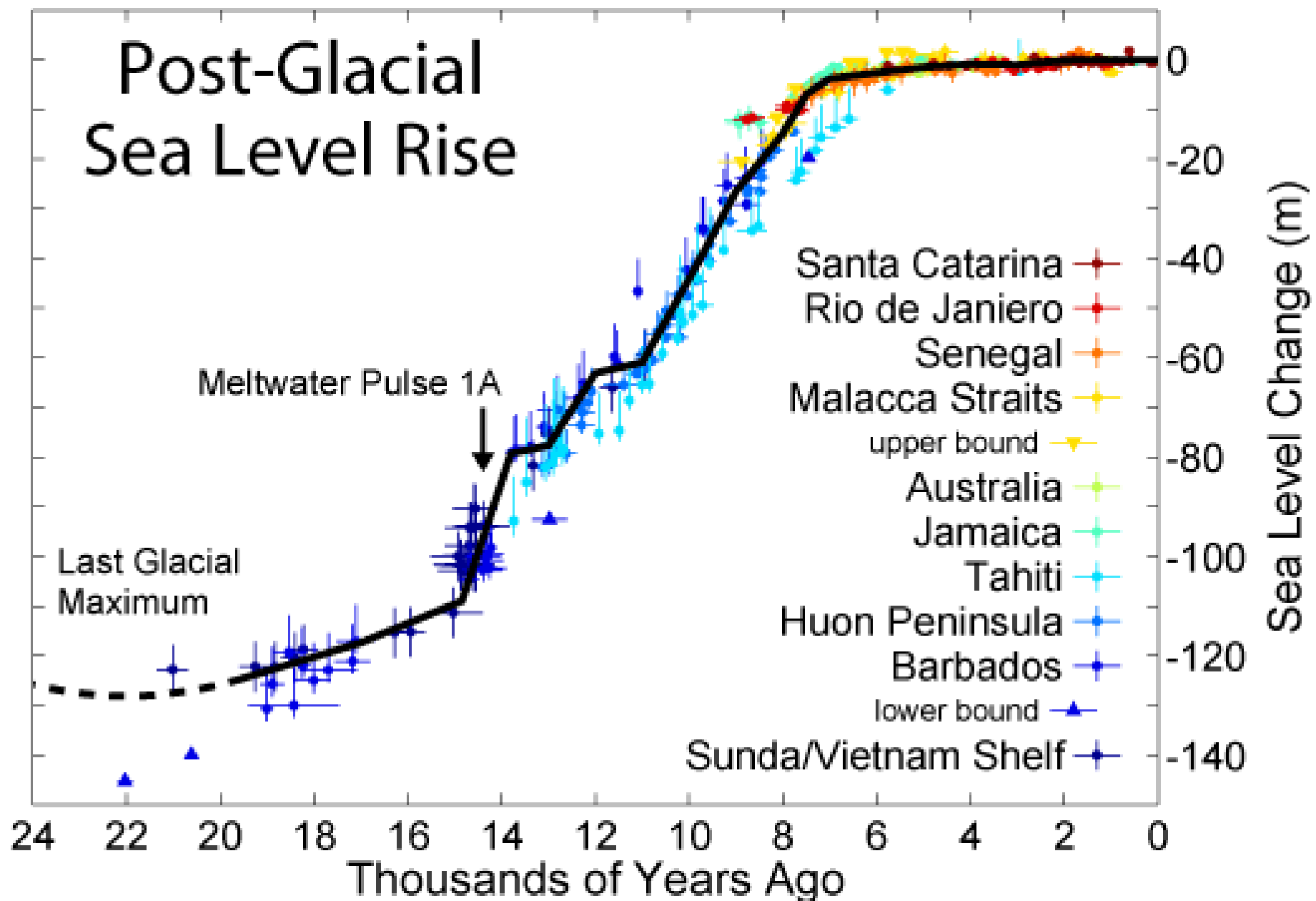


Climate Change and Plant Communities in SW Florida

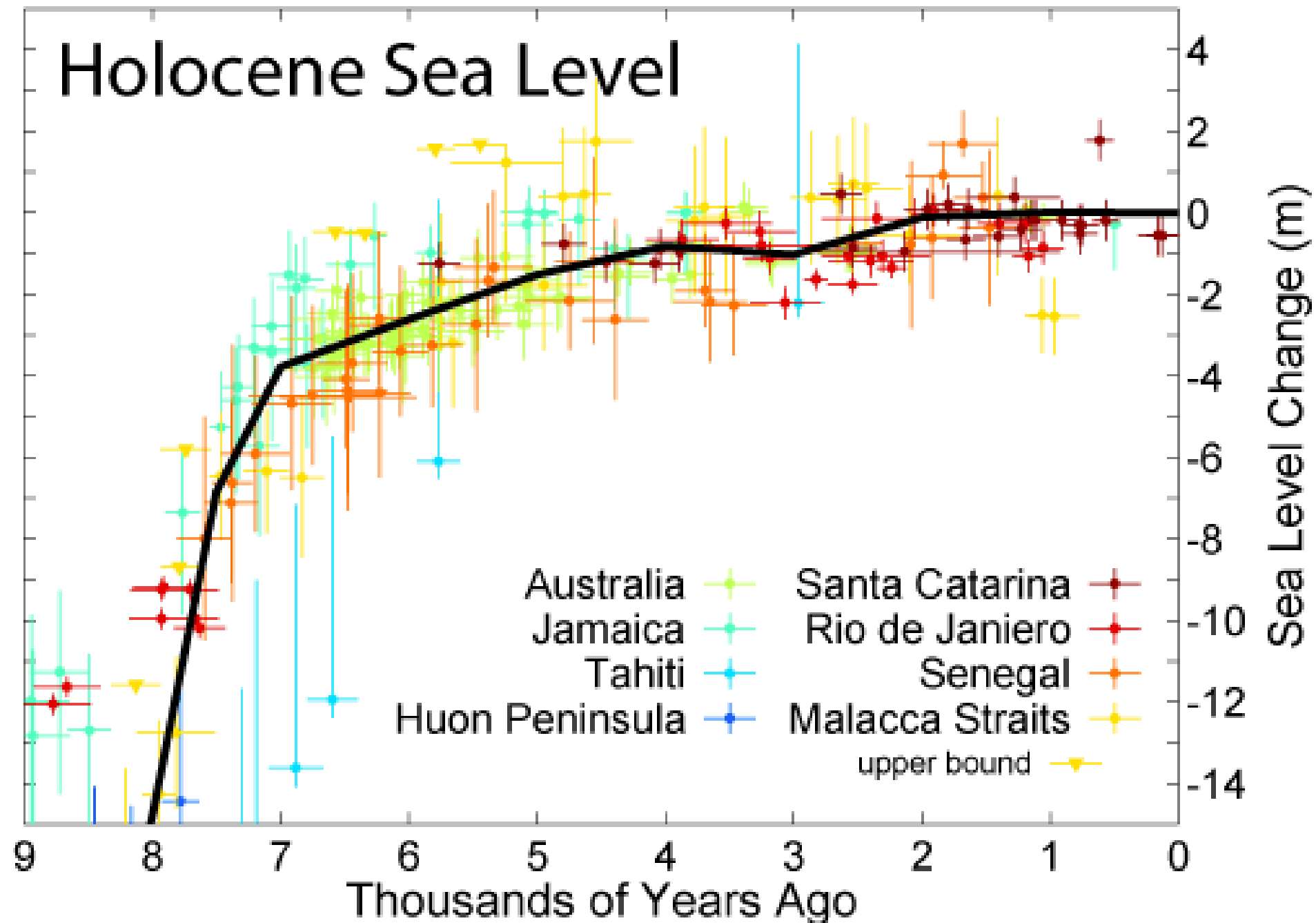
by Mike Barry

Institute for Regional
Conservation

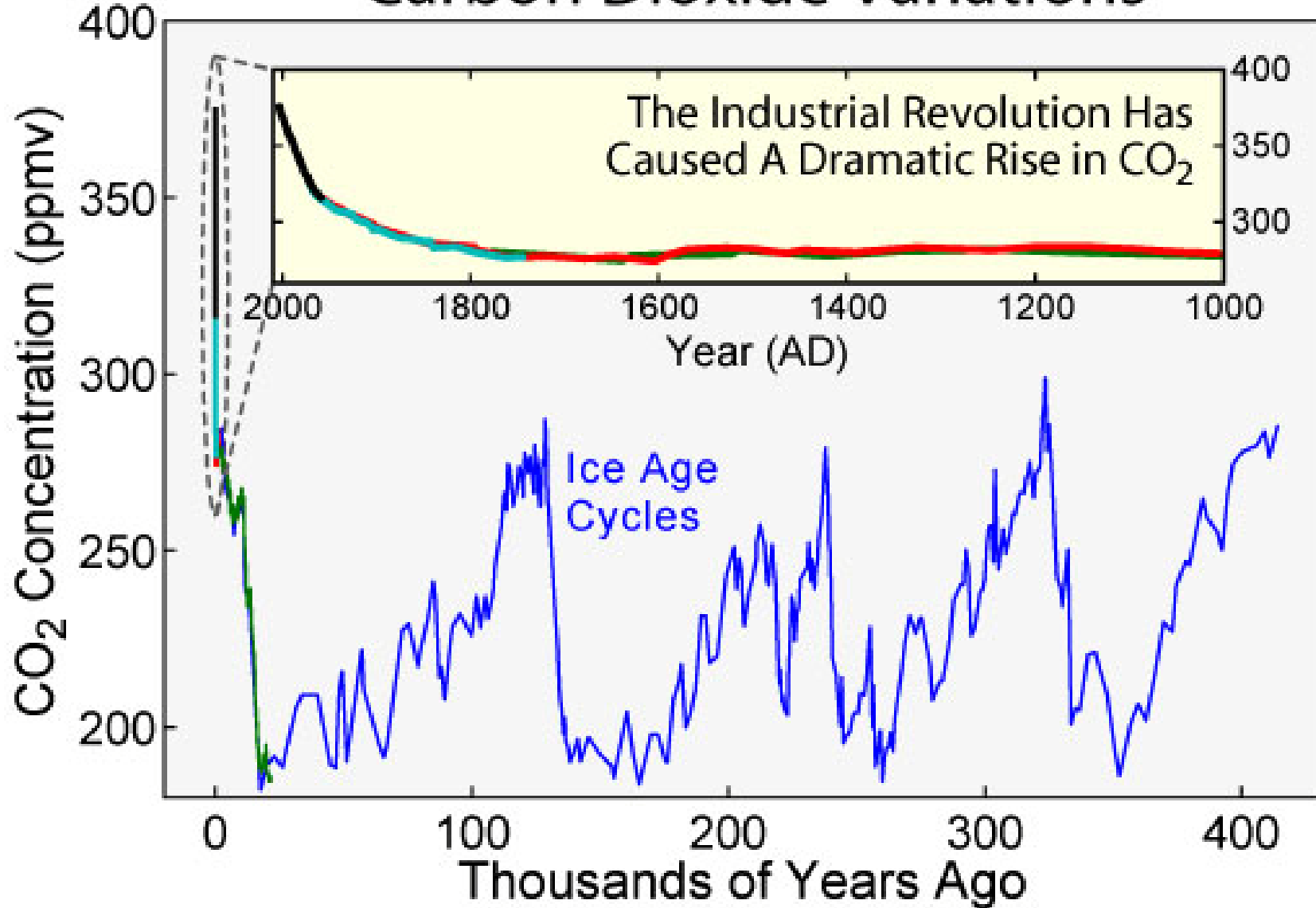
Post-Glacial Sea Level Rise



Holocene Sea Level



Carbon Dioxide Variations



Vegetation Changes in TTINWR from 1940 to 2007

-field observations, aerial photo
interpretation etc while mapping
and coordinating control of exotics

Methods

- Utilized existing NWI and USGS shape files
- Collier Property Appraisers aerials 2000-2007
- DOQQ's 1995, 1999 infrared
- 1940's black and white from USGS
- Geodatabase with ArcPad in field for ground-truthing
- CERP vegetation classification system
- Digitized, ground-truthed, digitized, ground-truthed and on and on from 2004 to present 13,000 record geodatabase created
- Includes 20% of biosci tech USFWS position from 2004-2006 (2 years GS 7) and 2007-2009 as part of 60K contract with IRC including facilitation of exotic control contractors in marsh areas

CERP Vegetation Classification System

- Hierarchical
- **Authors:** Rutchey, K.1,* , T.N. Schall1, R.F. Doren2, A. Atkinson3, M.S. Ross2, D.T. Jones2, M. Madden4, L. Vilchek5, K.A. Bradley6, J.R. Snyder7, J.N. Burch8, T. Pernas9, B. Witcher3, M. Pyne10, R. White10, T.J. Smith III11, J. Sadle8, C.S. Smith12, M.E. Patterson3, and G.D. Gann6
- Thank you authors!

CERP Vegetation Classification System

- Level 1 **M Marsh**
- Level 2 MS Salt marsh
- Level 2 MF Freshwater marsh
- Level 3 MFB Broadleaf emergent marsh
- Level 3 MFG Graminoid emergent marsh
- Level 4 MFGc Sawgrass
- Level 5 MFGcS Sawgrass-Short
- Level 5 MFGcT Sawgrass-Tall

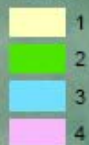
Vegetative Zones of TTINWR

- 1 Marsh/Mangrove Ecotone
- 2 Mainland Mangrove Forest
- 3 Back Bays and Middle Islands
- Outer Islands

Ten Thousand Islands
National Wildlife Refuge
Vegetation Zones

TTI_VEG_TYPES

ZONE



Zone 1 and non-tidal areas of Zones 2,3 and 4 Surveyed Preferentially for Exotics



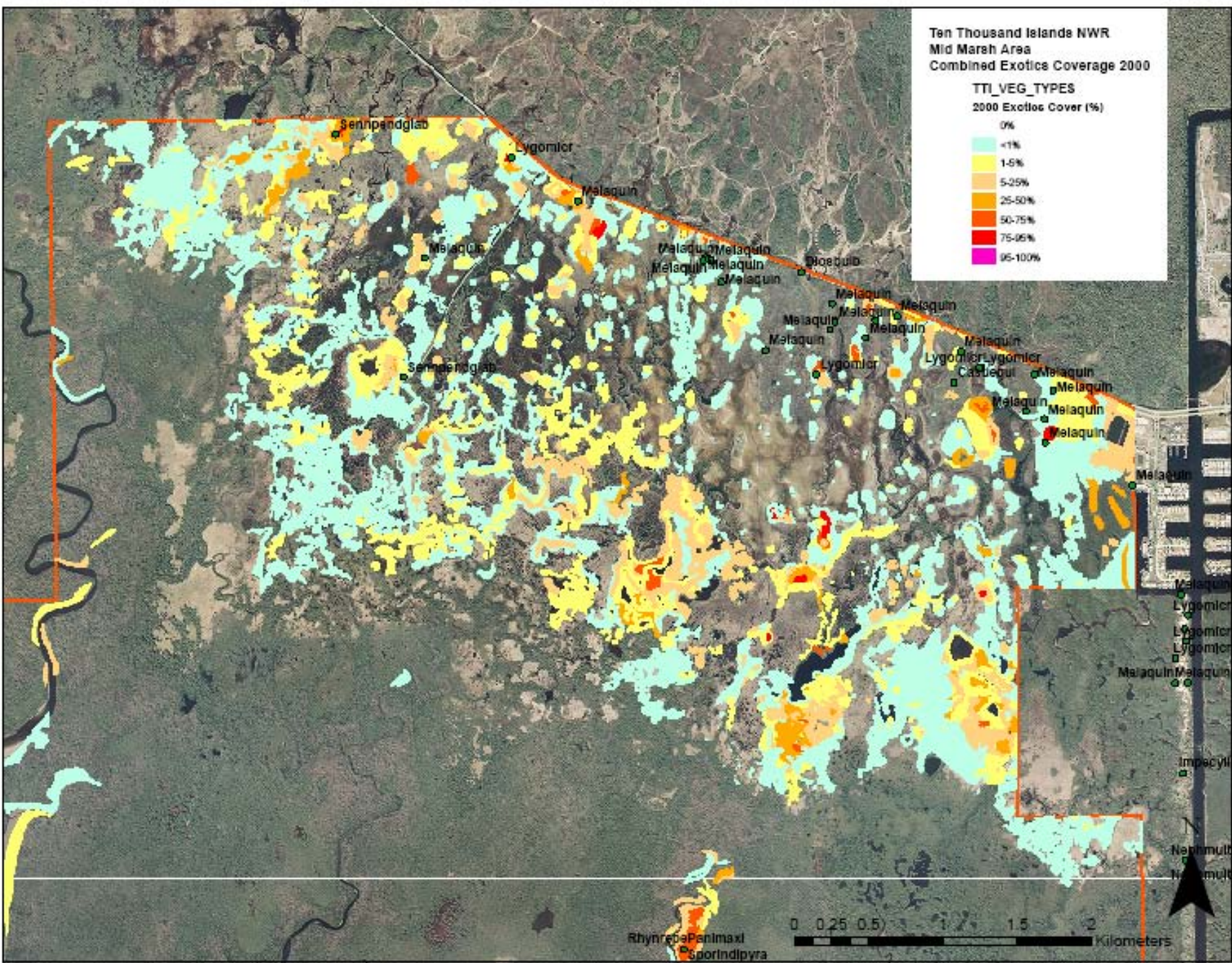
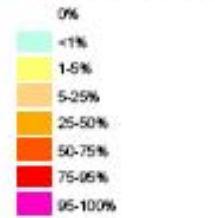
Field Survey Effort

Zone	Description	Survey Distance (m)	Buffer by Sight distance (acres)	Total Acres	Percent Total	Total (Excluding Open Water)	Percent Total (Excluding Open Water)	Ground-Truthed Polygons
1	Marsh/Mangrove Ecotone	243967.6	2447.4	9234.0	26.5	8715.8	28.1	3520.4
2	Mainland Mangrove Forest	14063.5	115.7	7010.8	1.7	6851.0	1.7	2467.6
3	Back Bays and Middle Islands	14129.4	97.5	17521.9	0.6	5290.1	1.8	12324.1
4	Outer Islands	9042.5	80.2	1012.0	7.9	884.4	9.1	183.3

TOTAL: 281202.9 2740.8 34778.6 36.6 21741.3 40.7 18495.4

Ten Thousand Islands NWR
Mid Marsh Area
Combined Exotics Coverage 2000

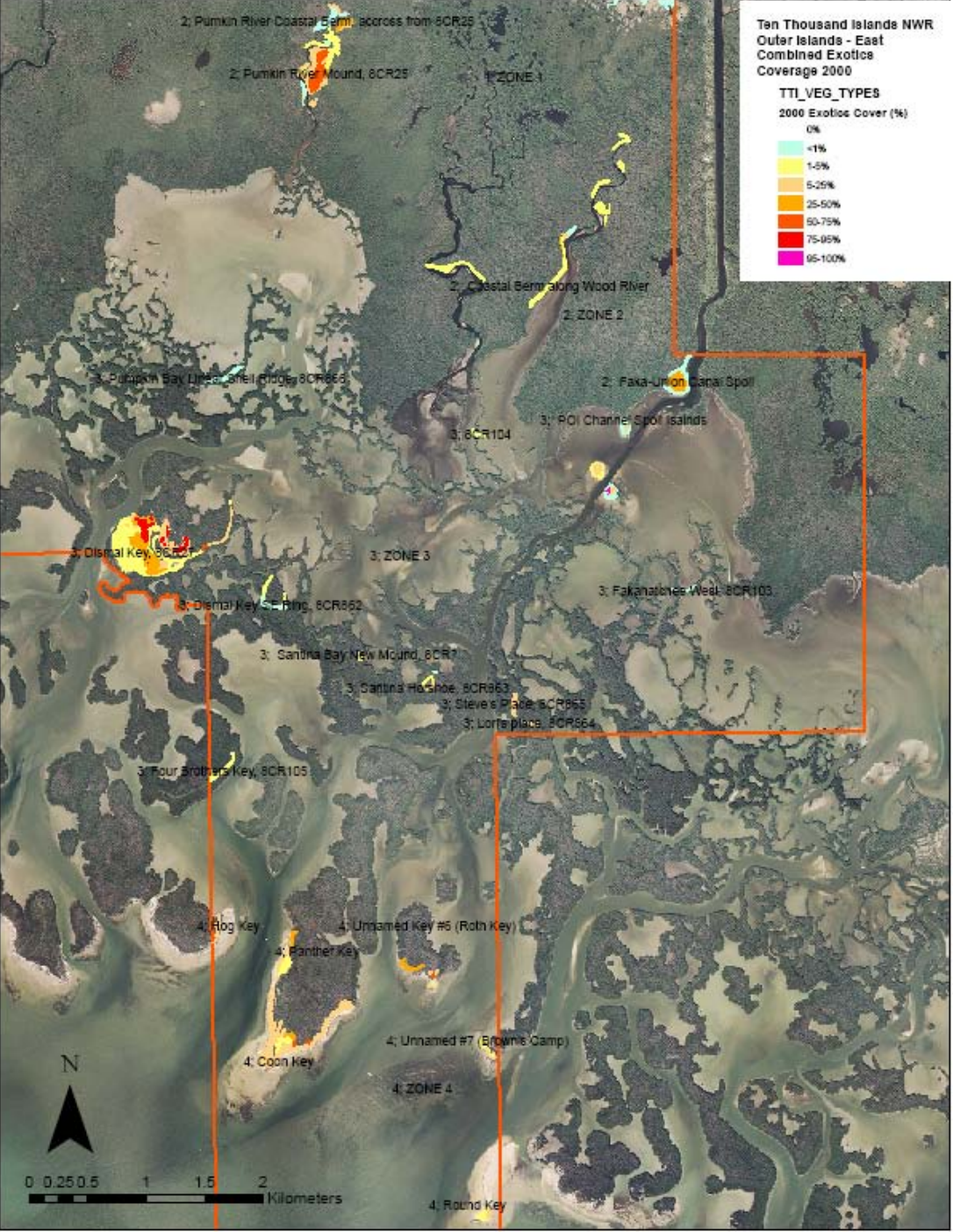
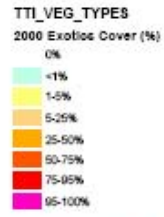
TTL_VEG_TYPES
2000 Exotics Cover (%)



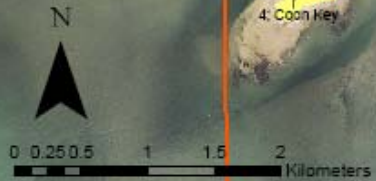
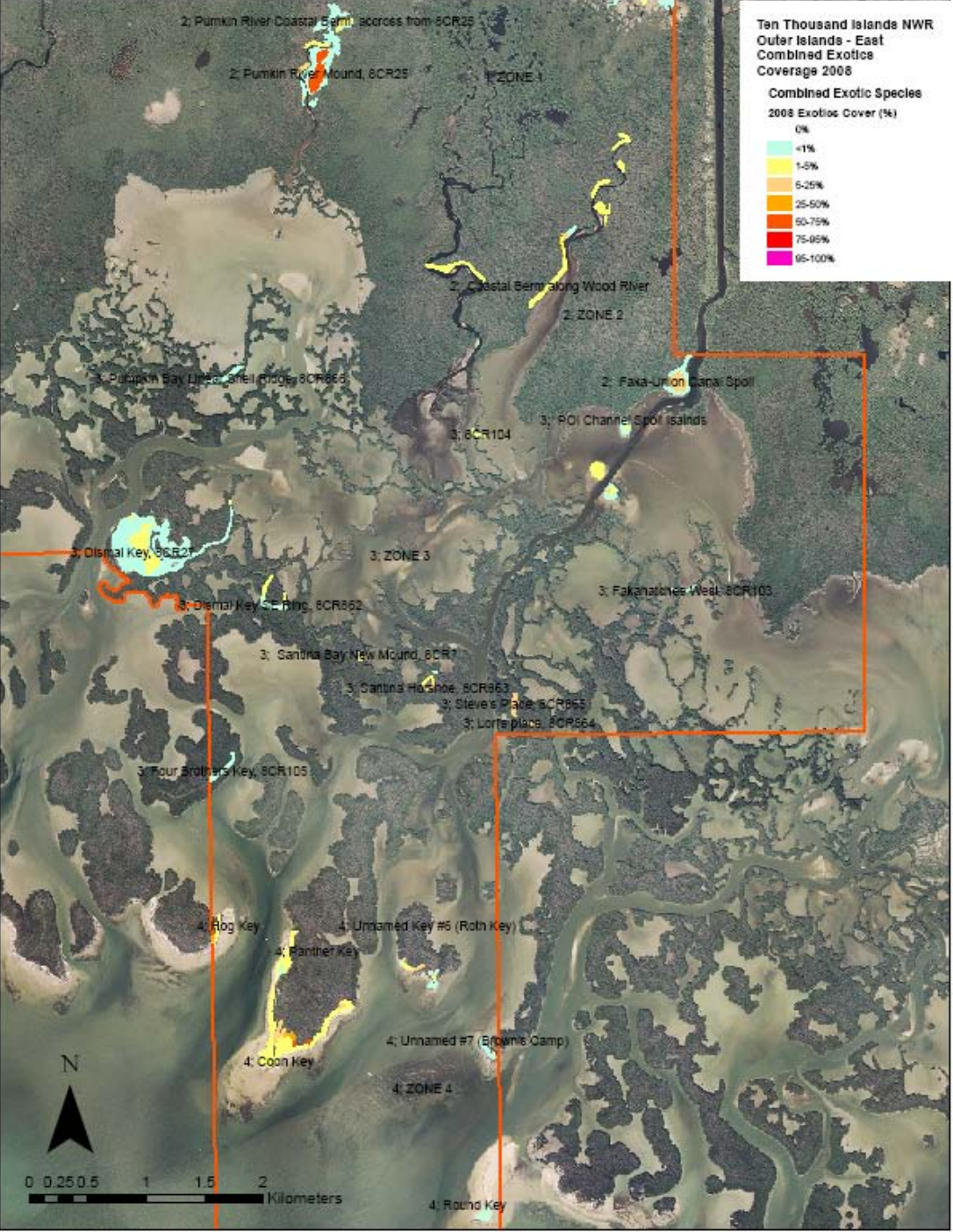
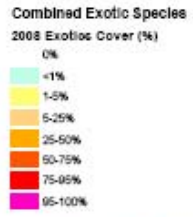
Rhynrepa Panlmaxl
SporIndlpyra

0 0.25 0.5 1 1.5 2 Kilometers

Ten Thousand Islands NWR
 Outer Islands - East
 Combined Exotics
 Coverage 2000



Ten Thousand Islands NWR
 Outer Islands - East
 Combined Exotics
 Coverage 2008



Results/Discussion

- Hydrological changes upstream
- Fire Suppression
- Freezes
- Storm Erosion
- Sedimentation
- Sea Level Rise (22 cm since 1930)

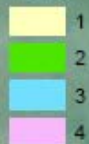
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Ten Thousand Islands
National Wildlife Refuge
Vegetation Zones

TTI_VEG_TYPES

ZONE



1 Marsh/Mangrove Ecotone

- Hydrology/Drainage
- Fire Suppression
- Freezes
- Sea Level Rise

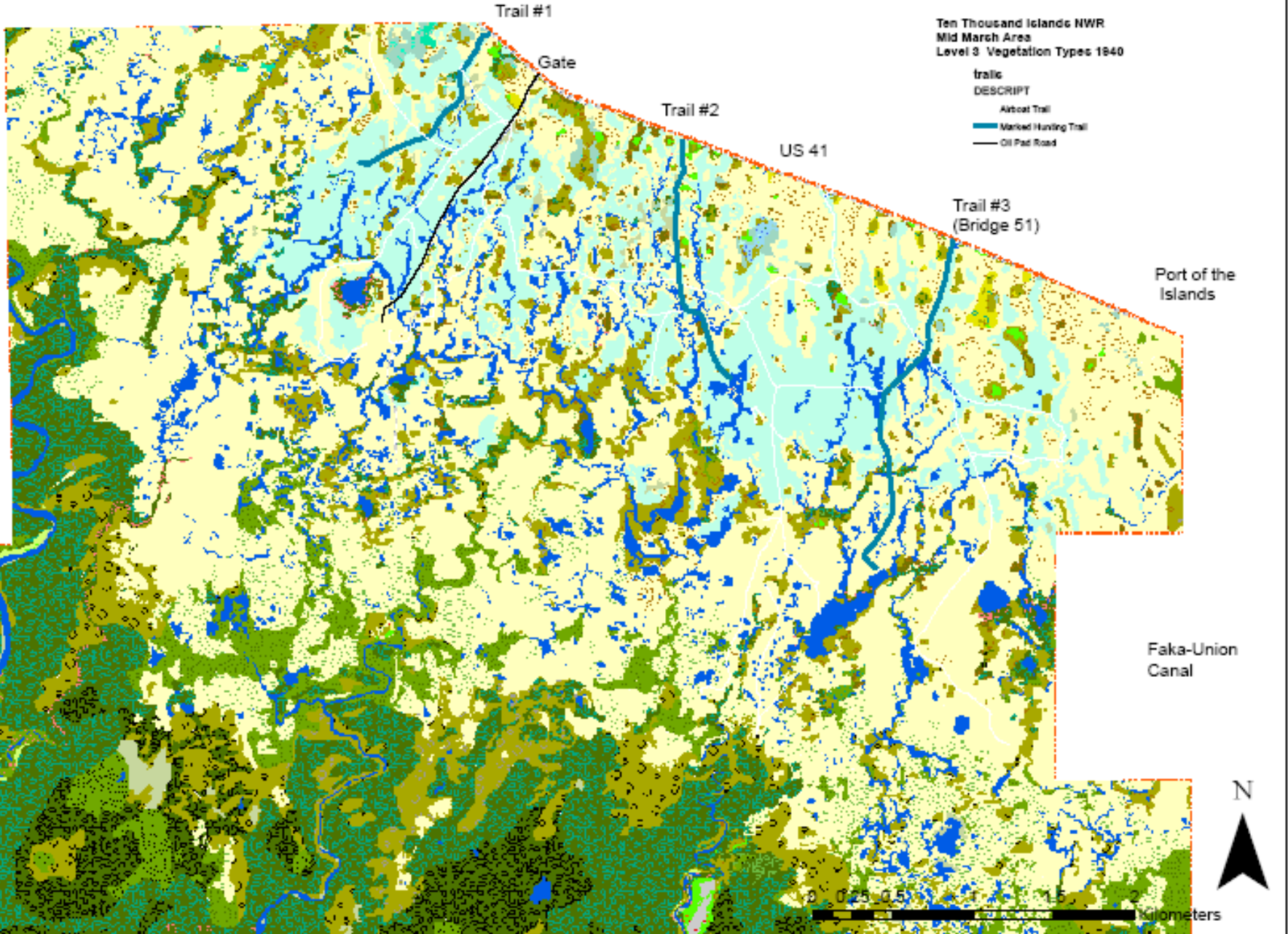
Ten Thousand Islands
National Wildlife Refuge
Vegetation Zones

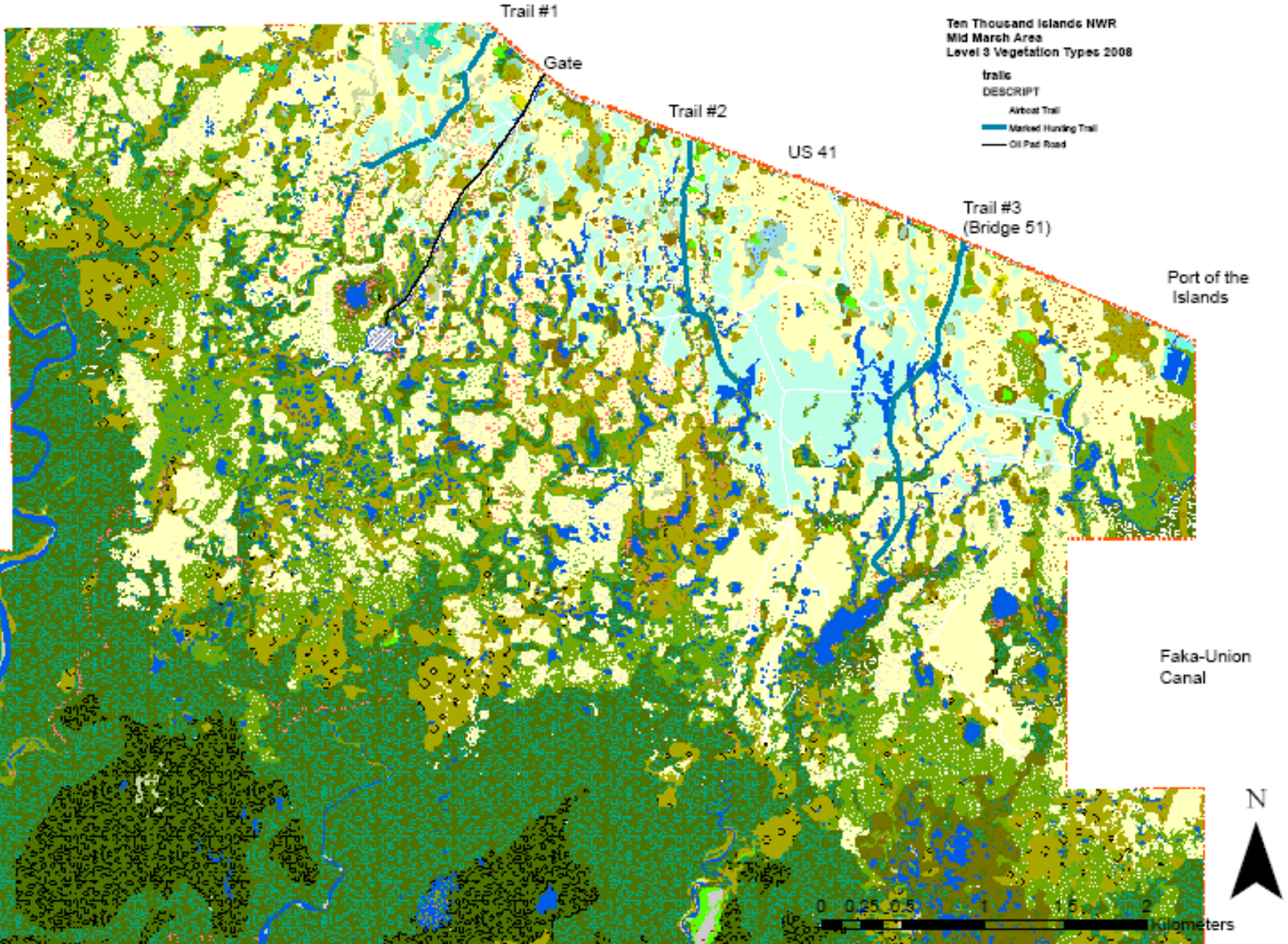
TTI_VEG_TYPES

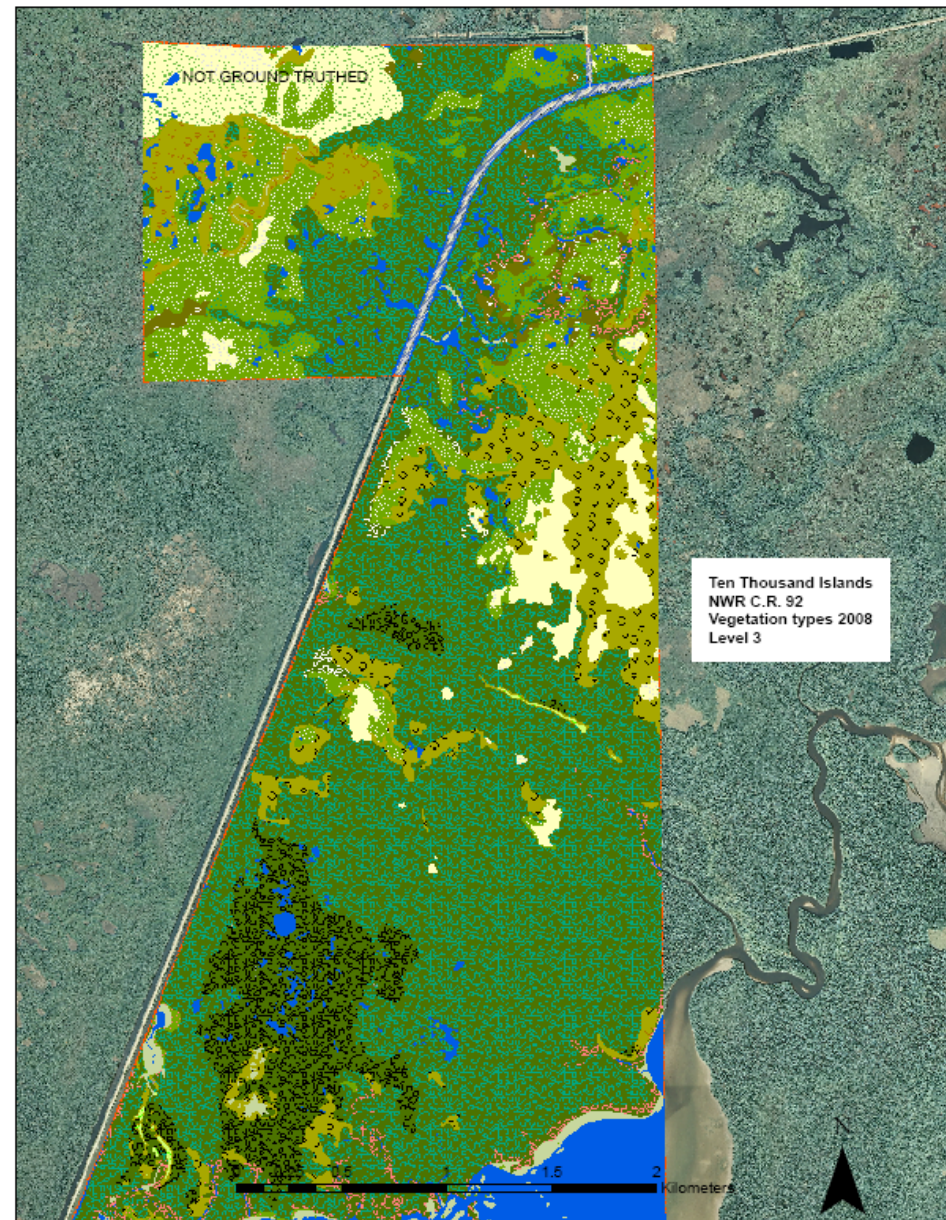
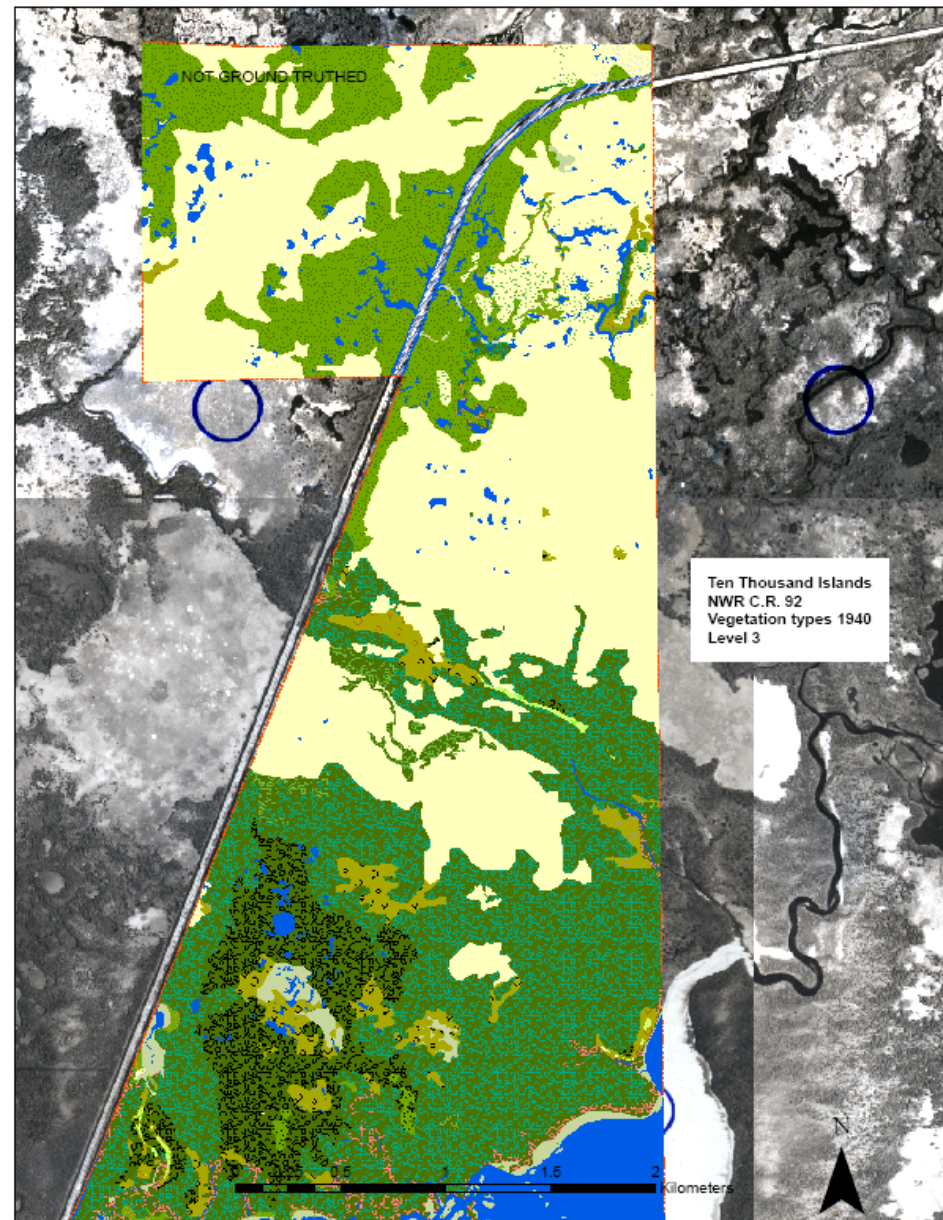
ZONE

- 1
- 2
- 3
- 4









Zone 1 1940 to 2007: (9234 acres)

- MS, MF 4126 total acres to 1266 acres
- SM, FM 1301 total acres 4190 acres
- MF, MS to SM 1056 acres
- MF, MS to FM 600 acres
- WM with SM understory 930 acres 2007
- MF, MS to CM 1195 acres
- MF, MS to WM 305 acres
- CM to SM 443 acres
- CM to WM 359 acres
- CM to FM 157 acres



















Pineland/Buttonwood Scrub

- Buttonwood Scrub with slash pine stumps
- 1940's signatures suggest bigger pinelands
- WSp, WUp 26 acres to 8.4 acres
- WSp, WUp to FH, SUC 3.5 acres
- WSp, WUP to CMc, WMc, SMC, FMc accounts for rest of change



CMcGj after freeze in January 20067



























non mangrove species
die off observed in
southern areas of marsh
mangrove ecotone...

hydrology and/or
sea level rise?





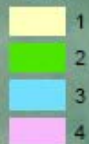
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Ten Thousand Islands
National Wildlife Refuge
Vegetation Zones

TTI_VEG_TYPES

ZONE



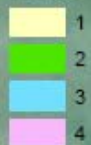
2 Mainland Mangrove Forest

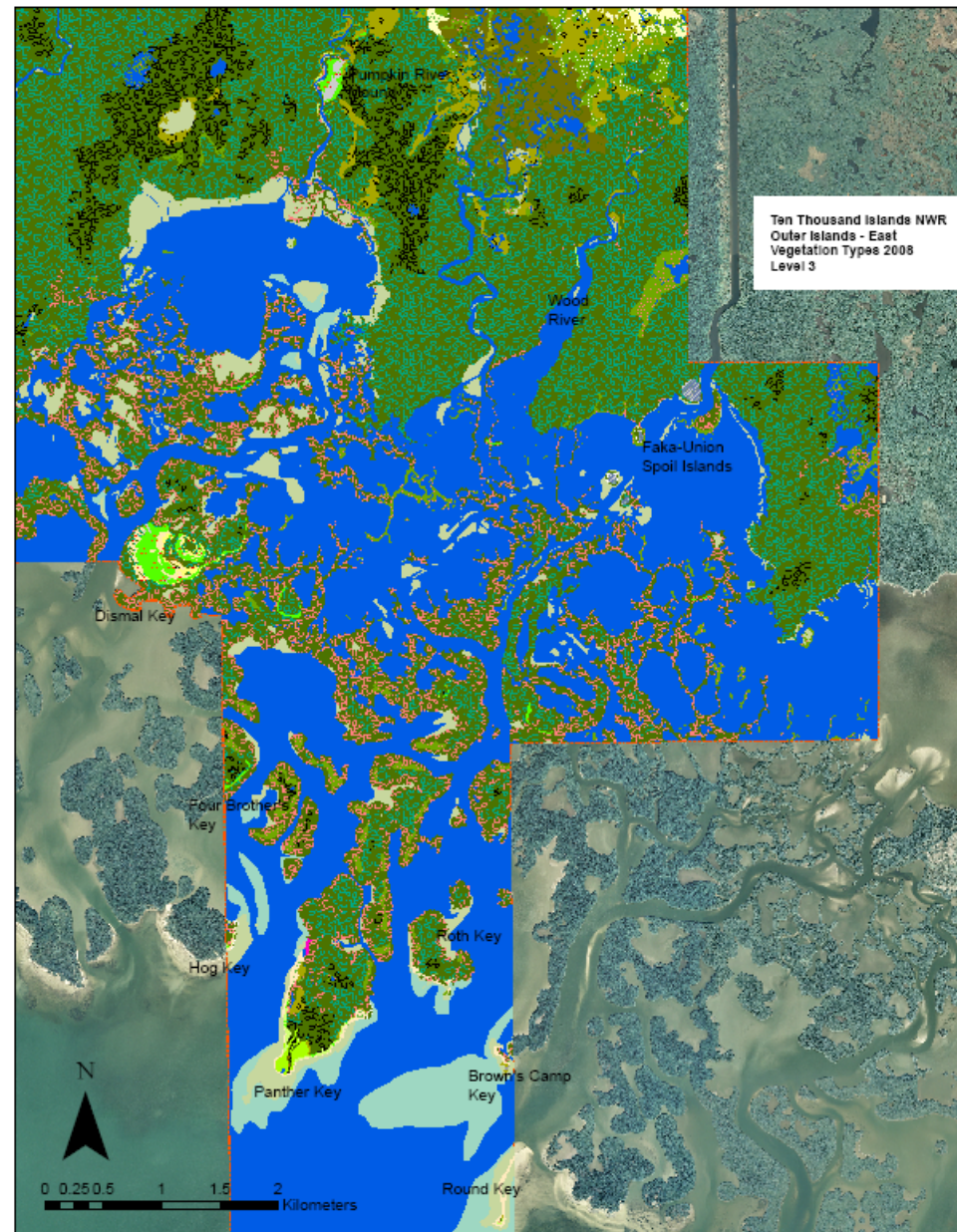
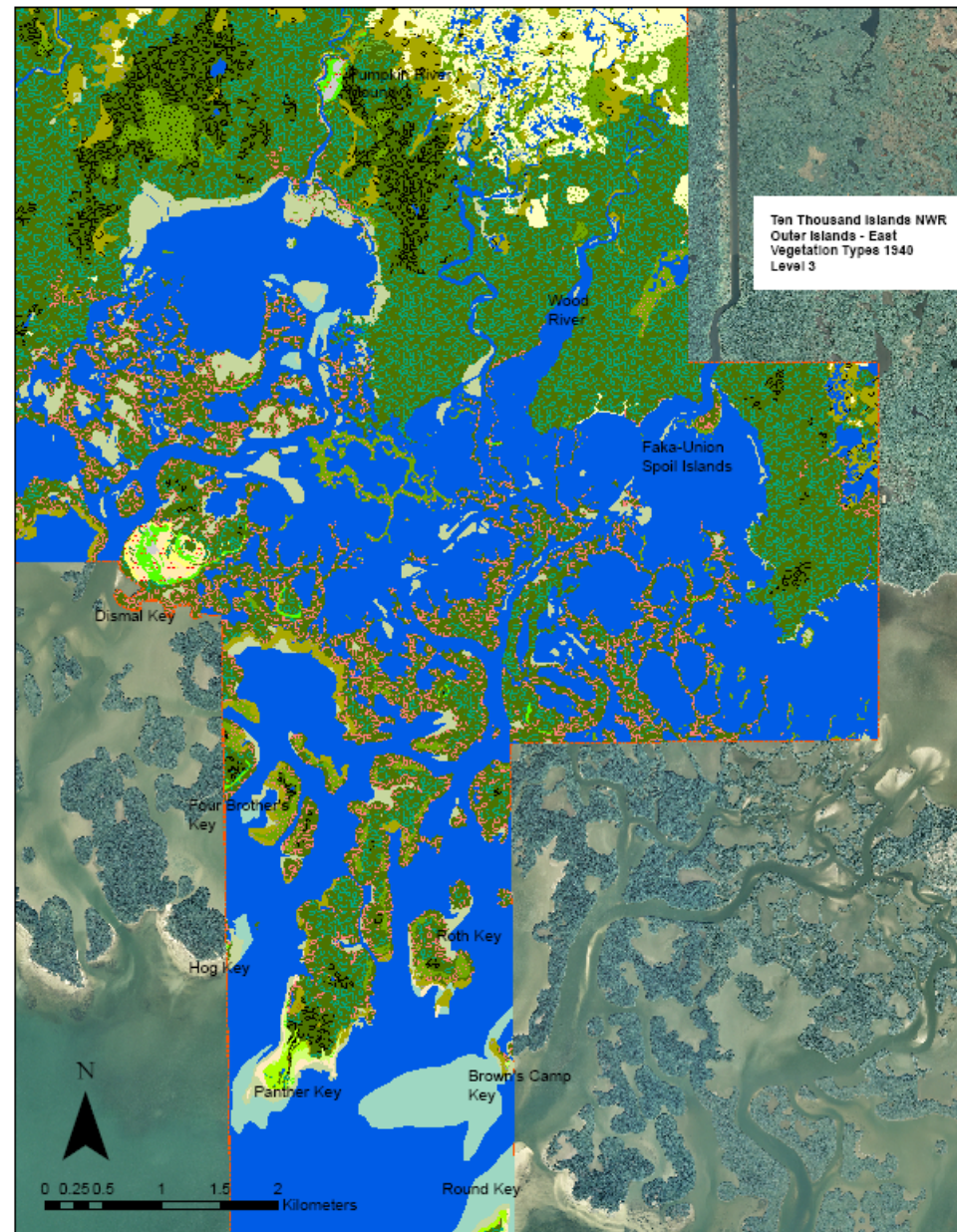
- Hydrology/Drainage
- Sea Level Rise

Ten Thousand Islands
National Wildlife Refuge
Vegetation Zones

TTI_VEG_TYPES

ZONE





Ten Thousand Islands NWR
Outer Islands - West
Vegetation Types 1940
Level 3

CR 92

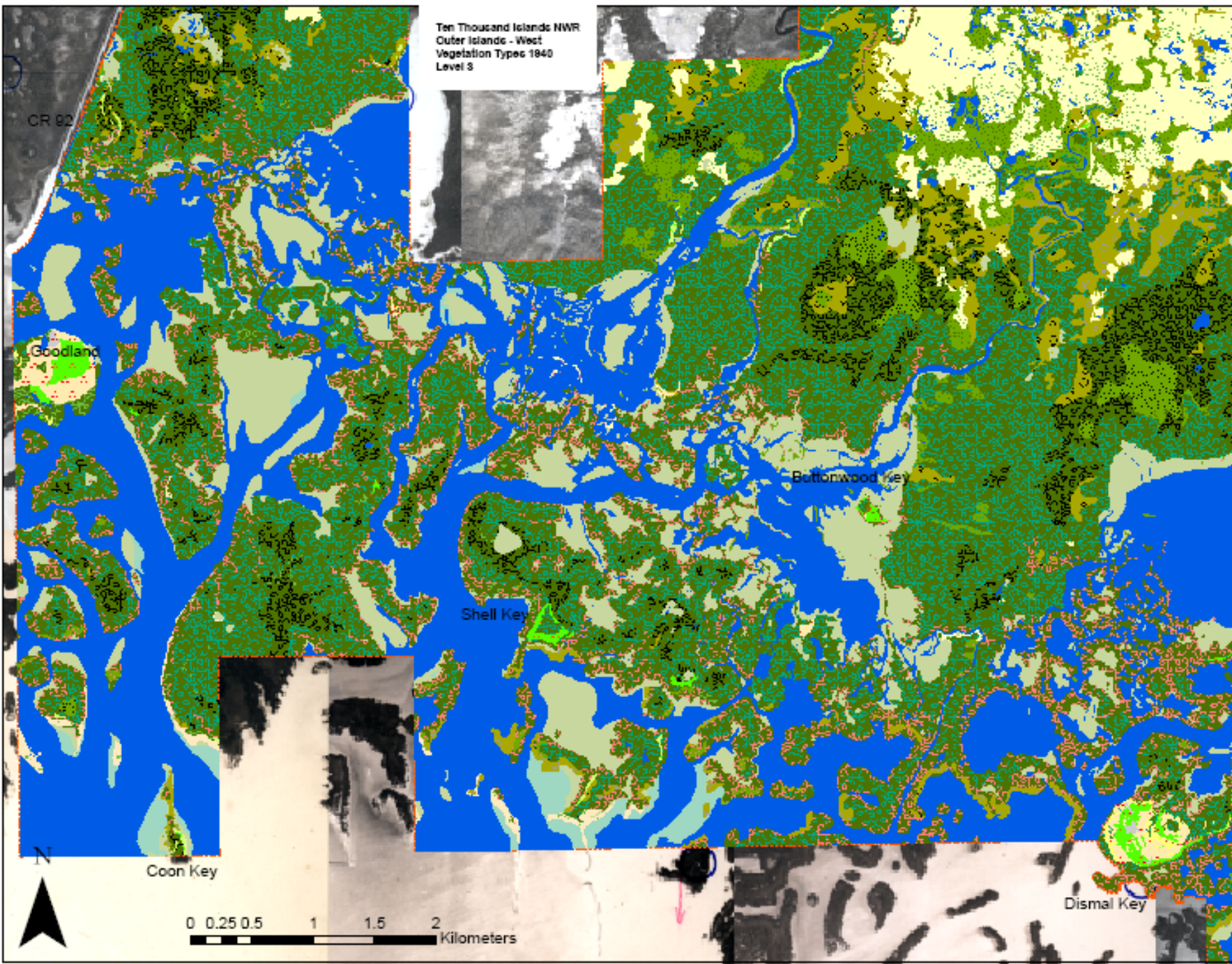
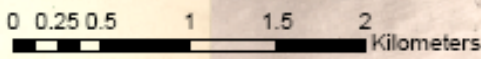
Goodland

Buttonwood Key

Shell Key

Coon Key

Dismal Key



Ten Thousand Islands NWR
Outer Islands - West
Vegetation Types 2008
Level 3

CR 92

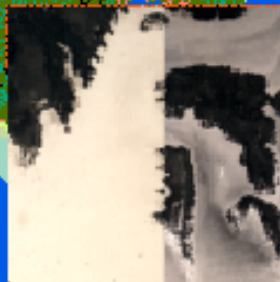
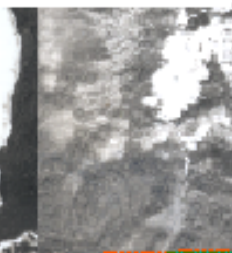
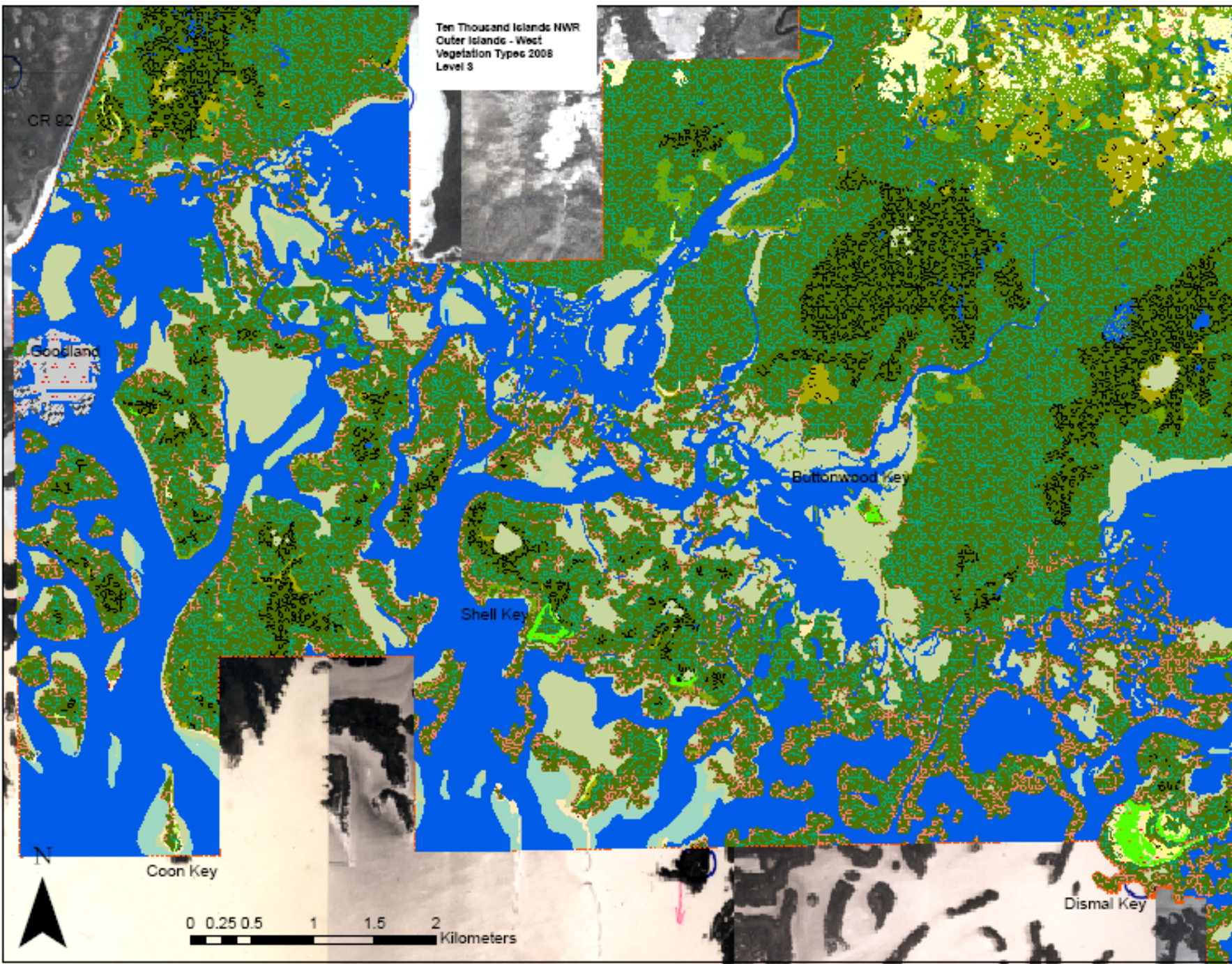
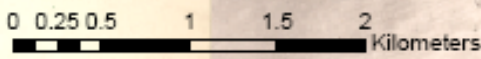
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Buttonwood Key

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Dismal Key

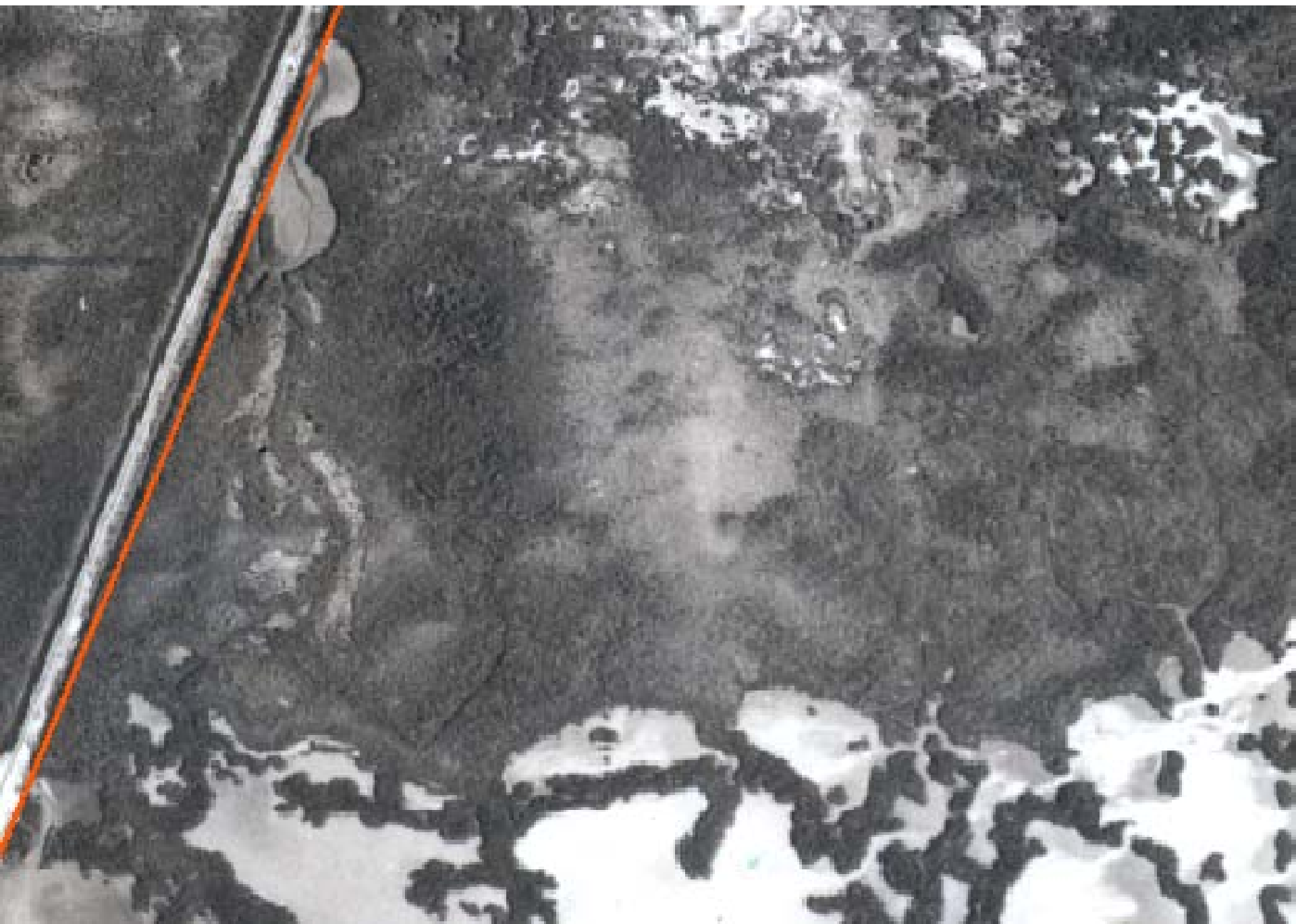


Zone 2 1940 to 2007: (7010 acres)

- FM, SM total 6474 acres to 6689
- FM with no change 5164 acres
- FMa/SMa 1013 acres
- SM with no change 119 acres
- WM with no change 43 acres
- WMc with no change 21 acres
- MUD/OW/MS to FMa/SMa 22 acres at inland/North edge
- FMa/SMa to OW/MUD/WMa 48 acres at basin centers
- WUh (Riverin Coastal Berm) 17.5 acres to 7.5 acres
- CMc/WMc to FM/WM 5 acres (buttonwood die-off)







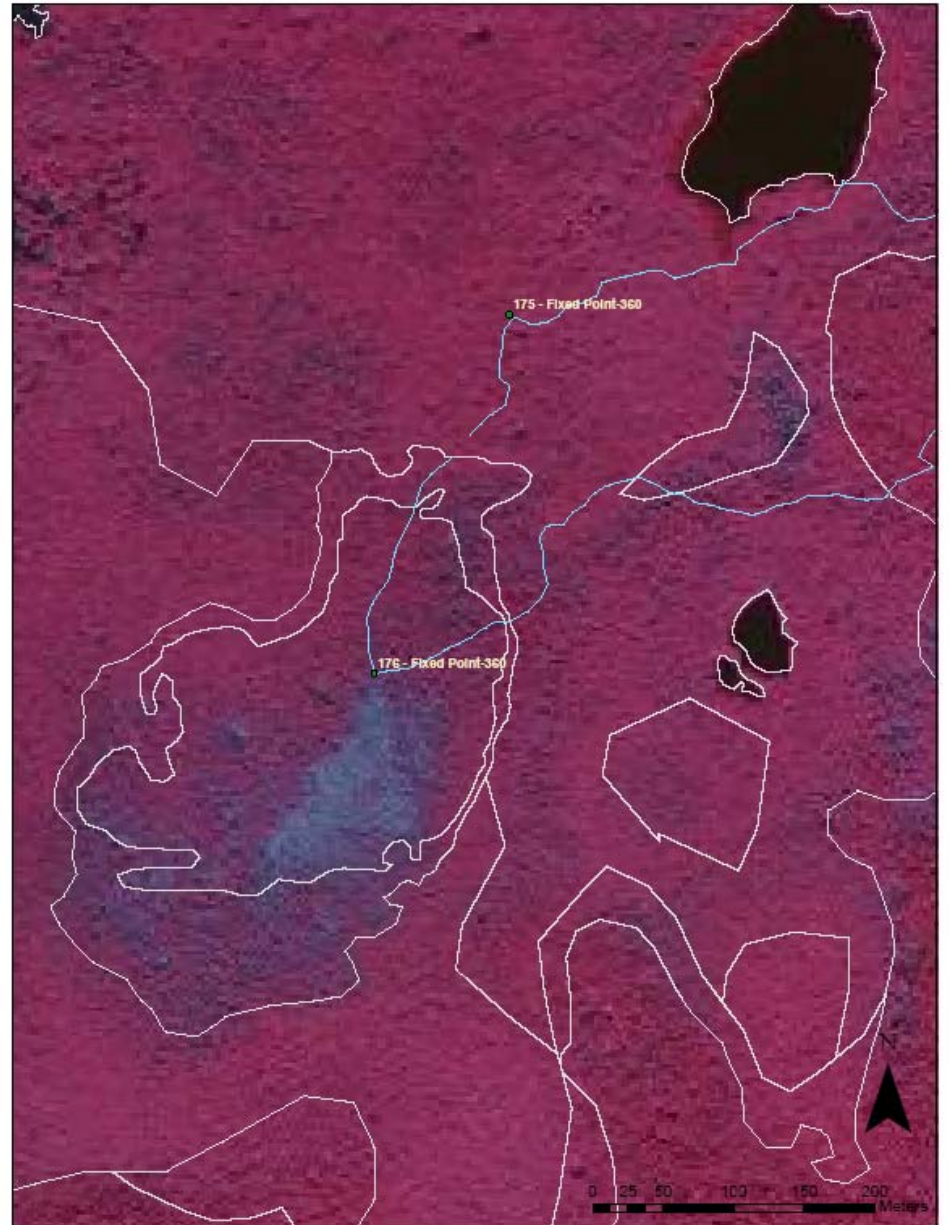
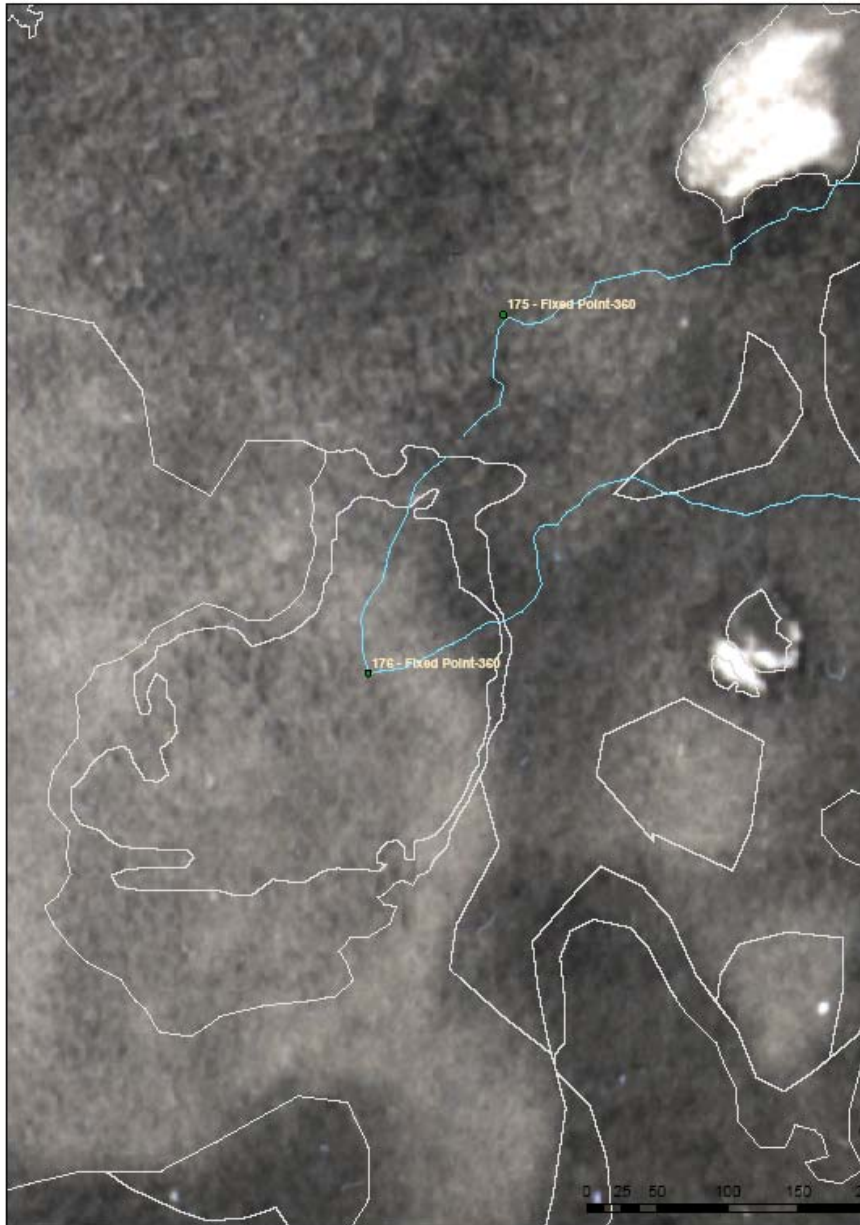


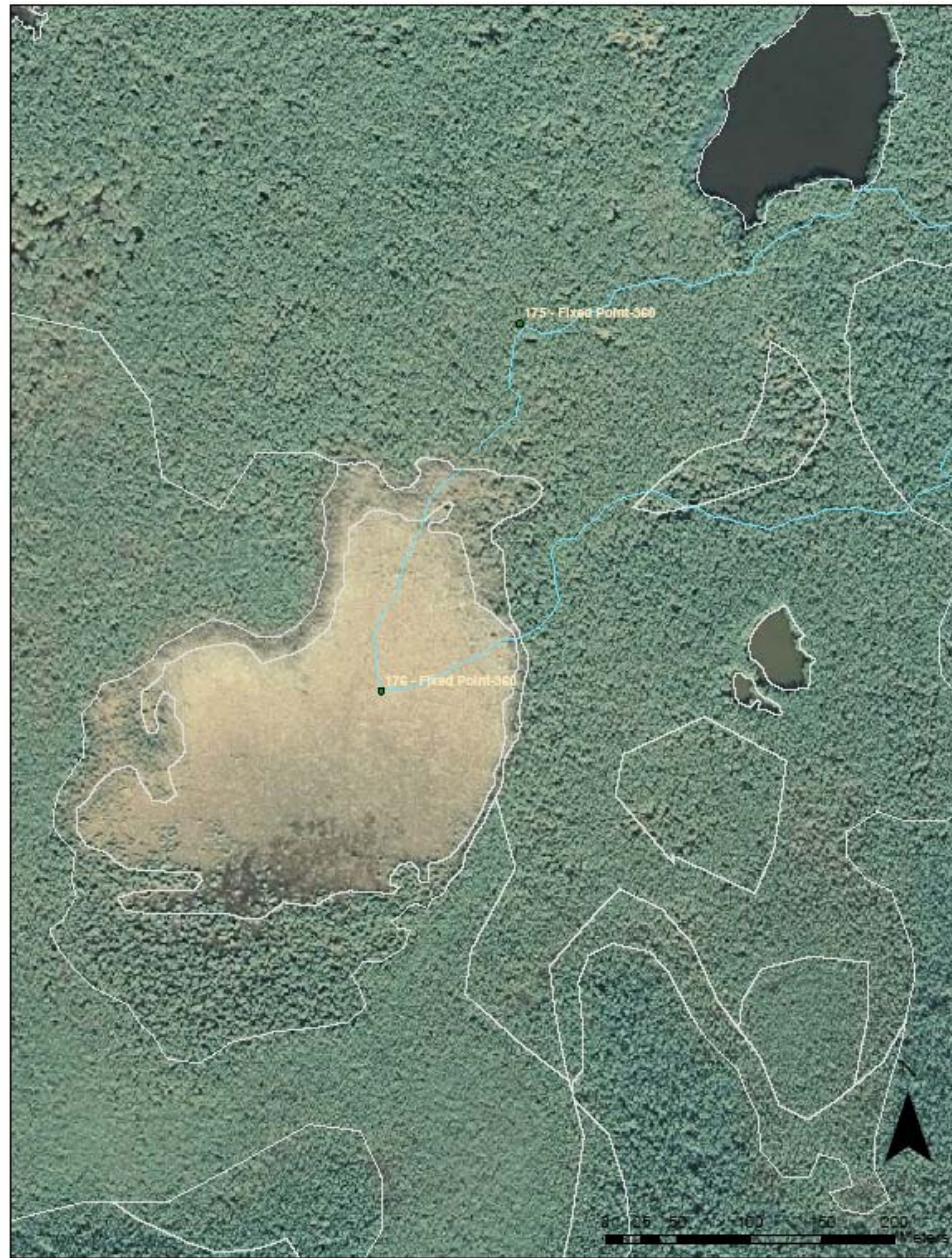
























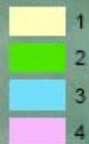
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Ten Thousand Islands
National Wildlife Refuge
Vegetation Zones

TTI_VEG_TYPES

ZONE



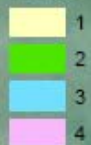
3 Back Bays and Middle Islands

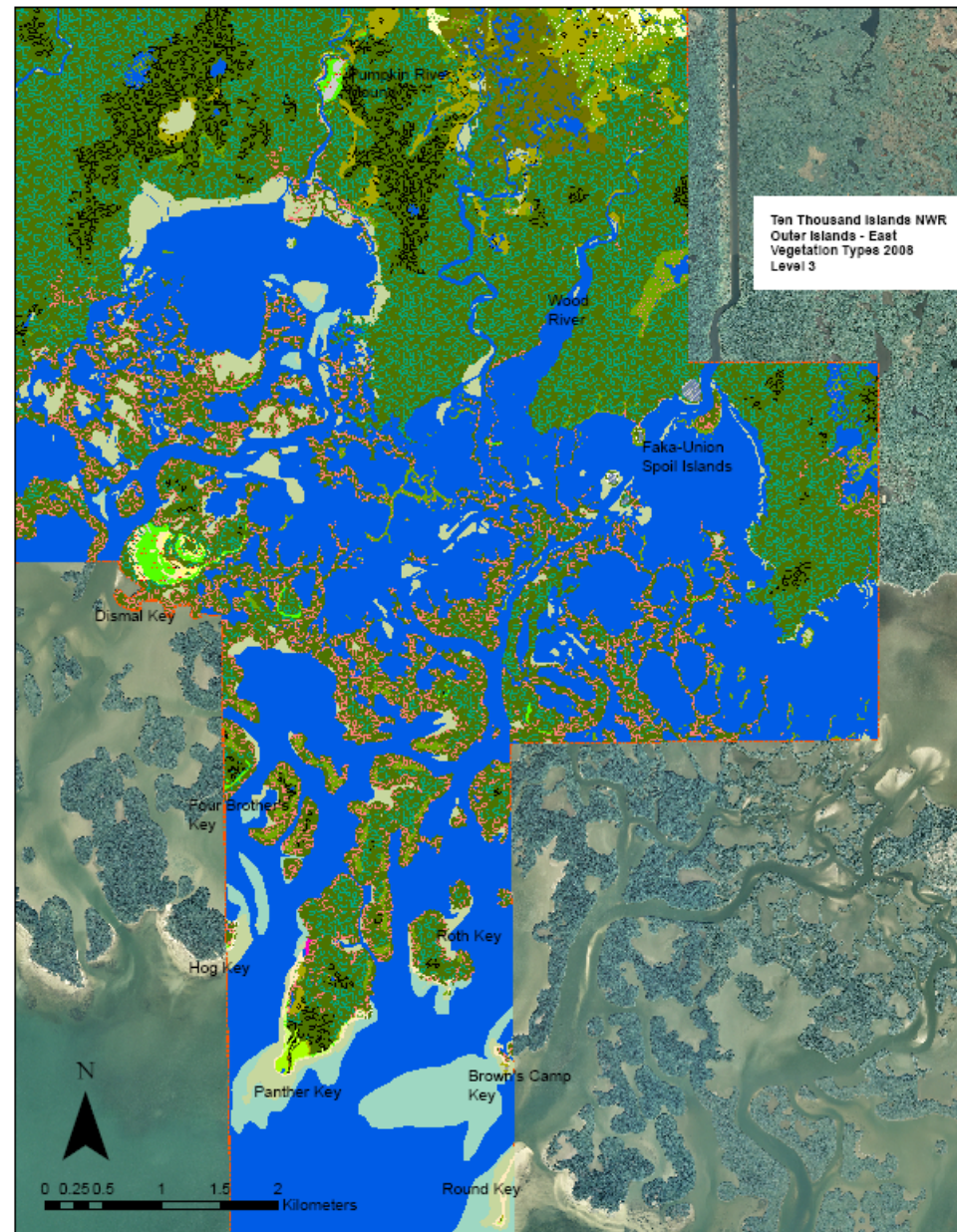
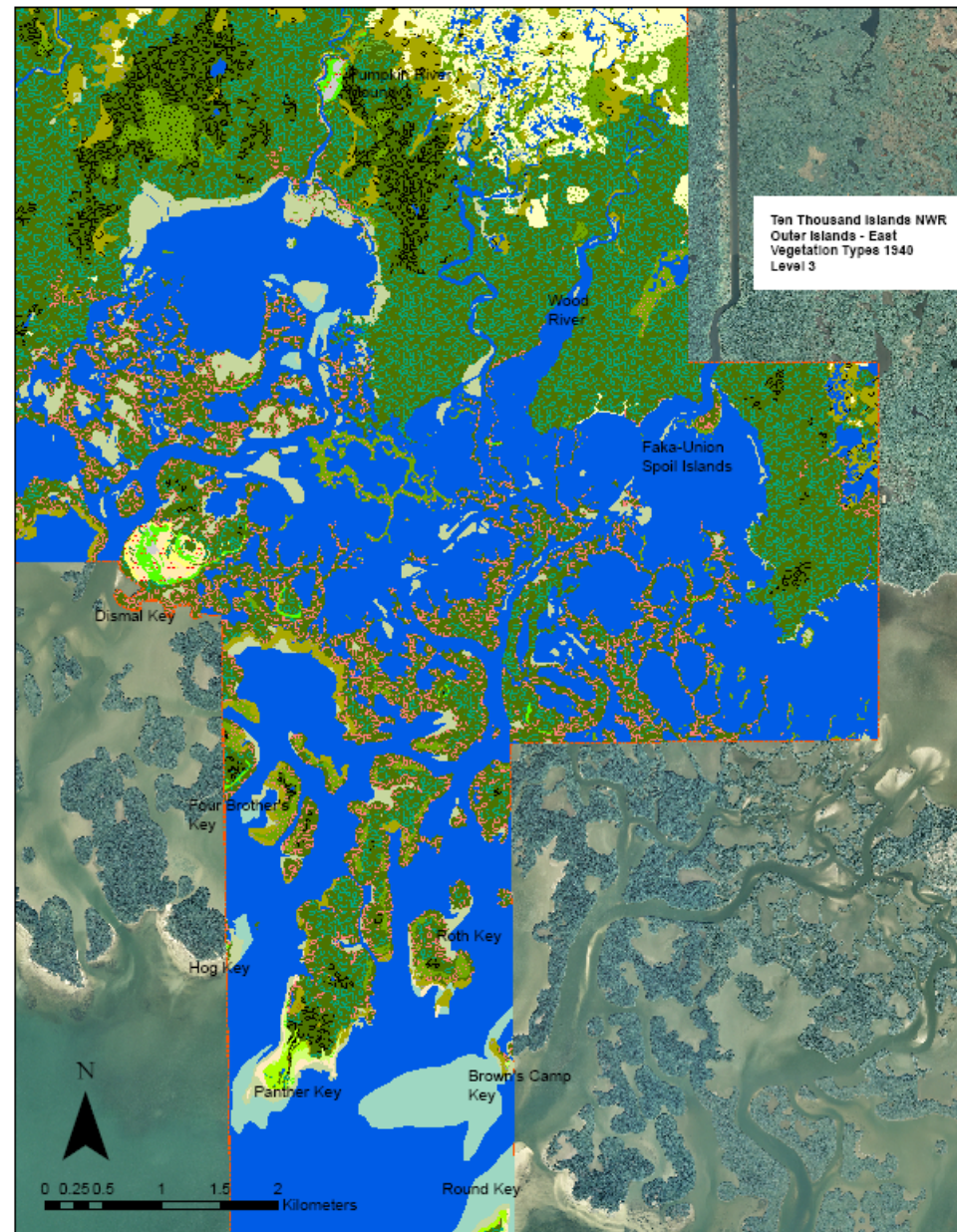
- Sea Level Rise
- Sedimentation

Ten Thousand Islands
National Wildlife Refuge
Vegetation Zones

TTI_VEG_TYPES

ZONE





Ten Thousand Islands NWR
Outer Islands - West
Vegetation Types 1940
Level 3

CR 92

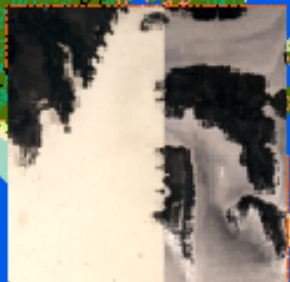
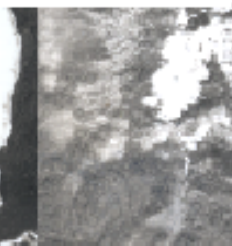
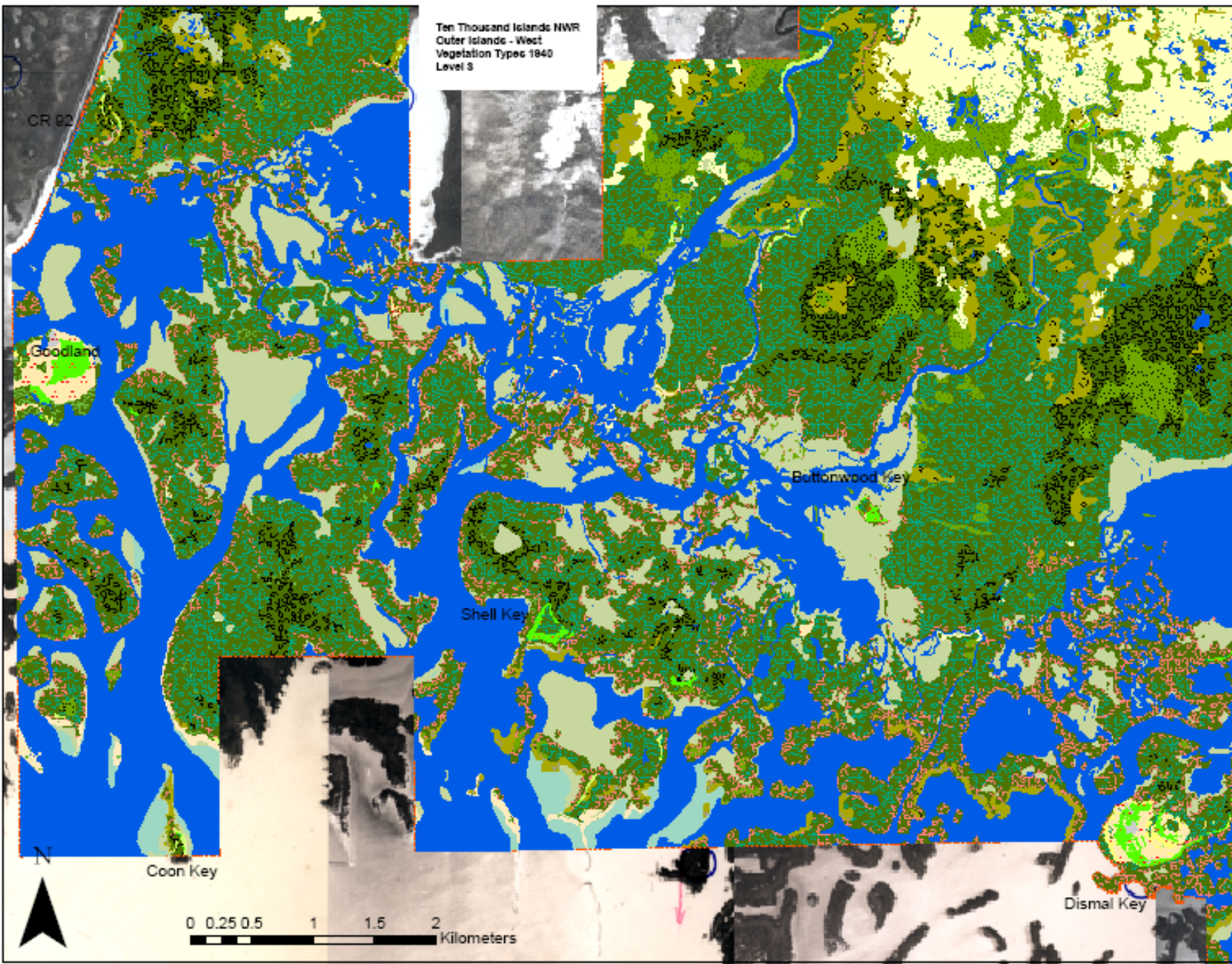
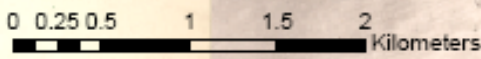
Goodland

Buttonwood Key

Shell Key

Coon Key

Dismal Key



Ten Thousand Islands NWR
Outer Islands - West
Vegetation Types 2008
Level 3

CR 92

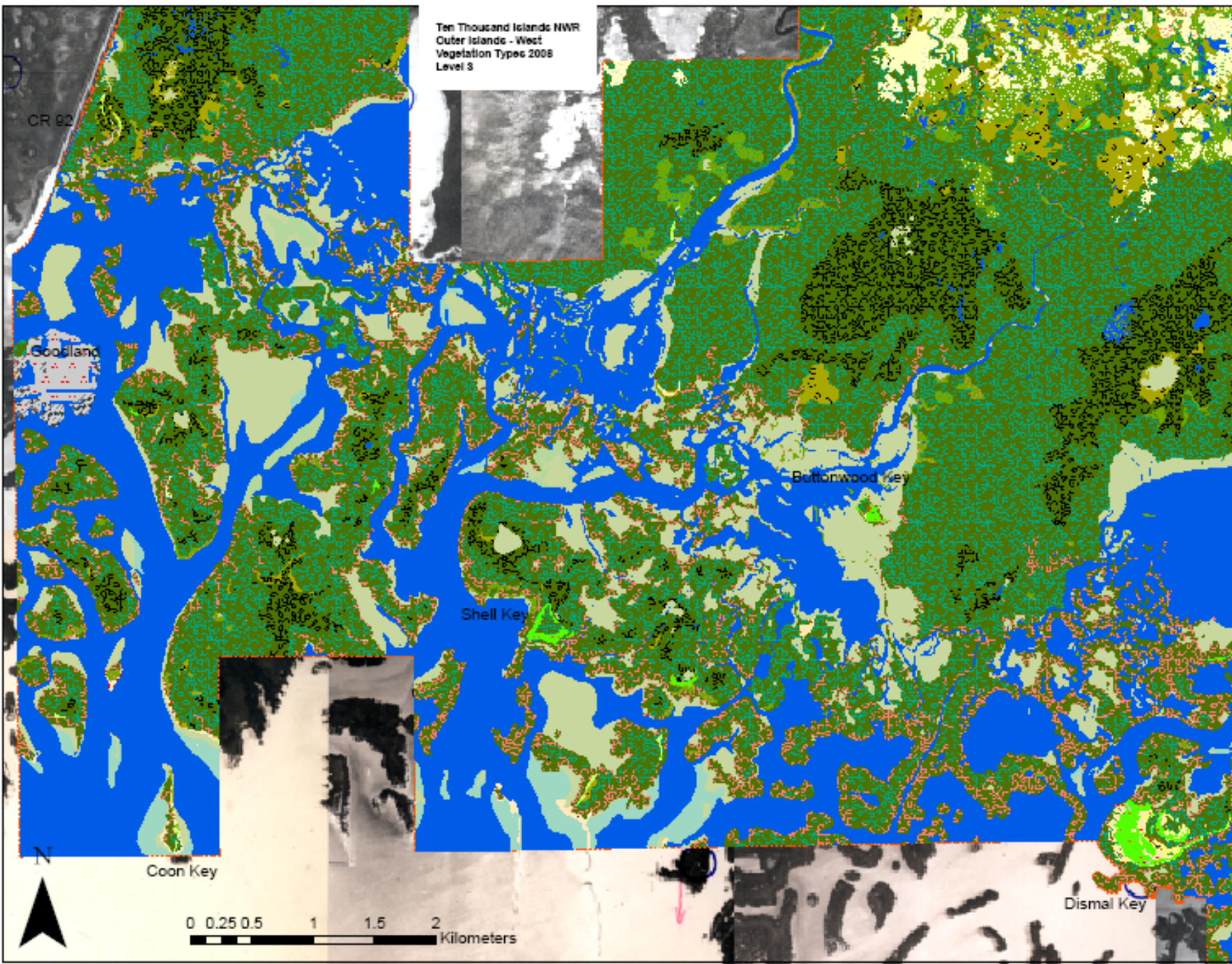
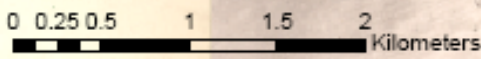
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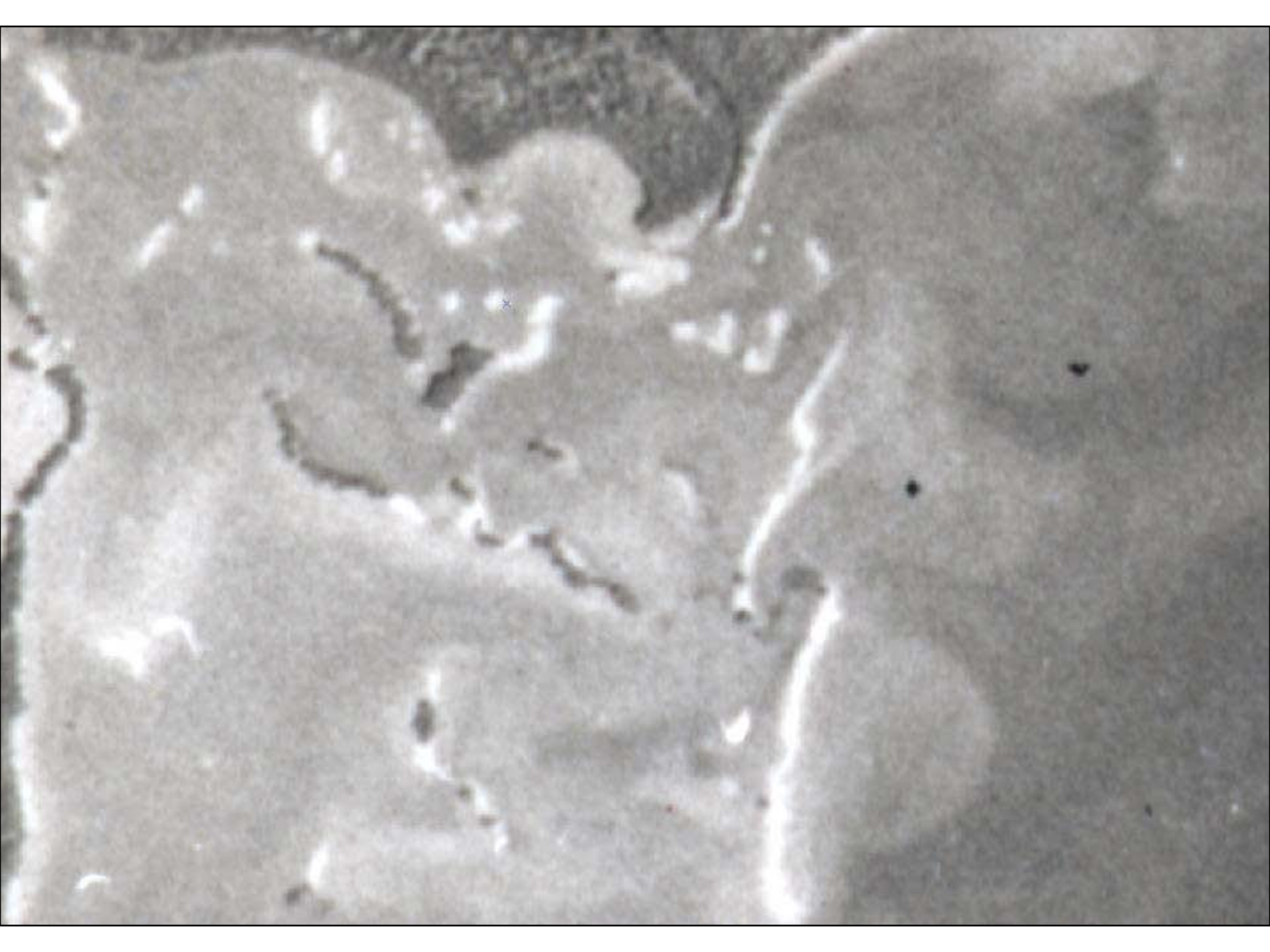
Coon Key

Dismal Key

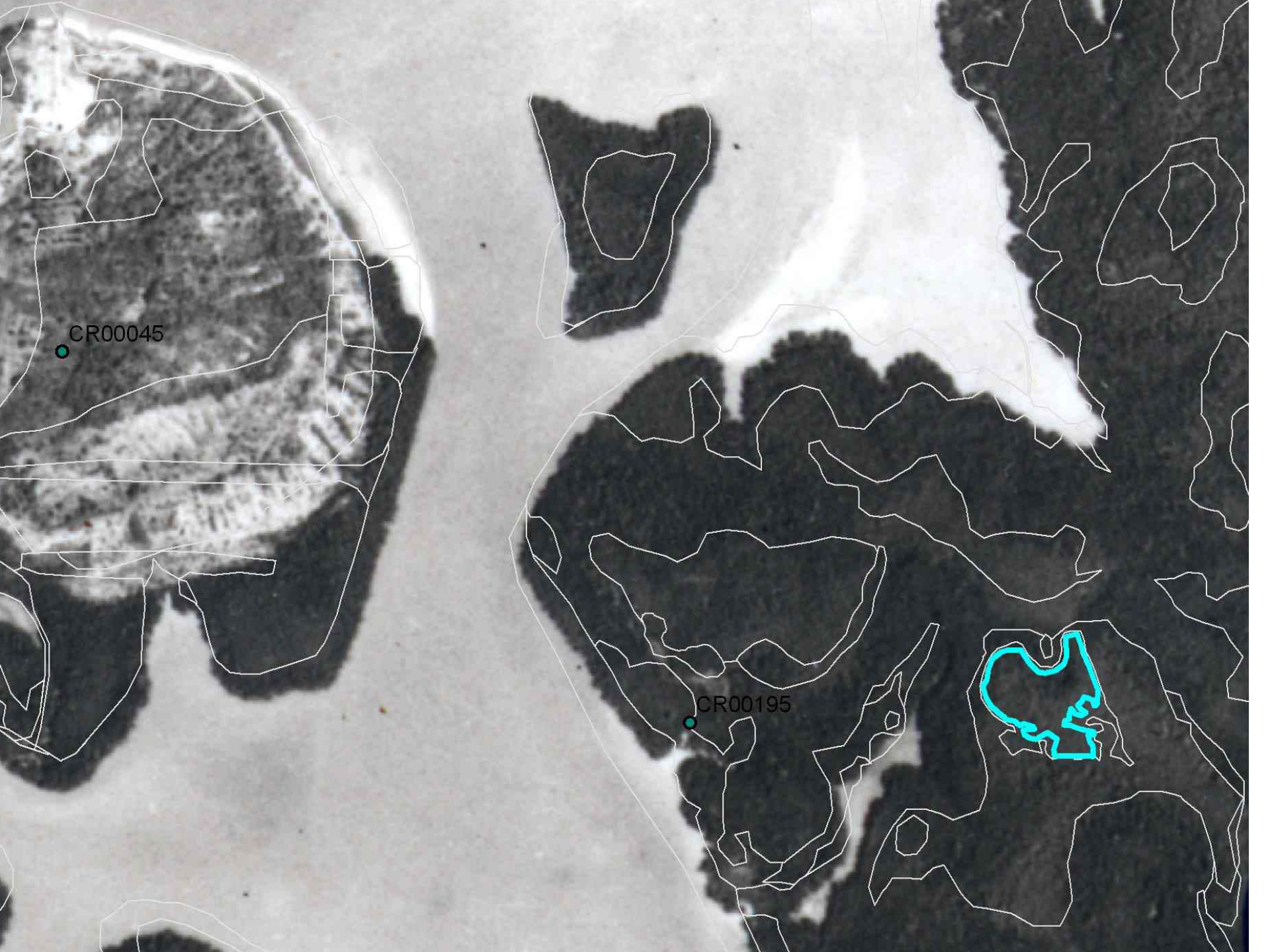


Zone 3 1940 to 2007: (17521 acres, 5290 acres excluding OW)

- FM,SM 4752 acres to 4908 acres
- OW to FM, SM was 33 acres
- FM to OW 10 acres
- WM, CM to FM 127 acres
- FMa/SMa to WMa/MUD/OW 4 acres
- WMc to FM 1.2 acres out of 3.6 acres total
- Mounds (FHM etc) 97 acres to 85 acres, excluding Goodland, changed to FM







CR00045

CR00195



PROJ 198

X









Dismal Key, TTINWR, Effects of Sea Level Rise on Vegetation 1940-2008

by Mike Barry (1/22/2009)

- protected from storm erosion
- minimal hydrological changes
 - hard substrate (shell)
 - minimal fire effects
- some recent human impacts
(settlers, conocarpus harvest?)

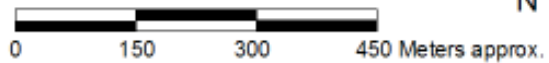


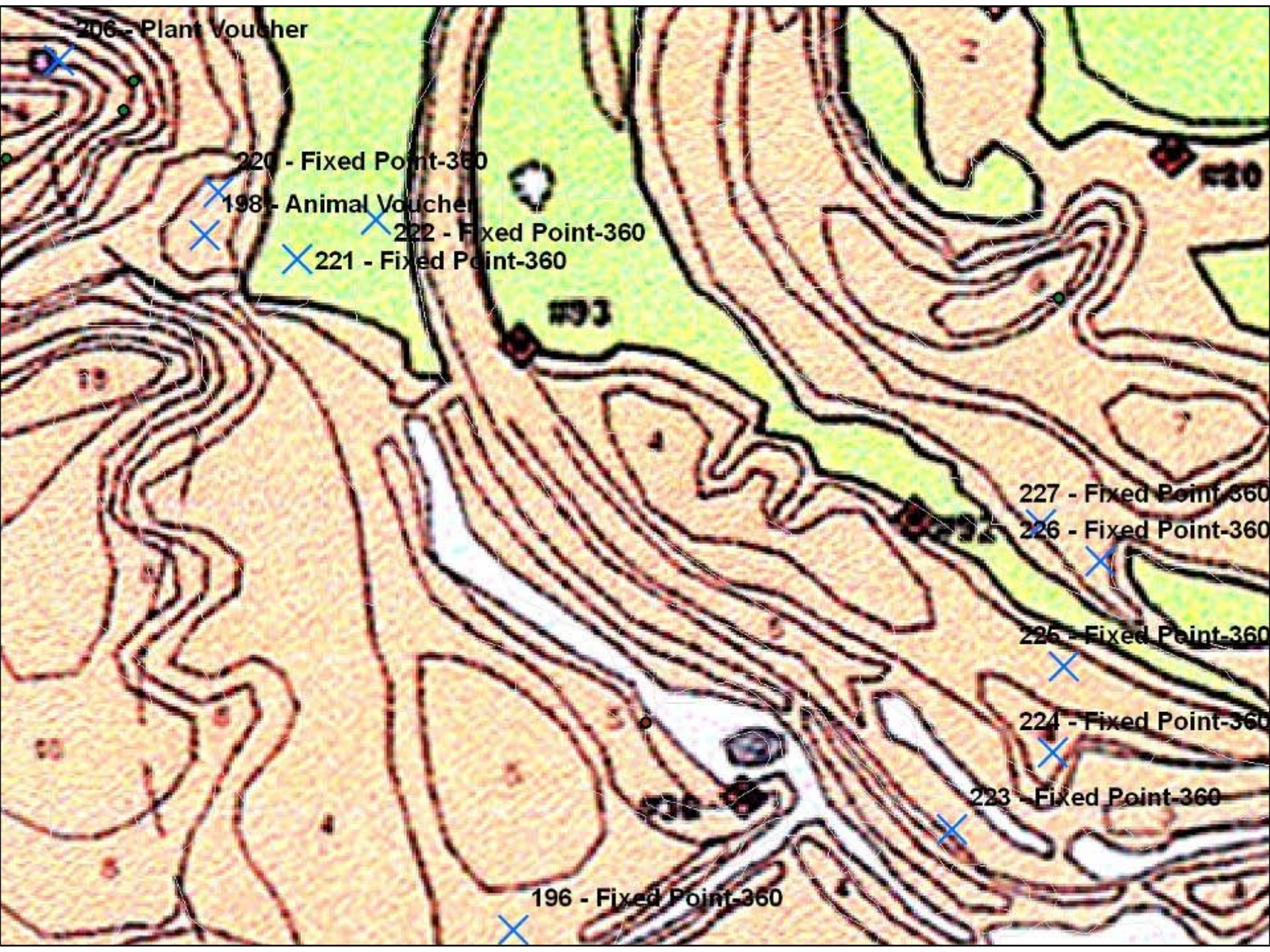
JOHN G. BÉRAULT - ARCHAEOLOGICAL AND HISTORICAL CONSERVANCY

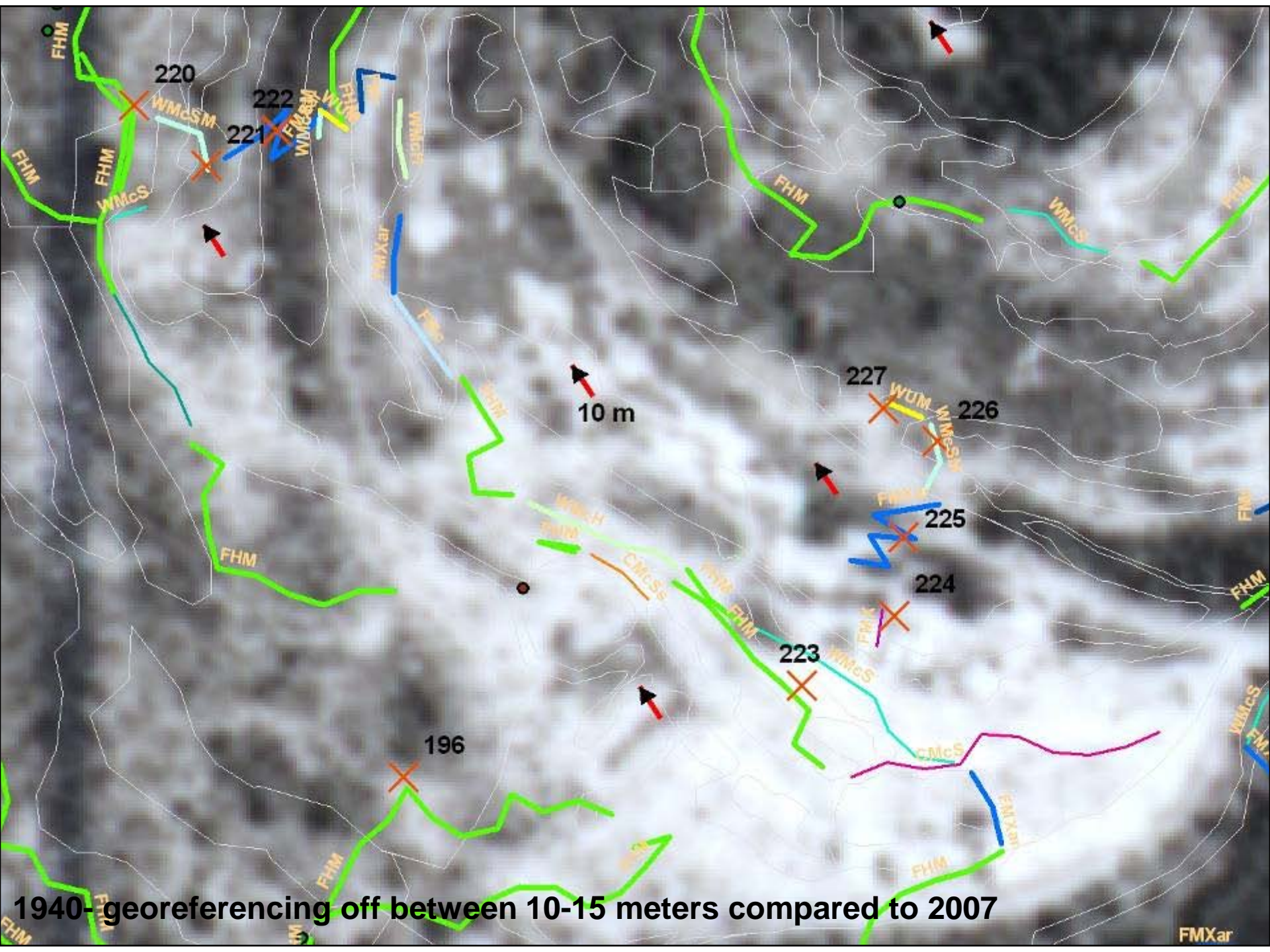
MAP NOT TO SCALE

Figure O. Map of Dismal Key, 8CR27. Map shows approximate positions of GPS readings taken.

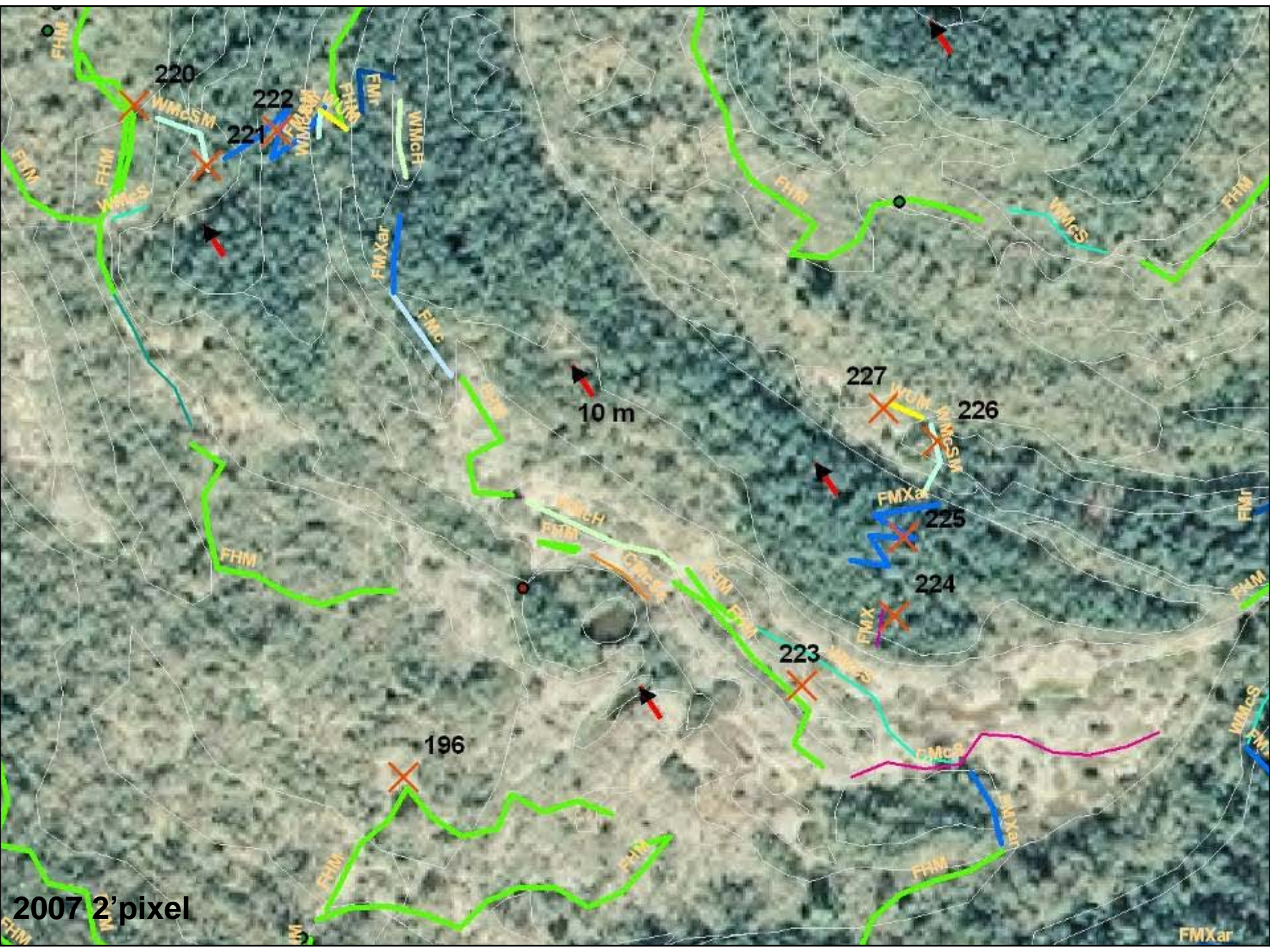
CONTOURS IN 2 FOOT INTERVALS

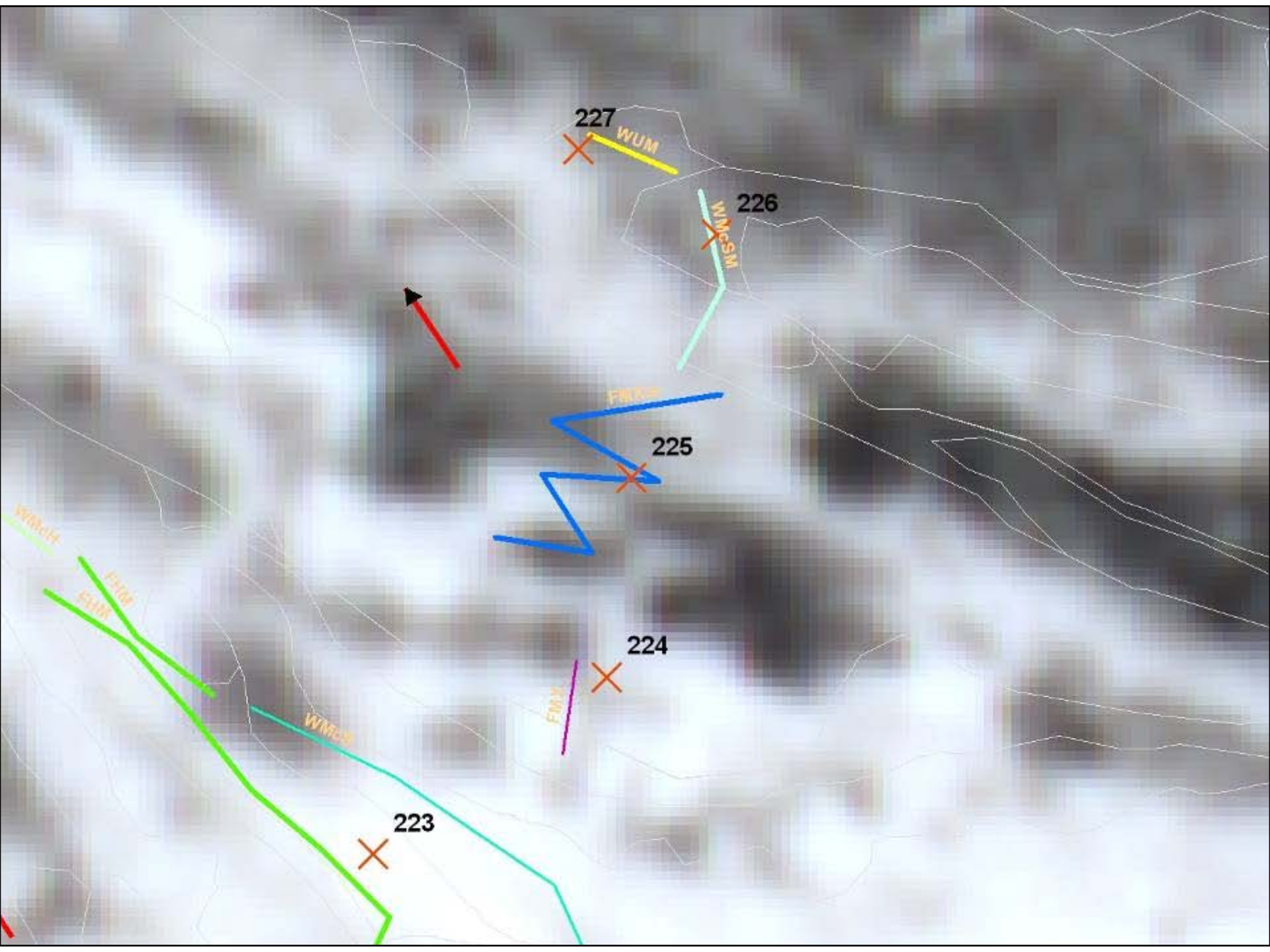






1940-georeferencing off between 10-15 meters compared to 2007







227

WUM

226

WMcSM

FMXar

225

224

FMX

WMcS

223

FMXar

FMX













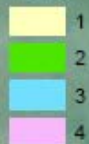
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Ten Thousand Islands
National Wildlife Refuge
Vegetation Zones

TTI_VEG_TYPES

ZONE



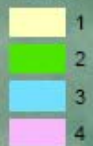
4 Outer Islands

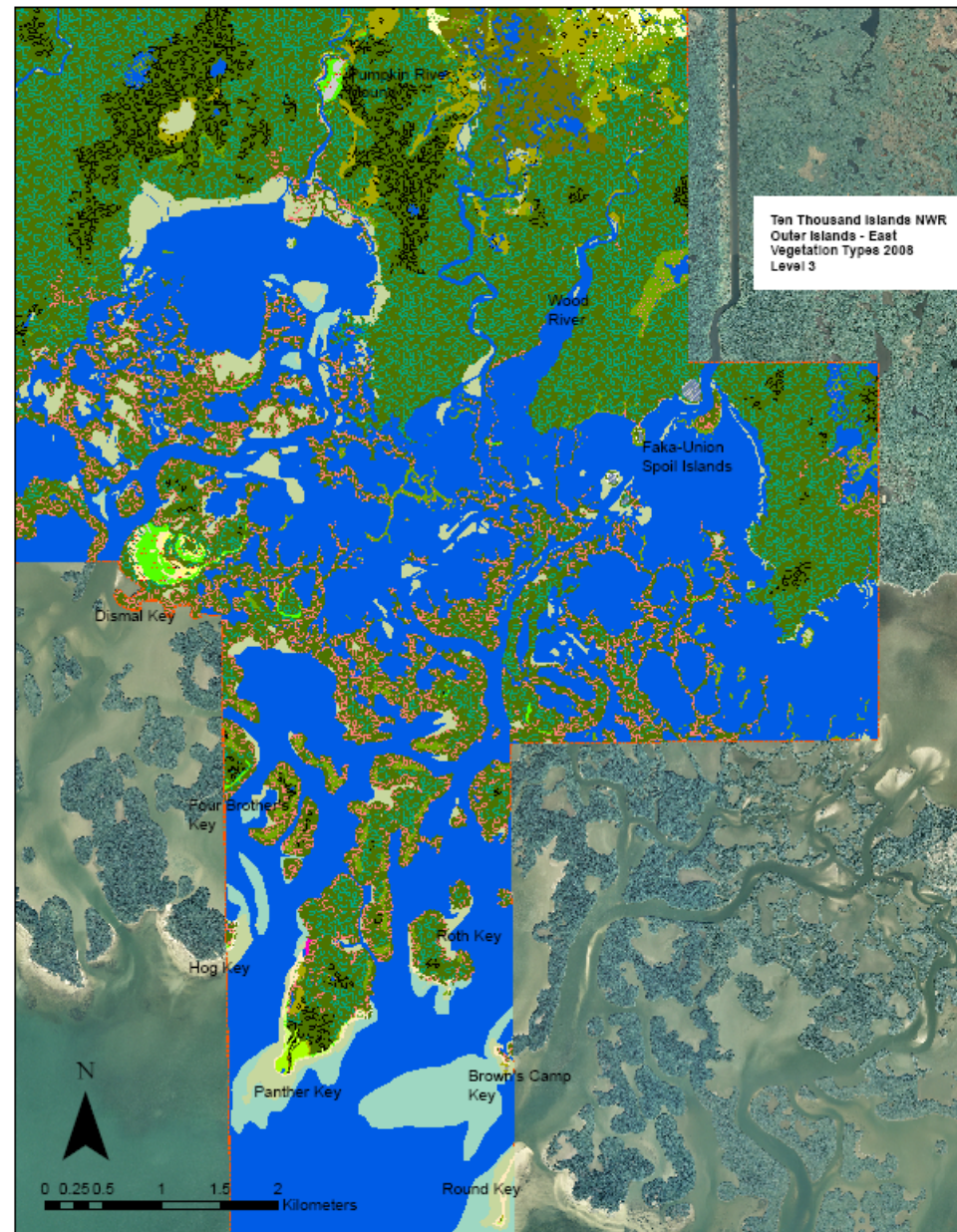
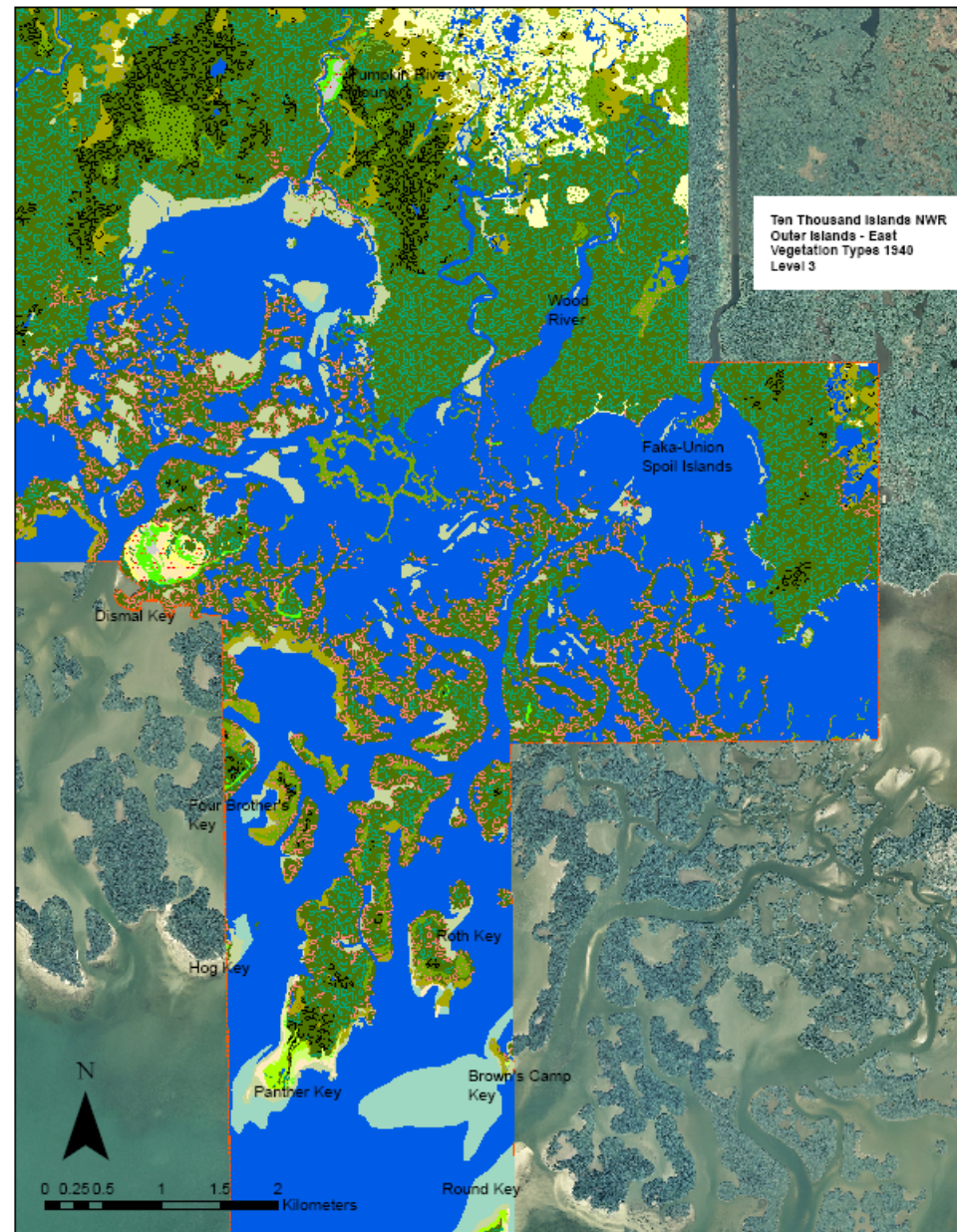
- Storm Erosion
- Sedimentation
- Sea Level Rise

Ten Thousand Islands
National Wildlife Refuge
Vegetation Zones

TTI_VEG_TYPES

ZONE





Ten Thousand Islands NWR
Outer Islands - West
Vegetation Types 1940
Level 3

CR 92

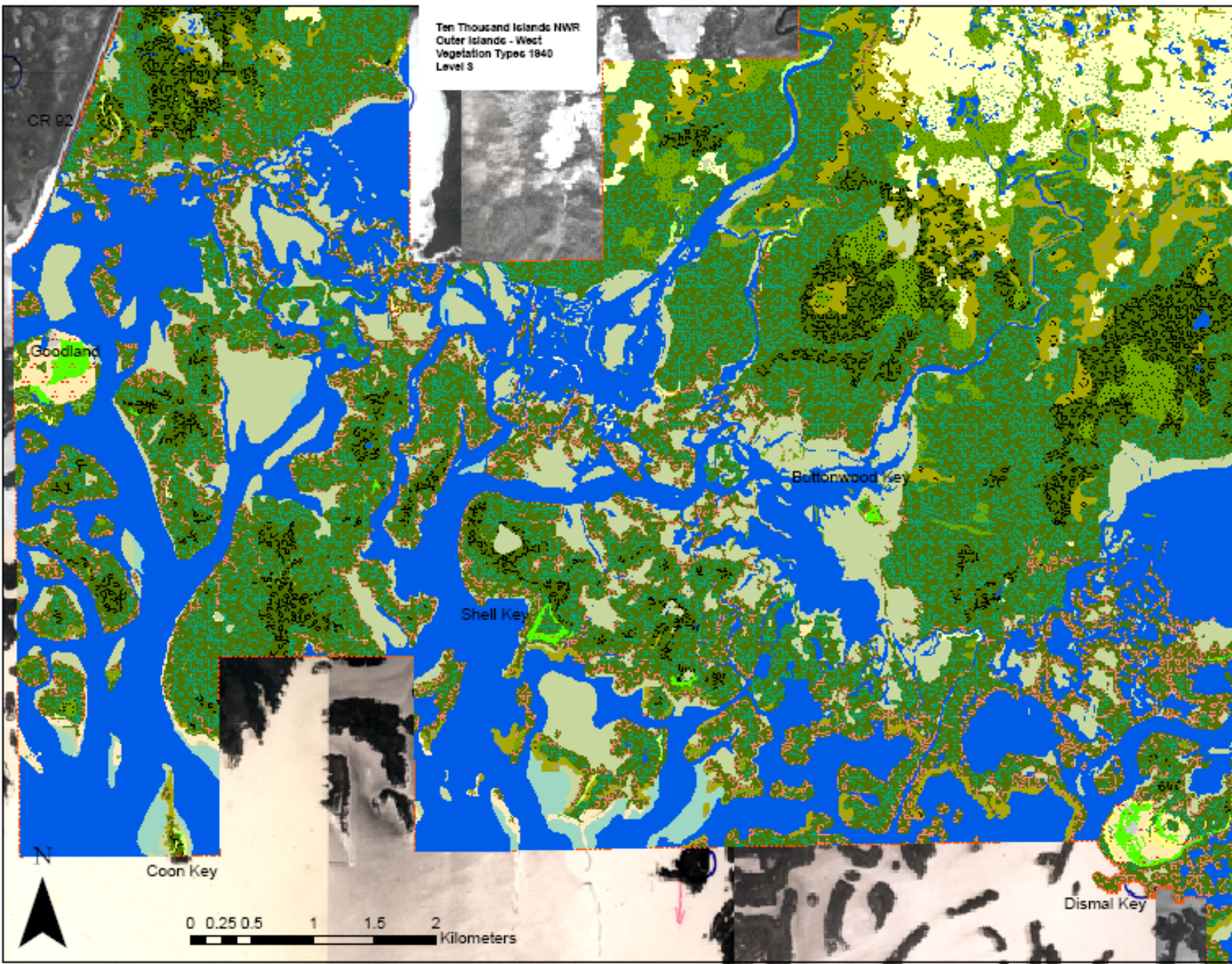
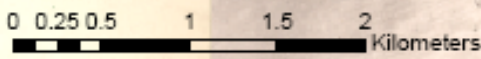
Goodland

Buttonwood Key

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Ten Thousand Islands NWR
Outer Islands - West
Vegetation Types 2008
Level 3

CR 92

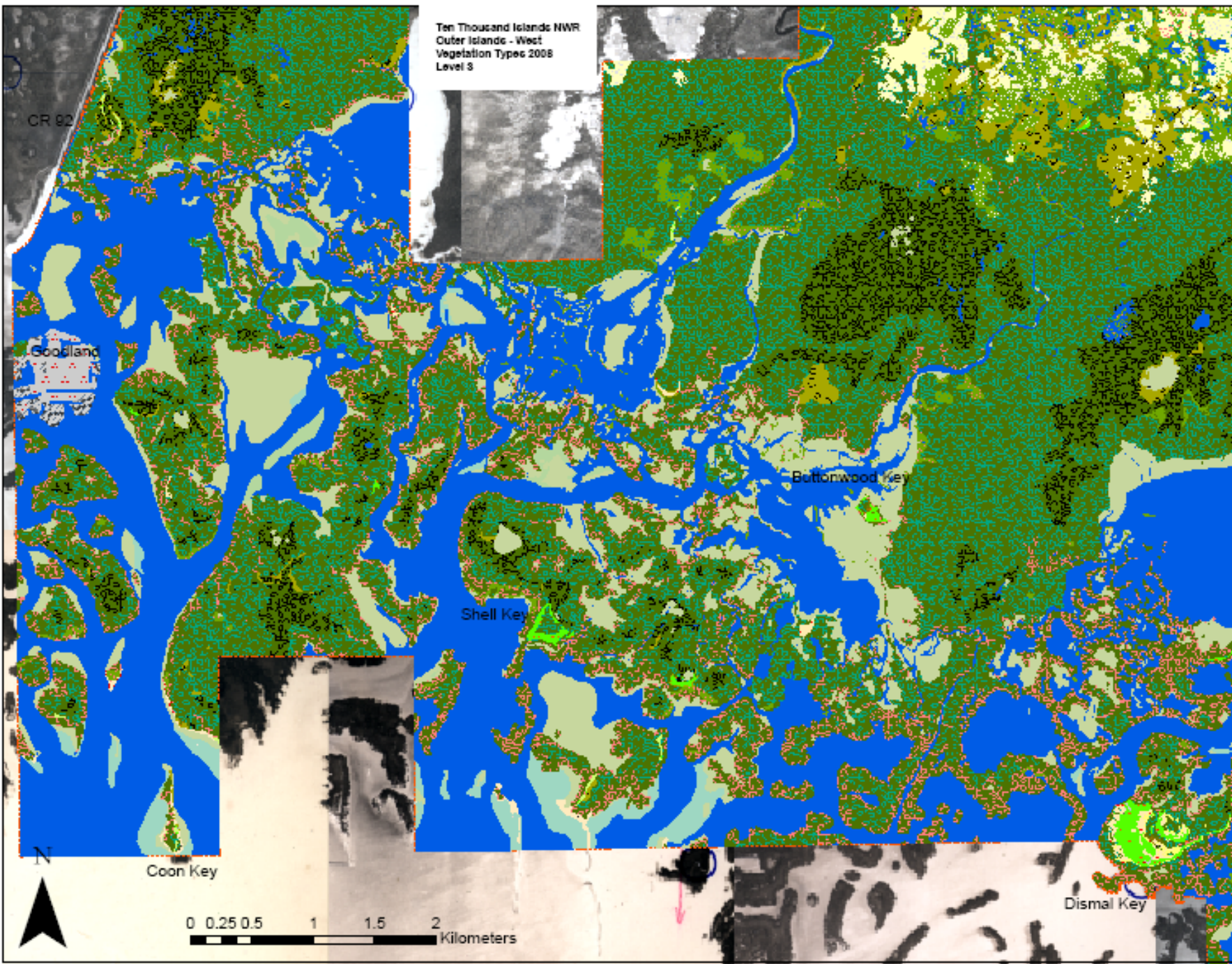
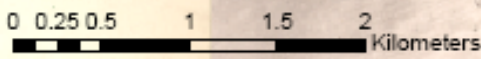
Goodland

Buttonwood Key

Shell Key

Coon Key

Dismal Key



Zone 4 1940 to 2007: (1012 acres, 884 acres excluding OW)

- FM, SM, WM 436 to 416 acres
- FM, SM, WM to OW 29 acres
- OW to Fm, SM, WM 9 acres
- FHC, WU_h 36 acres to 20 acres
- FHC, WU_h to OW 15 acres
- Mangrove w/new shell berm and Beaches 36 acres to 32 acres, but shifted inland
- DG, CUW 0.6 to 3.7 (difficult to discern in 1940 or recent addition?)

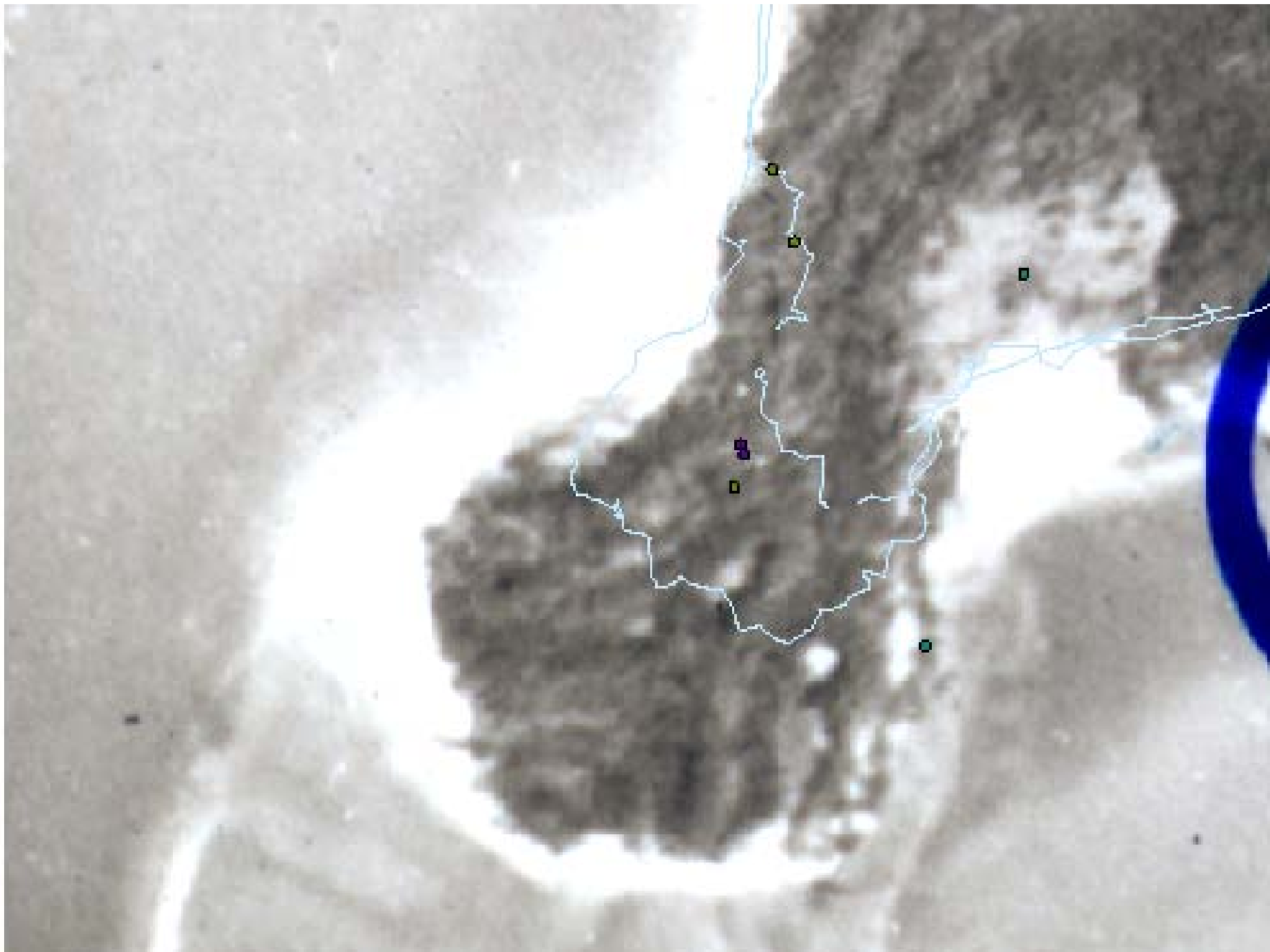


Panther Key
1940-2007

0 50 100 200 300 400
Meters

field_survey_tracklog



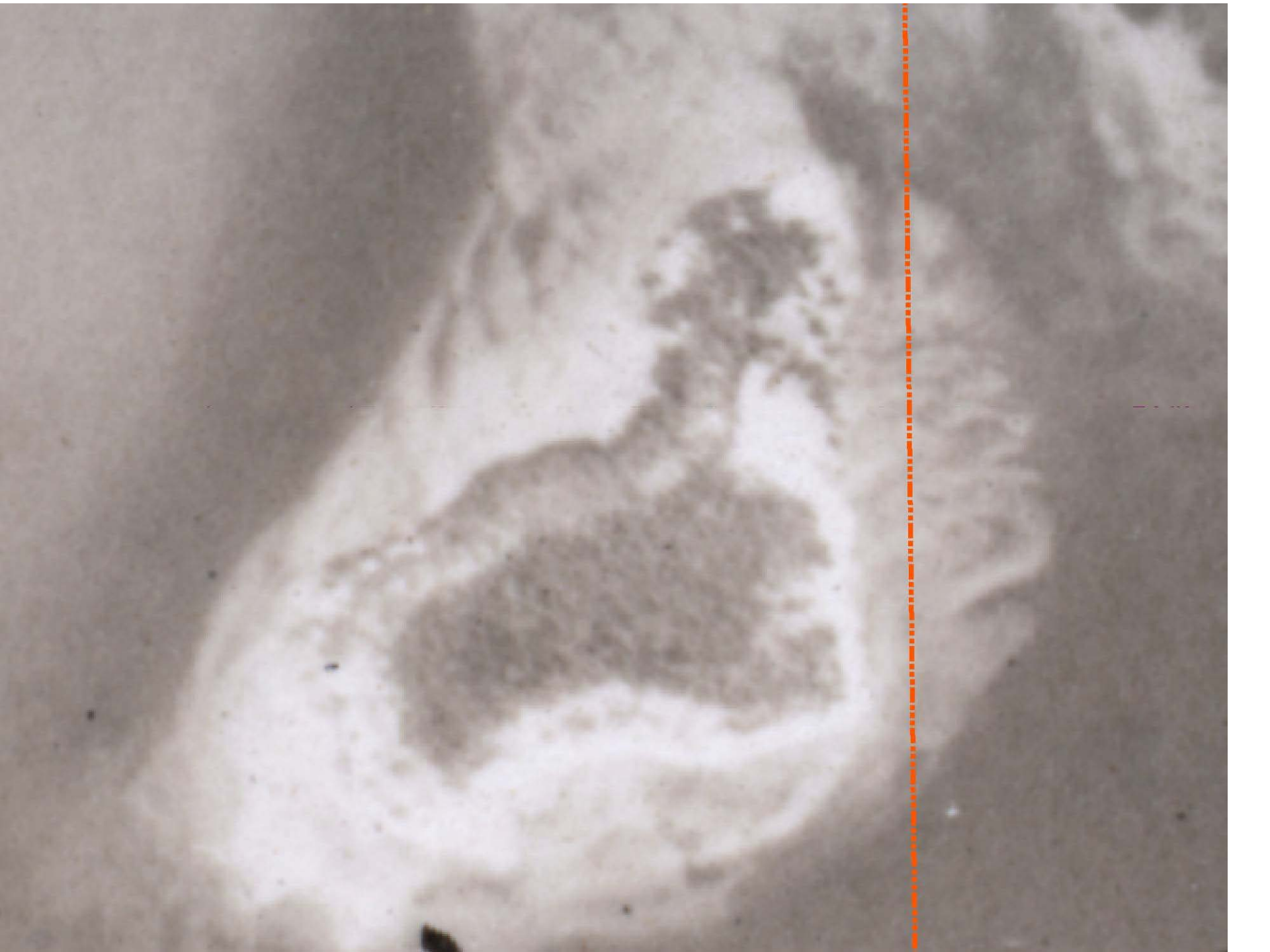


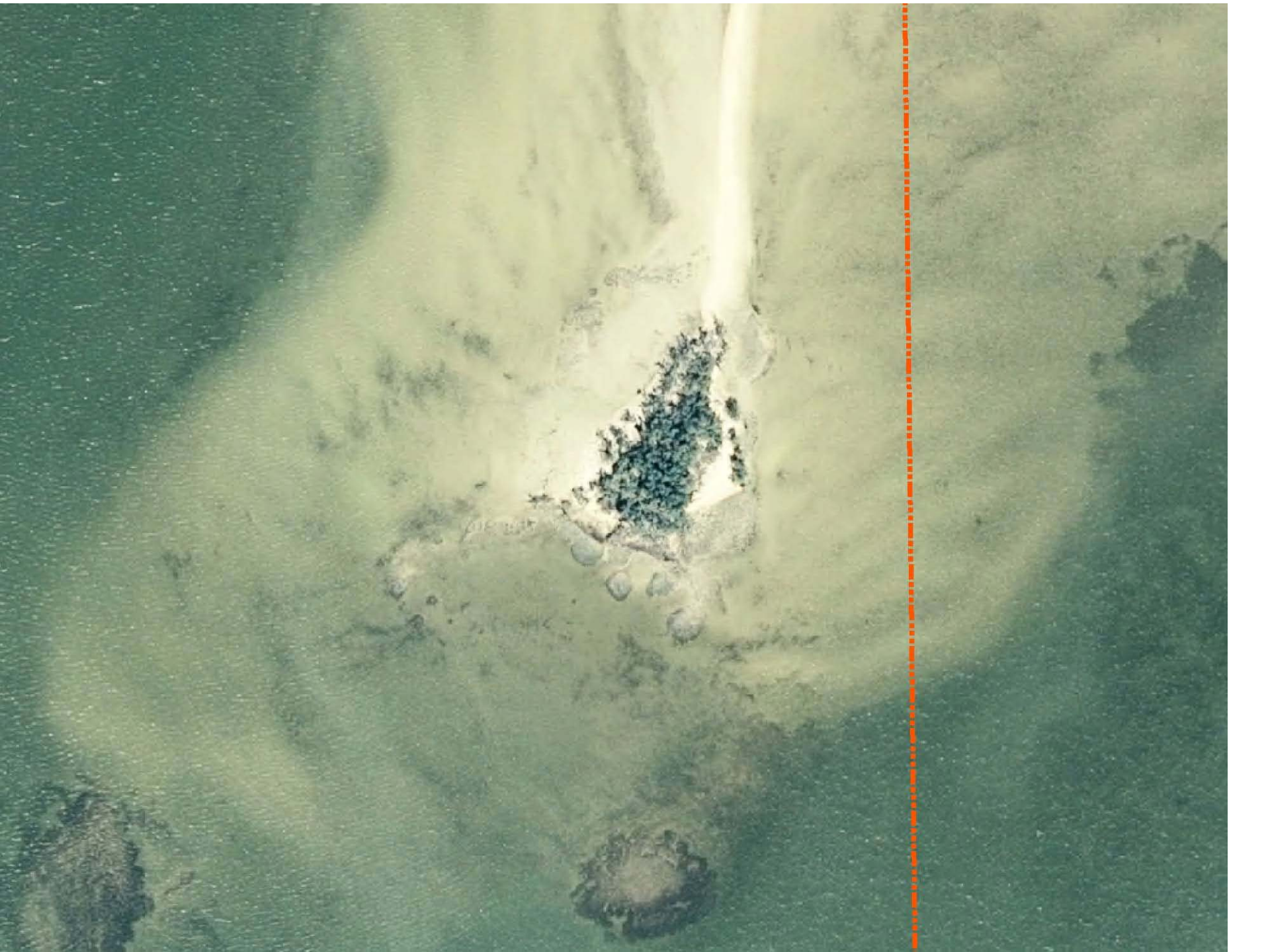












Thoughts on the future...

- Everything based on climate modeling is a guess... based on the data we have to work with!
- Thinking longer term... where will organisms move/shift?
- SLR and precipitation patterns?
- How can our actions now facilitate maintenance of biodiversity/ prevent loss of biodiversity?
- Rates of changes in the climate, effects on the ecosystem....
- Fragmentation, degradation and reduction in abundance of natives by invasive exotics already threaten biodiversity, a rapidly changing climate is an added challenge... but it makes our work even more important!



BEACHFRONT
HOMESITES
Preferred
JERRY ROBINSON
REAL ESTATE
1239 17-3300

CONCLUSION:

Changes in vegetation observed from 1940 to 2007 suggest (no statistical tests) parcels like this one on Cape Romano may not be a good long-term investment for your grandchildren!