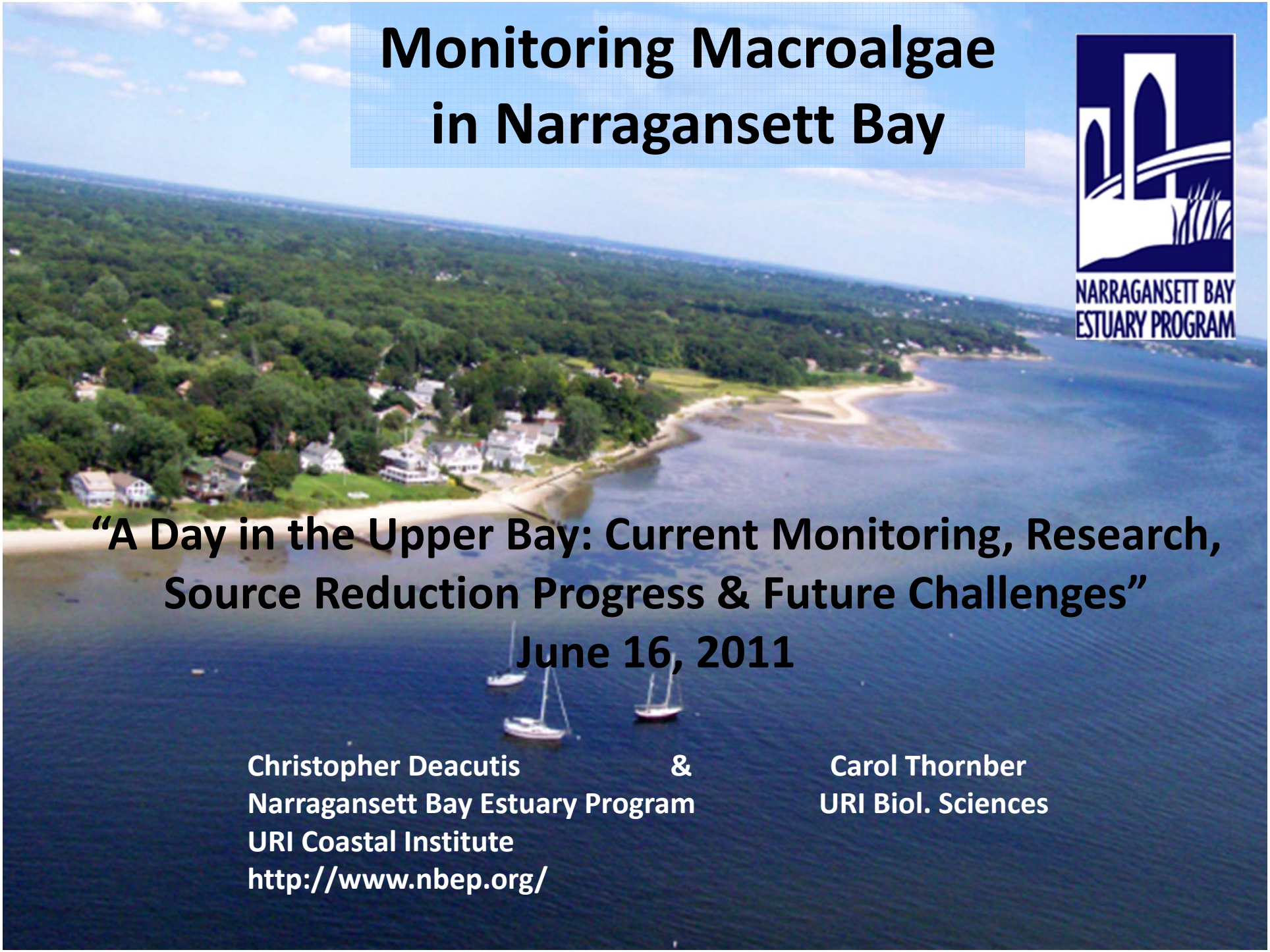
Monitoring Macroalgae in Narragansett Bay



NARRAGANSETT BAY ESTUARY PROGRAM

"A Day in the Upper Bay: Current Monitoring, Research, Source Reduction Progress & Future Challenges"

June 16, 2011

Christopher Deacutis
Narragansett Bay Estuary Program
URI Coastal Institute
http://www.nbep.org/

&

Carol Thornber
URI Biol. Sciences

Macroalgae Link to Nutrients:

Bioavailable nutrients (usually DIN for salinities > 20 psu) - actively absorbed by Phytoplankton species – but not very capable of storing nutrients for long periods – require steady nutrient input

- **Macroalgae** capable of **storing nutrients for max growth**

Browns (12d)> eph. Reds & Greens (5-9d) > Phyto (0.5 d)

(Pedersen & Borum 1996-97)

Ephemeral Greens + some reds -fast growth- *like* high nutrient cond**.**

Browns good intake summer+winter **– but much slower growth**

- Many macroalgae efficient at **storing pulsed nutrients** (surged uptake) - seen especially in shallow (<5 m)embayments

- esp. greens take advantage of pulsed nutrients

- (e.g.,stormwater pulses)

- **Ephemeral Drift Macroalgae may be good integrators of pulsed + steady nutrient loads**

Any evidence of Responses w/ Decreased N Load ?

Tampa Bay FLA – mid **1970's = 9.9 ton N**/yr – then **60% drop N in 1984 due to AWT** + ***complete removal*** of WWTF discharge (deep well injection)

Similar time line for **Mumford Cove in Groton, CT 1988 – Ulva out faster**

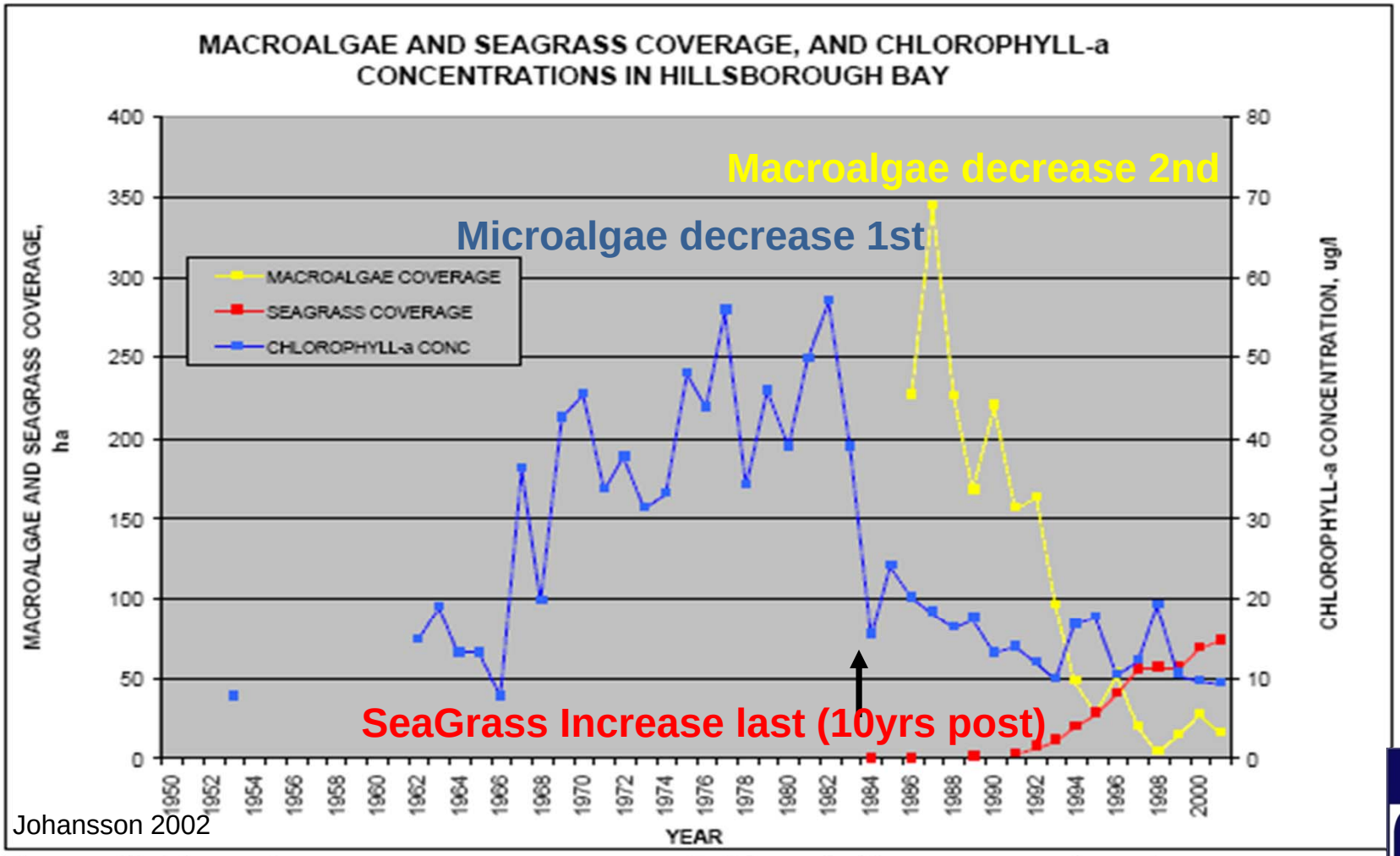
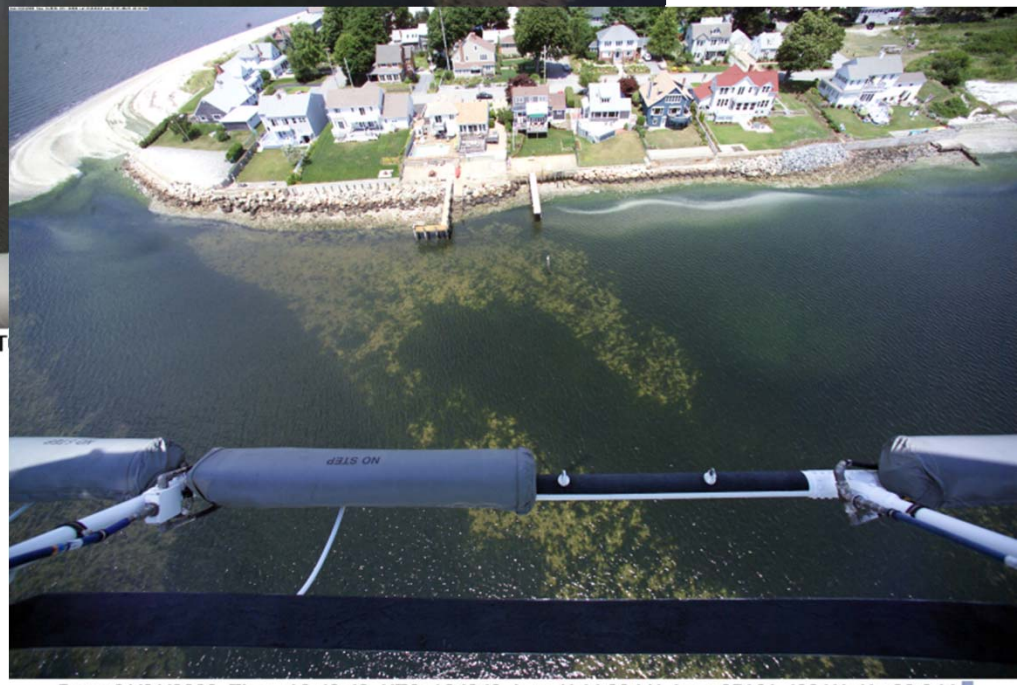


Figure 13. Macroalgae, seagrass coverage and chlorophyll a concentrations in Hillborough Bay, Florida.

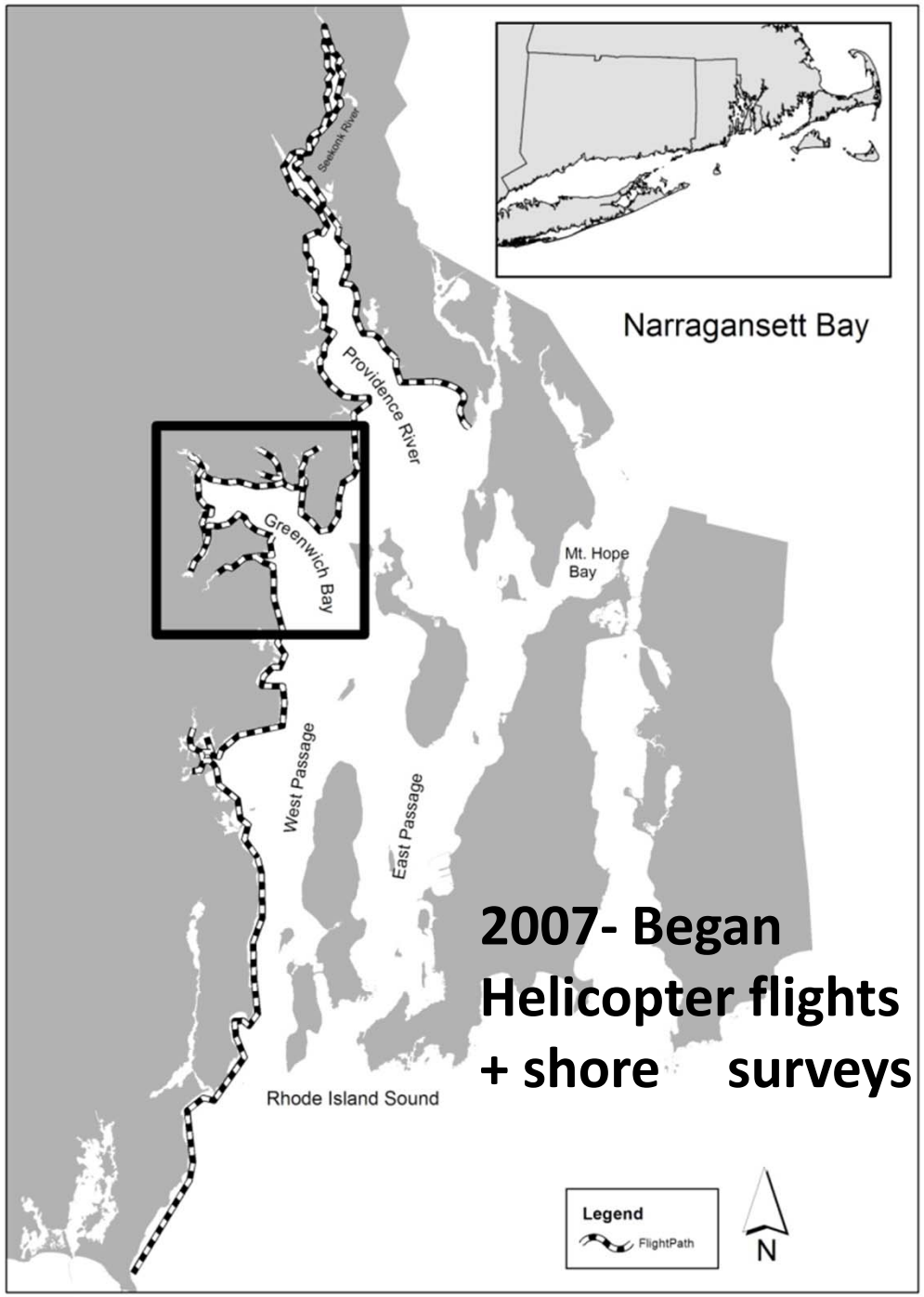
Narragansett Bay ?
Shallow Subembayments & Providence River - Excess Growth of Drift Macro algae (Seaweeds) – esp. Greens (Ulva spp.)

Wickford Cove July 16, 2007

Passeeonkquis Cove July 2007

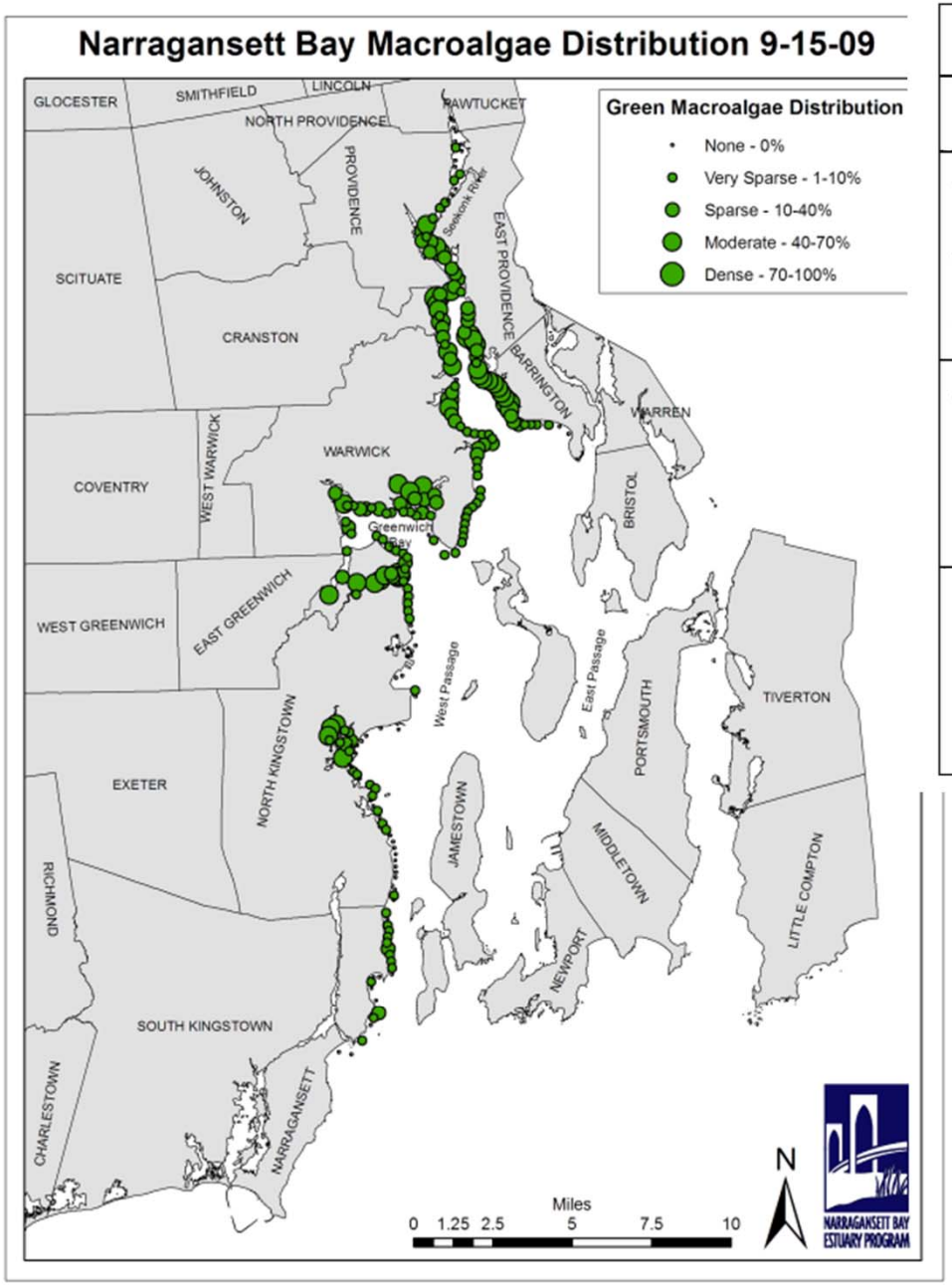


Bullock's Cove July 2007



2007- Began Helicopter flights + shore surveys

Oblique rectilinear photos
Taken 1 every 10sec


Narragansett Bay Macroalgae Distribution 9-15-09
Green Macroalgae Distribution
None - 0%
Very Sparse - 1-10%
Sparse - 10-40%
Moderate - 40-70%
Dense - 70-100%
GLOCESTER
SMITHFIELD
LINCOLN
NORTH PROVIDENCE
PAWTUCKET
JOHNSTON
PROVIDENCE
SCITUATE
CRANSTON
EAST PROVIDENCE
BARRINGTON
WARREN
COVENTRY
WEST WARWICK
WARWICK
BRISTOL
WEST GREENWICH
EAST GREENWICH
West Passage
East Passage
PORTSMOUTH
TIVERTON
EXETER
NORTH KINGSTOWN
JAMESTOWN
MIDDLETOWN
LITTLE COMPTON
RICHMOND
NEWPORT
SOUTH KINGSTOWN
CHARLESTOWN
NARRAGANSETT
Miles
0 1.25 2.5 5 7.5 10
N
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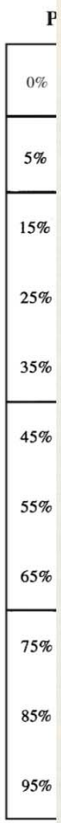

0%
5%
15%
25%
35%
45%
55%
65%
75%
85%
95%

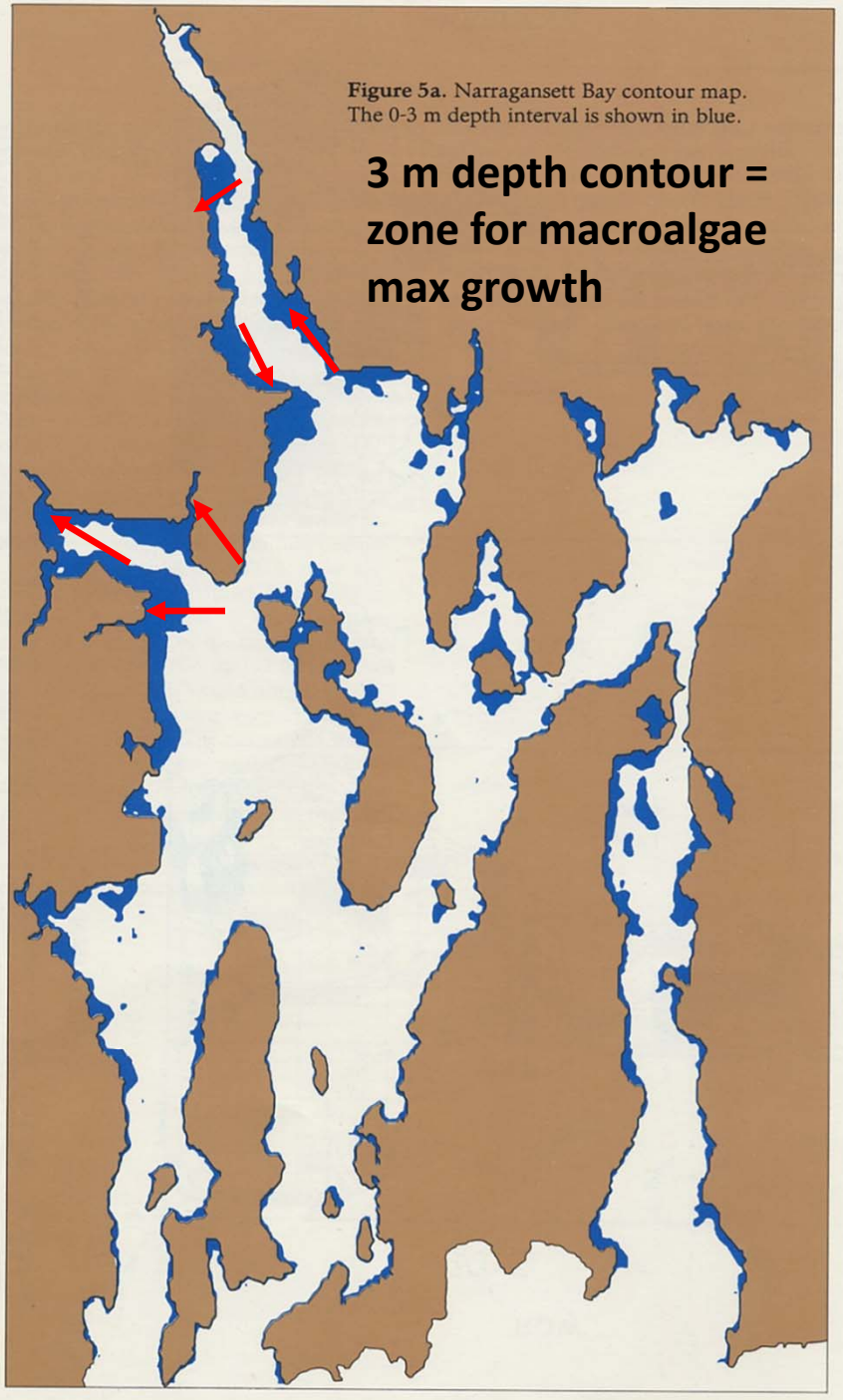
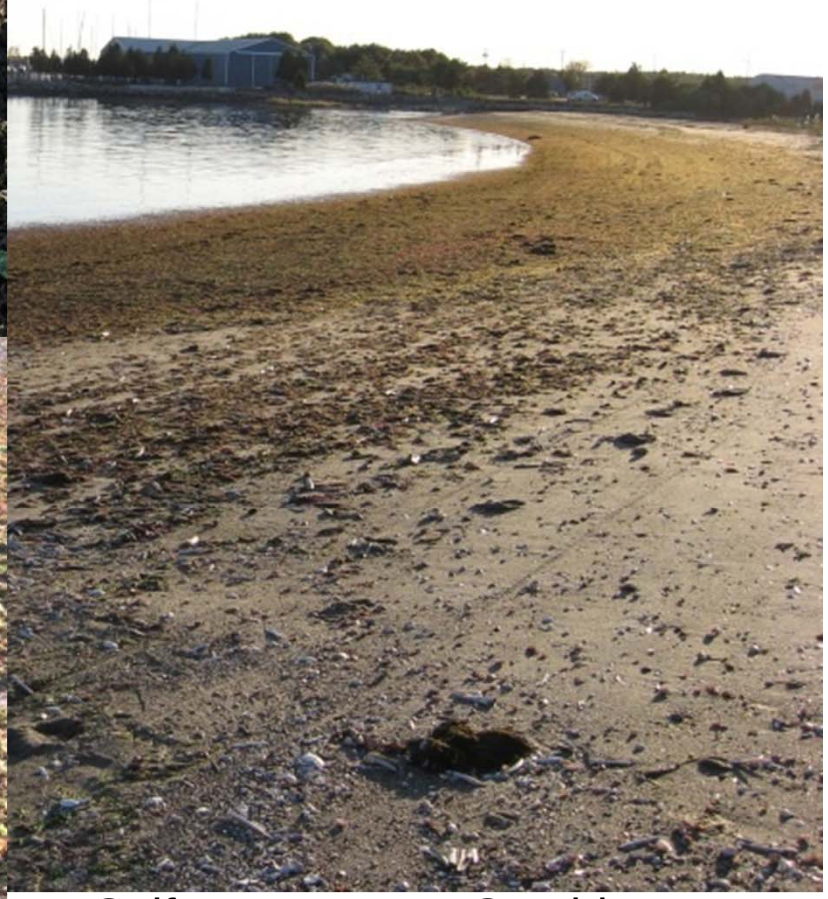


Figure 5a. Narragansett Bay contour map.
The 0-3 m depth interval is shown in blue.
3 m depth contour = zone for macroalgae max growth

Shoreline Groundtruthing for dominant sp ID + biomass estimates



Calf Pasture Pt - Outside Allens Harbor

-local signif. biomass

Biomass Estimates

Chlorophyta (Green)
Rhodophyta (Red)
Phaeophyta (Brown)

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Biomass Estimates

0.25 m^2 quadrat

Spring scale (100 & 300g)

Box cutter (or razor blade to cut macroalgae along quadrat sample edge

Salad spinner (remove excess water)

A zip-lock bag (for sample weight)

Dig photo of each biomass quad

Biomass Estimates

0.25 m^2 quadrat

Biomass Estimates

Biomass Estimates

Biomass Estimates

Results provide biomass (g) wet weight of greens / reds/ browns per 0.25 m^2 - get % by wet wt

- Picture can calc 2-D % cover red / green / brown algae

-trying to develop avg min wet wt by % cover category

Issue- depth of cover layer

Biomass Field Sheet

Date: 8/10/10

Location: Sandy Pt

Station	Time Start	Time End	Total Weight w/bag (g)	Bag Weight (g)	Total Biomass (g)	Red (g)	Green (g)	Brown (g)	Sum (R+G+B) (g)	Comments	Density (Red)	Density (Green)	Density (Brown)	Total Cover
1	2:45 p.m.			10	168	44	124	0	178	loaded with bladed Ulva	26	73	0	4
2			330	10	320	44	284	0	328		13.7	88.7	0	4
3			292	10	282	64	214	0	278		22	75.8	0	4
4			340	10	330	66	260	0	326	a lot of mud snails in area	20	78.7	0	4
5			90	10	80	30	50	0	80		37.5	62.5	0	3

Total Biomass= Total Weight-Tare

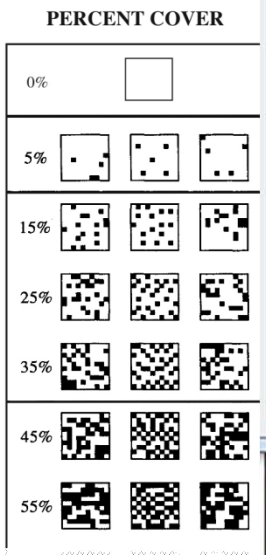
additional comments:

~stations 1and 2 are one sample

~stations 3 and 4 are one sample

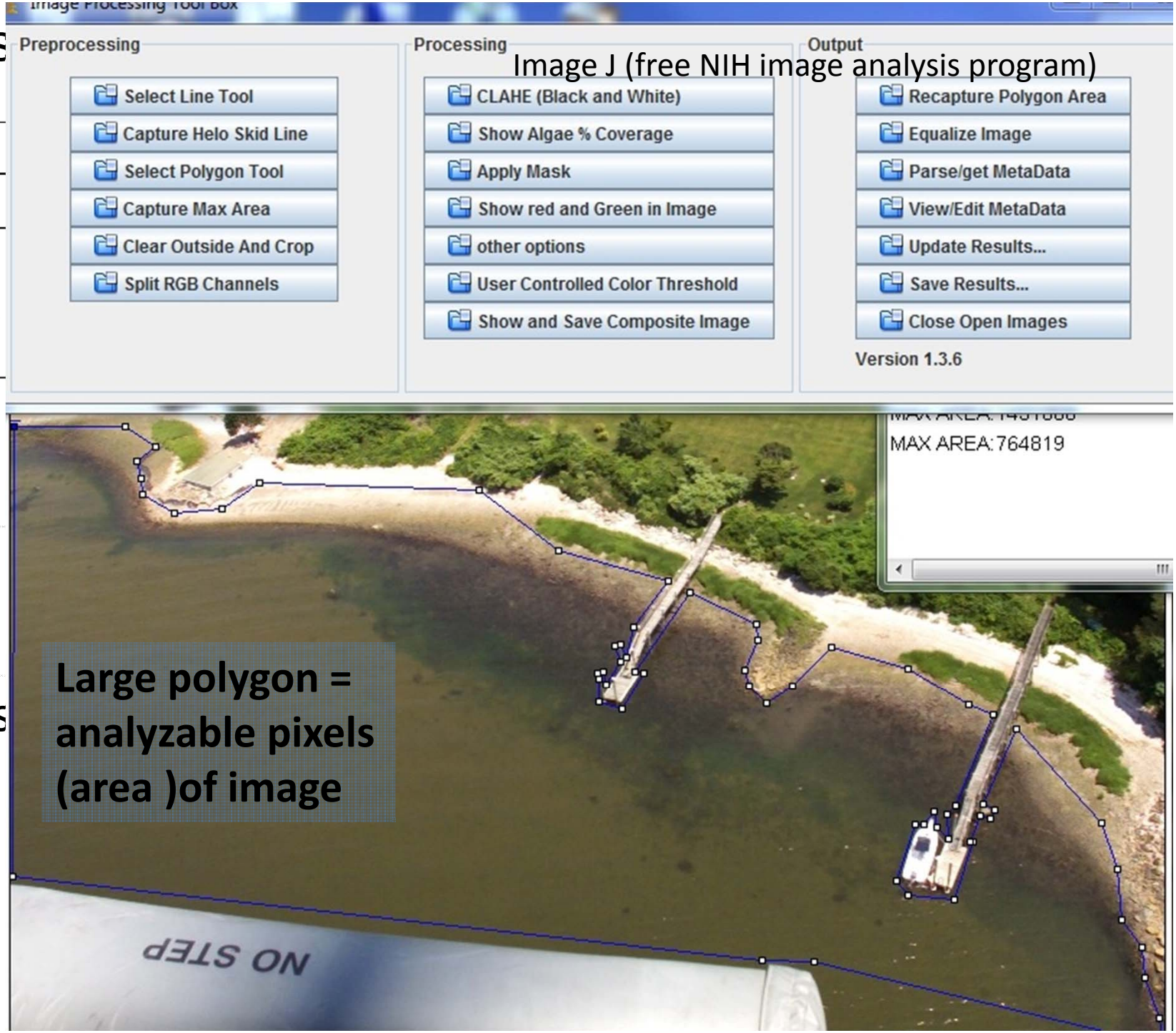
the densities for red, green, and brown are percentages, while the Total Cover is 0-4

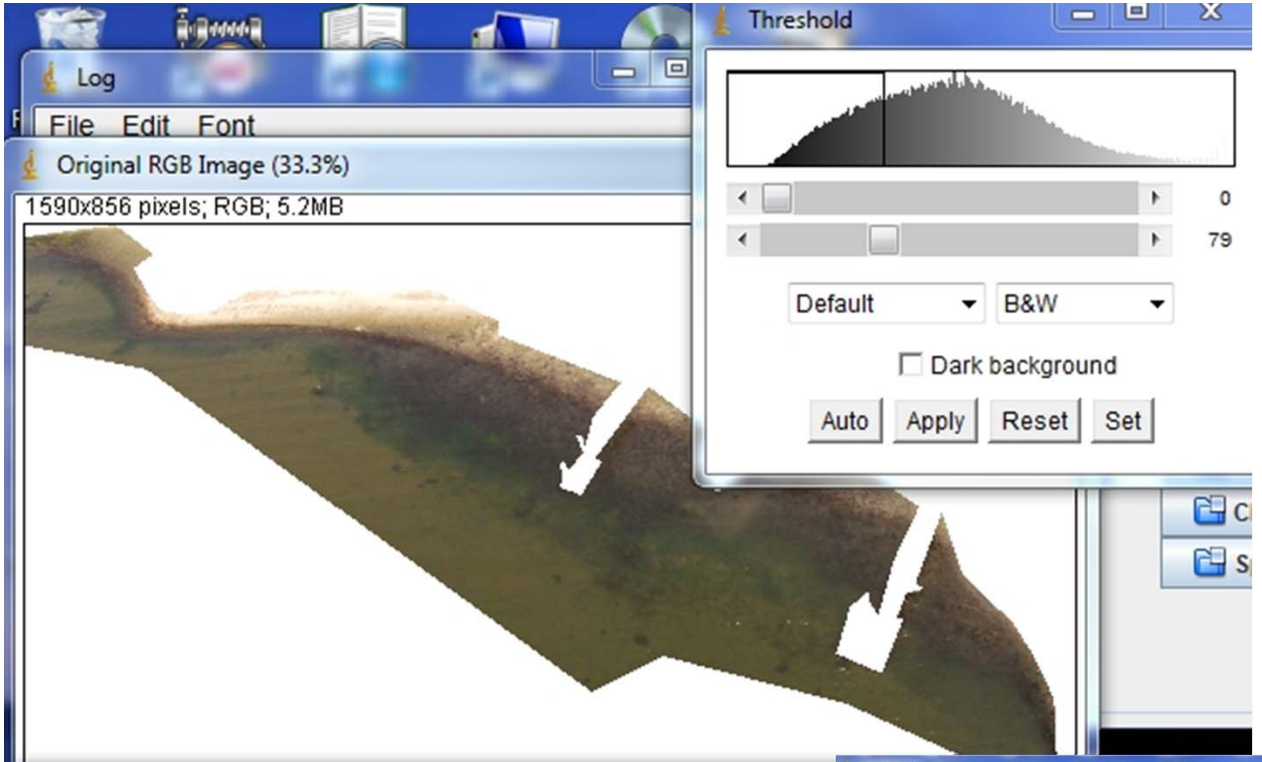
Due to s



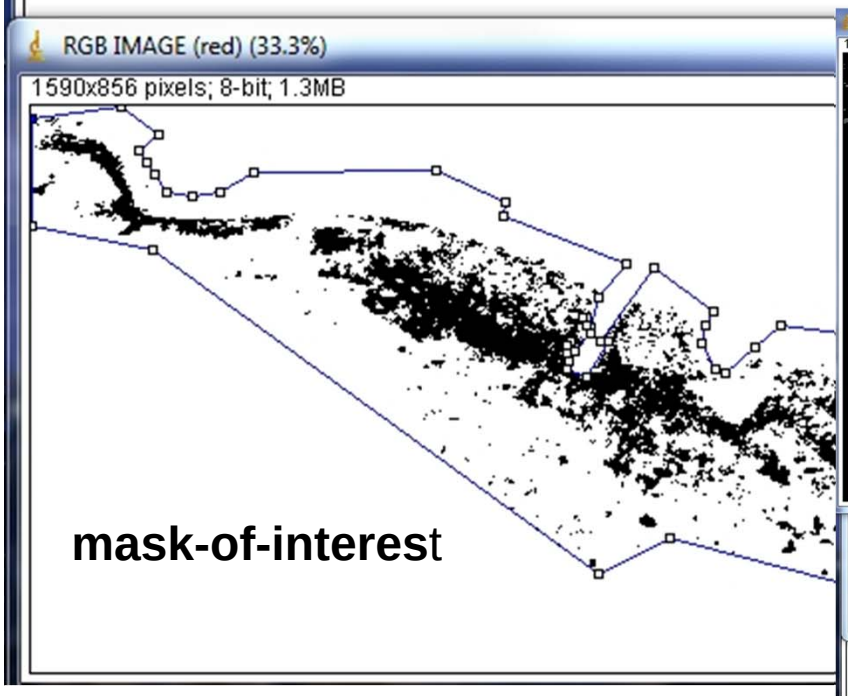
Andrew Bird (URI) develops ImageJ Plug-in

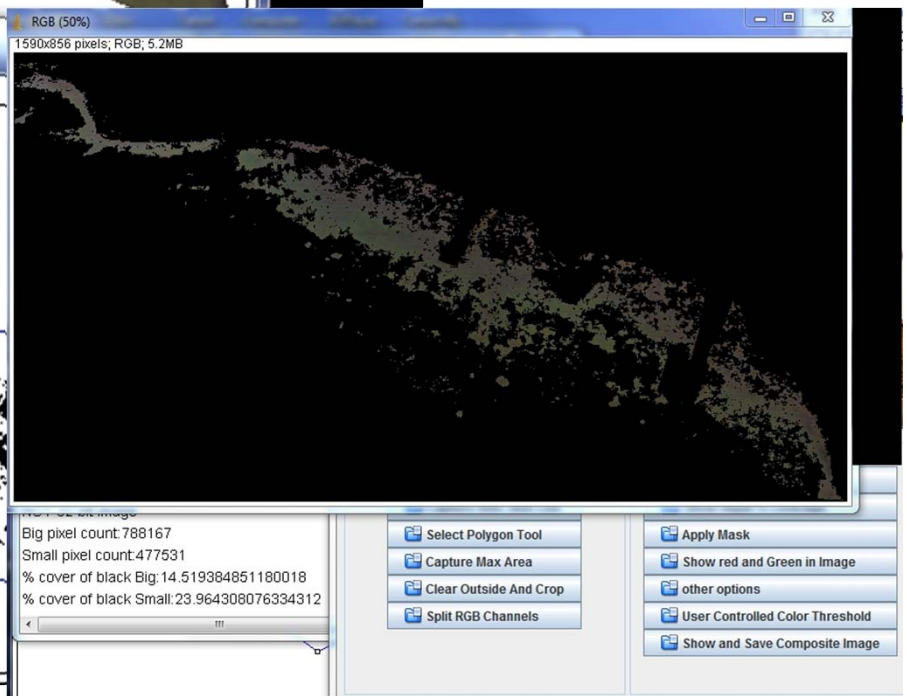
Image J (free NIH image analysis program)

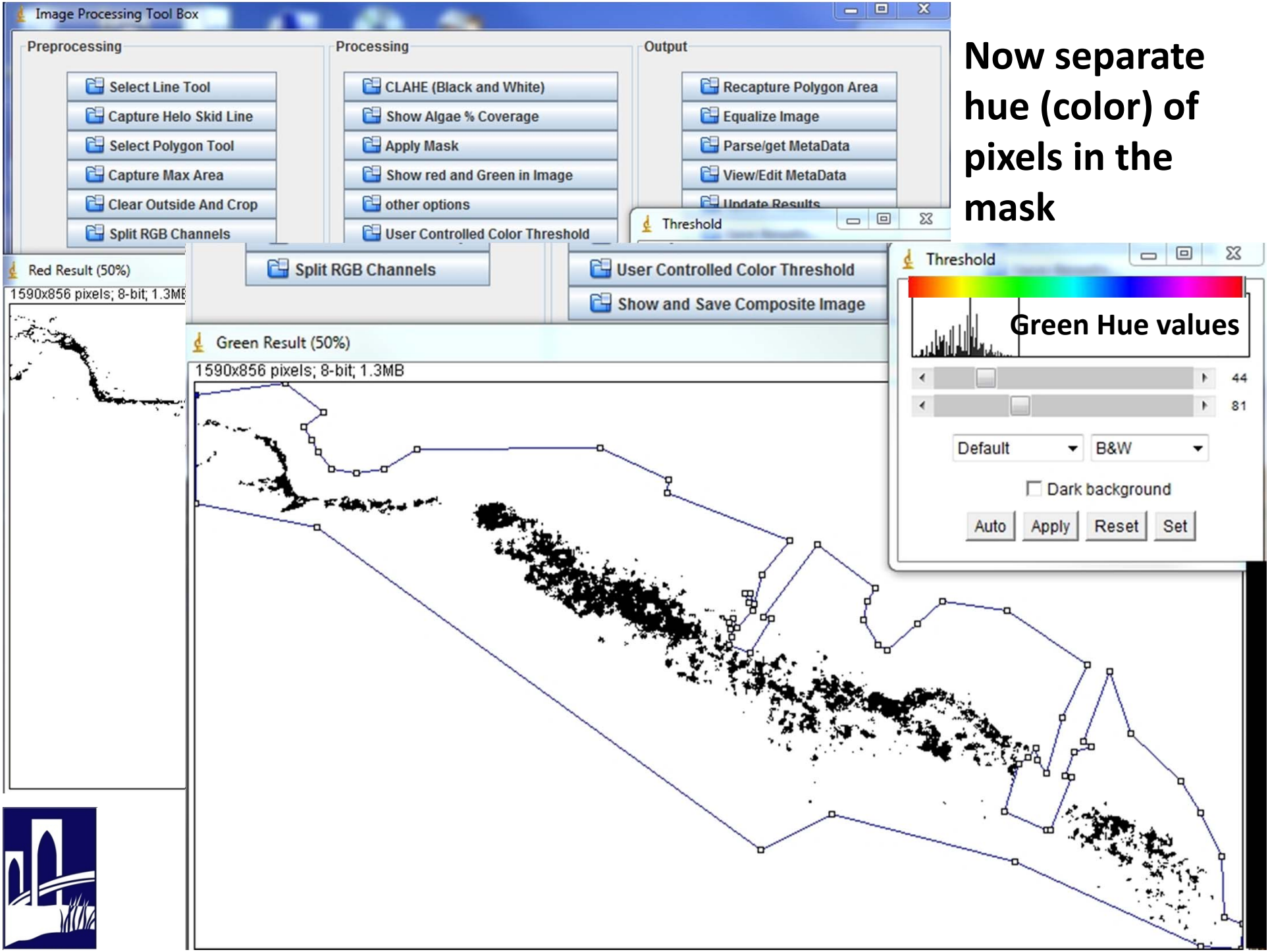




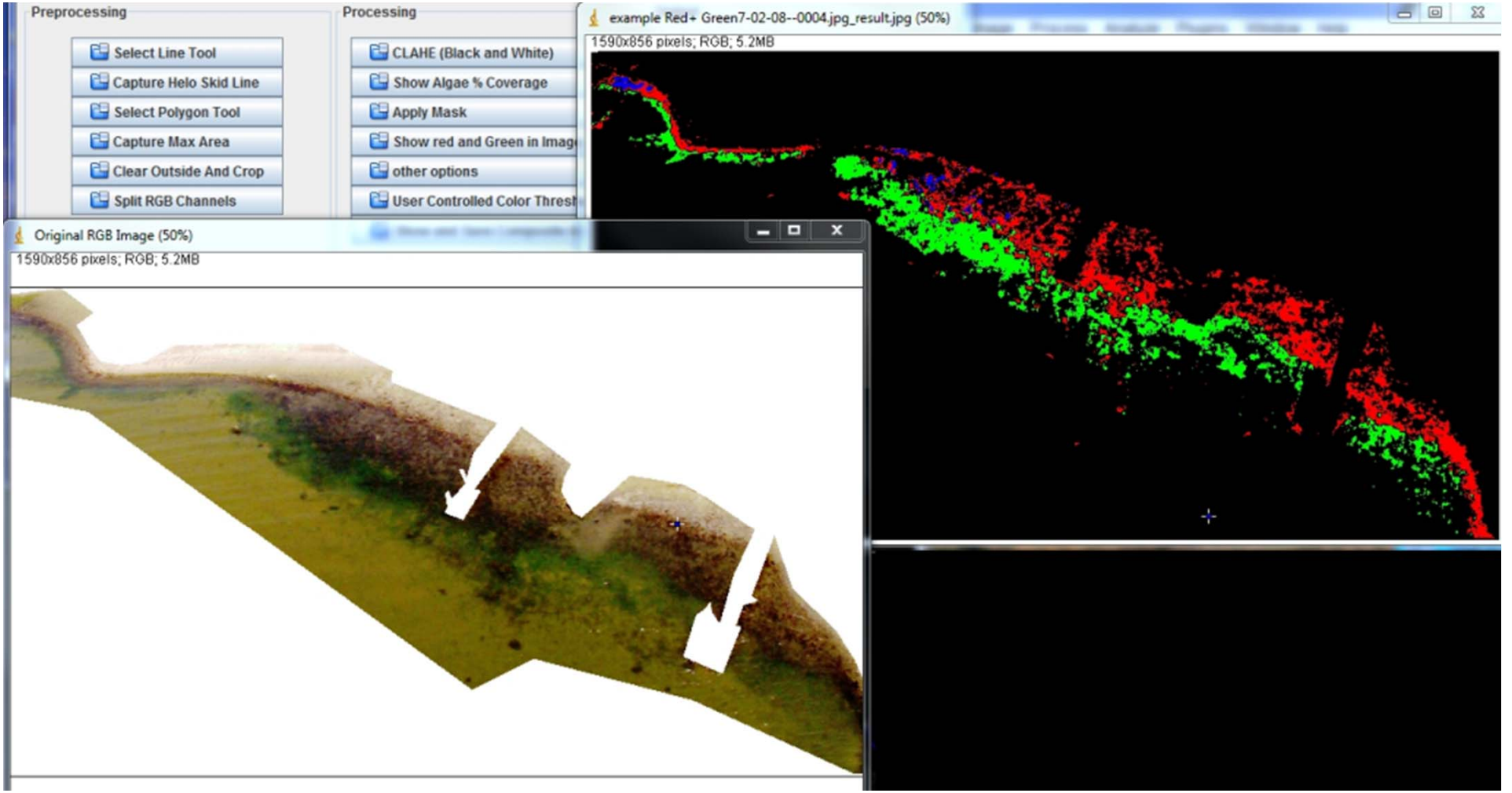
Contrast Limiter allows selection of area with algae based on contrast level (form mask-of-interest)







Now separate hue (color) of pixels in the mask

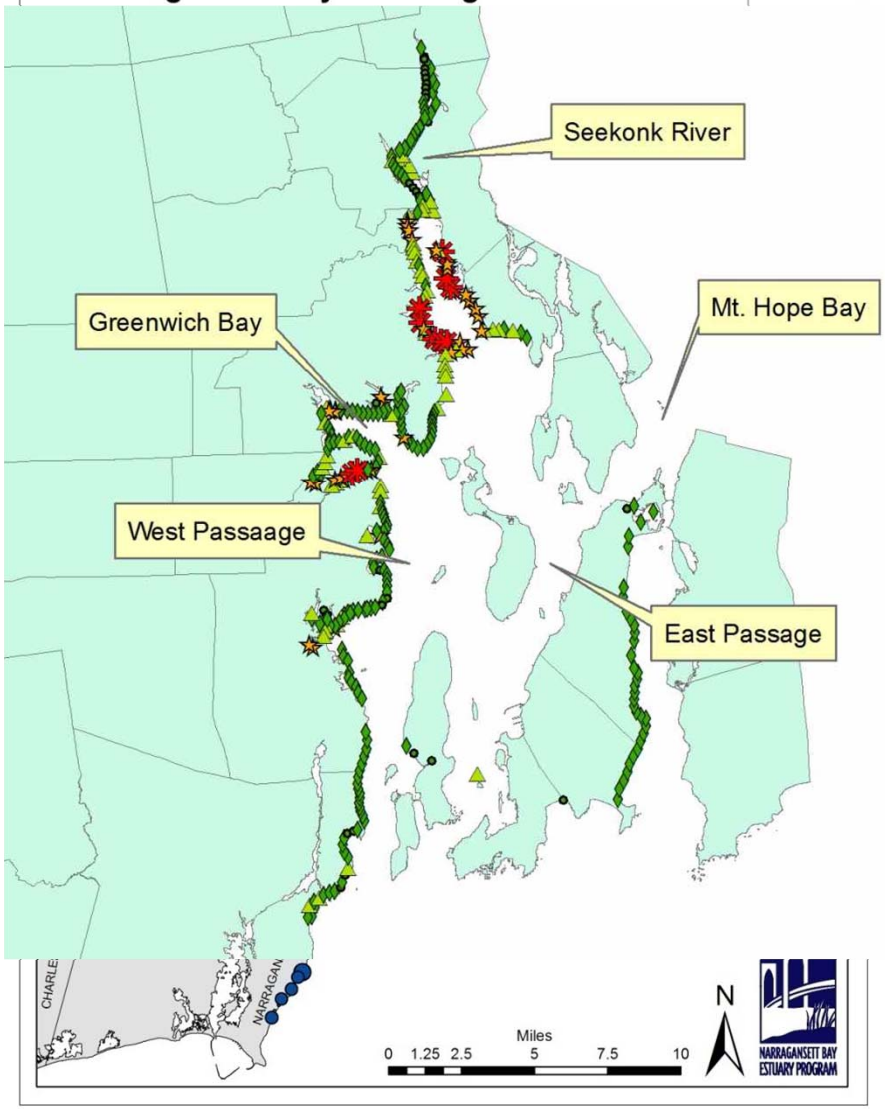


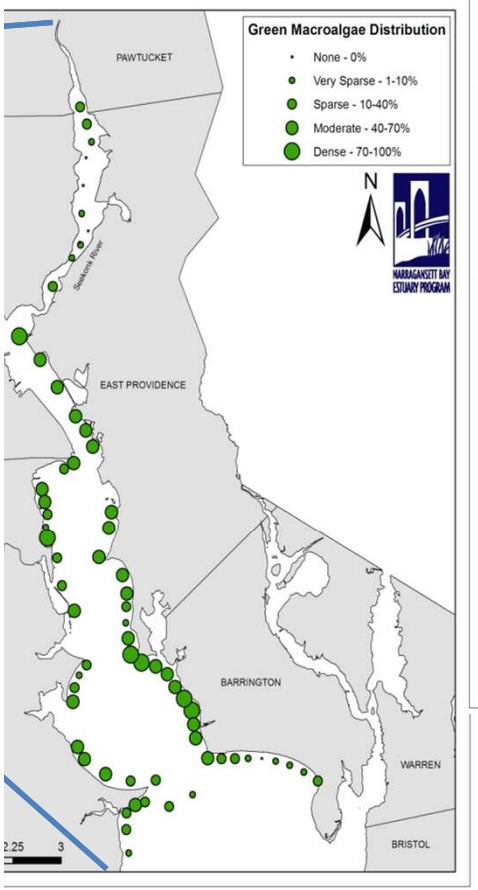
AR8

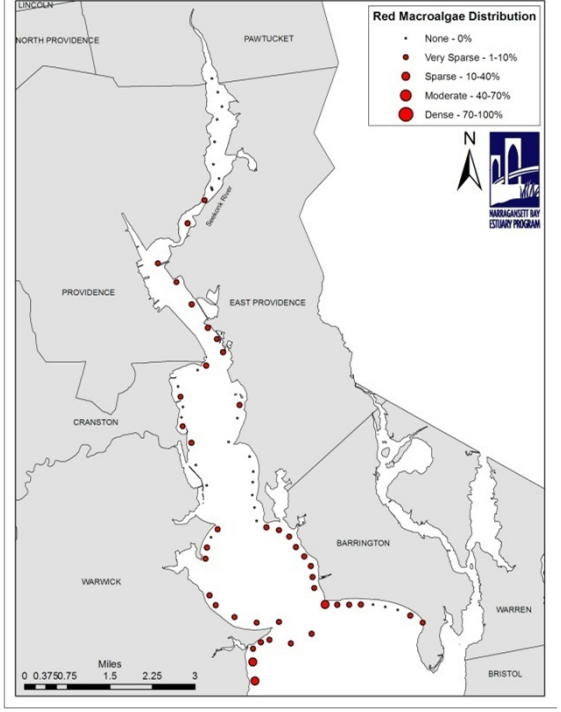
	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS
1	Usr	Min Thres	Max Thresh	Min Green	Max Greer	Min Red	Max Red	Ot	Other Band % Cover E	Min Other	Max Other	Final Green %	Final Red %	Final Brown %	DIRECT
2	18	0	79	44	81	1	31	0	0.295	200	31	5.33	5.84	0	C:\Users
3															

Final output of Red / Green and “other” Hue jpg + % 2D cover values by color

Macroalgae Mapping







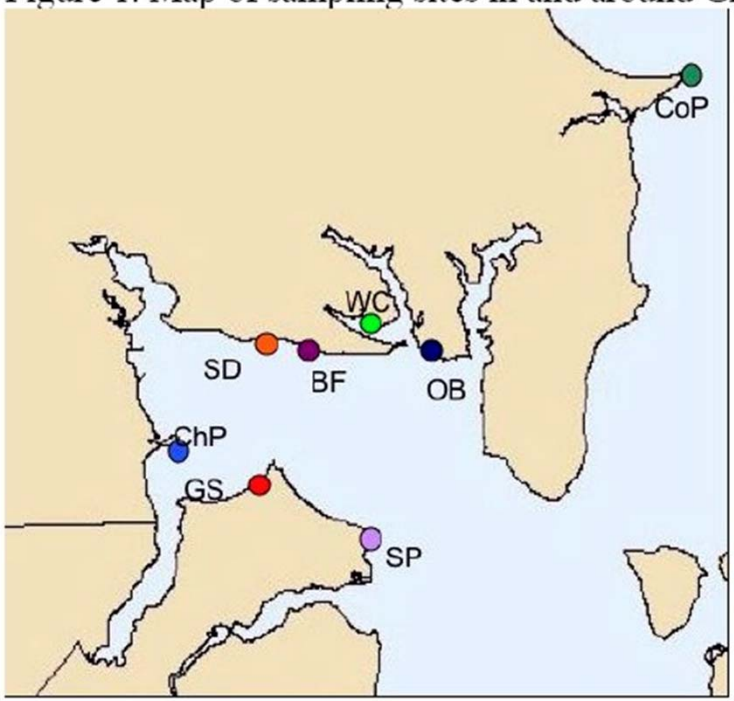
Dr Carol Thornber (URI) – Near-shore transect surveys

(**2005-2010**) - **monthly/bimonthly** baseline data on macroalgal + invertebrate sp. composition, abundance, and biomass

at 8 field sites - Greenwich Bay & Conimicut Pt.

ID + quantify abundance of all macroalgal sp. + inverts in the algae

Figure 1. Map of sampling sites in and around Greenwich Bay, RI.



Map of Greenwich Bay with sampling sites labeled:

Sandy Point (SP) Goddard State Park (GS) Chepiwanoxet Point (ChP)
Sylvia Drive (SD) Budlong Farm (BF) Warwick City Park (WC)
Oakland Beach (OB) Conimicut Point Park (CoP)

Sites surveyed mo in summer / bimo all other mos. (spring low tide) :
Since 2005 for intertidal,
since 2006 for subtidal
Sandy Point, Goddard State Park, Chepiwanoxet Point, Sylvia Drive, Budlong Farm, Warwick City Park, Oakland Beach, + Conimicut Pt.

All **info from NOAA final grant report 2009 for grant # NA05NMF4721253**

Fig. 1. A. Beach front heavily impacted by green tide in August 2006 (Sylvia Dr., Warwick, RI). B. Close-up showing biomass removed from 0.25 m^2 plots for dry weight determination.

2 x 10 m transects ~ 30 m apart parallel to shore
- **0.25m^2 quad** for **% cover + % bare ea. meter** along ea. transect + count and **record # of each invert. Sp**. + bag all living algal material – in lab - remove sand/grit - record **wet biomass of all species/quad**
– ID unknown sp. by microscopic techniques

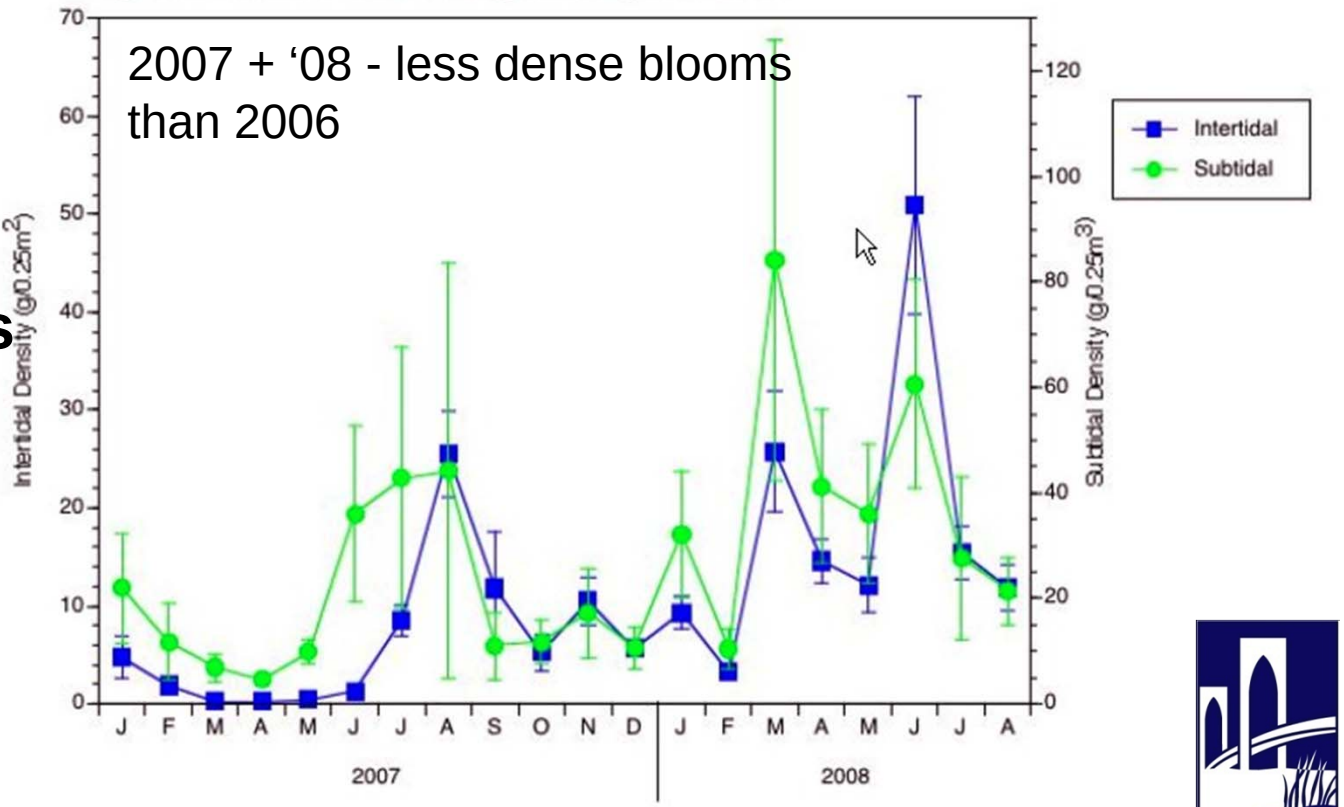
- For **subtidal** surveys – **1 X 30m transect *perpendicular* to the shore** – every **3rd m - sweep 0.4m wide dip net for 0.5m** along bottom - capture all living material – record water depth – bag all living materials - in lab – rinse + **sort to sp.level**. **Wet biomass of all species** recorded + % ea. Invert. species present.

Macroalgae - found yr-round in intertidal and shallow subtidal habitats in **Greenwich Bay** - both **drift & attached** morphologies**.**
June-August typically = highest densities (&biomass) of drift macroalgae

Most macroalgae on shoreline = drift Most commonly encountered species = green algae: *Ulva lactuca, Ulva intestinalis, Ulva linza,* and *Cladophora* spp., + red algae *Gracilaria tikvahiae, Gracilaria vermiculophylla, Agardhiella subulata,* and *Ceramium virgatum*.

Large interannual variability is common -requires extended baseline data to distinguish significant changes due factors beyond summer weather differences between yrs

Figure 2: Mean +1 SE Macroalgal density at all sites



Thank you !

Questions?