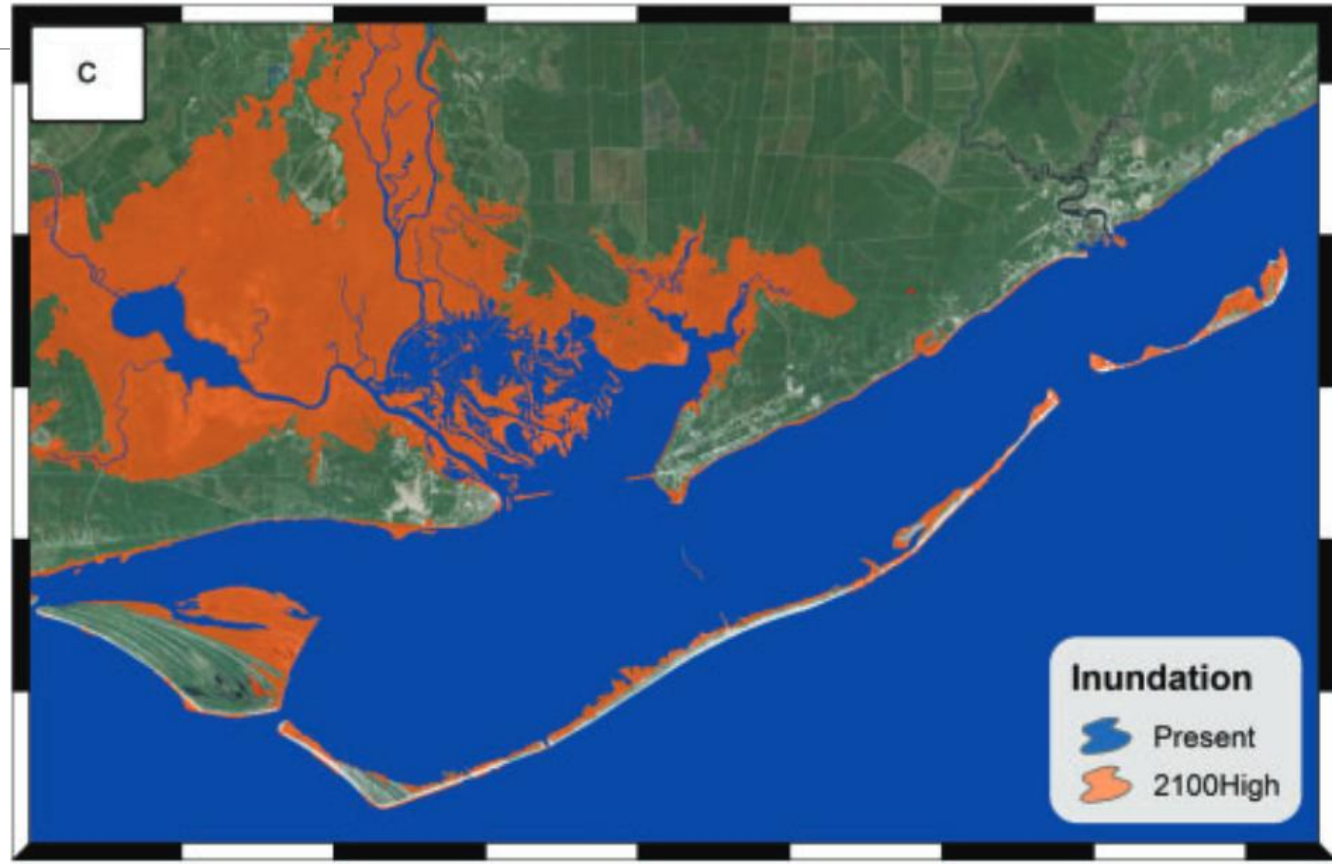
Restoration and experiments can be influenced by seasonal variations in larval supply and connectivity



Future work

Habitat Suitability Model (Index)

Projection under future climates



Passeri et al. 2016

Thanks!

Apalachicola Bay System Initiative – Dr. Sandra Brooke, all the marine tech's

Center for Ocean and Atmospheric Predictive Services – Dr. Steve Morey, Dr. Xu Chen

FSU Coastal Marine Laboratory

Apalachicola National Estuarine Research Reserve

Florida Fish and Wildlife Conservation Commission

Triumph Gulf Coast Inc. – Grant #69

Questions?

Competency: 255m – supported by literature

Year	Season	Avg time to Pediveliger (D)	Avg Time to Settle (D)	Settled %	Dead%
2019	Spring	12.89	11.88	51.20	48.80
2019	Fall	11.27	11.28	57.37	42.63
2012	Spring	15.40	14.58	52.38	47.62
2012	Fall	12.15	12.25	46.58	53.42
1998	Spring	14.37	13.44	45.16	54.84
1998	Fall	11.08	10.58	44.51	55.49

Notes:

-Fall increase survival
-Fall most impacted by change

-Increased spring development time
-Impact to Fall Surv

-Increased spring development time
-Impact to Both Surv