An aerial map of the Huron-Erie Corridor, showing a winding river and surrounding land. The map is overlaid with a grid of colored squares, likely representing different land use or habitat types. The colors range from dark blue to light blue, green, and brown.

Potential use for fish and fish habitat modelling in assessments of a changing Huron-Erie Corridor

Investigators: Susan Doka & Ken Minns

GIS: Carolyn Bakelaar, Charlene Rae, Andrew Doolittle

Project Support: Lynn Bouvier, Jason Barnucz, Matt Stuart, Kathy Seifried, Cindy Chu, Kris VandeSompel

Partners: Linda Mortsch, Andrea Hebb, Joel Ingram, Maggie Galloway, Krista Holmes, Nick Mandrak

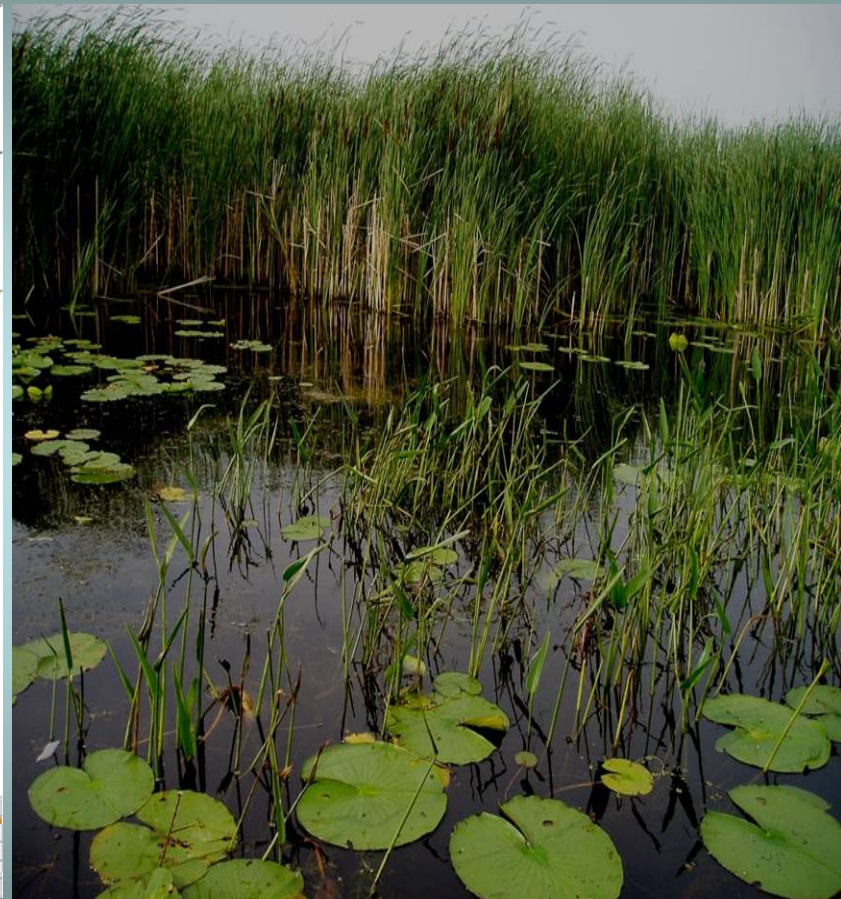
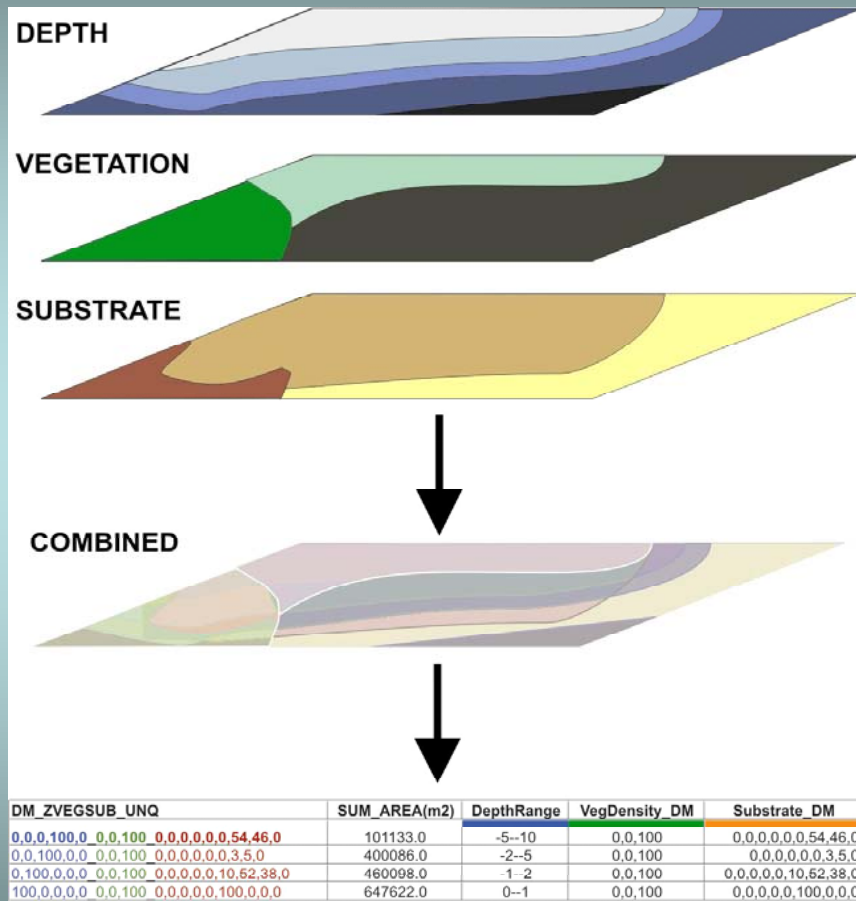
Funding Support: CCIAP & IJC



Fish & Fish Habitat Modelling Examples

- Static Weighted Suitable Area Assessments by Fish Guild of Climate Change-Induced Habitat Changes
- Deterministic Long-term Trends in Population Dynamics based on Water Level Fluctuations
- Short-term Spatially Explicit Trends in First Year Dynamics for Select Fish Species

Fish Habitat Supply Model Layers

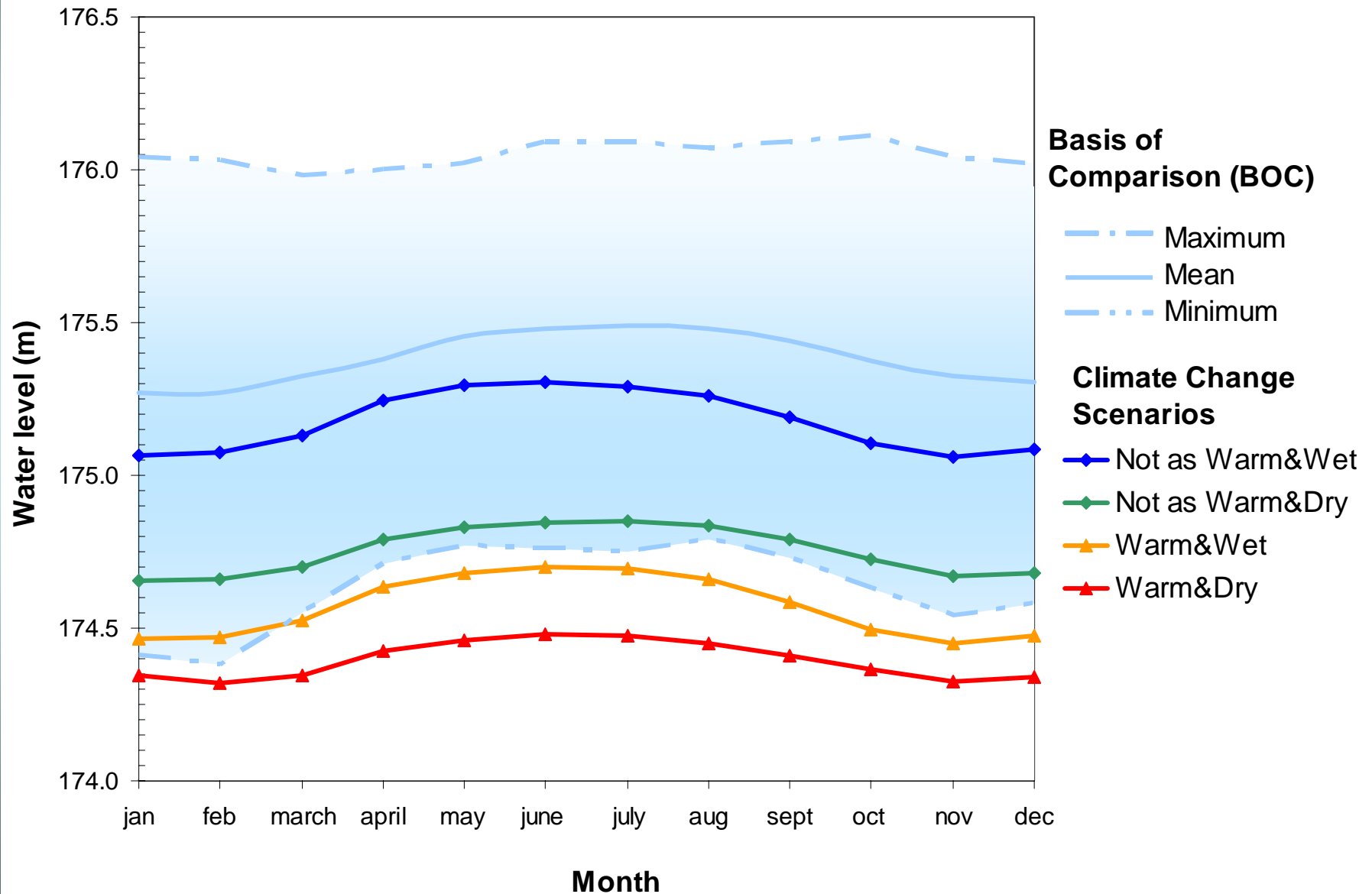


Lake St. Clair - Water Level Scenarios

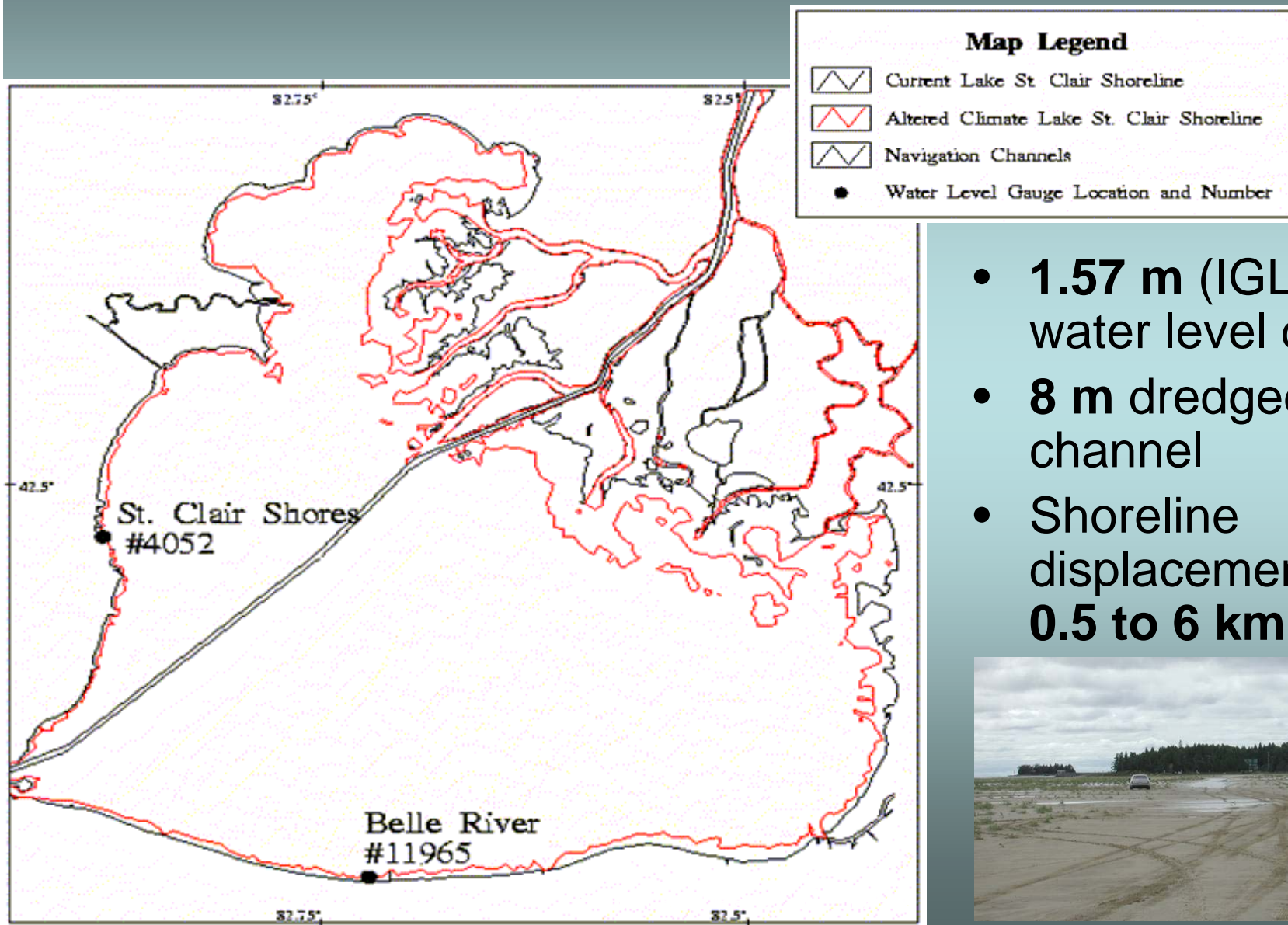
	BASE CASE	WARM & DRY	NOT-AS Warm & Dry	WARM & WET	NOT-AS Warm & Wet
LAKE STATISTICS					
Mean	175.38	174.40	174.75	174.57	175.18
Maximum	176.11	175.12	175.43	175.36	175.95
Minimum	174.38	173.37	173.72	173.46	174.05
Annual Range	1.73	1.75	1.71	1.90	1.90
CHANGE FROM BASE CASE					
Annual		-0.98	-0.63	-0.81	-0.20
Winter		-0.95	-0.62	-0.81	-0.21
Spring		-0.98	-0.61	-0.77	-0.16
Summer		-1.01	-0.64	-0.80	-0.20
Autumn		-1.01	-0.65	-0.87	-0.26
Growing Season		-1.00	-0.63	-0.78	-0.18

Source: David Fay & Yin Fan, Environment Canada

Lake St. Clair Water Level Scenarios



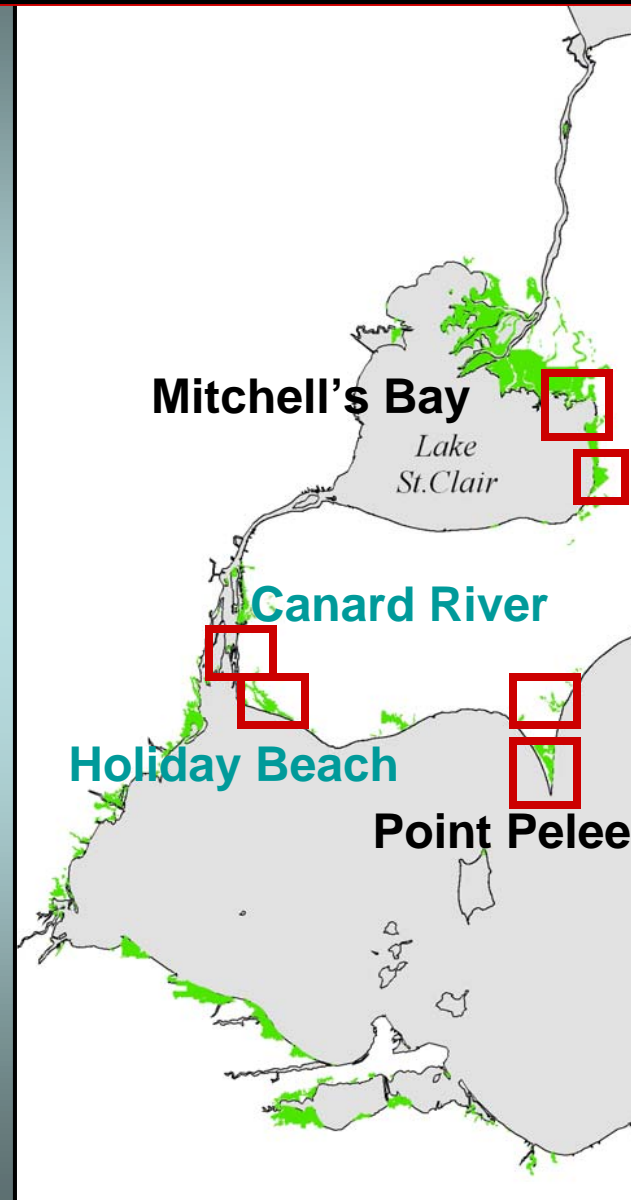
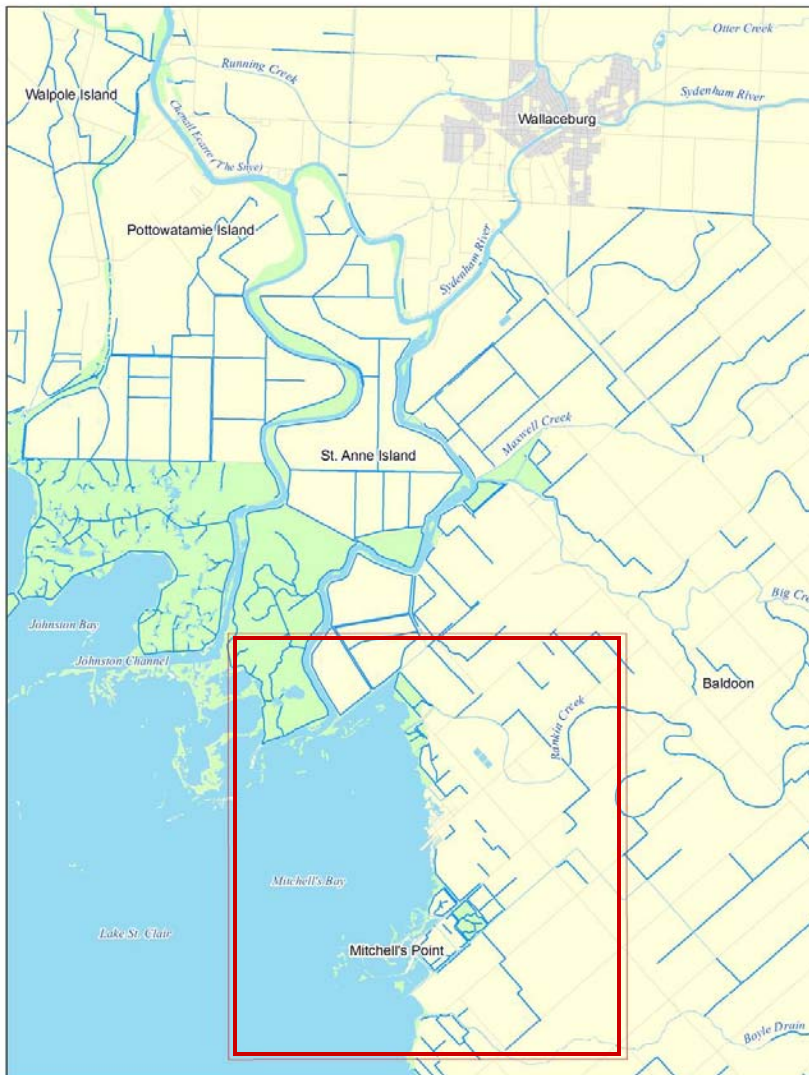
Lake St. Clair “What-if” Scenario



- **1.57 m (IGLD85)** water level decline
- **8 m** dredged channel
- Shoreline displacement from **0.5 to 6 km**



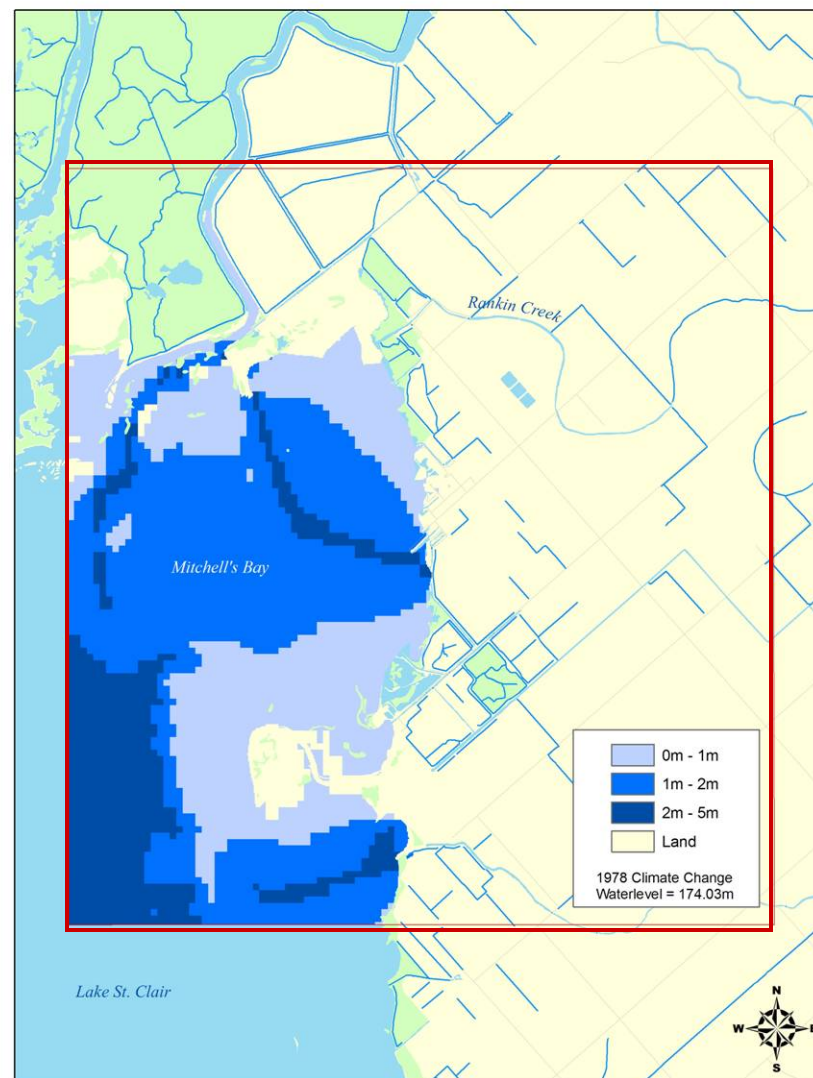
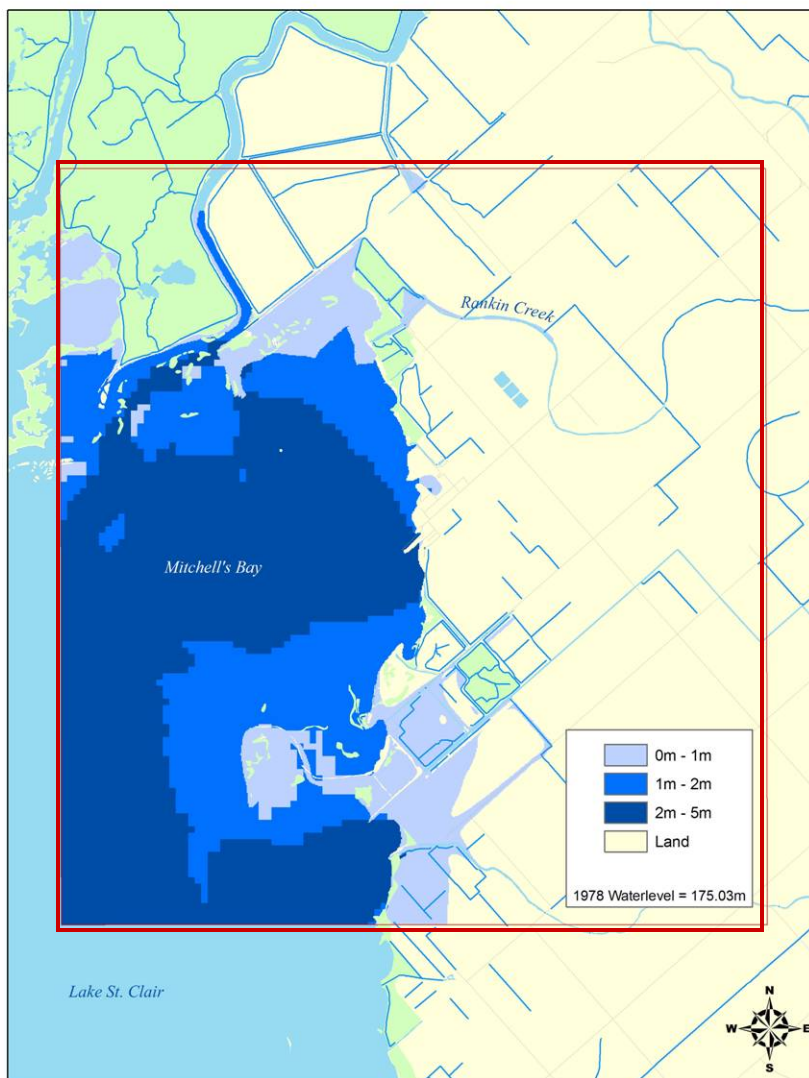
Huron-Erie Corridor Wetland Locations



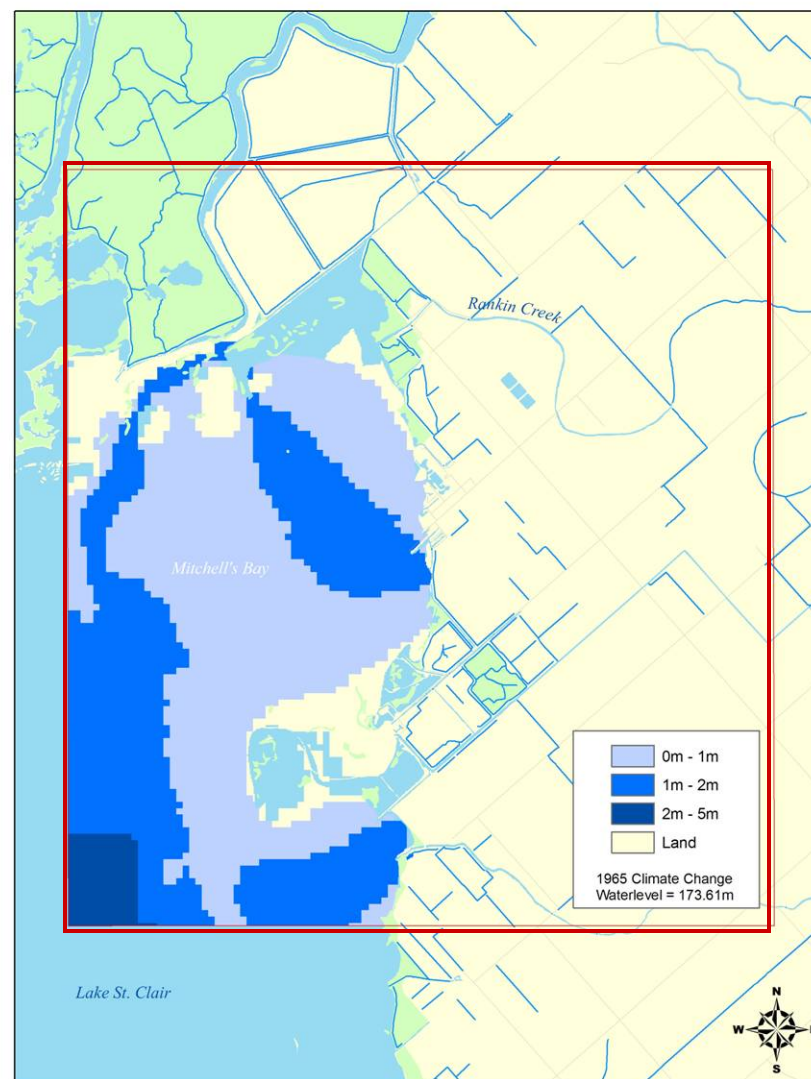
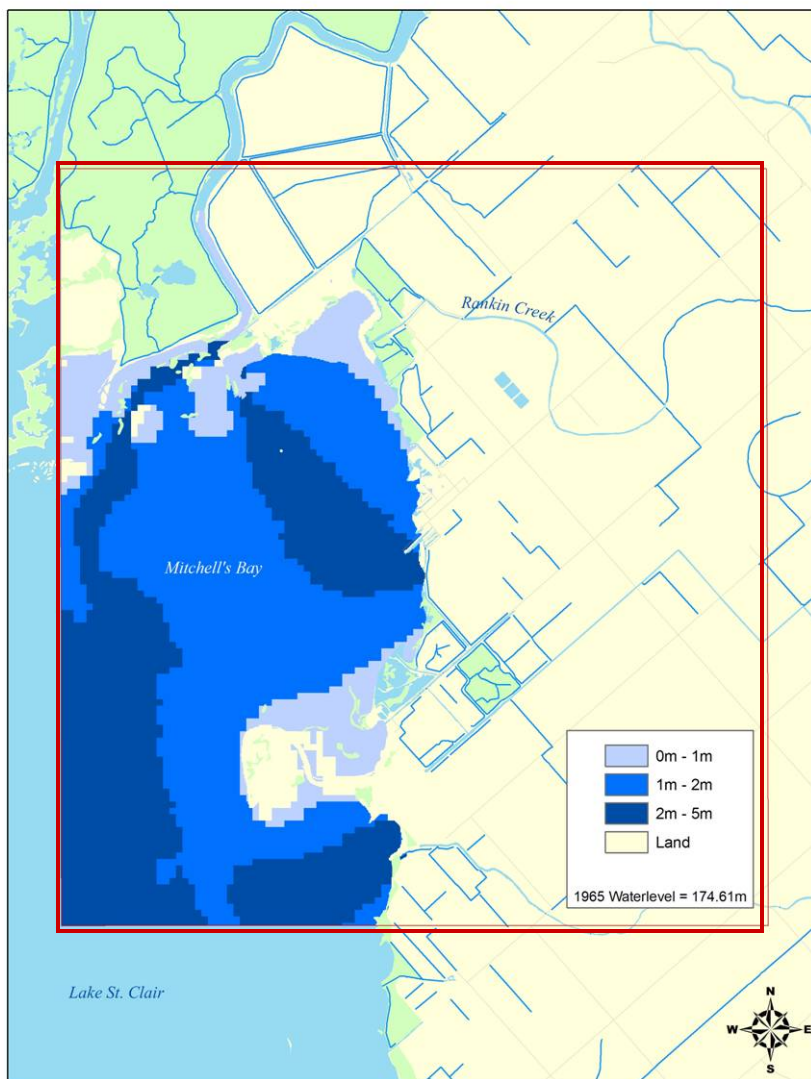
**St Clair
NWA**

**Hillman
Marsh**

Average ice-free water depths for Mitchell's Bay: High Water Historic (1978) and Climate Change Predictions



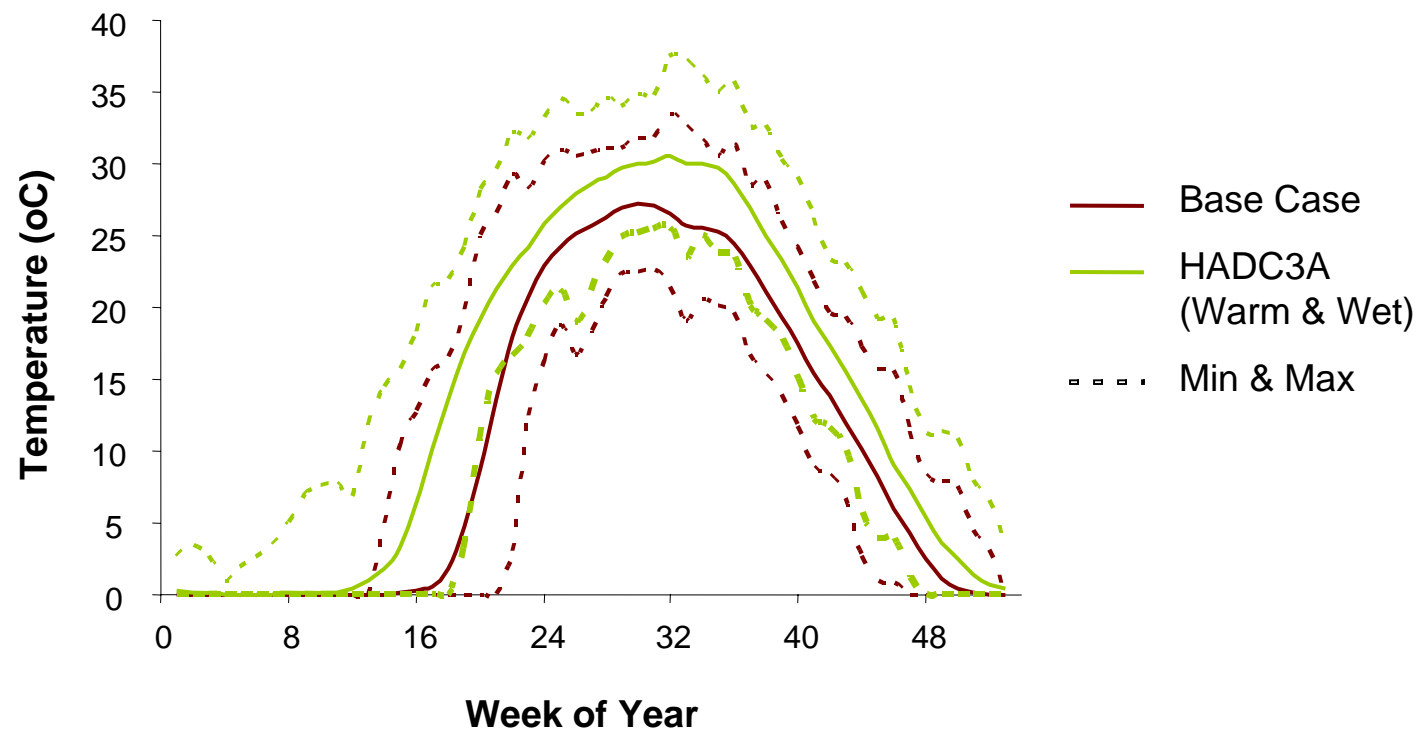
Average ice-free water depths for Mitchell's Bay: Low Water Historic (1964) and Climate Change Predictions



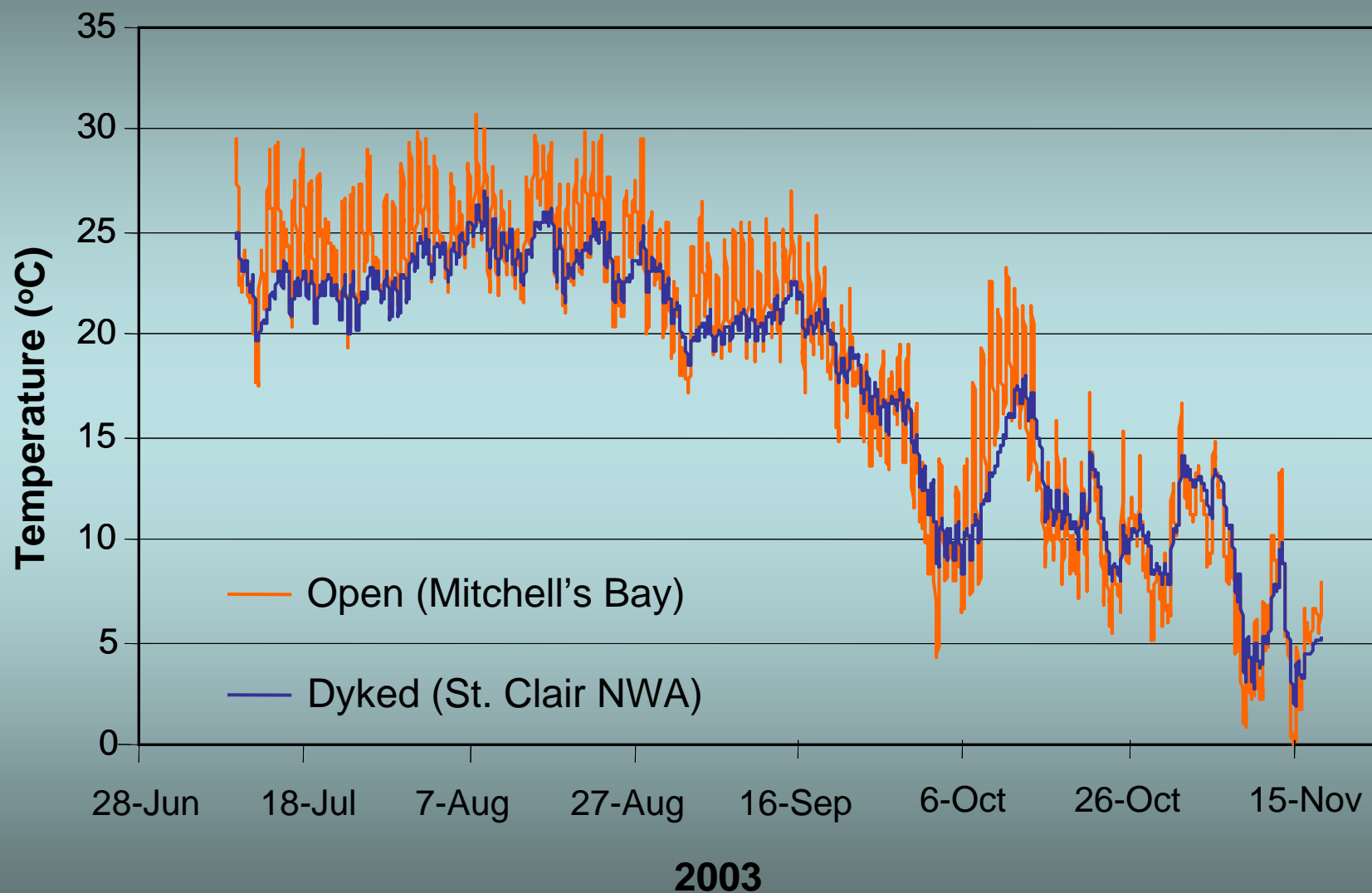
Summary of average annual predictions for Lake St. Clair under four climate change scenarios (from Croley 2004)

GCM	Surface Temp (°C)	Overlake Precipitation (mm)	Ice Cover %	Humidity (mb)
Base Case	T 10.7	P 803	I 35.5%	H 10.7
CGCM2 A21 Warm & Dry	T +3.0	P 0	I -11%	H +2.9
CGCM2 B23 Not so Warm-Dry	T +2.1	P -37	I -7%	H +2.1
HadCM 3 A1FI Warm & Wet	T +3.2	P +37	I -12%	H +2.1
HadCM 3 B22 Not so Warm-Wet	T +2.7	P +110	I -11%	H +2.1

Average weekly temperature predictions for Lake St. Clair: Historic and Extreme Climate Change (from Croley 2004)



Lake St. Clair Wetland Temperatures



HEC Fishes Captured in Coastal Wetlands by Guilds

	Cool	Warm
Non-Piscivore	white sucker, Iowa darter, banded killifish, brook silverside, striped shiner, shorthead redhorse, round goby, river chub, golden shiner, pugnose shiner, emerald shiner, blackchin shiner, spottail shiner, yellow perch	rock bass, black bullhead, yellow bullhead, brown bullhead, freshwater drum, goldfish*, goldfish, quillback, common carp, gizzard shad, lake chubsucker, channel catfish, bigmouth buffalo, green sunfish, pumpkinseed, orangespotted sunfish, bluegill, spotted sucker, ghost shiner, mimic shiner, tadpole madtom, white crappie, bluntnose minnow, black crappie, central mudminnow
Piscivore	longnose gar, northern pike, walleye	bowfin, smallmouth bass, largemouth bass, muskellunge, white perch*, white bass
Non-Piscivore	Cold trout-perch	Locations: Mitchell's Bay (Lake St. Clair), St. Clair National Wildlife Area, Canard River (Detroit River), Holiday Beach (West Lake Erie)

Wetland Species at Risk in HEC

Pugnose Shiner *Endangered*

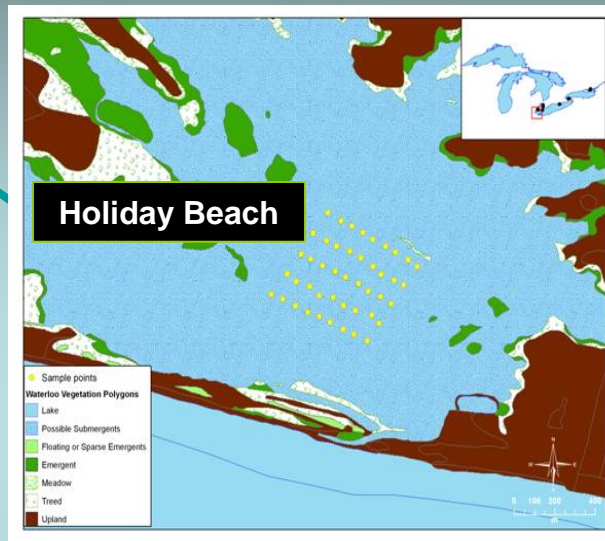


Notropis anogenus

Spotted Sucker *Special Concern*



Mintytrema melanops

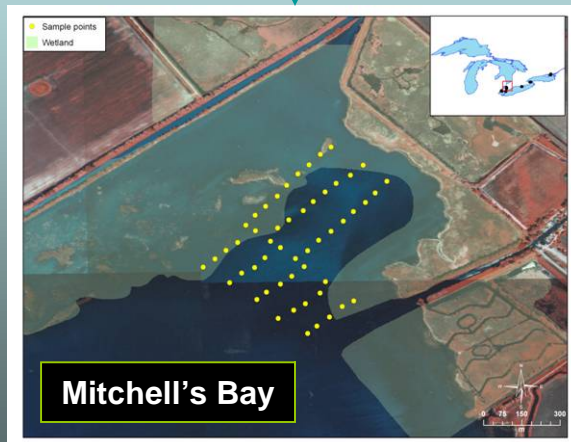


Holiday Beach

Lake Chubsucker *Threatened*



Erimyzon sucetta



Mitchell's Bay



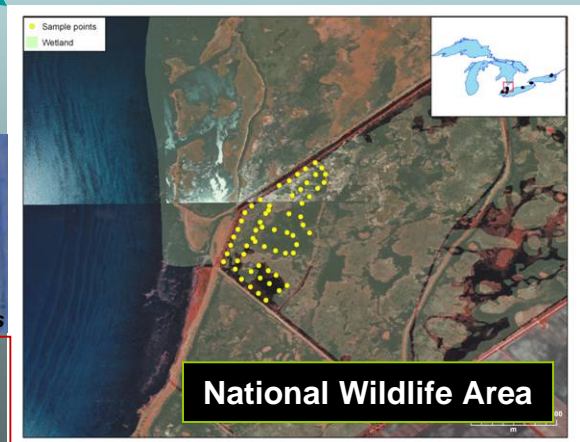
Lepomis humilis

Orangespotted Sunfish
Special Concern



Ictiobus cyprinellus

Bigmouth Buffalo
Special Concern



National Wildlife Area

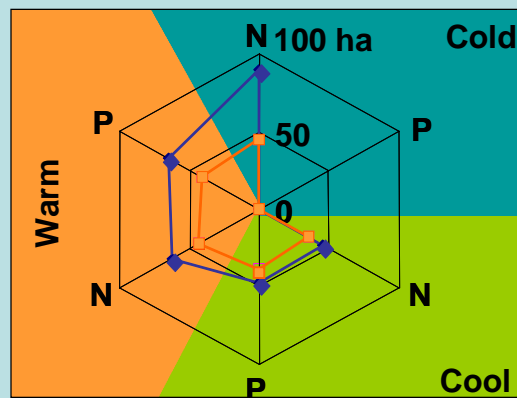
Habitat Supply Model Results

Field Work: Coastal wetland fish community sampled in 2003 barrier and open marshes

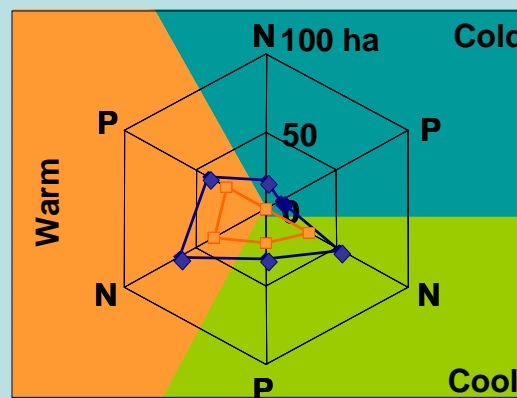
	Cold	Cool	Warm
Non-Piscivore (N)	troutperch	white sucker, banded killifish, brook silverside, greater redhorse, shorthead redhorse, round goby, golden shiner, pugnose shiner, emerald shiner, blackchin shiner, spottail shiner, yellow perch, logperch	rock bass, black bullhead, yellow bullhead, brown bullhead, freshwater drum, goldfish, spottfin shiner, common carp, gizzard shad, channel catfish, bigmouth buffalo, green sunfish, pumpkinseed, warmouth, orangespotted sunfish, bluegill, pugnose minnow, white perch, mimic shiner, tadpole madtom, white crappie, bluntnose minnow, fathead minnow, black crappie, central mudminnow
Piscivore (P)	chinook salmon, brown trout	longnose gar, northern pike, spotted gar, walleye	bowfin, smallmouth bass, largemouth bass, white bass

Climate Change Scenario: **Baseline** is 2m, 100 ha wetland with mixed vegetation and fine substrates
Effect is 1m water level drop with same habitat (i.e. gradual change)

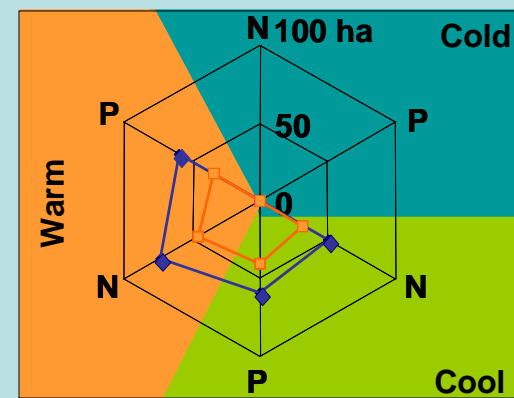
Spawning Habitat



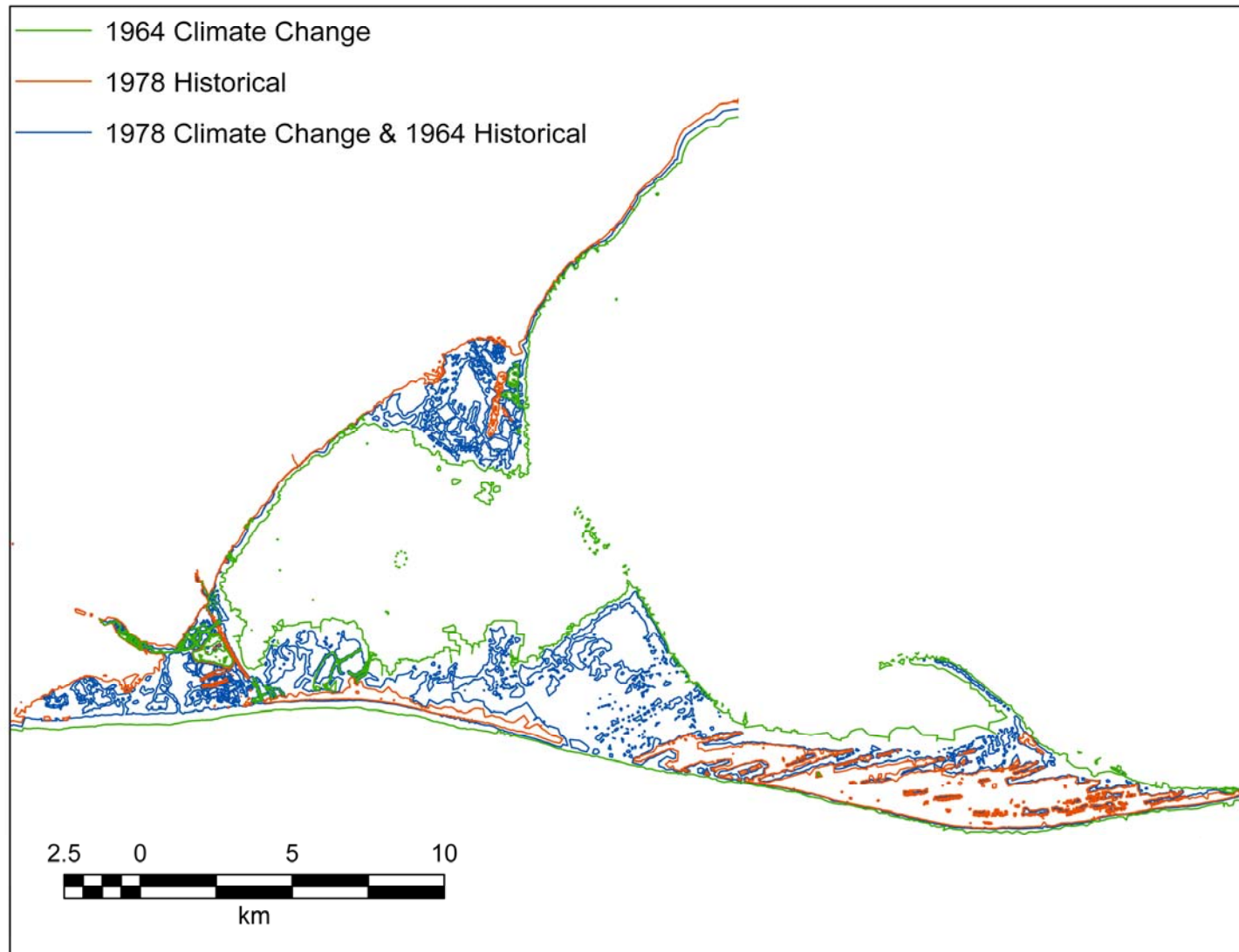
YOY Habitat

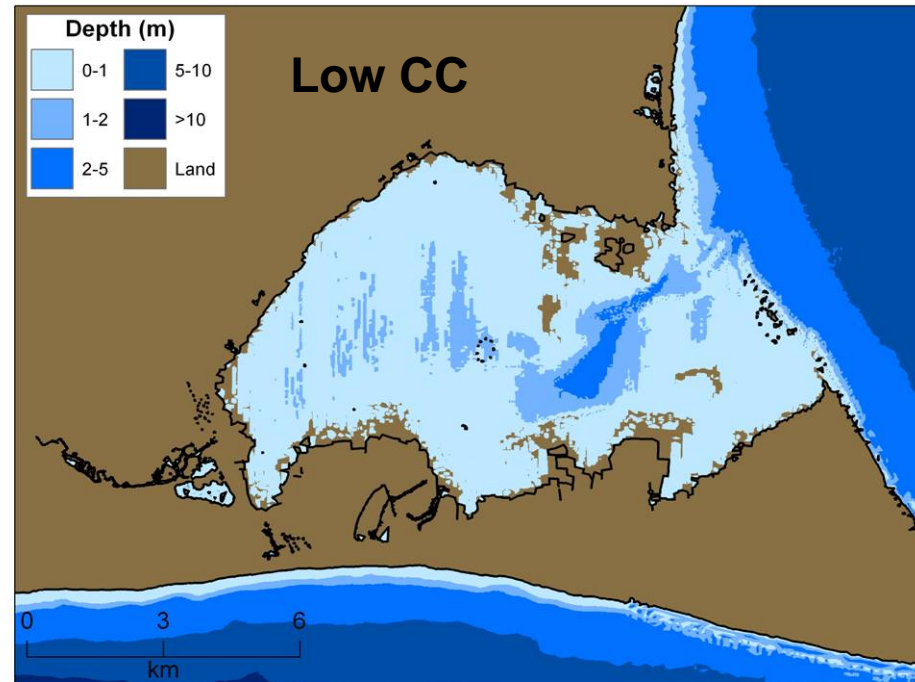
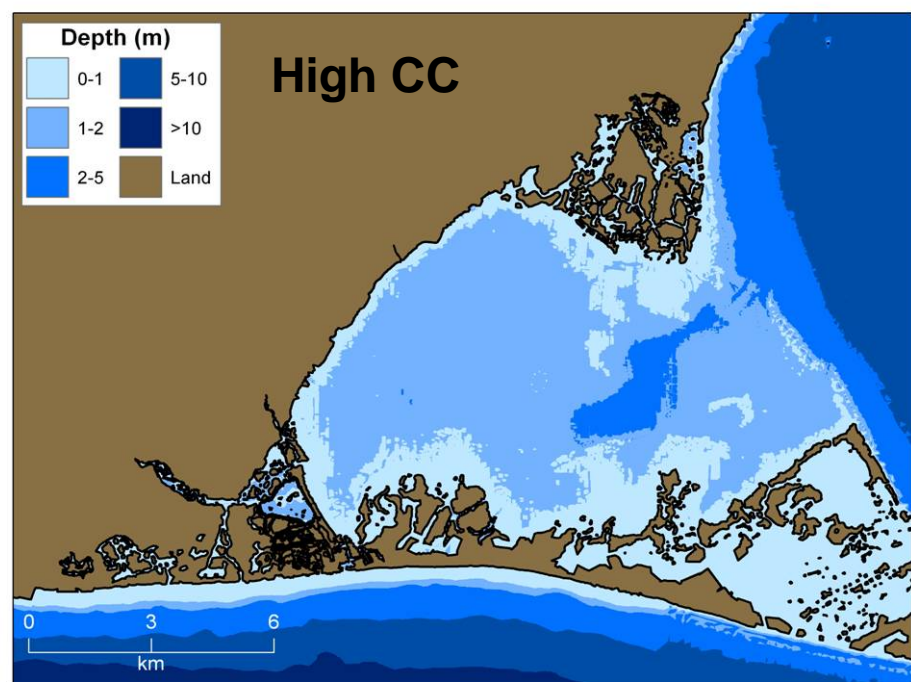
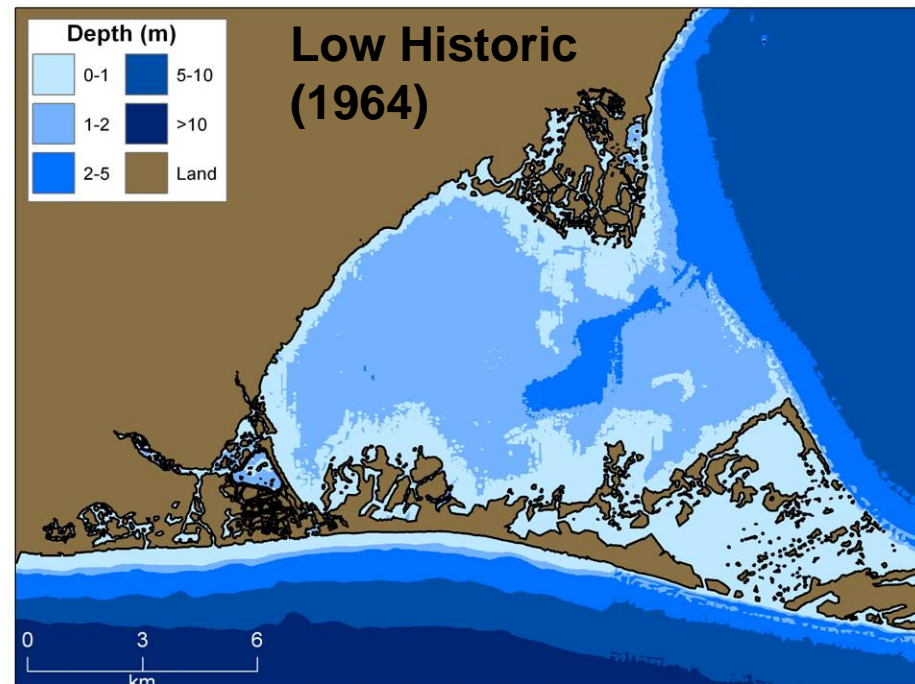
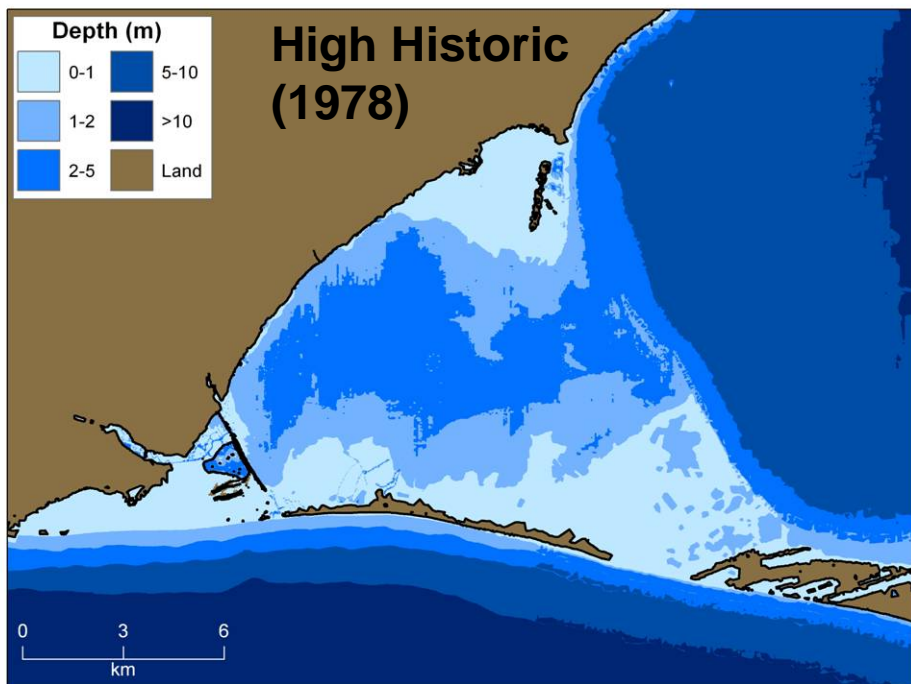


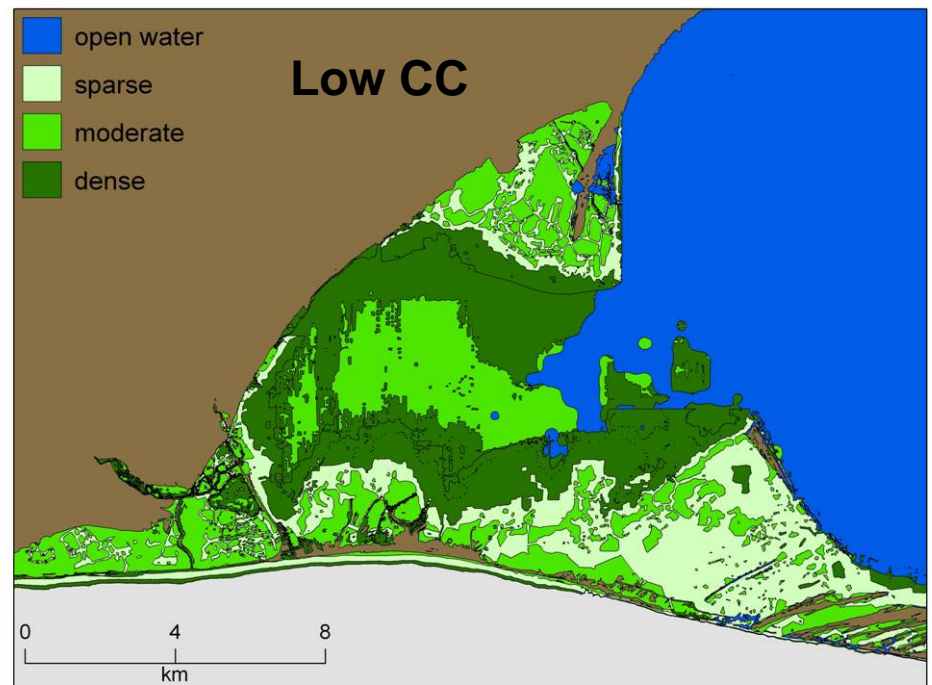
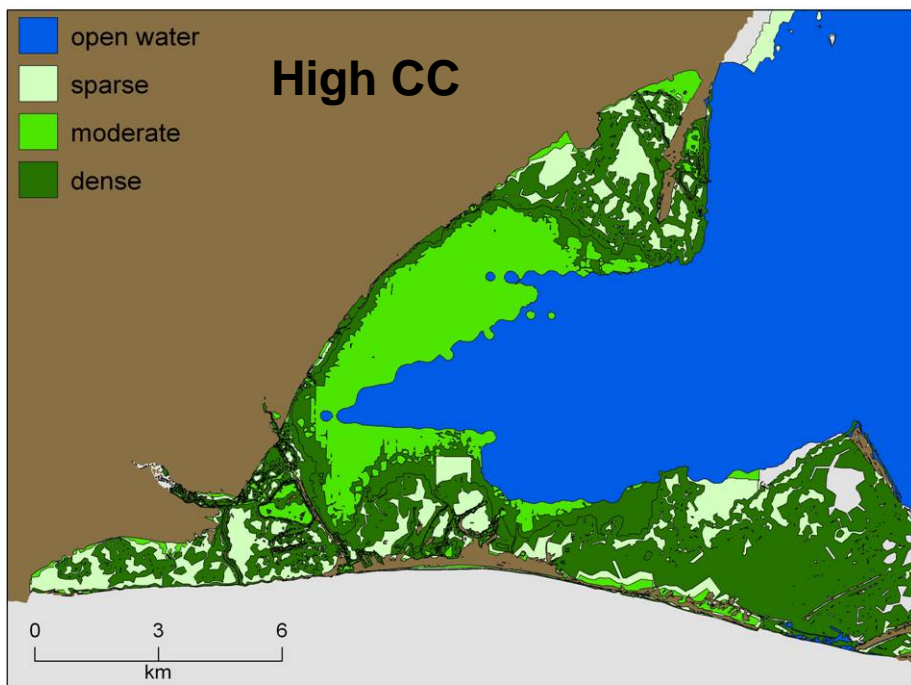
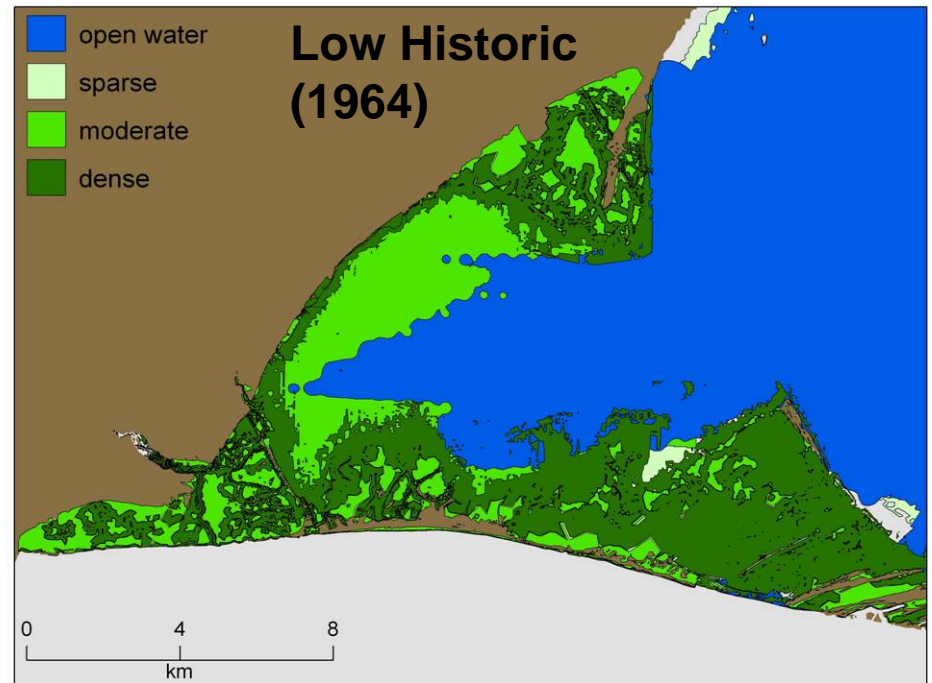
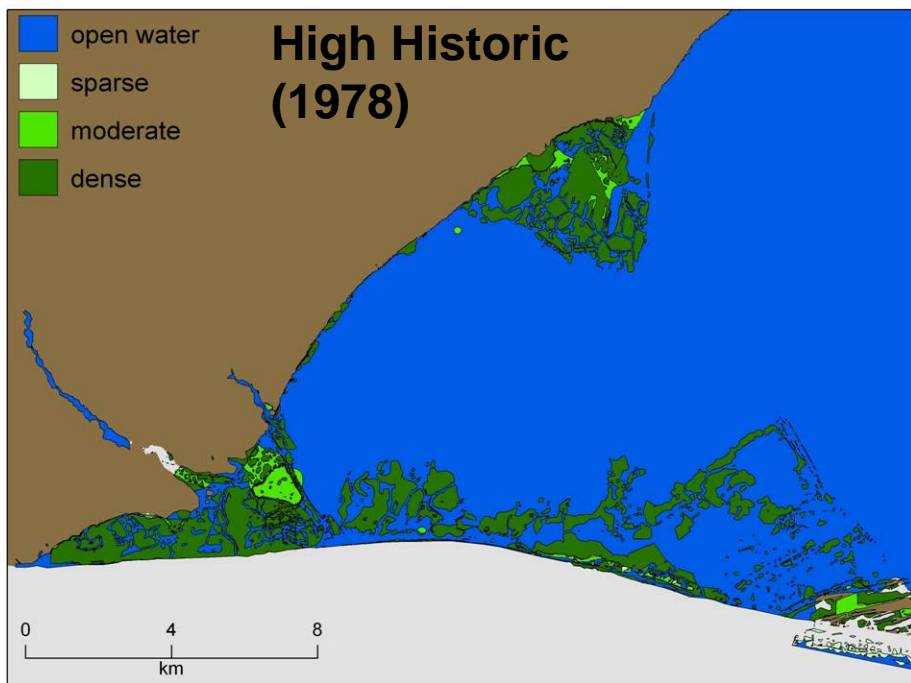
Adult Habitat



Year	Historical water level (m) Mar-Nov (average)	Climate change water level (Historical -0.8m)
1978	174.42	173.66
1964	173.66	172.86





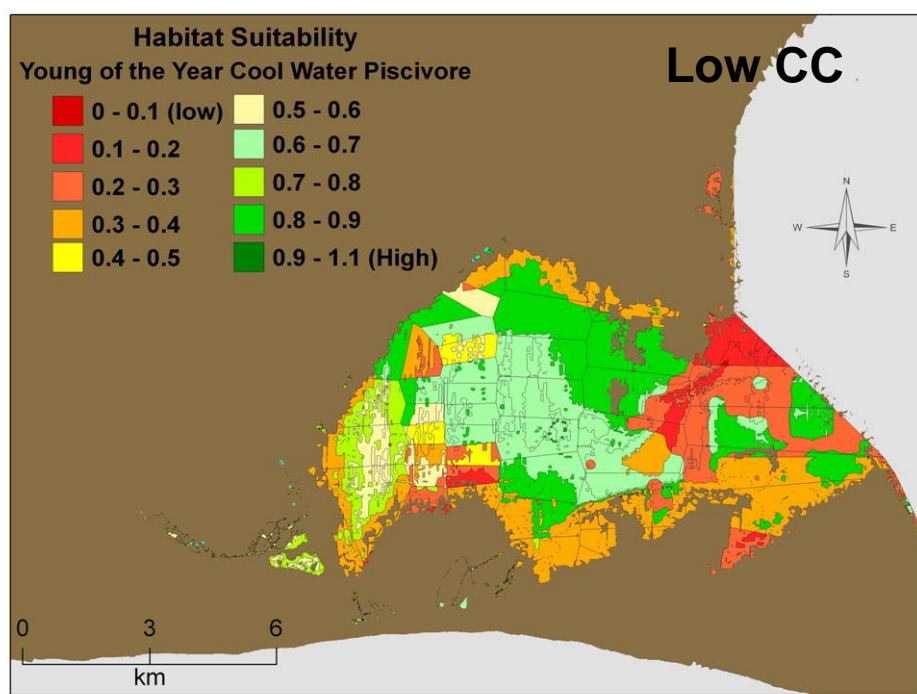
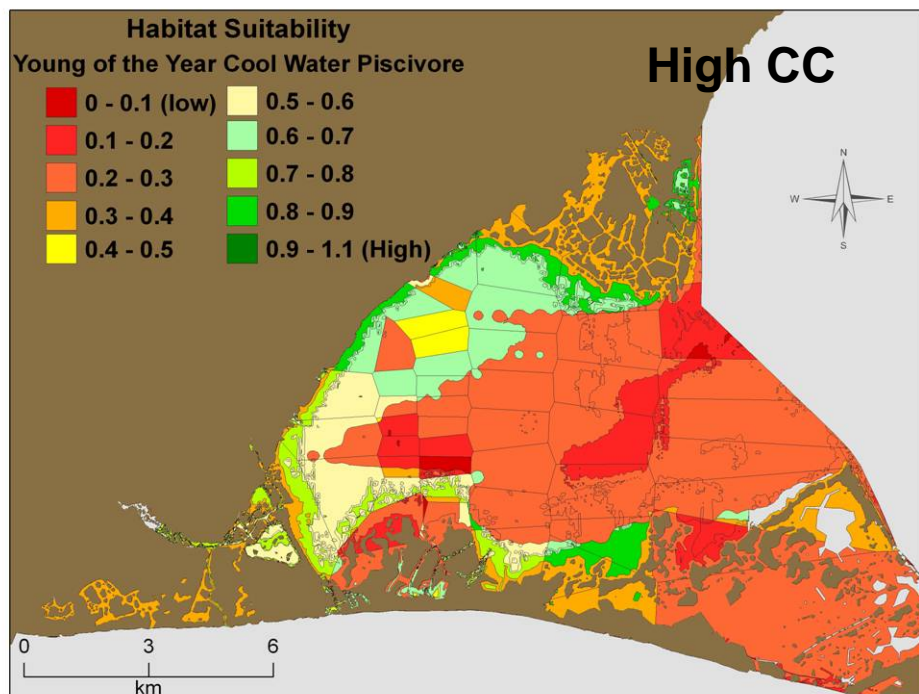
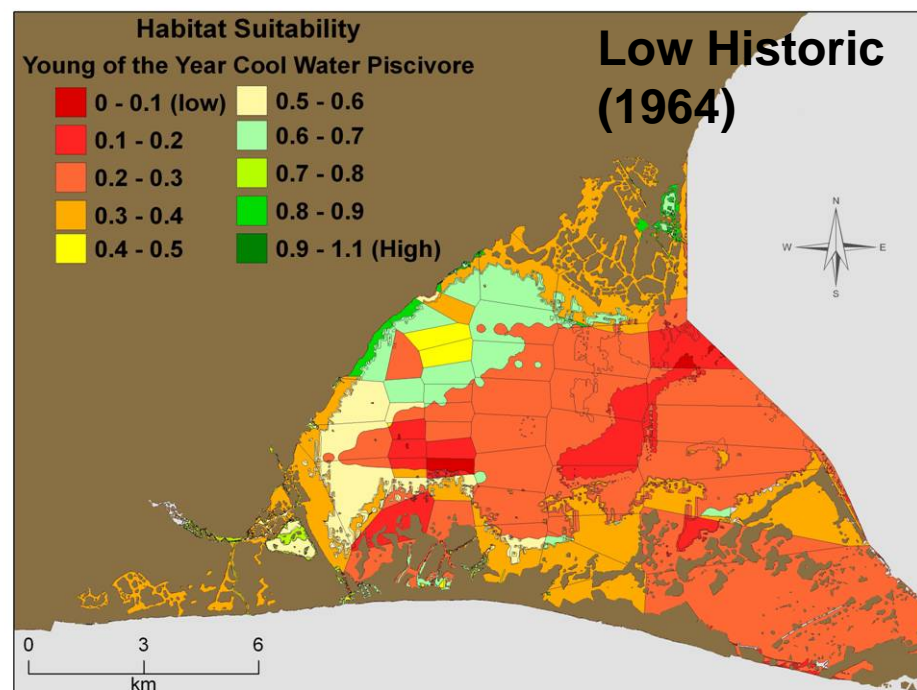
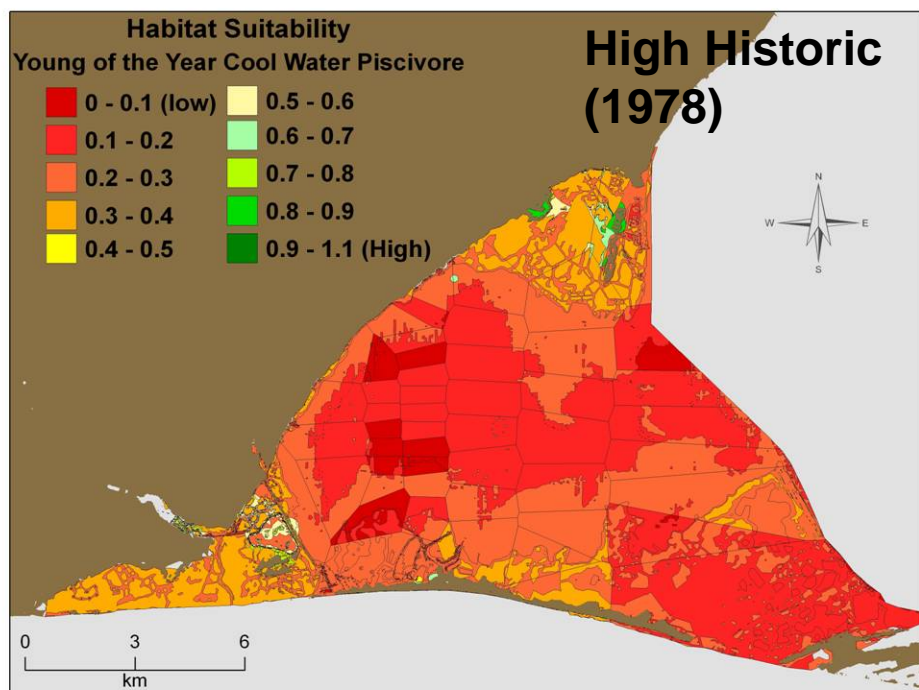


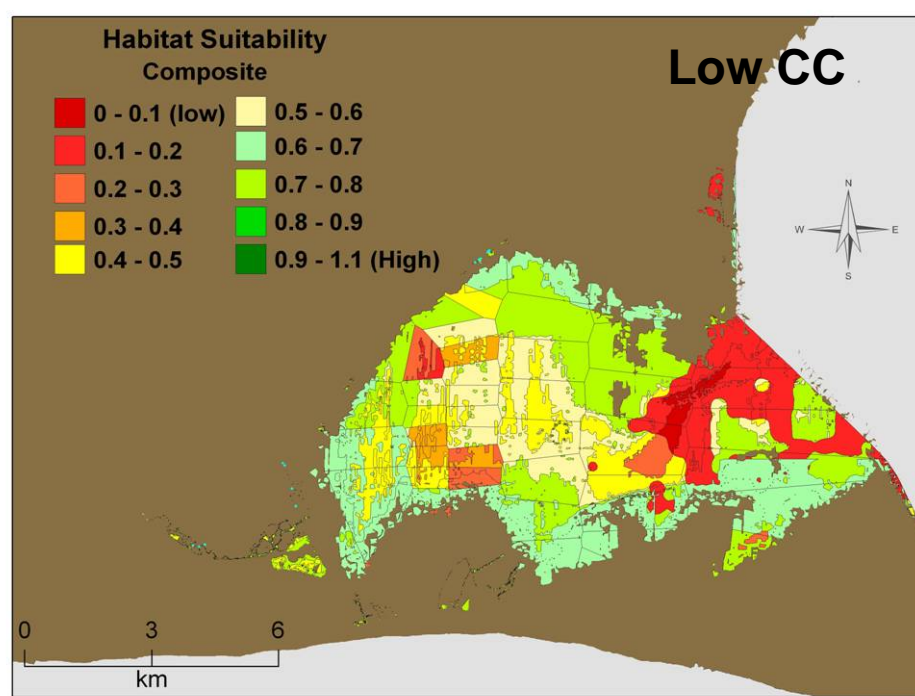
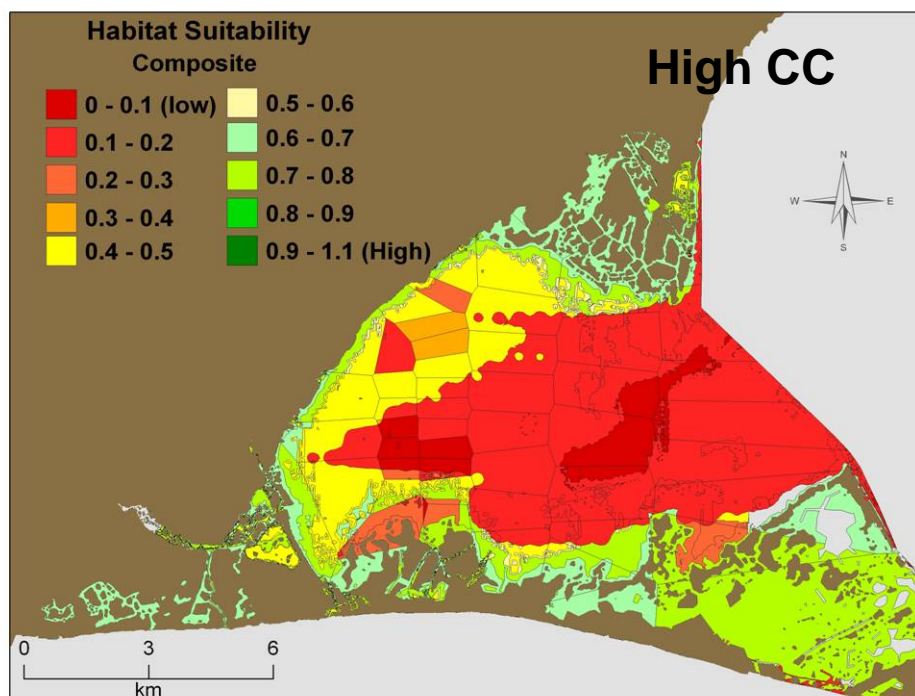
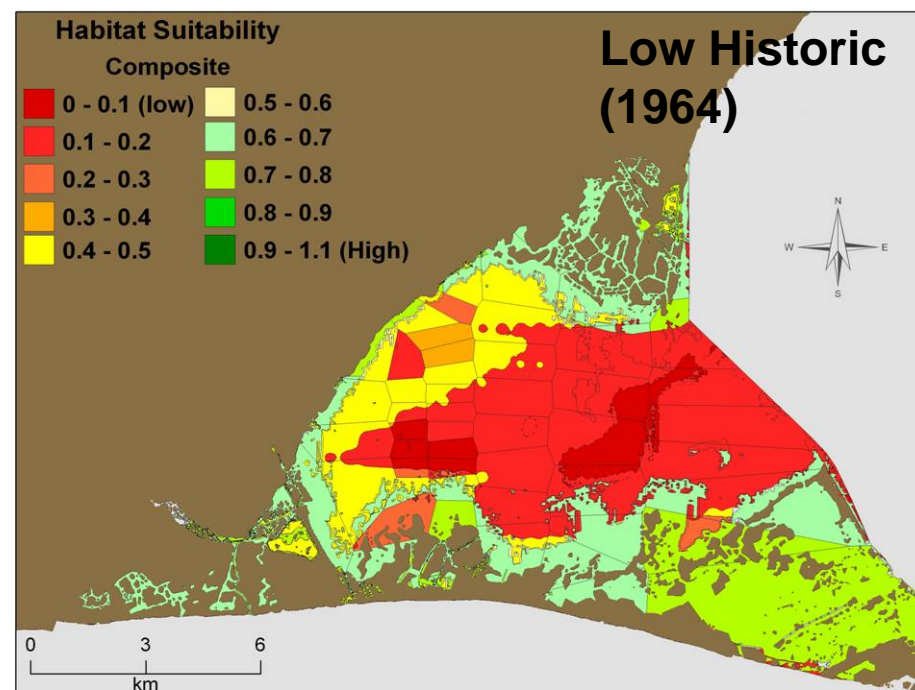
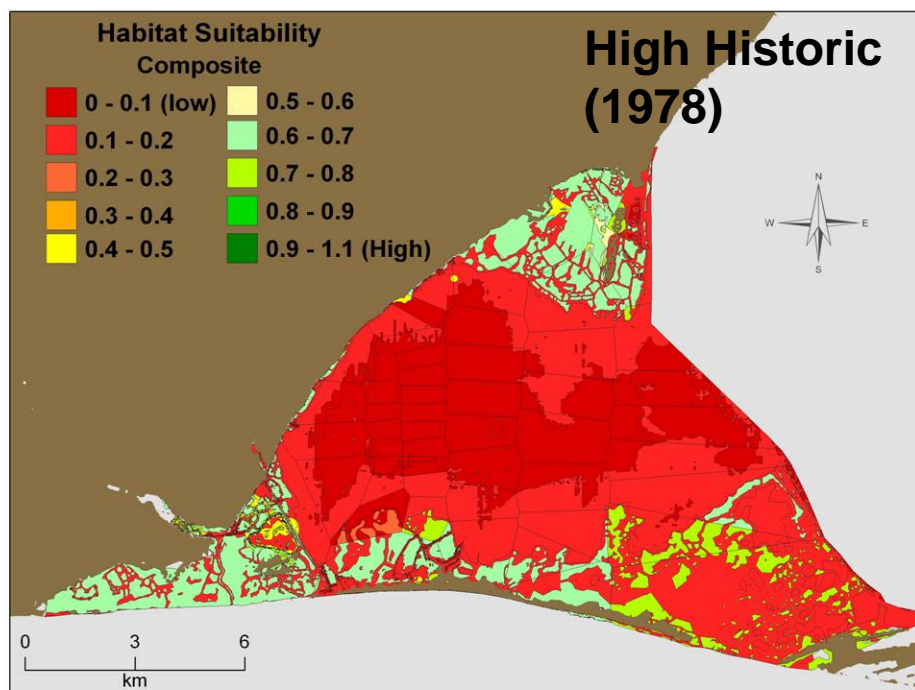
Long Point Fish Guilds in Habitat Supply Model

	Cool	Warm
Non-Piscivore	white sucker, johnny darter, banded killifish, brook silverside, golden shiner, pugnose shiner, emerald shiner, blackchin shiner, blacknose shiner, spottail shiner, yellow perch, logperch	rock bass, black bullhead, yellow bullhead, brown bullhead, freshwater drum, quillback, gizzard shad, pumpkinseed, bluegill, mimic shiner, tadpole madtom, pugnose minnow, bluntnose minnow, black crappie, warmouth central mudminnow, carp, goldfish
Piscivore	northern pike, spotted gar, longnose gar	bowfin, largemouth bass

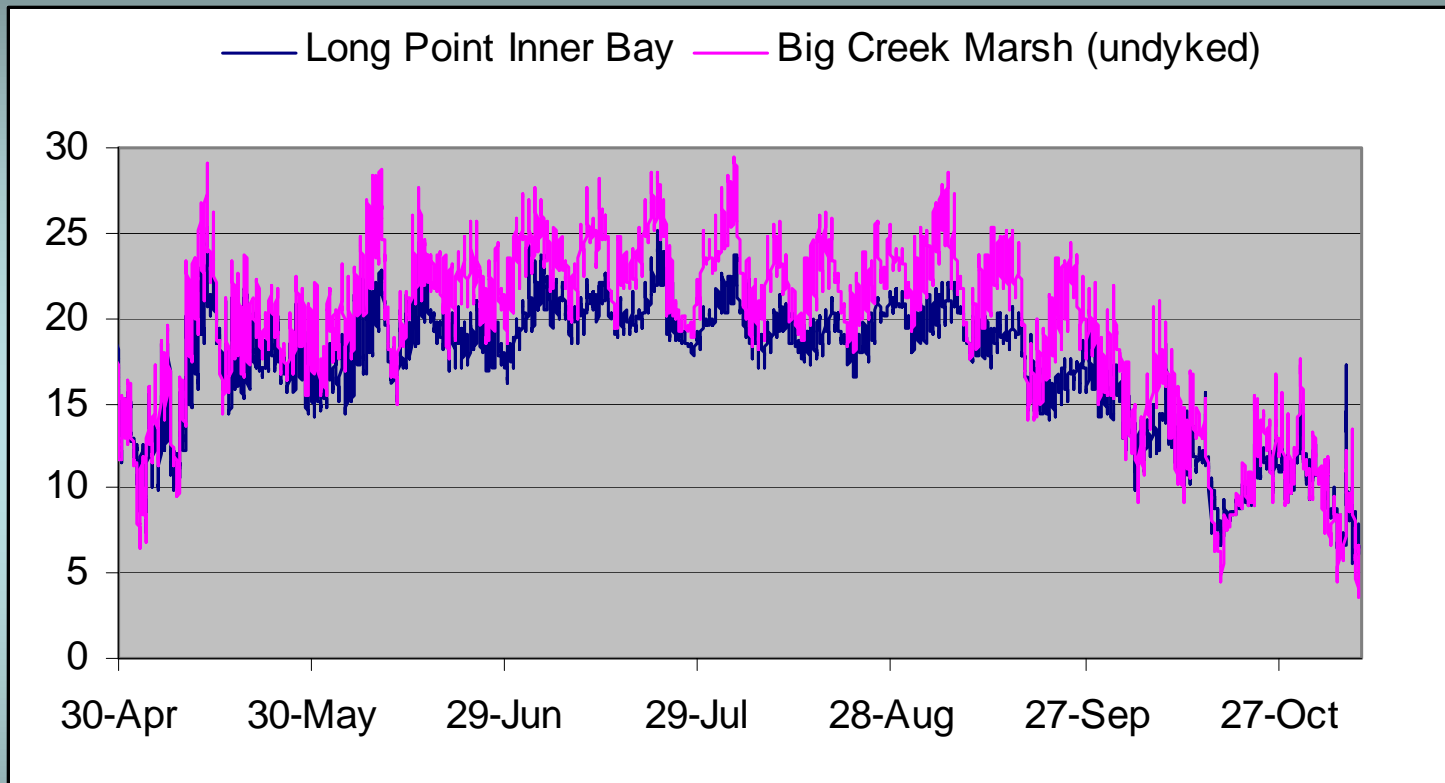
Potential Invaders (*Mandrak 1989*)

	Cool	Warm
Non-Piscivore (N)	ironcolour shiner	blacktail shiner, golden topminnow, blackspotted topminnow, flier, banded pygmy sunfish, bantam sunfish, goldeye, plains minnow, plains topminnow, river carpsucker, blue sucker, shovelnose sturgeon, steelcolour shiner, mud sunfish, blackbanded sunfish, banded sunfish, Ozark minnow
Piscivore (P)		shortnose gar

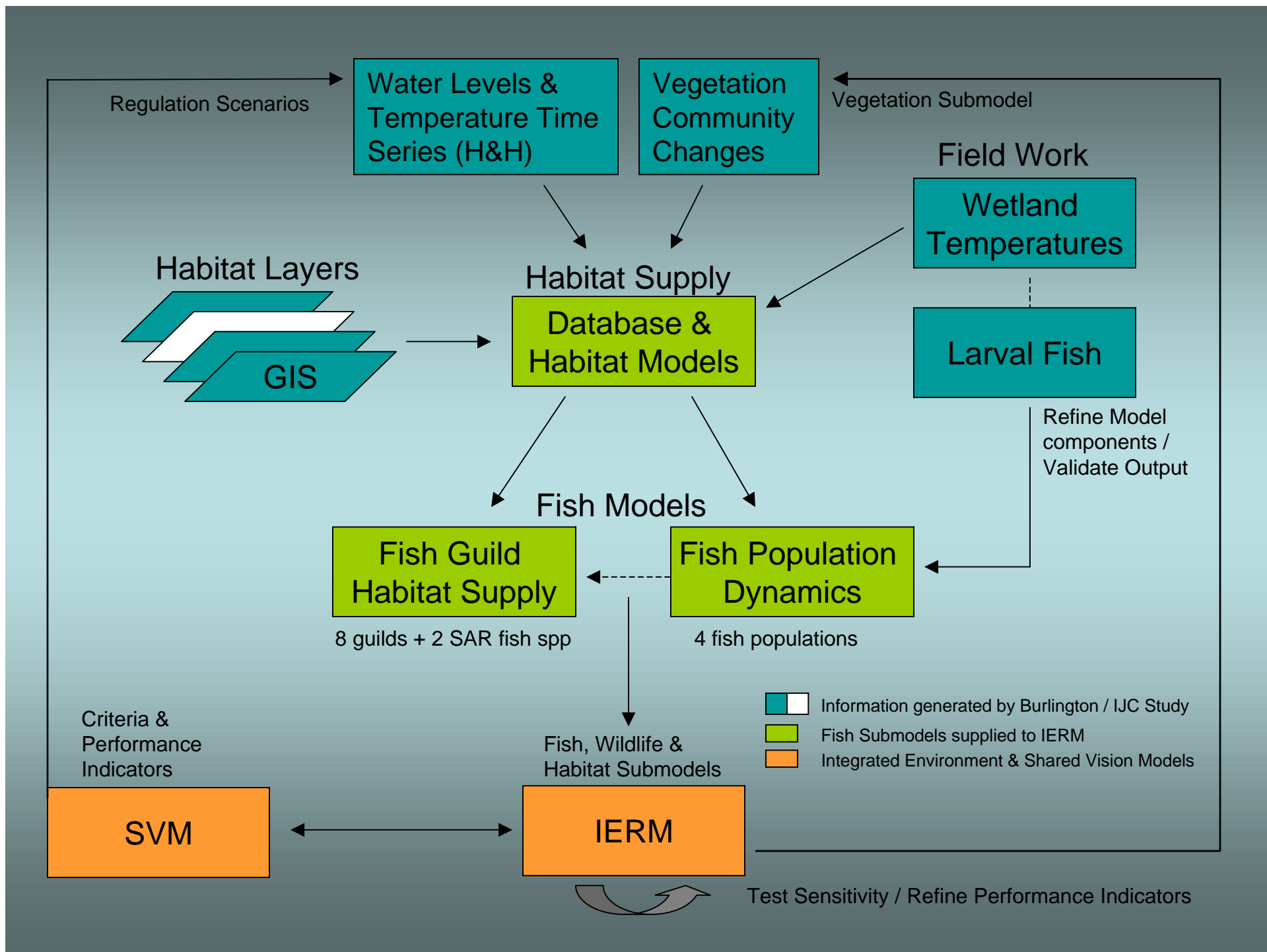




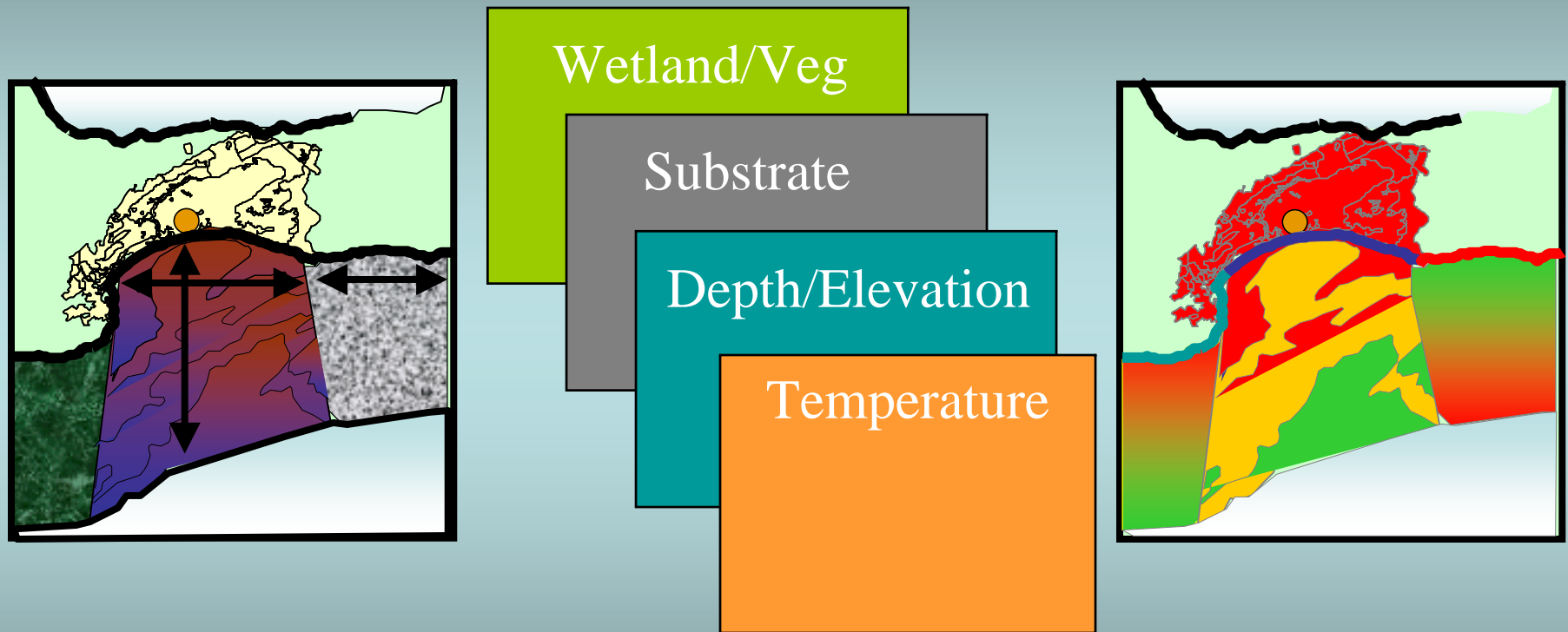
Long Point Nearshore Temperature Variability



Climate Change Predictions: +2.1 to +3.3 °C



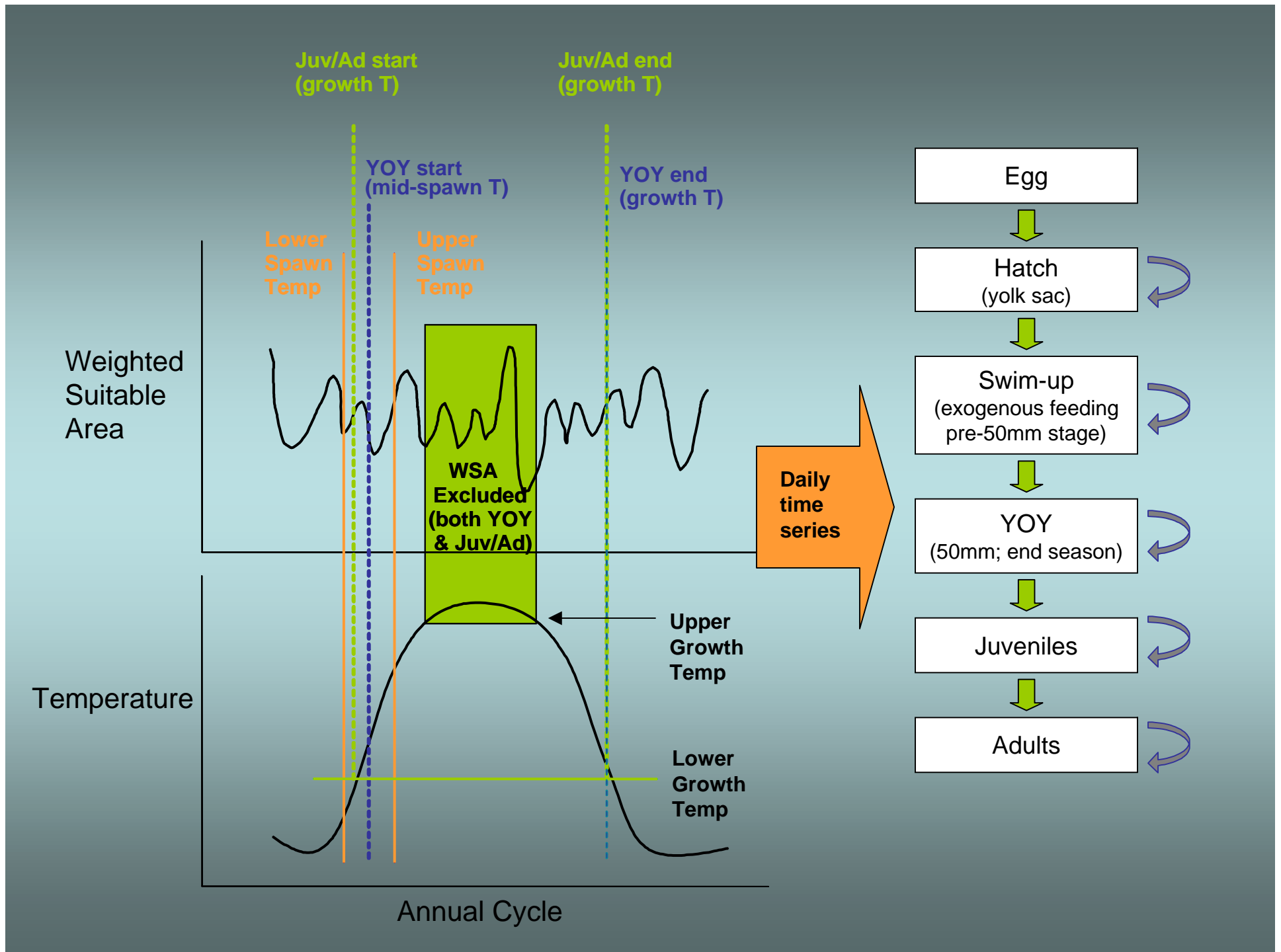
Habitat Suitability Modelling



Buffer shoreline
types to depth
contour

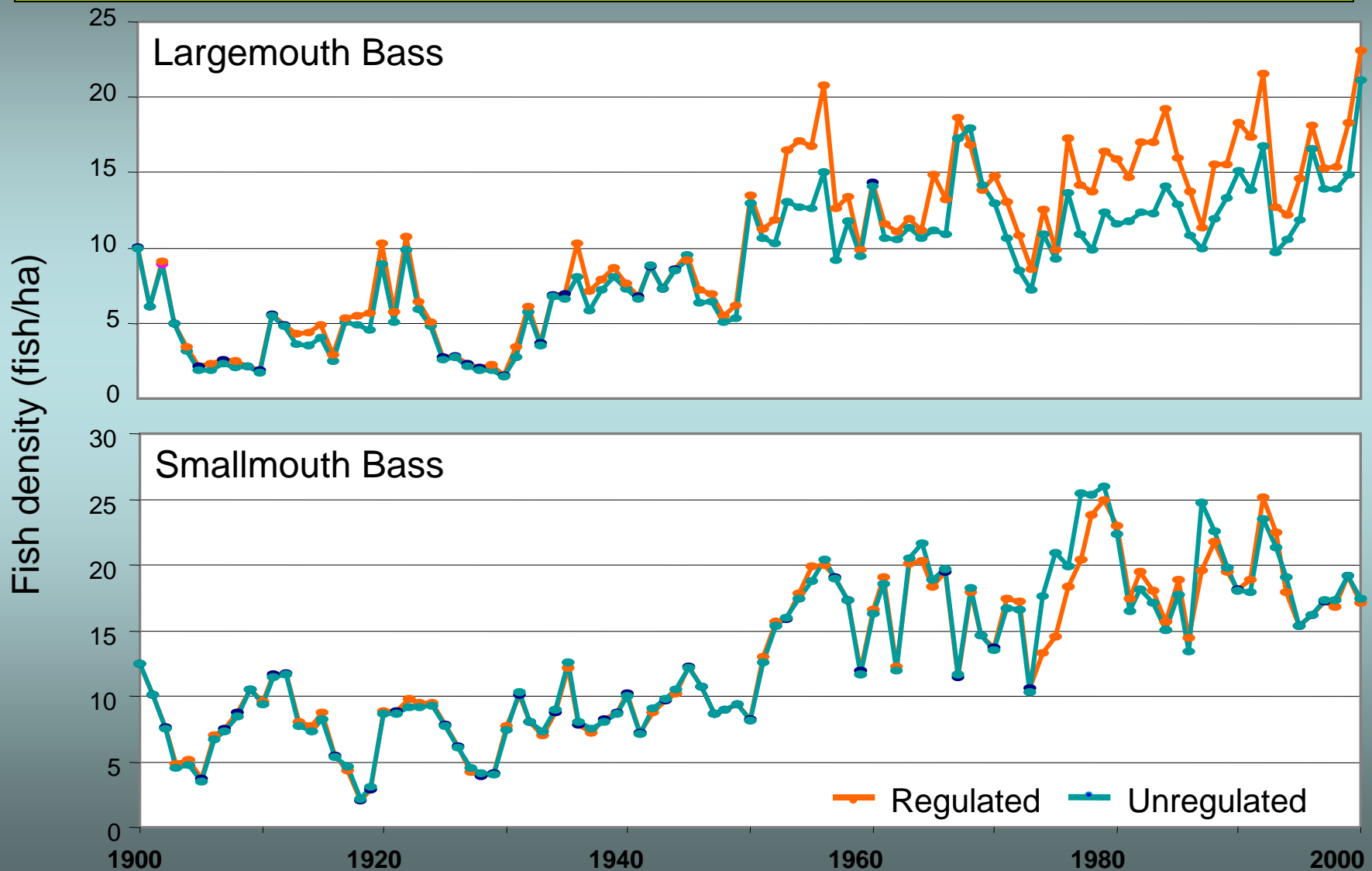
Map habitat
combinations

Model suitabilities for
different life stages,
species & guilds



Fish population densities in Presqu'ile Bay, Lake Ontario

- Regulated and unregulated conditions





Next Steps & Potential Hypotheses

- Good spatial information for assessment, especially digital elevation models & dynamic substrate, but add other important variables (turbidity & flow)
- Location of high quality fish habitat under climate change in HEC and important transition areas for protection
- Assessment of likely development changes & strategies and their effects on fish & fish habitat
- Whole fish community & fish population assessments, both spatial and temporal to test extremes