KINGS BAY VEGETATION MAPPING AND EVALUATION

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
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FINAL REPORT
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BACKGROUND

The influence of submersed plants in Kings Bay spans its ecology from water clarity to wildlife. For example, the opportunity to dive using SCUBA and observe West Indian manatees (*Trichechus manatus*) represents one of the principal attractions in Kings Bay (Buckingham 1989). Manatees use the bay primarily as a thermal refuge in the winter, but they also feed on submersed aquatic vegetation (Hauxwell et al. 2004a, b). Furthermore, recent research implicates reduced coverage of rooted aquatic macrophytes as the predominant factor contributing to diminished water clarity in this system (Hoyer et al. 2001). In fact, the distributions and abundances of native macrophytes, especially *Vallisneria americana*, have decreased noticeably in recent years, with invasive plant and algal species, e.g., *Myriophyllum spicatum* and *Lyngbya* spp., becoming more prevalent (Frazer and Hale 2001; Hauxwell et al. 2003; Notestein et al. 2005, 2006; Jacoby et al. 2007).

The distribution of submersed aquatic vegetation (SAV) within the bay is thought to reflect a complex interaction of physical, chemical and biological factors. For example, short-term and long-term variations in salinity regimes; variable nutrient loads to the system; variation in water clarity and light transmission; the introduction of non-native plants, e.g., *Hydrilla verticillata* and *Myriophyllum spicatum*; and grazing from manatees potentially influence the appearance and function of the SAV assemblage (Hauxwell et al. 2004a, b; Jacoby et al. 2007).

Water quality and quantity interact with several of the factors affecting SAV by altering light penetration, salinity regimes, residence times, loading rates and other hydrologic processes. Thus, coupling spatial and temporal patterns in SAV abundance with data related to water chemistry, salinity fluctuations and other variables represents an important task for the Southwest Florida Water Management District. ***This project provides an evaluation of vegetation for the Kings Bay–Crystal River system that compares to one conducted in 2004, 2005 and 2006 (Jacoby et al. 2007)***. This final report and the accompanying databases document results from October 2010 through November 2013.

METHODS

Study system

Kings Bay is a tidally influenced, spring-fed system located near the City of Crystal River in Citrus County on the west coast of peninsular Florida (approximate coordinates 28° 53.3' N and -82° 35.9' W). The bay comprises approximately 1.75 km^2 of water from 1 m to 3 m deep (Haller et al. 1983; Hammett et al. 1996; Bachmann et al. 2001). Numerous springs supply groundwater to the bay, with the total discharge averaging 27.6 $m^3 s^{-1}$ (Yobbi and Knochenmus 1989). Kings Bay forms the headwaters of the Crystal River, which flows westward for approximately 10 km to the Gulf of Mexico.

Field sampling and laboratory processing

Sampling was conducted at 71 previously established stations (Frazer and Hale 2001; Figure 1; Appendix A). At each station, divers sampled three, haphazardly placed, replicate quadrats. In each quadrat, they visually estimated total percent cover of all plants and percent cover for different taxa. Previous sampling yielded data for eleven types of vegetation: filamentous algae (including *Lyngbya* spp.)[1], *Ceratophyllum demersum*, *Chara* sp., *Hydrilla verticillata*, *Myriophyllum spicatum*, *Najas guadalupensis*, *Potamogeton pectinatus*, *Potamogeton pusillus*, *Ruppia maritima*, *Vallisneria americana*, and *Zannichellia palustris*. After making these estimates, the divers removed all aboveground

[1] Filamentous algae often appeared to be a single species, but samples collected in February 2004 revealed multiple species in the entangled mats (Notestein et al. 2005). Therefore, only attached macroalgae in the genus *Chara* were identified separately. *Lyngbya* spp. consistently comprised a major component of filamentous algae.

plant biomass and placed it into a uniquely labeled plastic bag. Bags were transported to the University of Florida for processing.

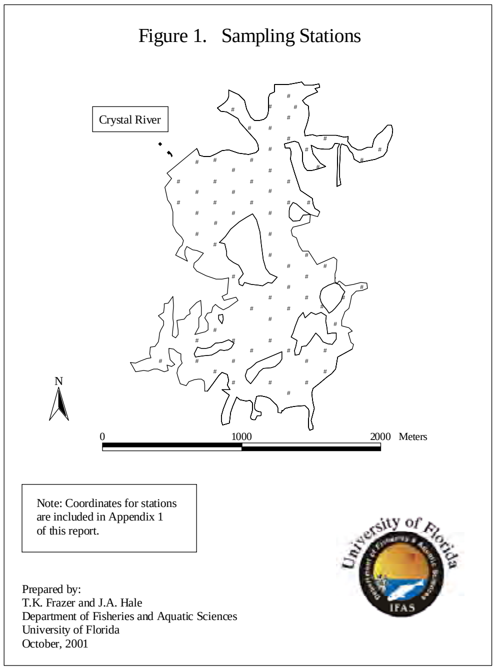

Figure 1. An illustration of the 71 sampling stations previously established in Kings Bay.

In the laboratory, samples from each quadrat were rinsed in fresh water and sorted into taxonomic categories. Samples for each category were dried at 70 °C to a constant weight. These dry weights, recorded to the nearest 0.001 g, represented a quantitative measure of biomass.[2]

Percent cover and biomass provide complementary views of submersed aquatic vegetation. Percent cover data elucidate the distribution of plants and algae and provide a quantitative measure of abundance based on the amount of "space" occupied. Space was considered three-dimensional because quadrats typically contained multiple layers of plants and algae. Due to layering, the coverage of plants, algae, and bare substratum (the area without vegetation) can sum to more than 100%, but values reported here are scaled to 100%. Biomass, expressed as kilograms dry weight per square meter (kg DW m^{-2}), provides additional data on the distribution of plants and algae and yields a quantitative measure of abundance as standing crop, which indicates the amount of carbon, nutrients and other resources sequestered in the tissues of plants and algae.

Production of maps

Maps of percent cover and biomass were created in ArcGIS Desktop v.10.1 (ESRI 2012) using Transverse Mercator projection and the North American 1983 HARN Geographic Coordinate System (Appendices C and D). To be consistent with Frazer and Hale (2001) and Jacoby et al. (2007), interpolations were based on Inverse Distance Weighting (IDW). Interpolations for composite categories and taxa were based on means of data from each of the 71 sampling stations.

Estimated values were interpolated into a grid using the ESRI ArcMap v.10.1 IDW algorithm (Geostatistical Wizard). Key parameters were:

- power = 3
- neighborhood search or neighbors included = 5 (include at least 5 neighboring values)
- searching ellipse angle = 0
- radii of semimajor and semiminor axes = 400
- sector mode = 0

The resulting grid was converted to a shapefile containing polygons. Each polygon represented either:

i) one of five Braun–Blanquet percent cover classes (< 5%, 5–25%, 25–50%, 50–75% or > 75%; Braun–Blanquet 1965)

ii) one of five biomass classes (0.000–0.001, 0.001–0.010, 0.010–0.100, 0.100–1.000 or 1.000–10.000 kg dry weight m^{-2})

RESULTS

Sampling from October 2010 through August 2013 yielded 852 SAV samples. Submersed aquatic vegetation was found at all stations in at least one quarter. Eleven types of vegetation were recorded: i.e., filamentous algae (including *Lyngbya* spp.), *Ceratophyllum demersum*, *Chara* sp., *Hydrilla verticillata*, *Myriophyllum spicatum*, *Najas guadalupensis*, *Potamogeton pectinatus*,

[2] For most taxa, dry weights can be converted to wet weights using ratios that were determined in 2004 (Appendix B).

Potamogeton pusillus, *Ruppia maritima*, *Vallisneria americana*, and *Zannichellia palustris*. These data supported preparation of interpolated maps based on mean values (Appendices C and D).

Across the samples, percentage cover for all SAV combined ranged from 0.0 to 100.0%, with an overall mean and standard error (SE) of 33.15 ± 0.07% (Table 1). Mean percentage cover of more than 1% was recorded for filamentous algae, *Najas guadalupensis*, *Myriophyllum spicatum*, *Zannichelia palustris*, *Vallisneria americana*, *Chara* sp., and *Potamogeton pusillus*. In comparison to a previous report covering February 2004 through October 2006 (Jacoby et al. 2007), mean percentage cover of all common SAV decreased from 61.47% to 33.15%. Mean percentage cover of filamentous algae decreased from 22.80% to 18.01%, and mean percentage cover of *Vallisneria americana* decreased from 3.63% to 1.67%, which represented a loss of about half of the cover recorded in 2004–2006. Minor increases in mean percentage cover were recorded for *Najas guadalupensis*, *Potamogeton pectinatus*, and *Zannichellia palustris*.

The overall mean biomass for all SAV combined ± SE was 0.046 ± 0.004 kg DW m^{-2} (Table 1). Mean biomass ± SE for the seven taxa covering on average 1% or more of the bottom ranged from 0.00015 ± 0.00002 kg DW m^{-2} for *Potamogeton pusillus* to 0.0334 ± 0.004 kg DW m^{-2} for filamentous algae (Table 1). The mean biomass of filamentous algae decreased by 0.084 kg DW m^{-2} from the value reported previously (Jacoby et al. 2007). The mean biomass of *Vallisneria americana* decreased by 0.002 kg DW m^{-2} from values recorded between February 2004 and October 2006 (Jacoby et al. 2007).

Table 1. Summary statistics for percentage cover and biomass calculated from three replicate samples at each of 71 stations. Minimum cover and biomass were zero for all categories. SE = standard error

Category	Cover (%)			Biomass (kg dry weight m^{-2})		
	Maximum	Mean	SE	Maximum	Mean	SE
October 2010–August 2013						
All submersed aquatic vegetation	100.00	33.15	1.22	1.141867	0.045560	0.003931
Ceratophyllum demersum	21.67	0.55	0.07	0.009467	0.000127	0.000022
Chara sp.	96.67	1.67	0.26	0.337867	0.002692	0.000731
Filamentous algae	100.00	18.01	1.06	1.141867	0.033346	0.003714
Hydrilla verticillata	26.67	0.39	0.07	0.033521	0.000192	0.000051
Myriophyllum spicatum	93.33	4.34	0.32	0.118933	0.003704	0.000381
Najas guadalupensis	83.33	8.01	0.48	0.336000	0.003869	0.000532
Potamogeton pectinatus	43.00	0.85	0.13	0.035467	0.000276	0.000064
Potamogeton pusillus	30.00	1.04	0.10	0.012209	0.000152	0.000021
Ruppia maritima	8.33	0.01	0.01	0.002281	0.000003	0.000003
Vallisneria americana	63.33	1.70	0.21	0.074400	0.000862	0.000174
Zannichellia palustris	86.67	2.42	0.30	0.020056	0.000337	0.000054
February 2004–October 2006						
All submersed aquatic vegetation	100.00	61.47	1.63	1.228509	0.141993	0.012344
Ceratophyllum demersum	12.17	0.71	0.11	0.006306	0.000302	0.000051
Chara sp.	35.42	1.99	0.34	0.120597	0.003144	0.000767
Filamentous algae	100.00	40.81	1.98	1.227600	0.117212	0.012430
Hydrilla verticillata	62.33	5.62	0.66	0.115558	0.004936	0.000870
Myriophyllum spicatum	38.33	6.89	0.53	0.044771	0.005385	0.000557
Najas guadalupensis	45.09	7.78	0.64	0.057216	0.006244	0.000715
Potamogeton pectinatus	16.25	0.35	0.09	0.004918	0.000093	0.000031
Potamogeton pusillus	40.83	5.17	0.42	0.009304	0.000946	0.000107
Ruppia maritima	14.42	0.65	0.13	0.004345	0.000181	0.000041
Vallisneria americana	45.83	3.63	0.56	0.062273	0.003058	0.000557
Zannichellia palustris	26.09	2.22	0.32	0.007126	0.000492	0.000090

Discussion

Sampling from October 2010 through November 2013 documented percentage cover and biomass for eleven taxa of submersed aquatic vegetation across 71 stations in Kings Bay. The application of consistent methods means that these data and the resulting maps can be compared to data and maps from sampling in 2004, 2005 and 2006.

Initial comparisons suggest that vegetation in Kings Bay has changed. For example, on average, cover of the majority of taxa decreased relative to historical records, with the mean ± SE for percent cover of all submerged aquatic vegetation decreasing by over 25%. These changes represent a concern for managers of Kings Bay and its flora and fauna.

Acknowledgments

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APPENDIX A: COORDINATES FOR SAMPLING STATIONS

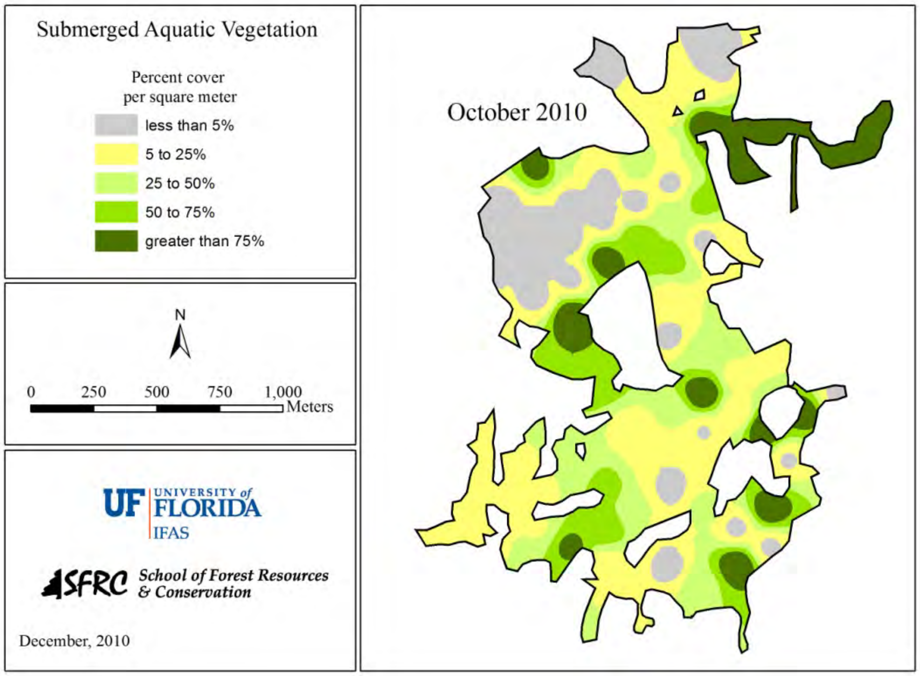
Station	Latitude	Longitude	Station	Latitude	Longitude
1	28.89814	-82.59752	54	28.89473	-82.59611
2	28.89677	-82.59749	55	28.89479	-82.59072
3	28.89540	-82.59747	56	28.89383	-82.60420
4	28.89543	-82.59478	57	28.89331	-82.60149
5	28.89396	-82.60284	58	28.89332	-82.59879
6	28.89399	-82.60015	59	28.89356	-82.59528
8	28.89409	-82.59206	60	28.89189	-82.60417
9	28.89256	-82.60553	61	28.89192	-82.60147
10	28.89259	-82.60282	62	28.89199	-82.59877
11	28.89262	-82.60013	63	28.89052	-82.60415
12	28.89265	-82.59743	64	28.89055	-82.60145
13	28.89119	-82.60551	65	28.89058	-82.59875
14	28.89122	-82.60280	66	28.88915	-82.60412
15	28.89125	-82.60011	67	28.88921	-82.59873
16	28.89128	-82.59741	68	28.88784	-82.59871
18	28.88985	-82.60275	69	28.88787	-82.59600
20	28.88848	-82.60276	70	28.88643	-82.60139
23	28.88717	-82.59735	71	28.88650	-82.59598
24	28.88720	-82.59465	73	28.88510	-82.59867
26	28.88580	-82.59733	74	28.88513	-82.59596
27	28.88586	-82.59193	75	28.88516	-82.59327
29	28.88439	-82.60000	78	28.88372	-82.59865
30	28.88443	-82.59731	79	28.88229	-82.60402
31	28.88457	-82.59483	80	28.88232	-82.60132
33	28.88299	-82.60268	81	28.88235	-82.59863
37	28.88165	-82.59996	83	28.88092	-82.60400
38	28.88168	-82.59726	84	28.88095	-82.60130
39	28.88171	-82.59457	85	28.88101	-82.59590
42	28.88025	-82.60263	86	28.87958	-82.60128
44	28.88034	-82.59455	87	28.87961	-82.59858
47	28.87894	-82.59722	88	28.87964	-82.59588
49	28.89723	-82.60159	90	28.88346	-82.59385
50	28.89744	-82.59886	93	28.89127	-82.59590
51	28.89744	-82.59698	101	28.89607	-82.60036
52	28.89607	-82.59884	102	28.88088	-82.60666
53	28.89470	-82.59882			

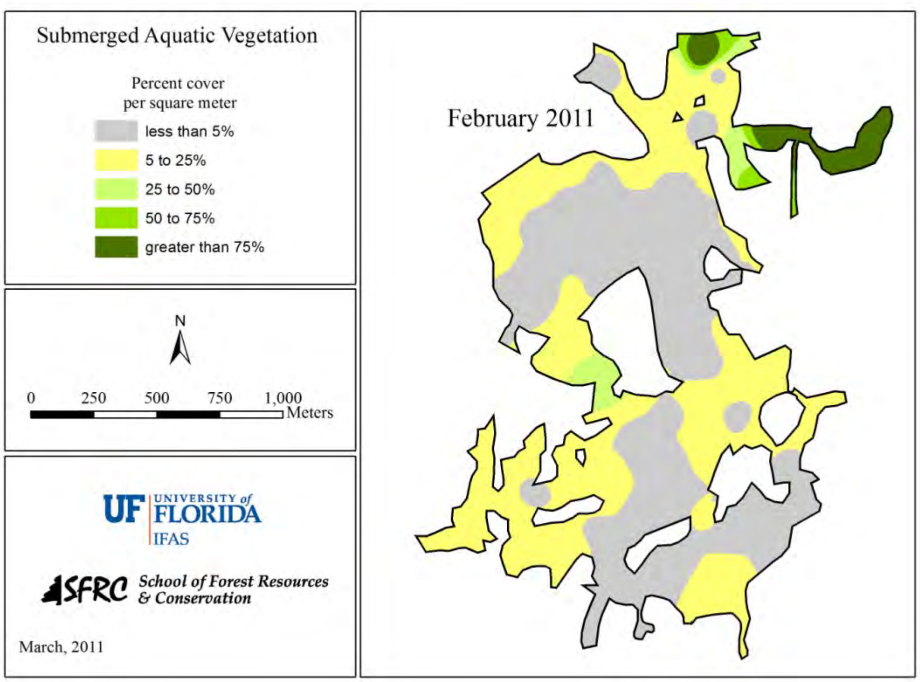
APPENDIX B: WET WEIGHT TO DRY WEIGHT RATIOS

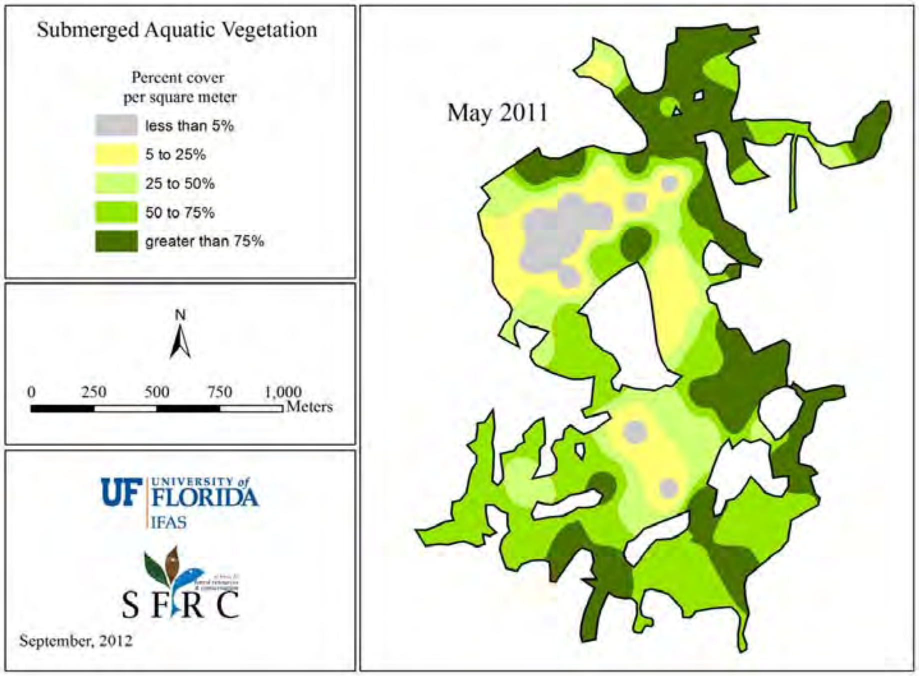
Category	Wet weight to dry weight ratio[1]			Number of samples
	Mean	95% confidence limit		
		Lower	Upper	
Submersed aquatic vegetation	10.74	10.51	10.97	1092
Ceratophyllum demersum	12.05	11.06	13.03	23
Chara sp.	7.70	7.14	8.26	49
Filamentous algae	6.58	6.27	6.90	281
Hydrilla verticillata	12.44	12.01	12.87	174
Myriophyllum spicatum	13.10	12.75	13.46	216
Najas guadalupensis	12.40	11.89	12.91	153
Potamogeton pectinatus	10.71	8.91	12.52	8
Potamogeton pusillus	10.58	10.24	10.91	120
Vallisneria americana	15.04	14.39	15.70	57

[1] Wet weights can be estimated by multiplying dry weights by the appropriate ratio. All ratios were determined from data collected in February and May 2004.

APPENDIX C: MAPS OF INTERPOLATED PERCENT COVER BASED ON BRAUN–BLANQUET CATEGORIES (BRAUN–BLANQUET 1965) AND INTERPOLATED BIOMASS






Submerged Aquatic Vegetation
Percent cover
per square meter
less than 5%
5 to 25%
25 to 50%
50 to 75%
greater than 75%
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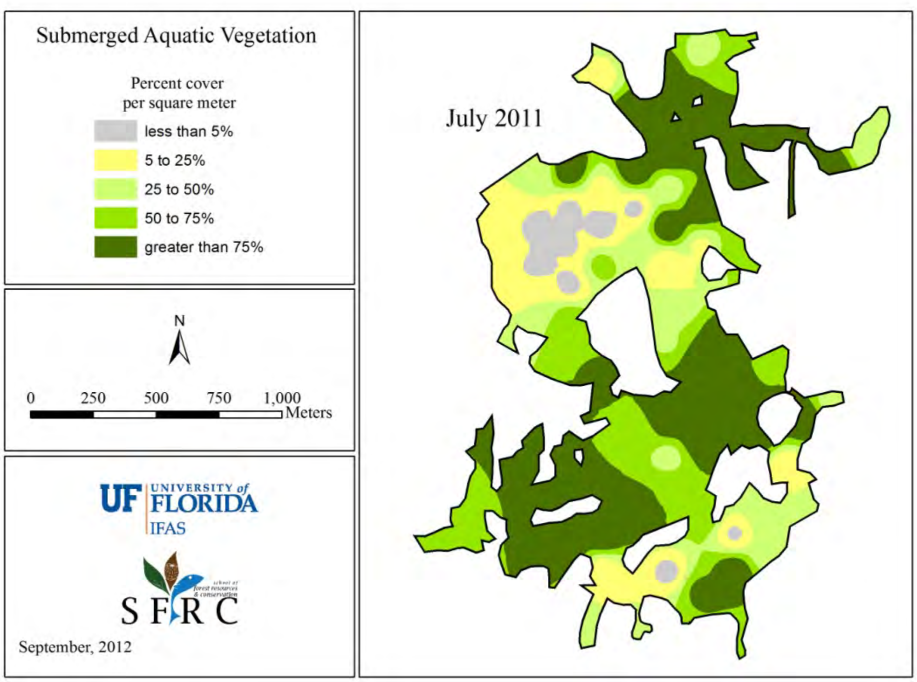
September, 2012
May 2011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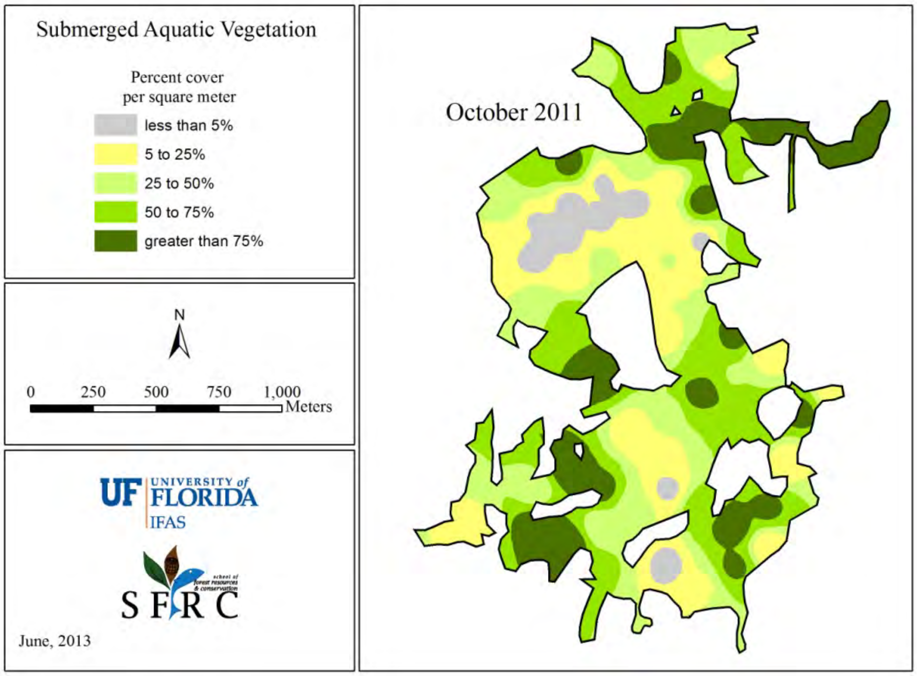
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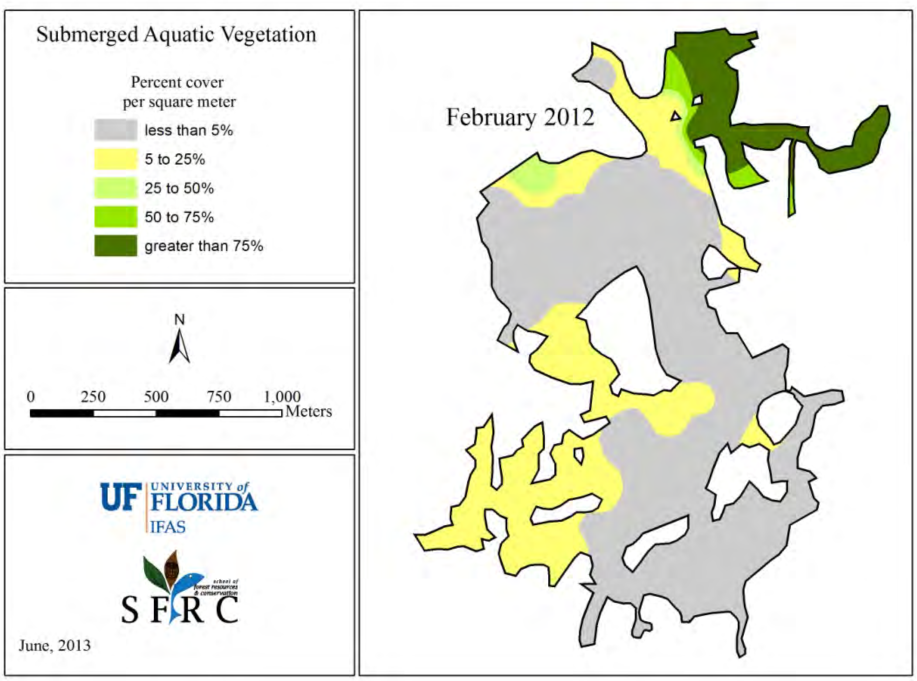
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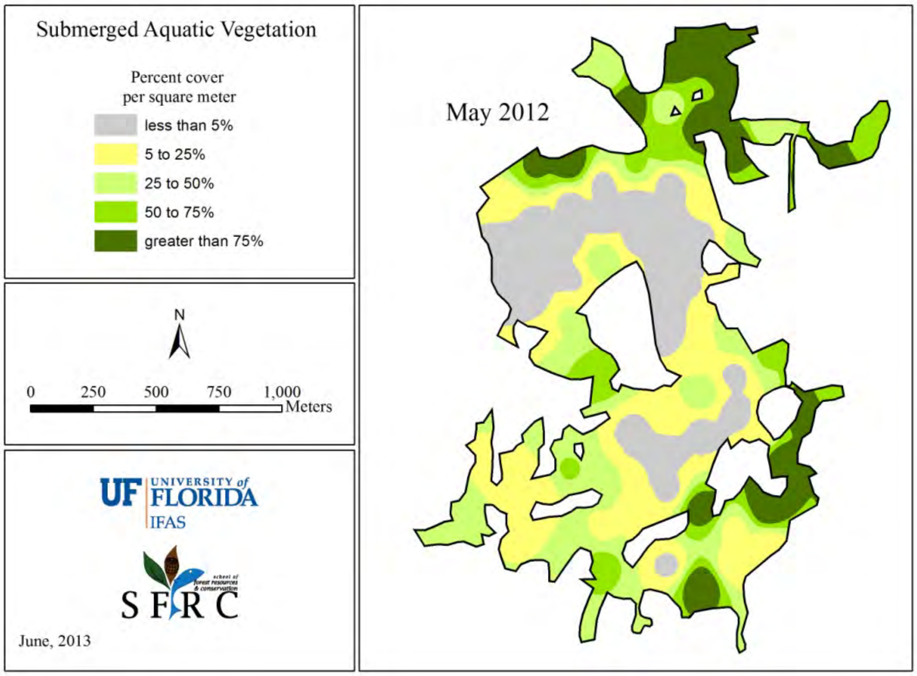
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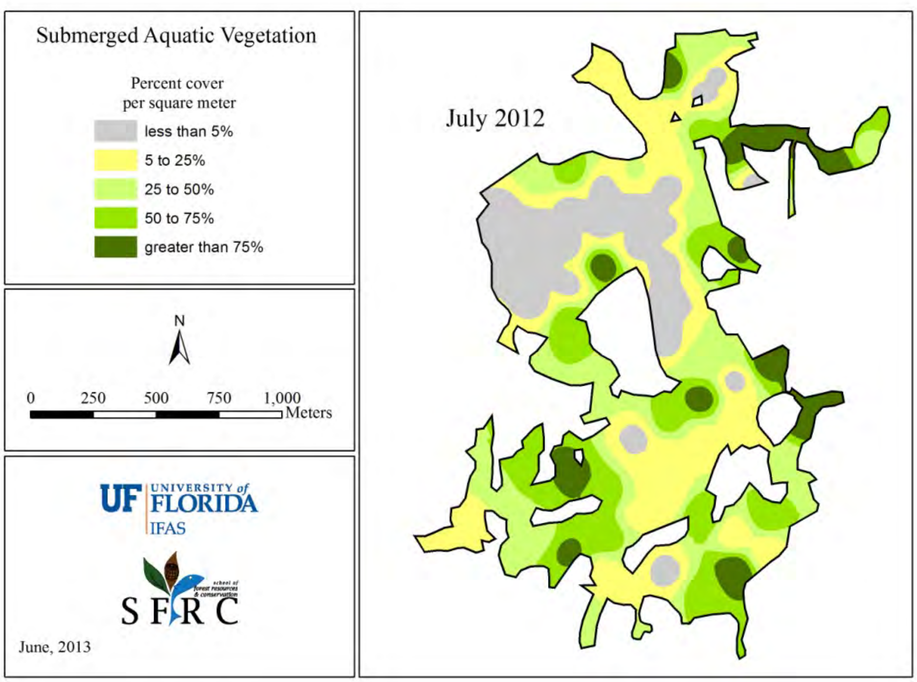
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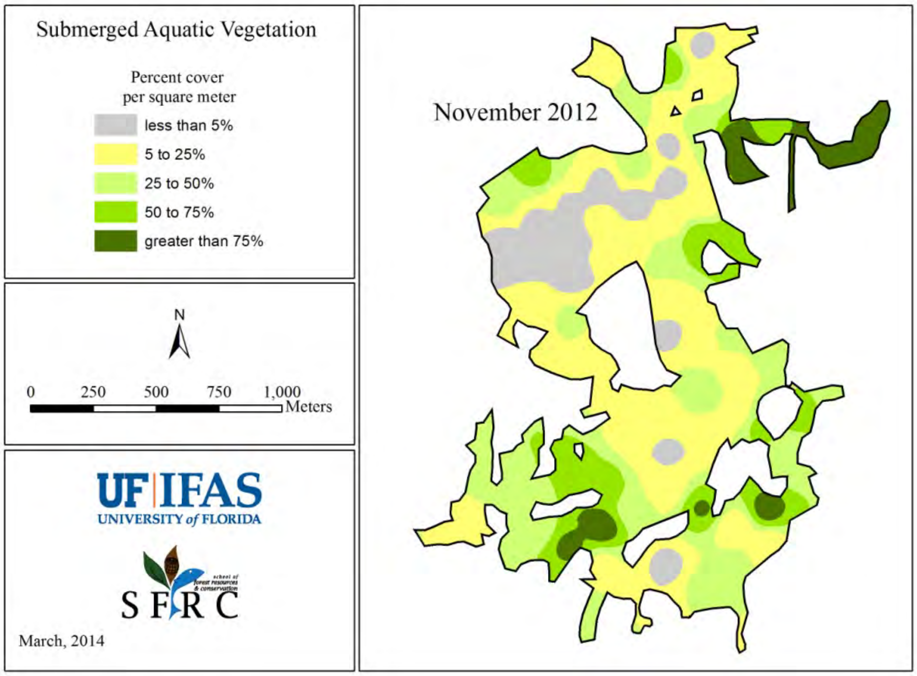
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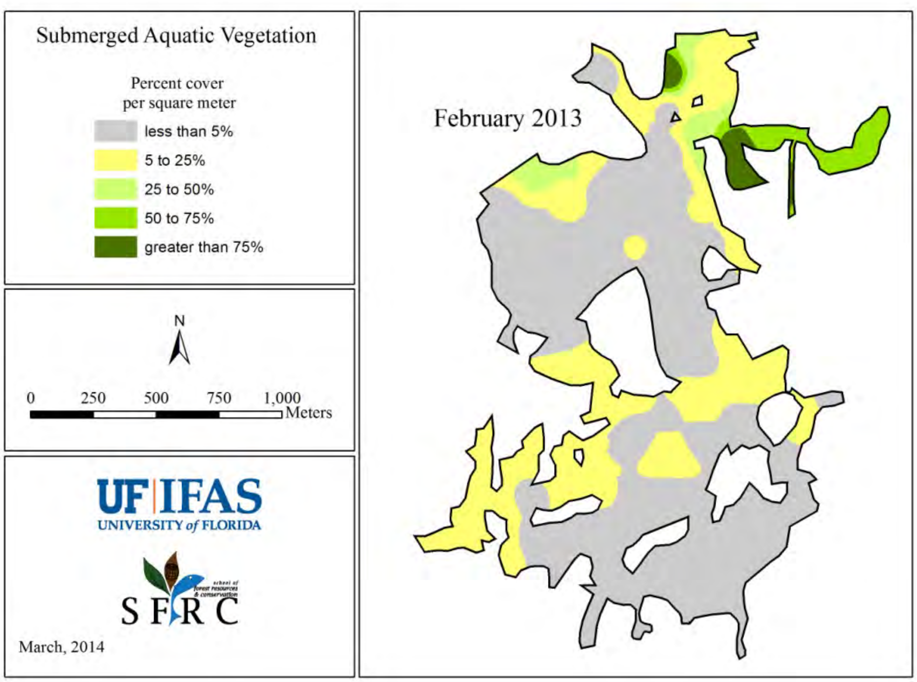
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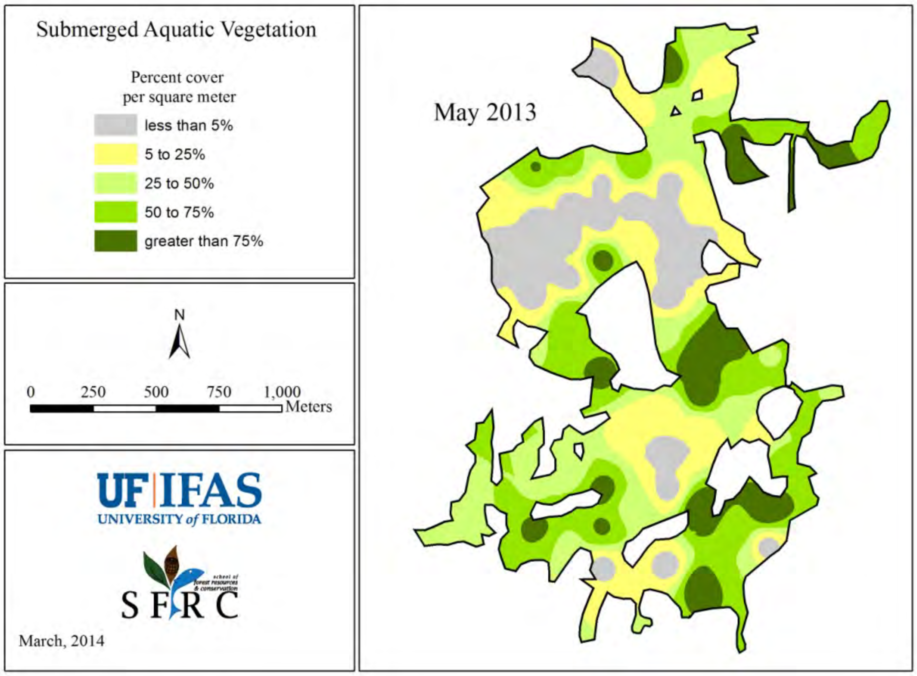
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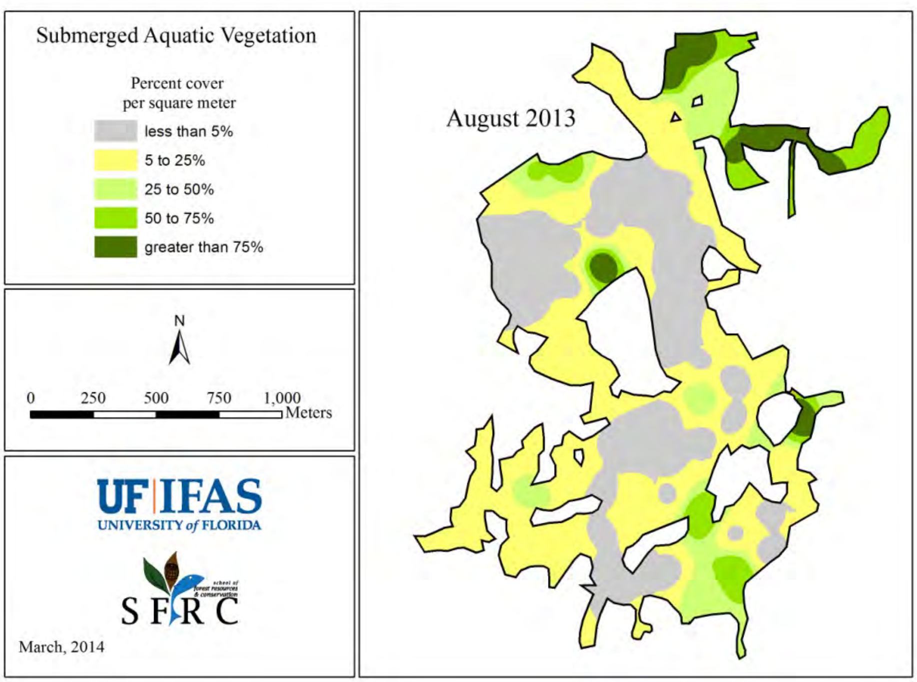
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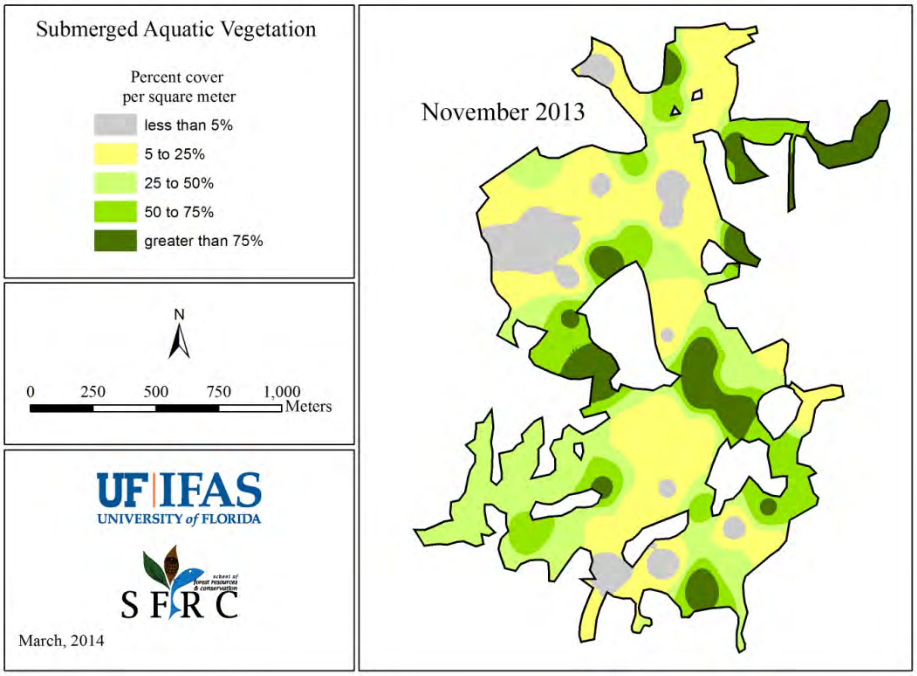
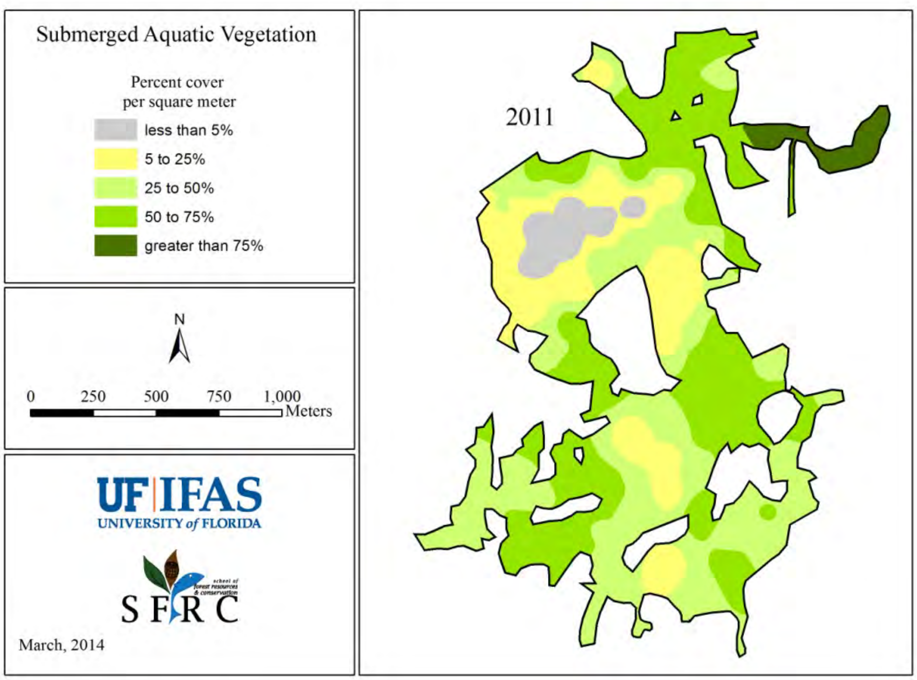
March, 2014
August 2013


Submerged Aquatic Vegetation
Percent cover
per square meter
less than 5%
5 to 25%
25 to 50%
50 to 75%
greater than 75%
N
0 250 500 750 1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
November 2013


Submerged Aquatic Vegetation
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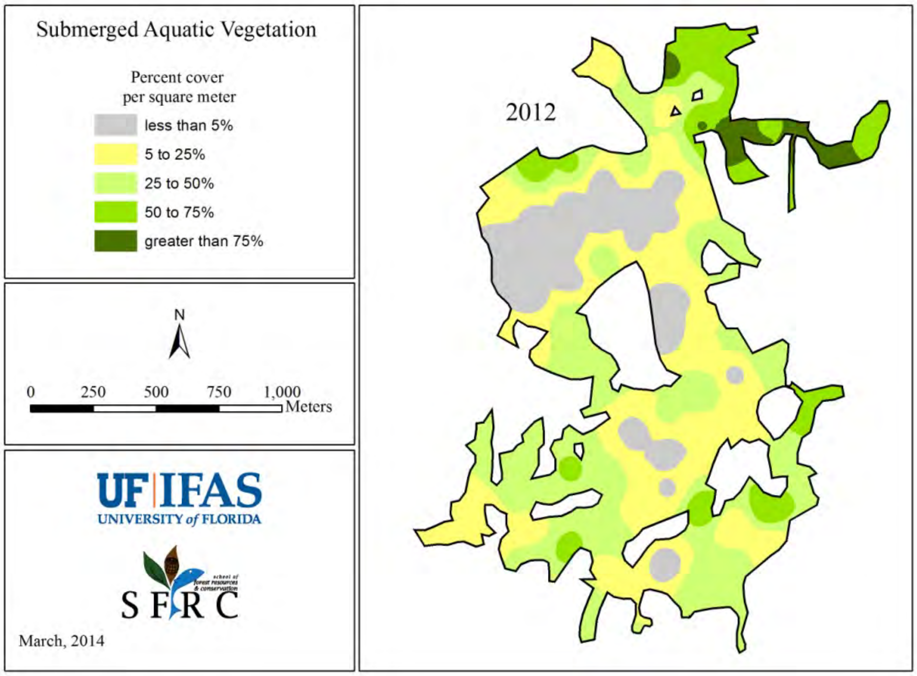
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2011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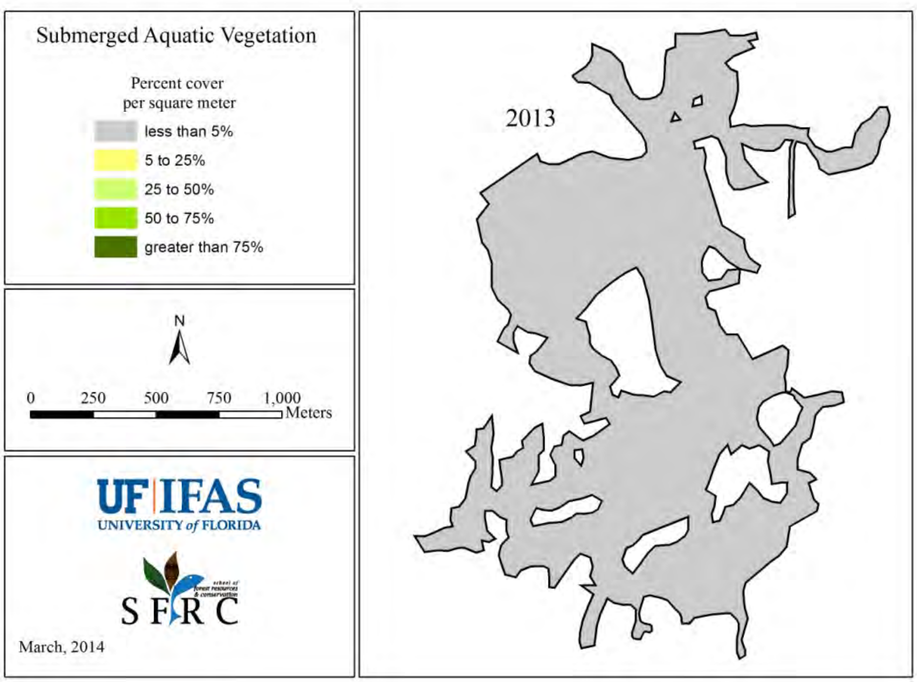
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2012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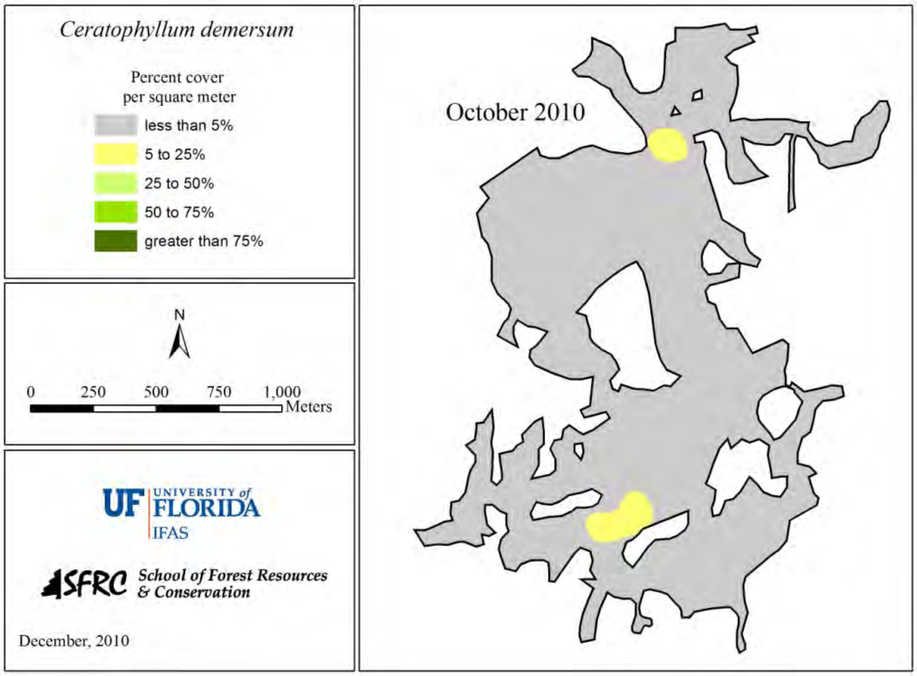
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2013


Ceratophyllum demersum
Percent cover
per square meter
less than 5%
5 to 25%
25 to 50%
50 to 75%
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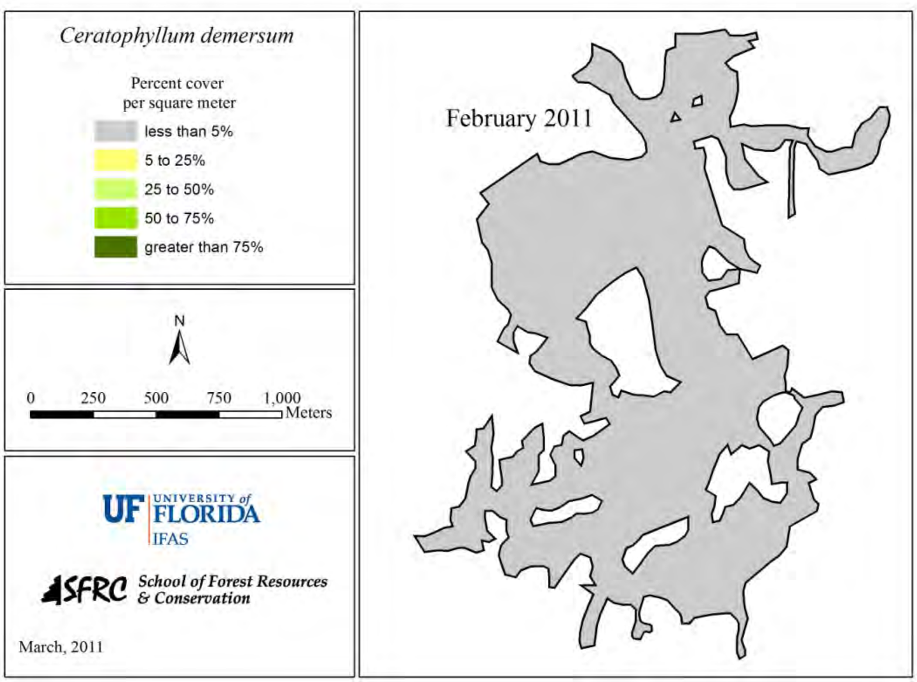
N
0 250 500 750 1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC School of Forest Resources & Conservation
December, 2010
October 2010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UF UNIVERSITY of FLORIDA
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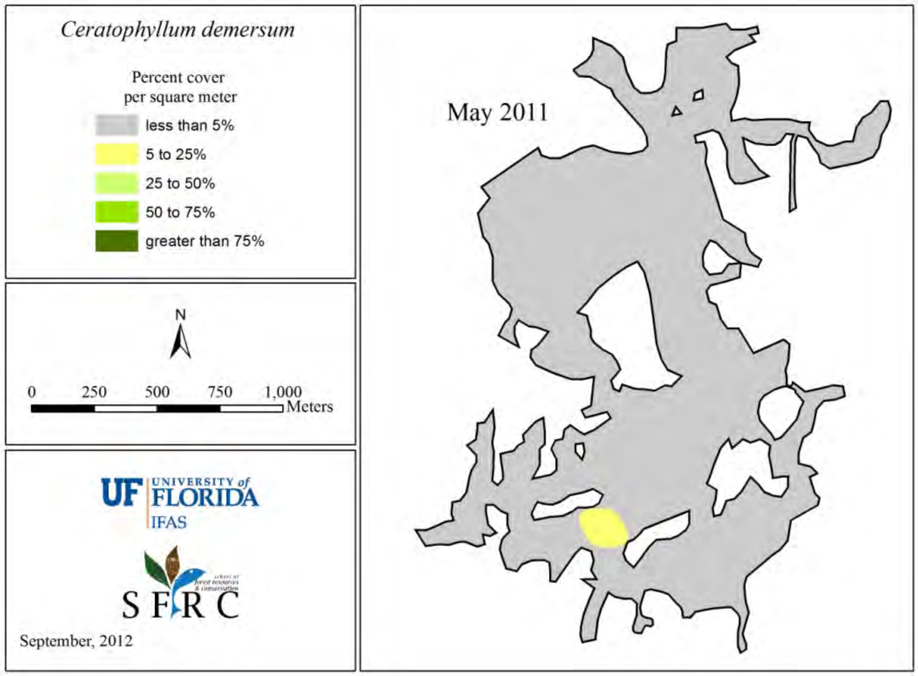
March, 2011
February 2011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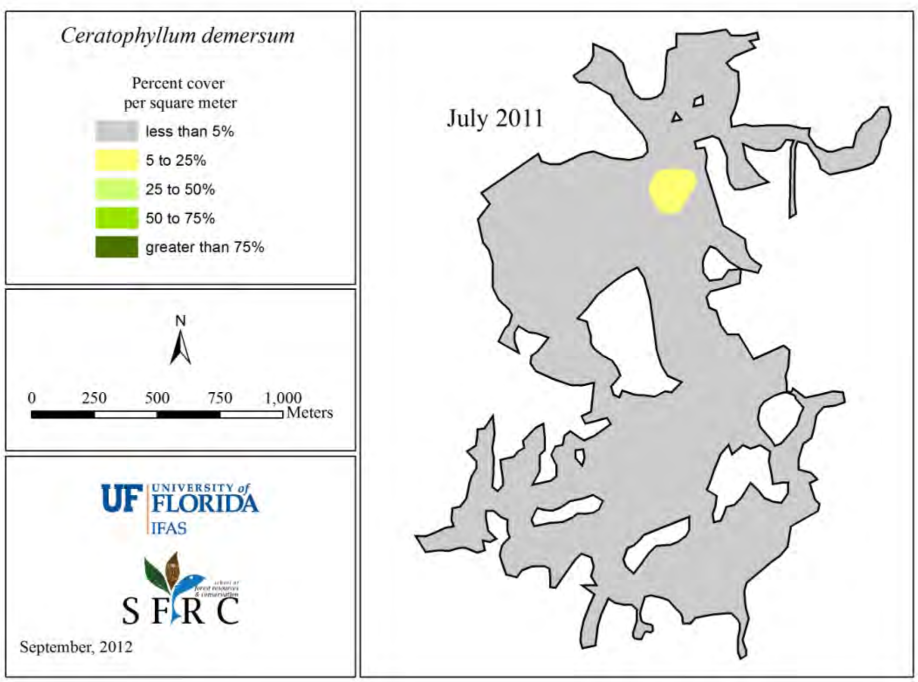
UF UNIVERSITY of FLORIDA IFAS
S F R C
September, 2012
May 2011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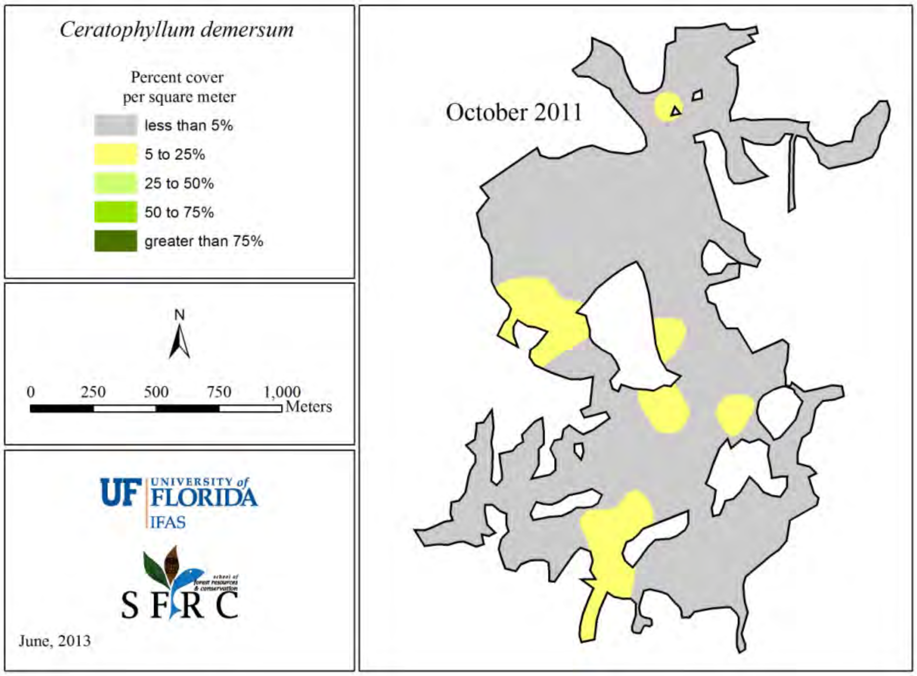
UF UNIVERSITY of FLORIDA IFAS
S F R C
September, 2012
July 2011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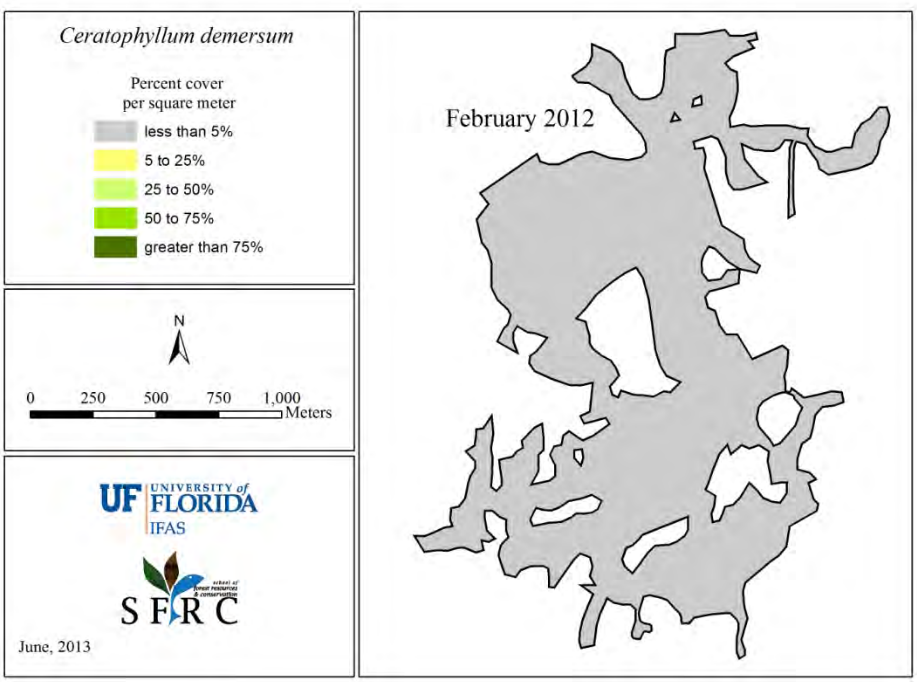
UF UNIVERSITY of FLORIDA IFAS
SFRC
June, 2013
October 2011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SFRC
June, 2013
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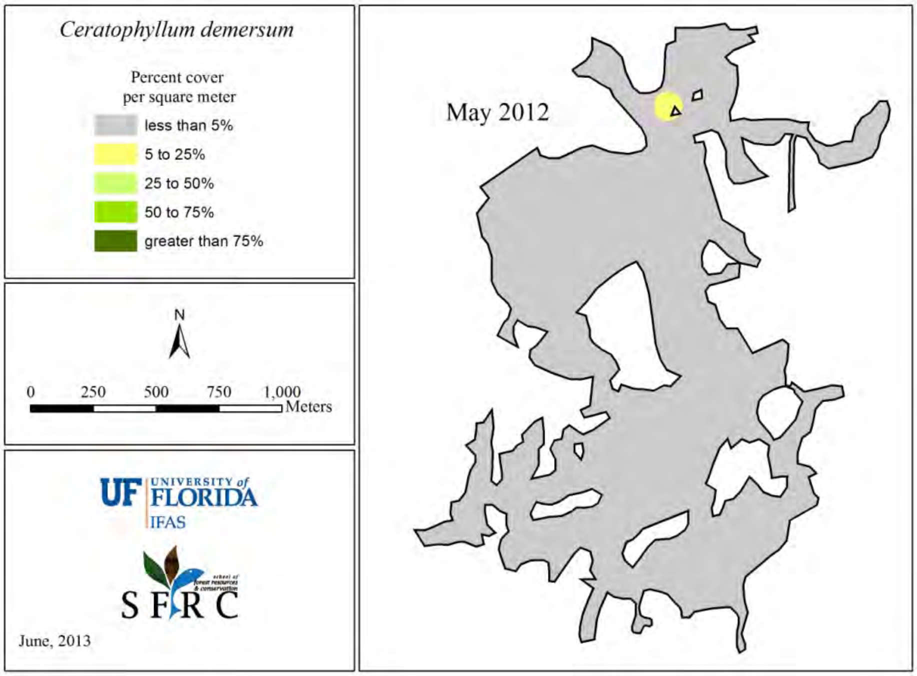
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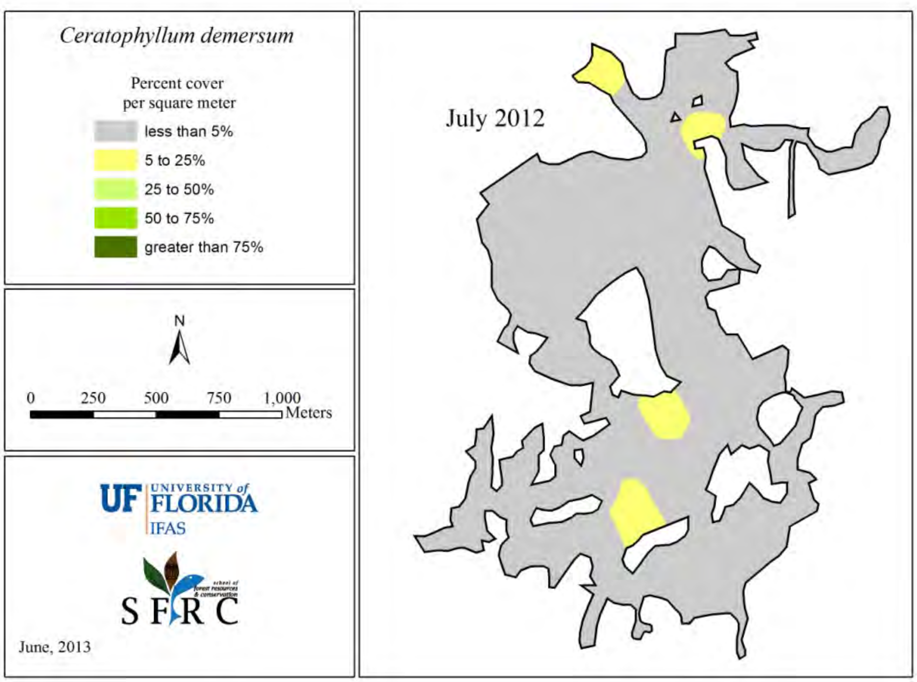
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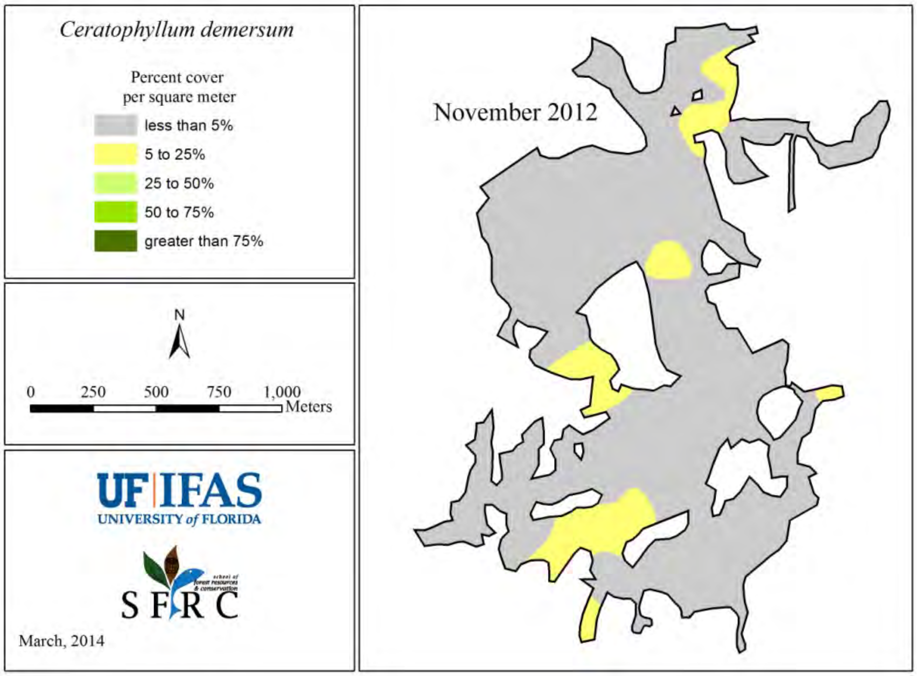
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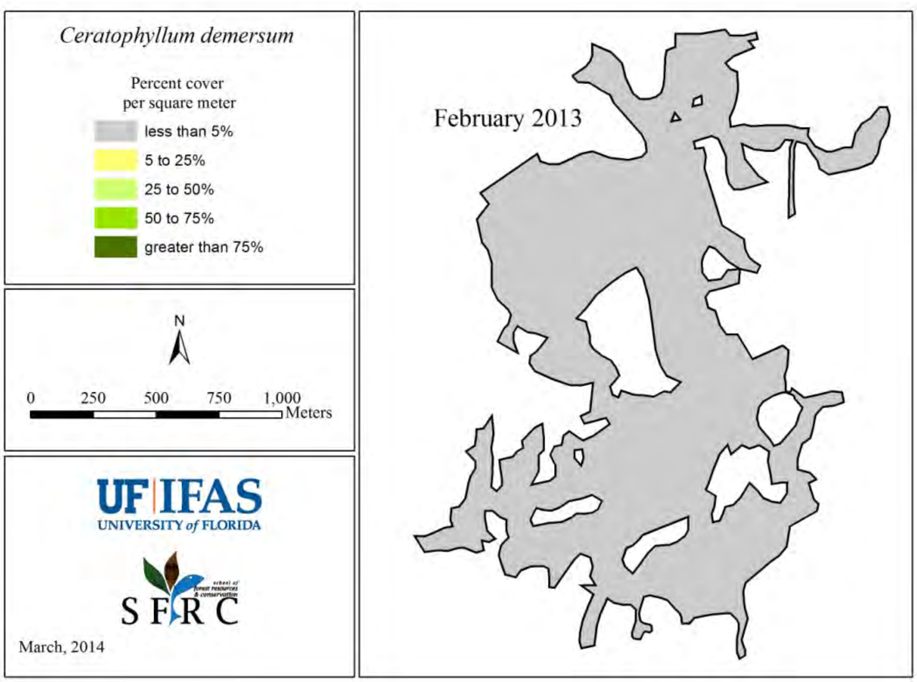
S F R C
March, 2014
November 2012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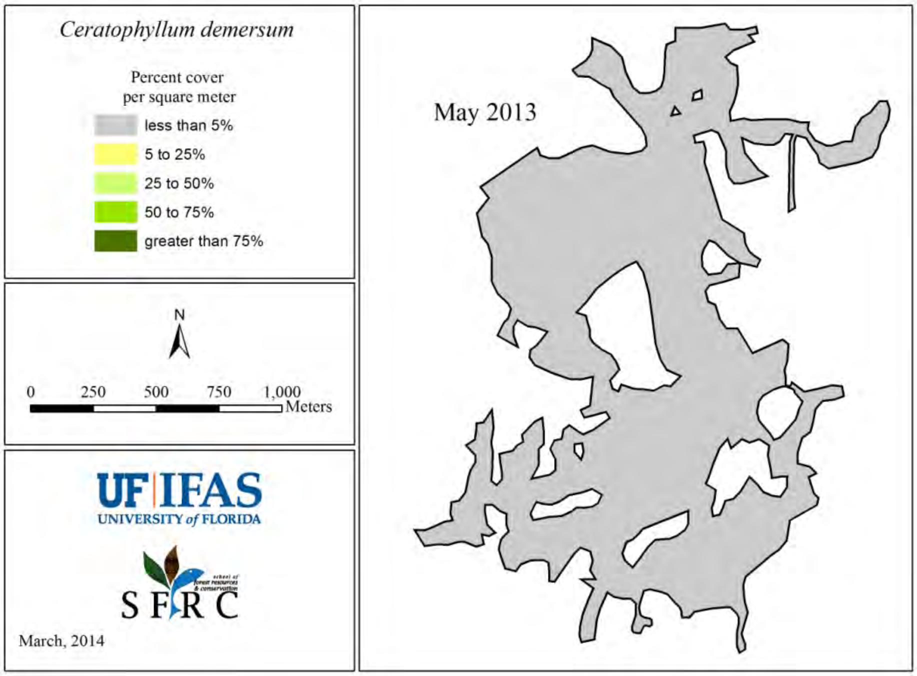
February 2013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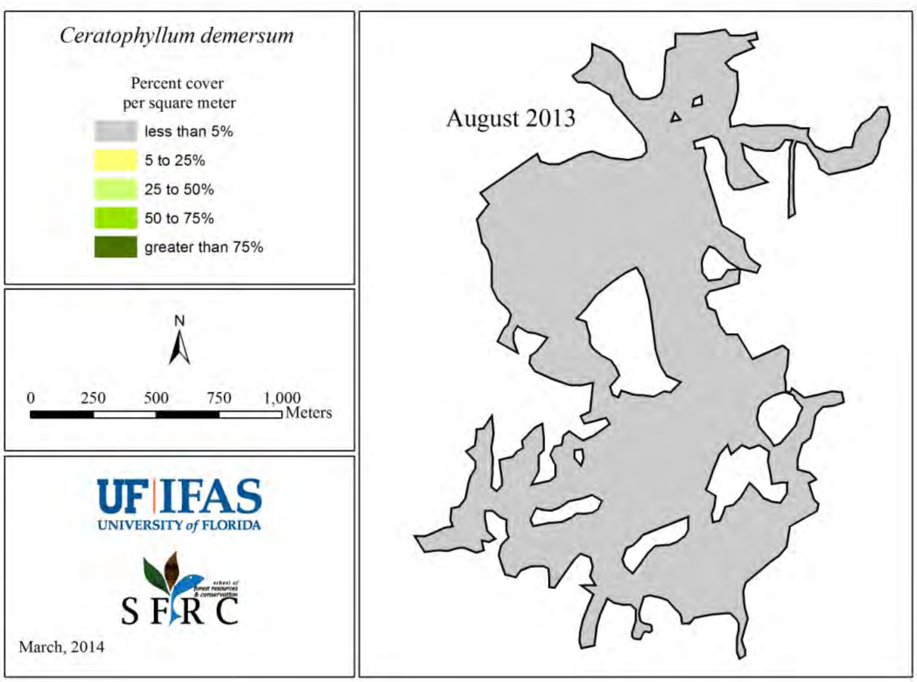
March, 2014
May 2013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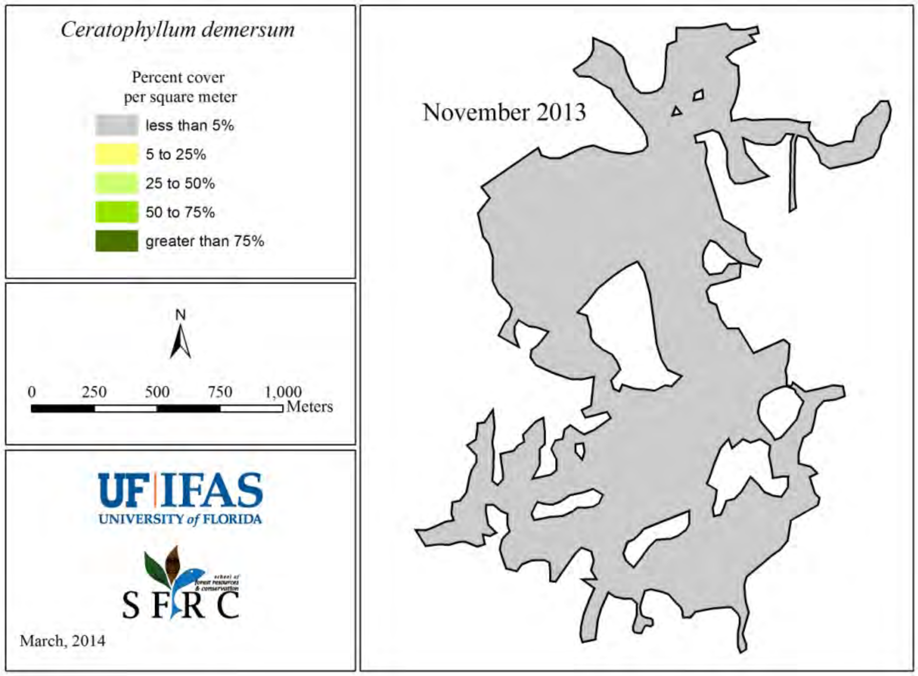
SFRC
March, 2014
August 2013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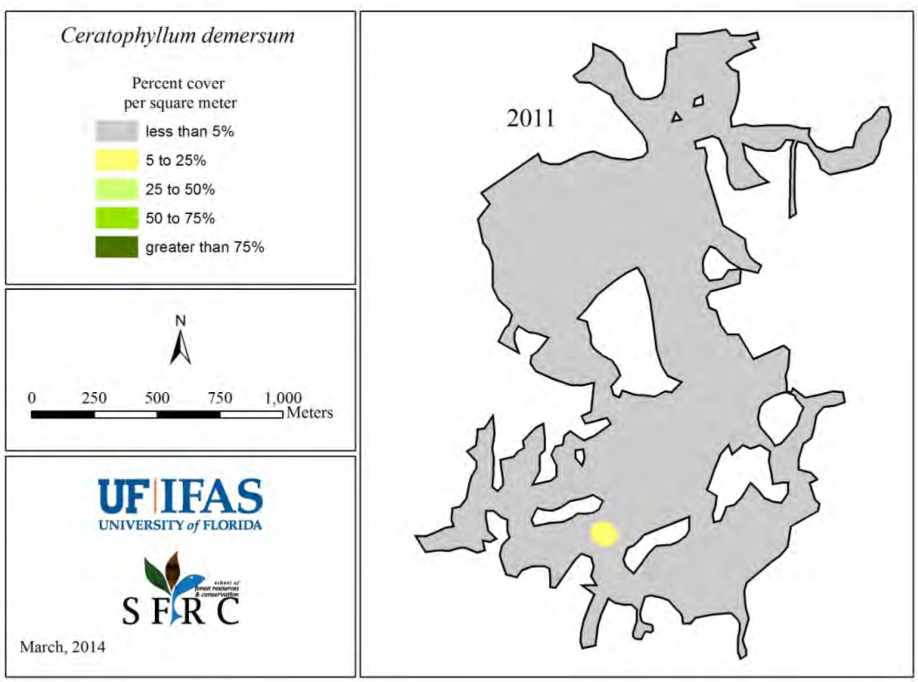
March, 2014
November 2013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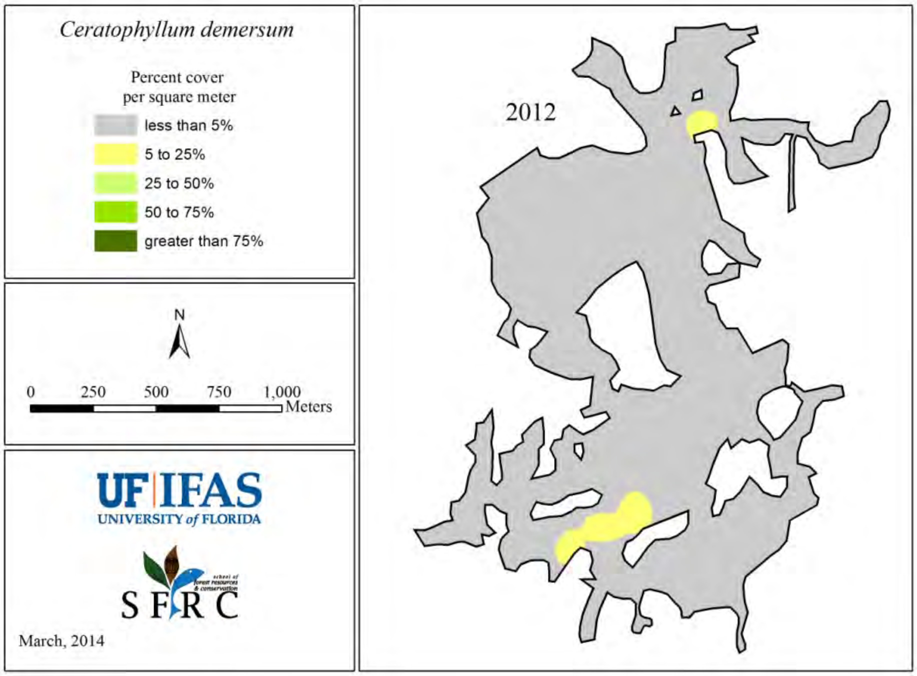
UF IFAS
UNIVERSITY of FLORIDA
S F R C
March, 2014
2011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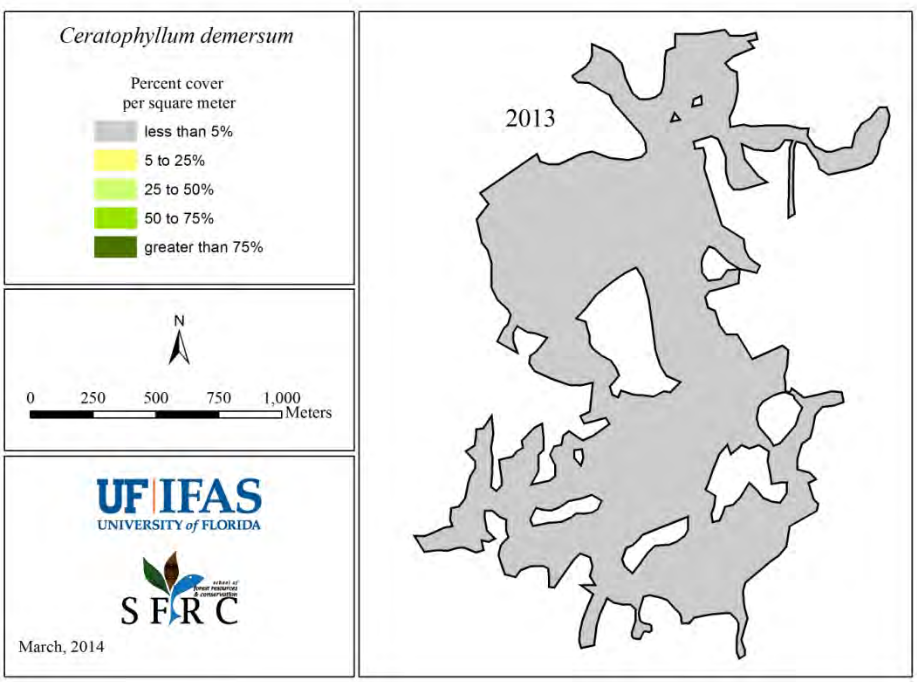
school of forest resources & conservation
March, 2014
2012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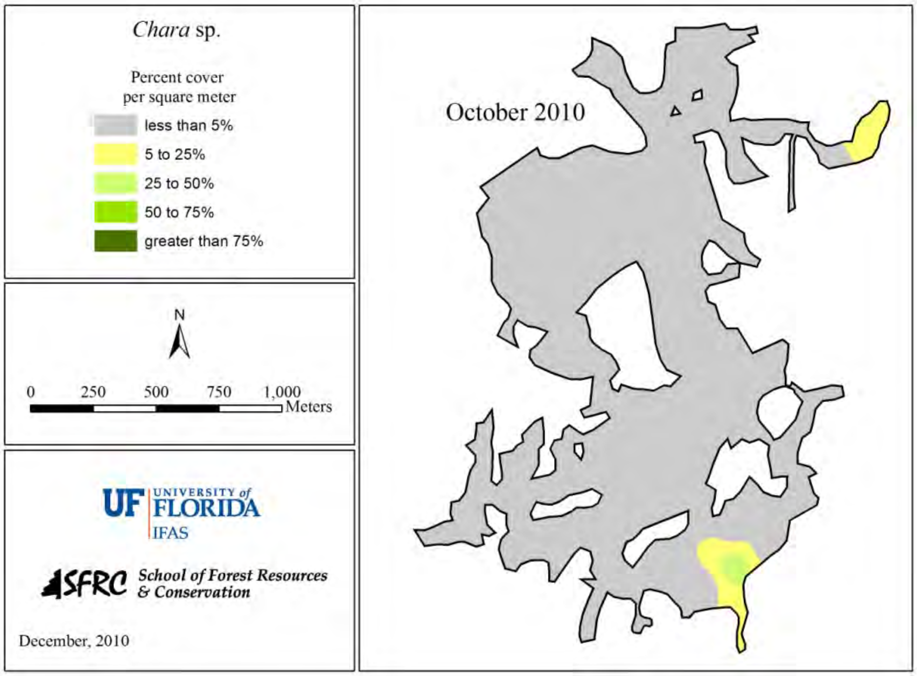
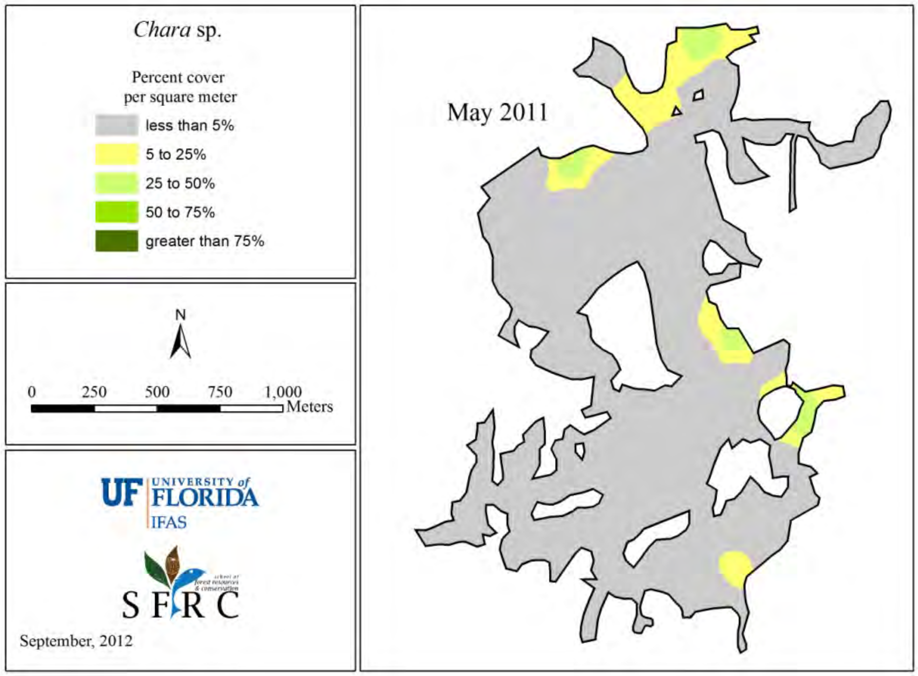
school of forest resources & conservation
March, 2014
2013



Chara sp. was not found in any quadrat in February 2011


Chara sp.
Percent cover
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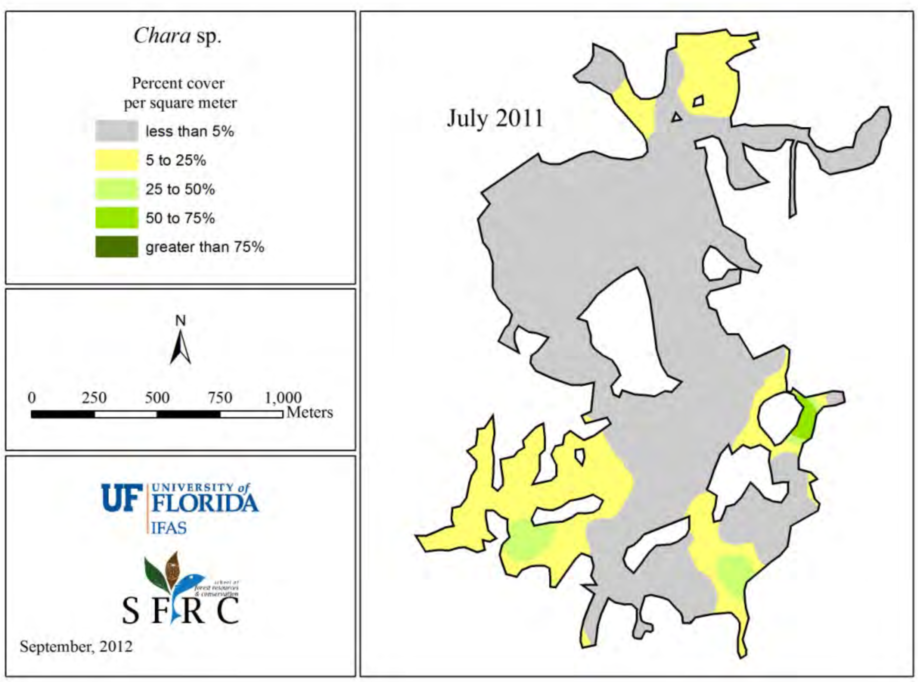
750
1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
S F R C
September, 2012
May 2011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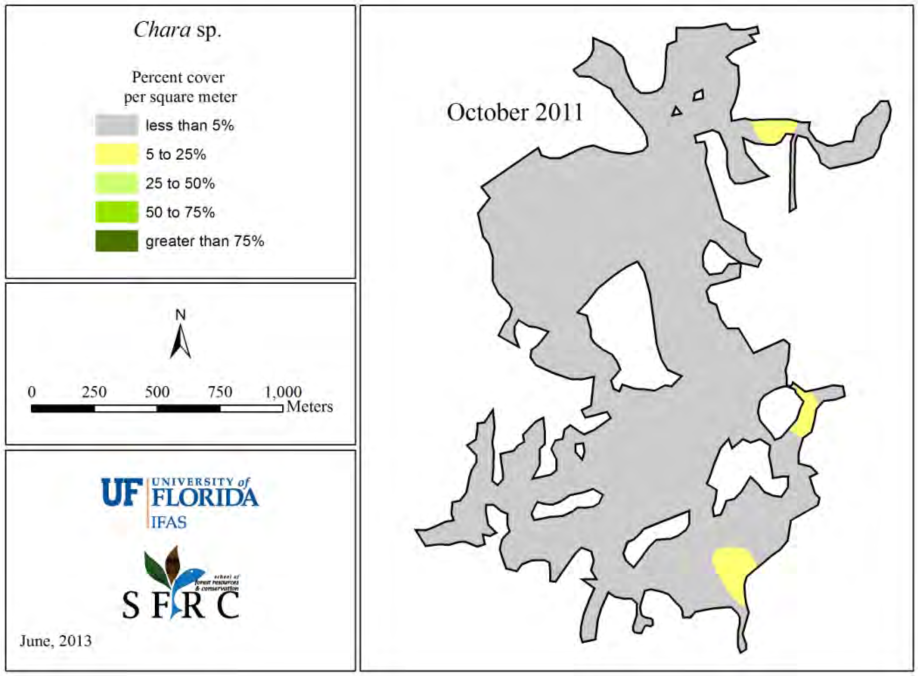
S F R C
September, 2012
July 2011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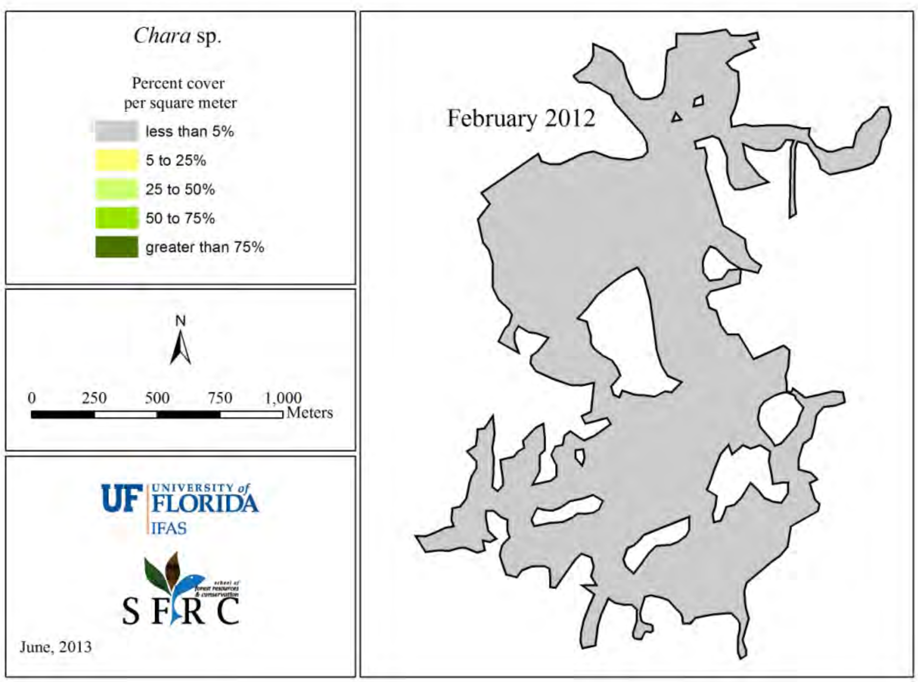
UF UNIVERSITY of FLORIDA
IFAS
S F R C
June, 2013
October 2011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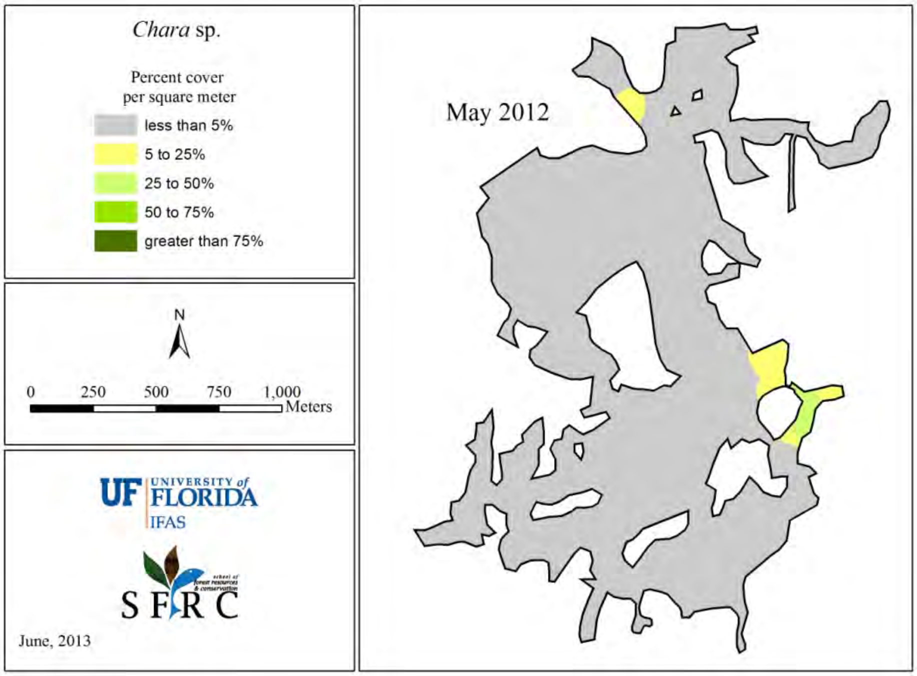
S F R C
June, 2013
February 2012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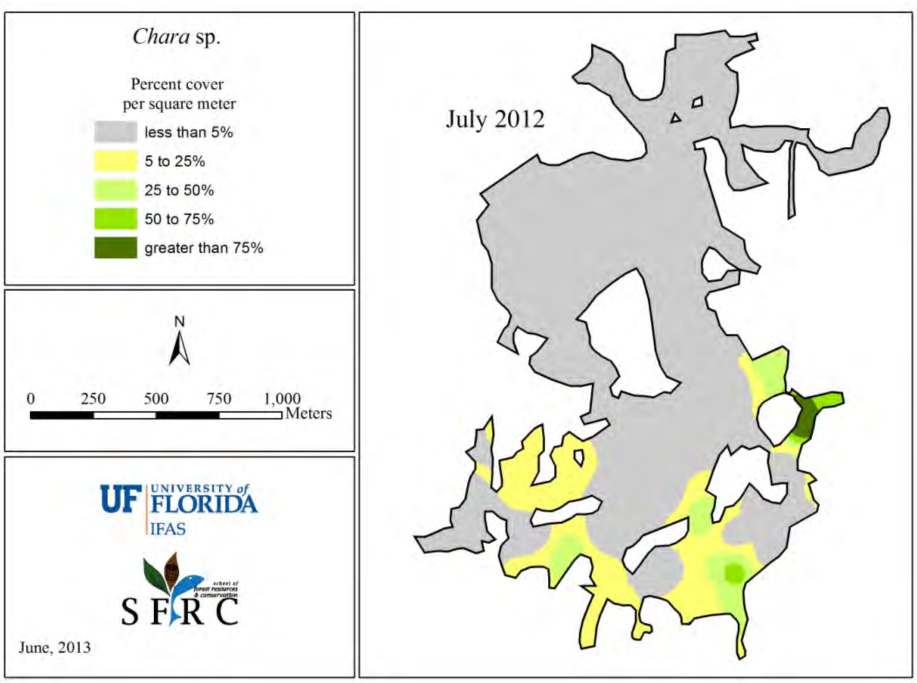
UF UNIVERSITY of FLORIDA
IFAS
SFRC
June, 2013
May 2012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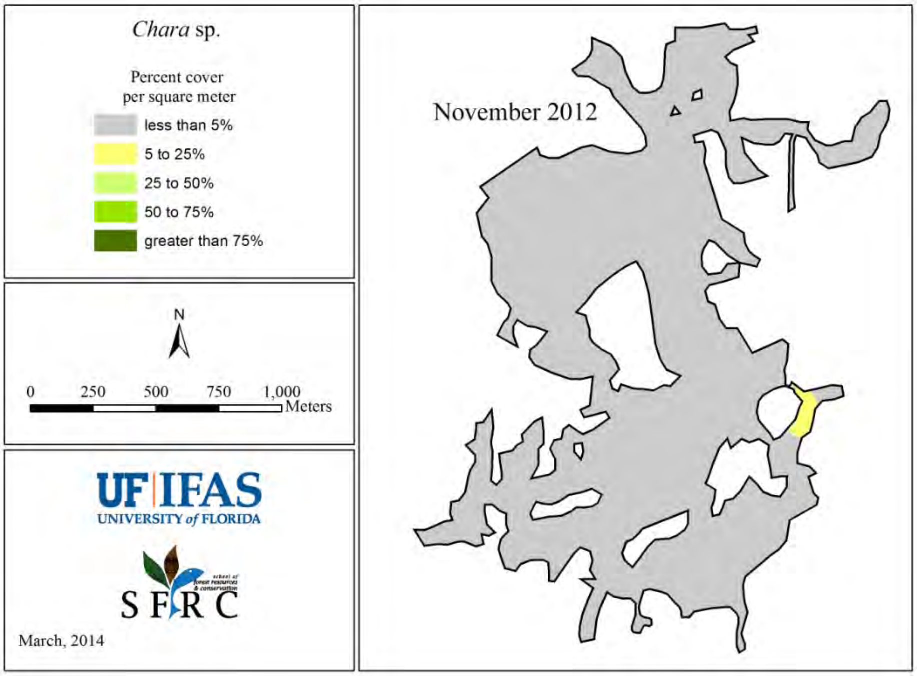
July 2012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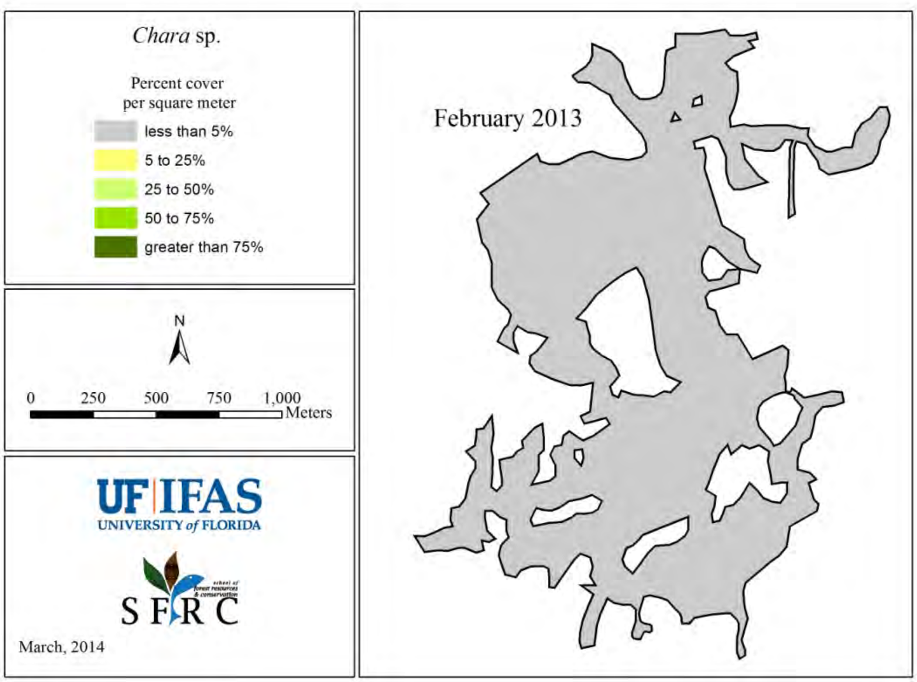
March, 2014
November 2012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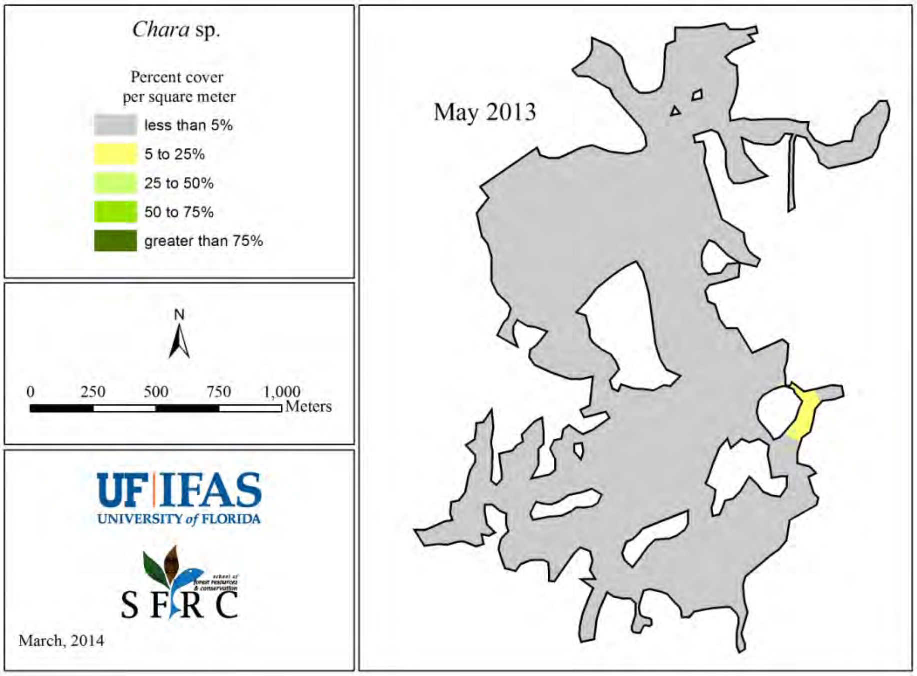
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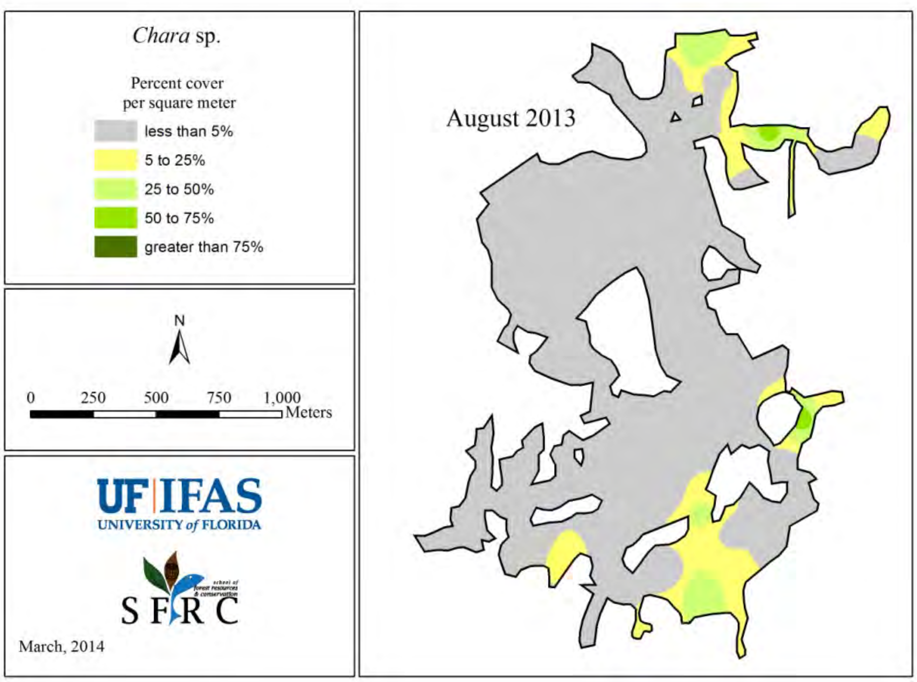
SFRC
March, 2014
May 2013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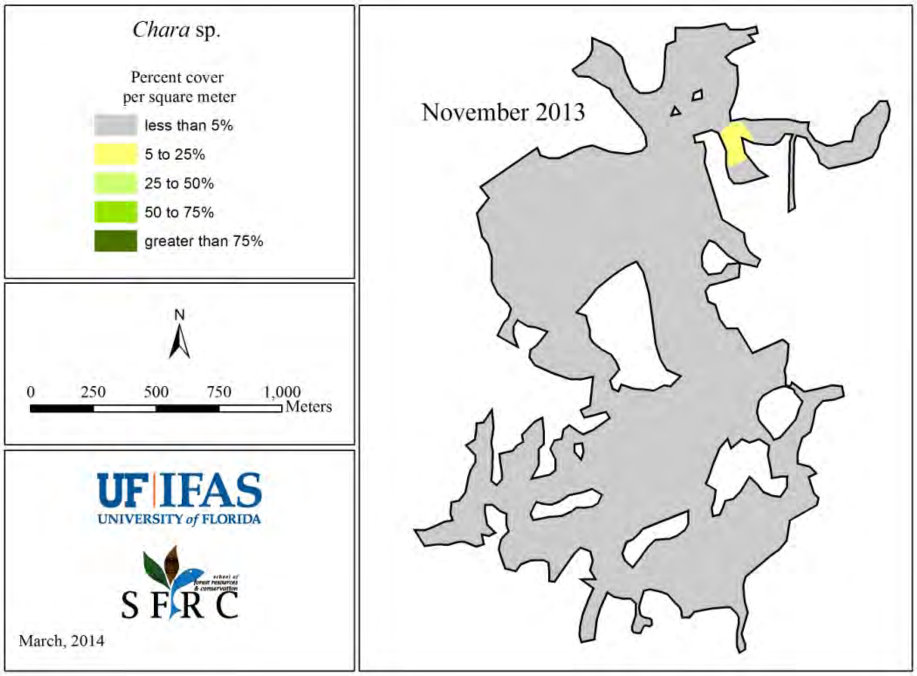
August 2013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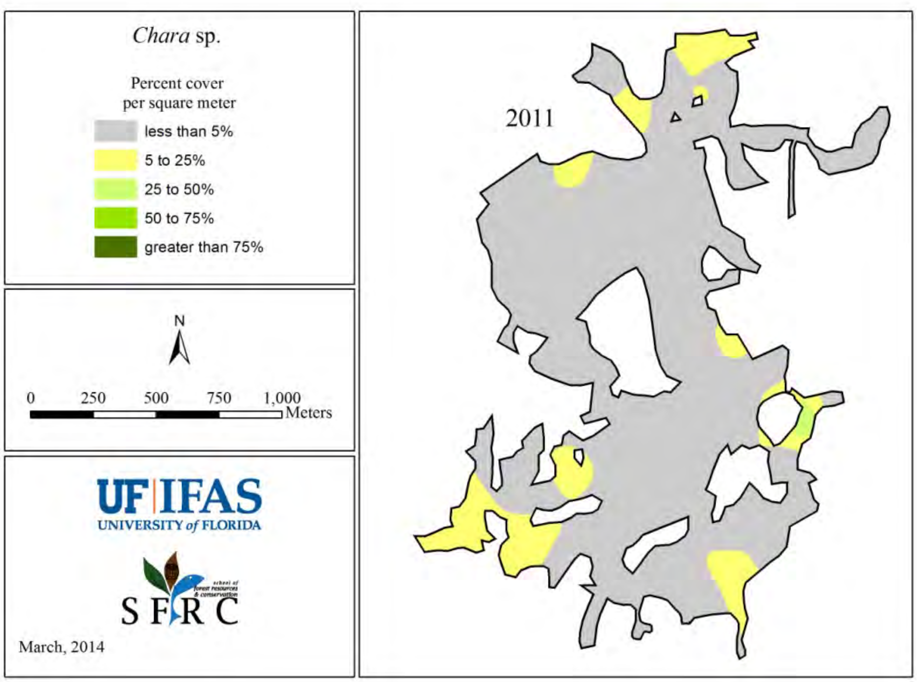
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SFRC
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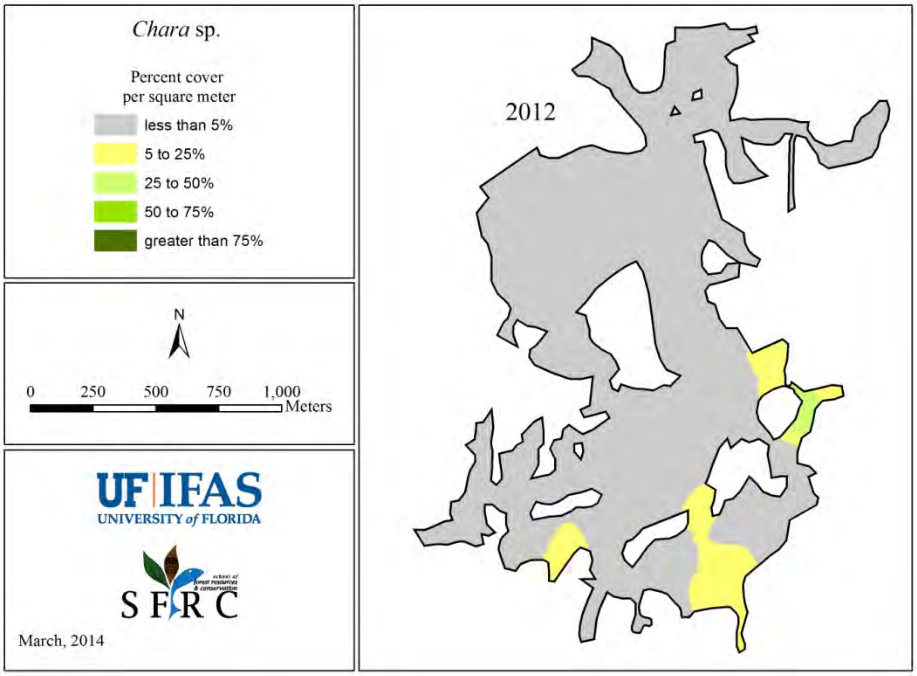
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March, 2014
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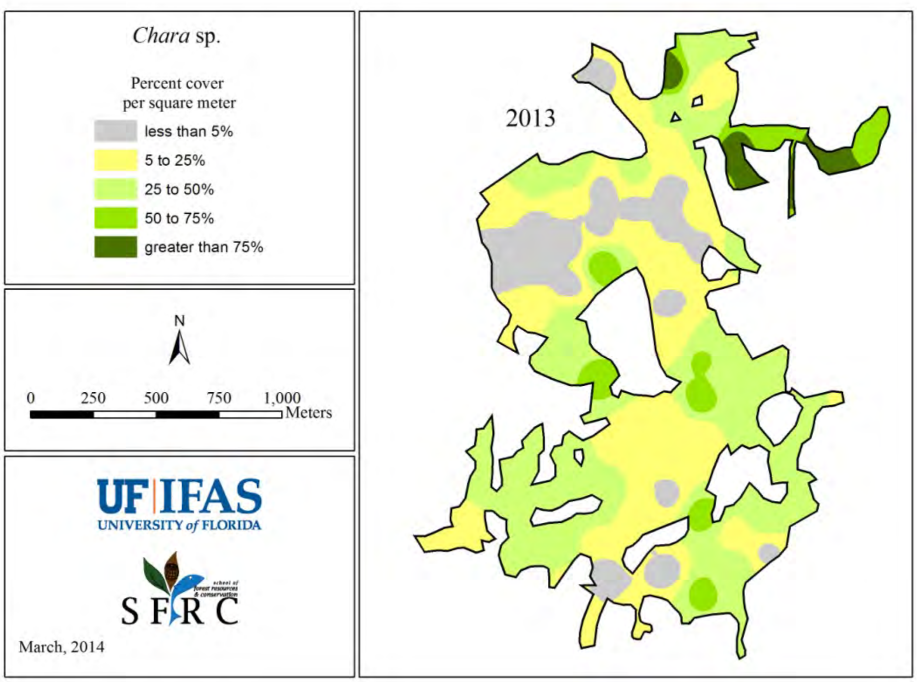
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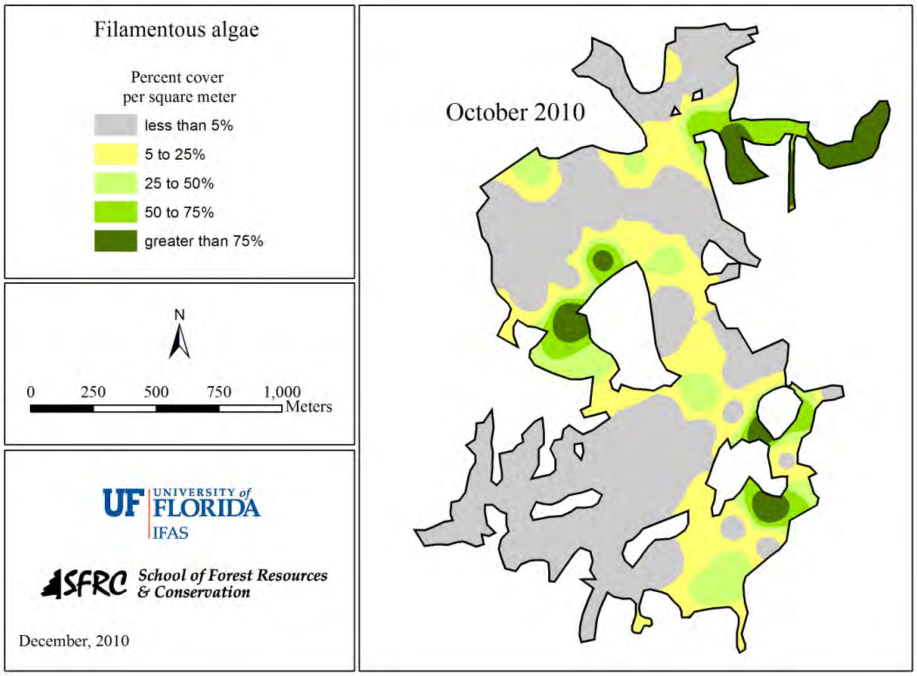
Filamentous algae
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UF UNIVERSITY of FLORIDA IFAS
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December, 2010
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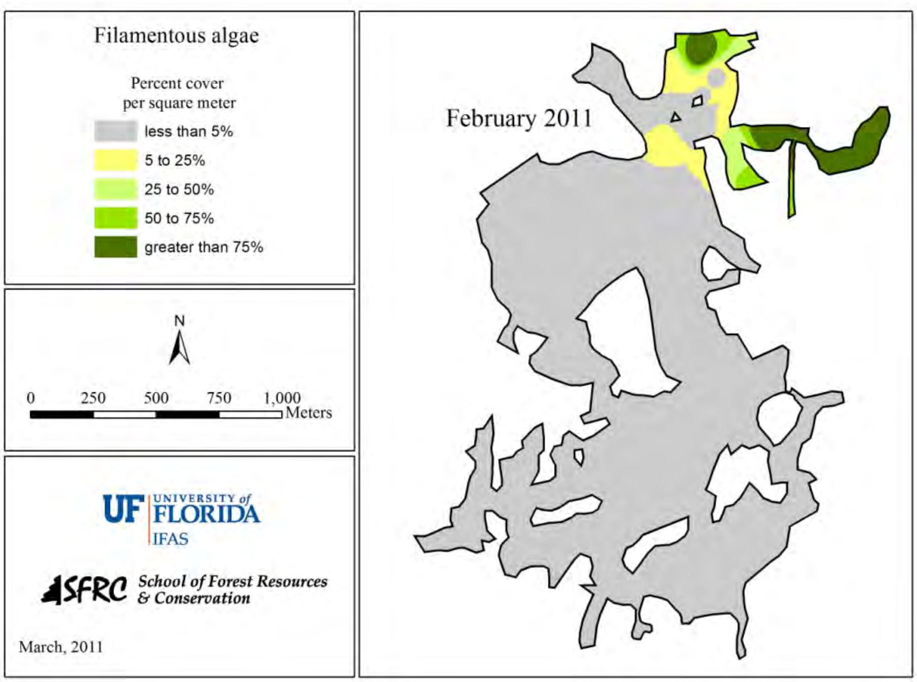
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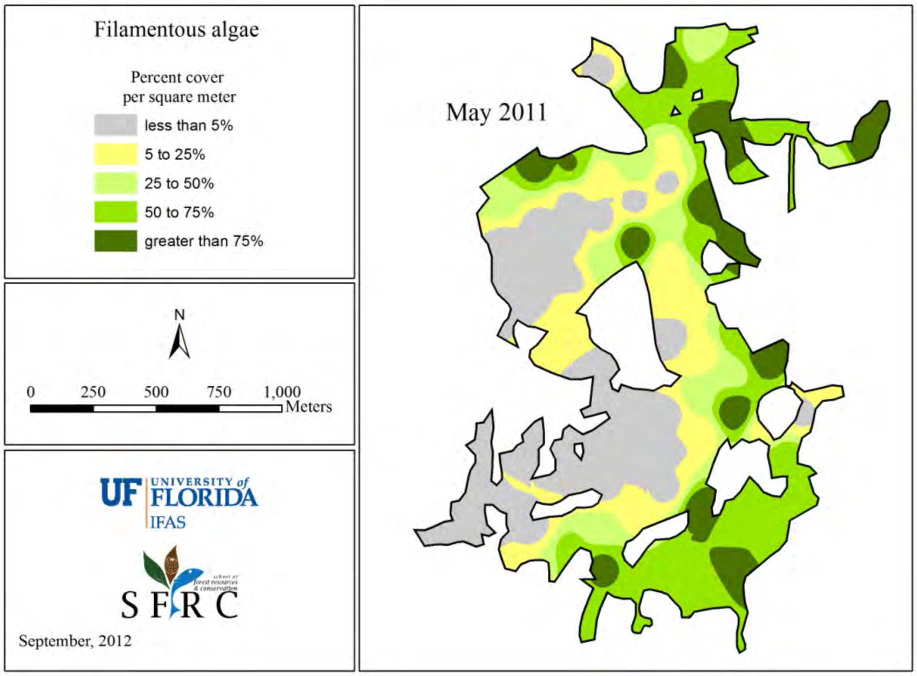
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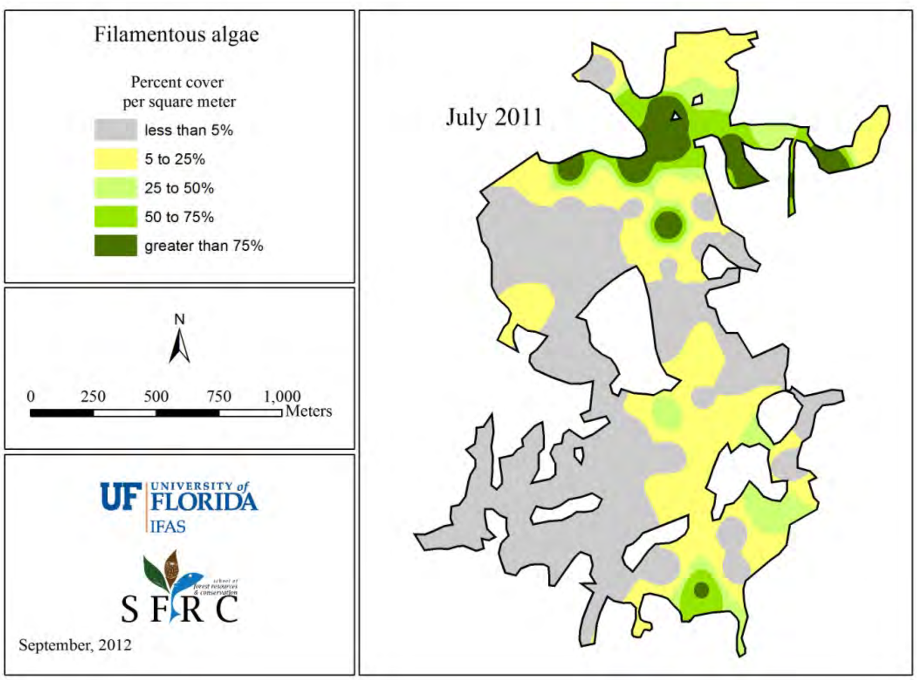
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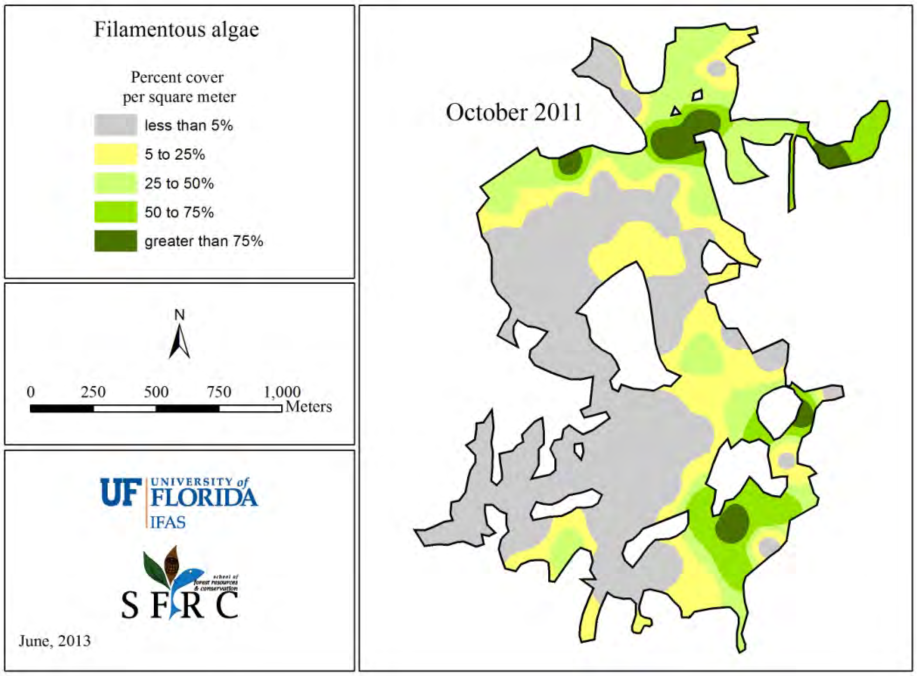
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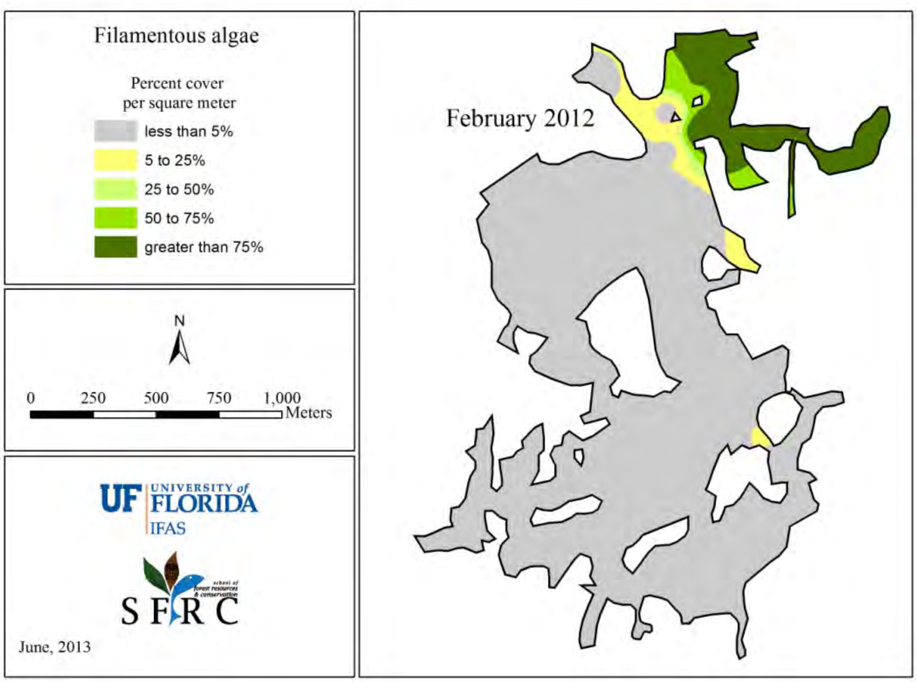
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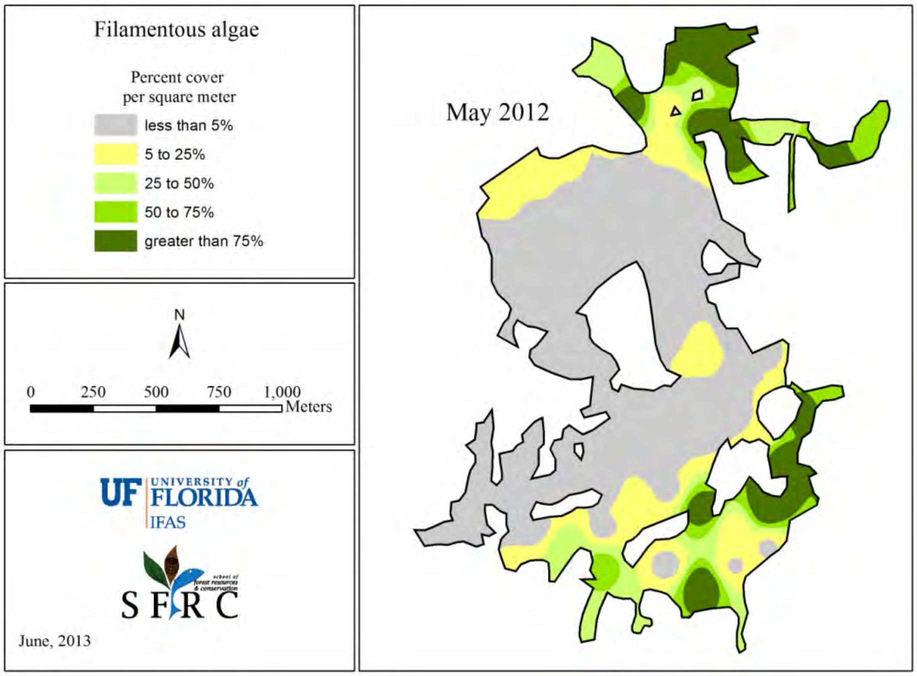
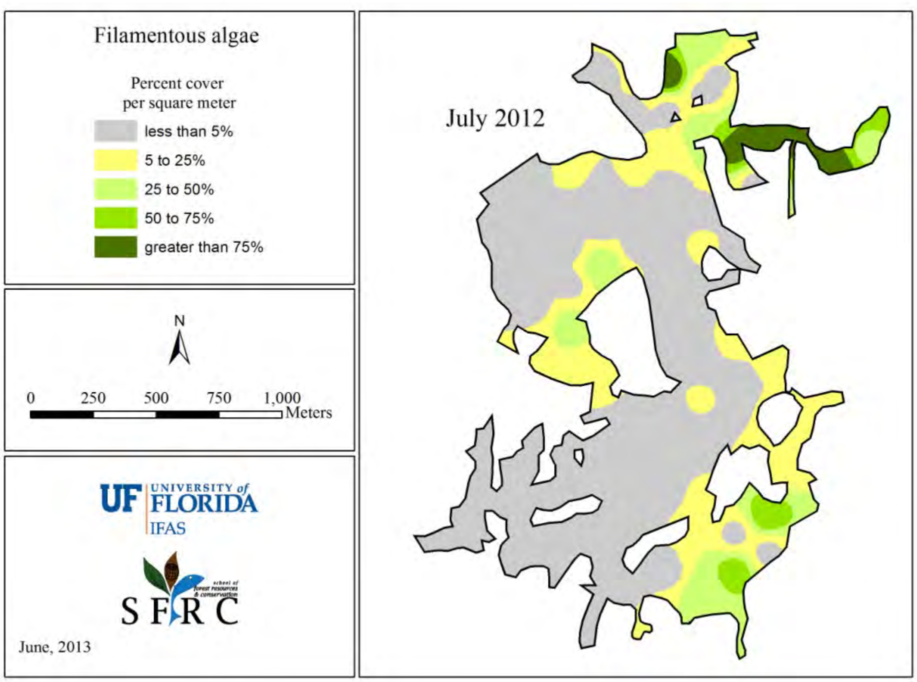

Filamentous algae
Percent cover
per square meter
less than 5%
5 to 25%
25 to 50%
50 to 75%
greater than 75%
N
0
250
500
750
1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC
June, 2013
May 2012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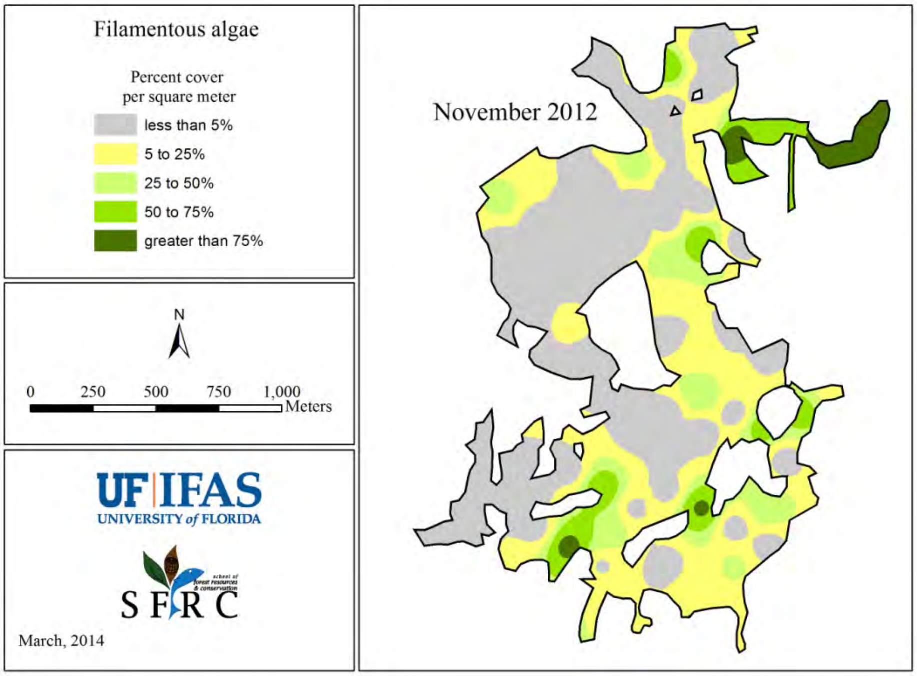
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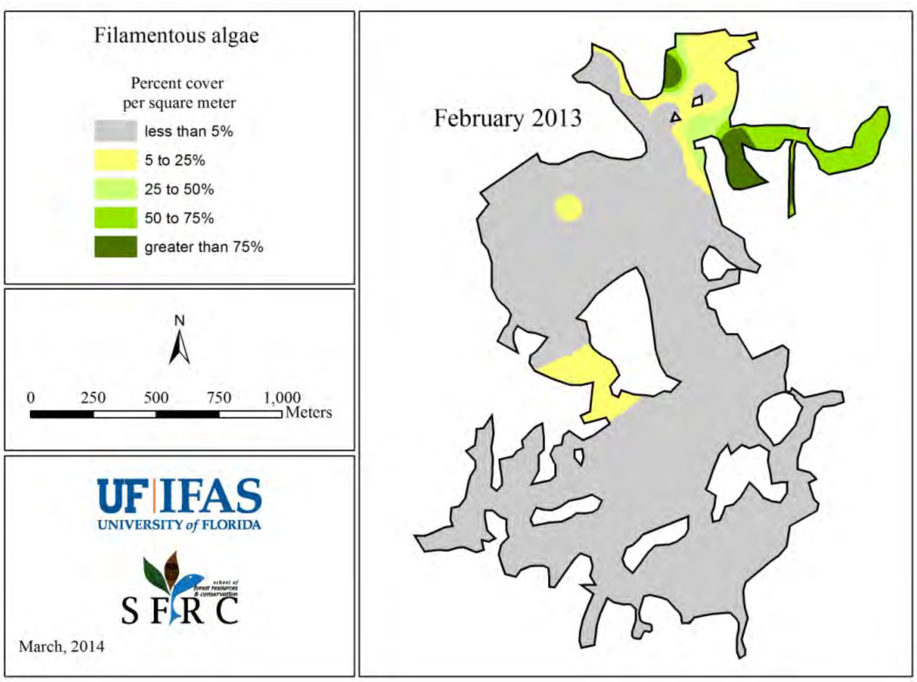
March, 2014
November 2012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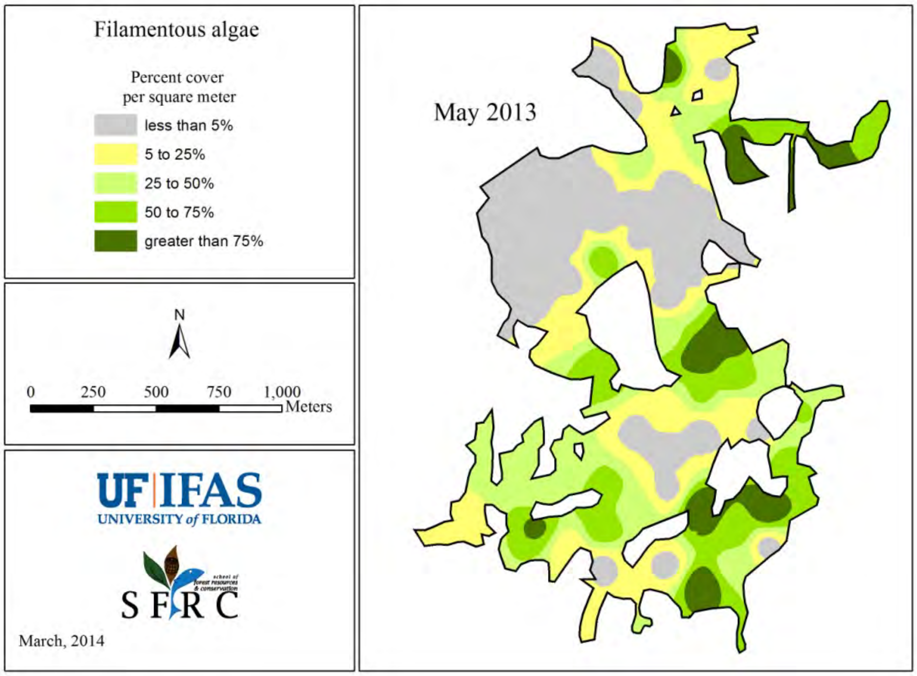
February 2013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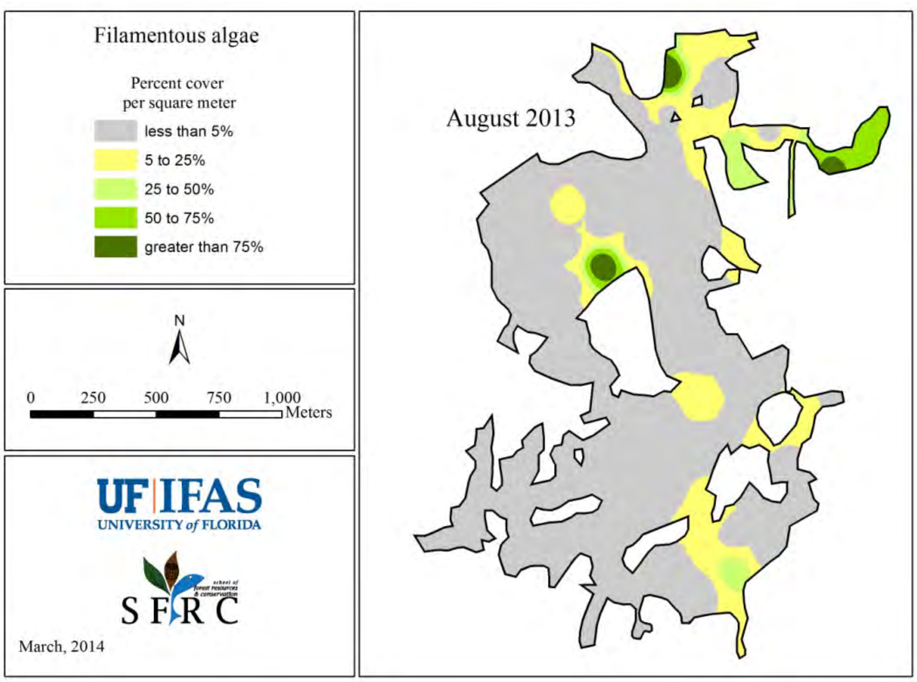
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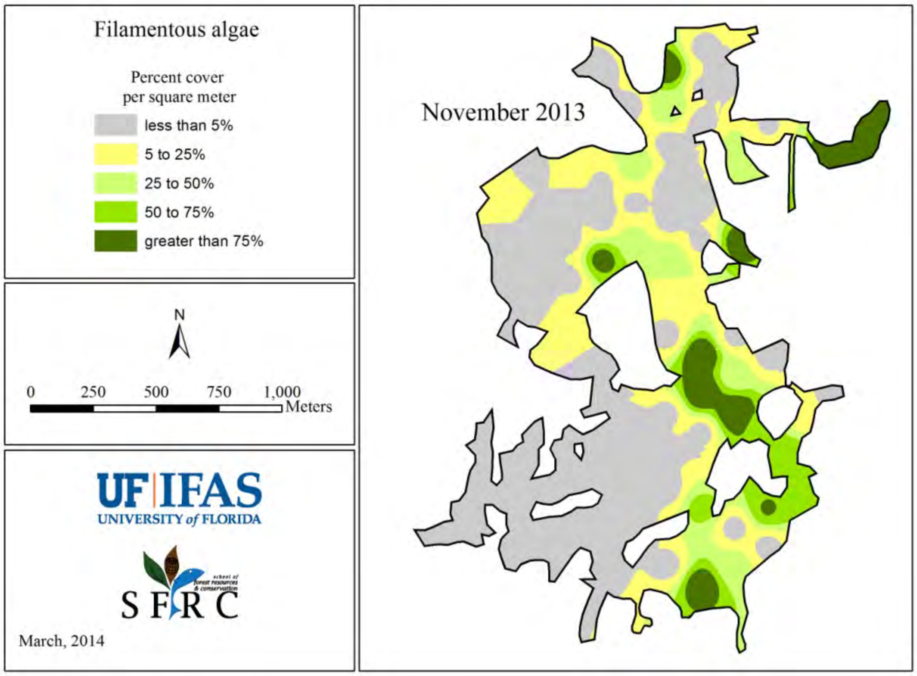
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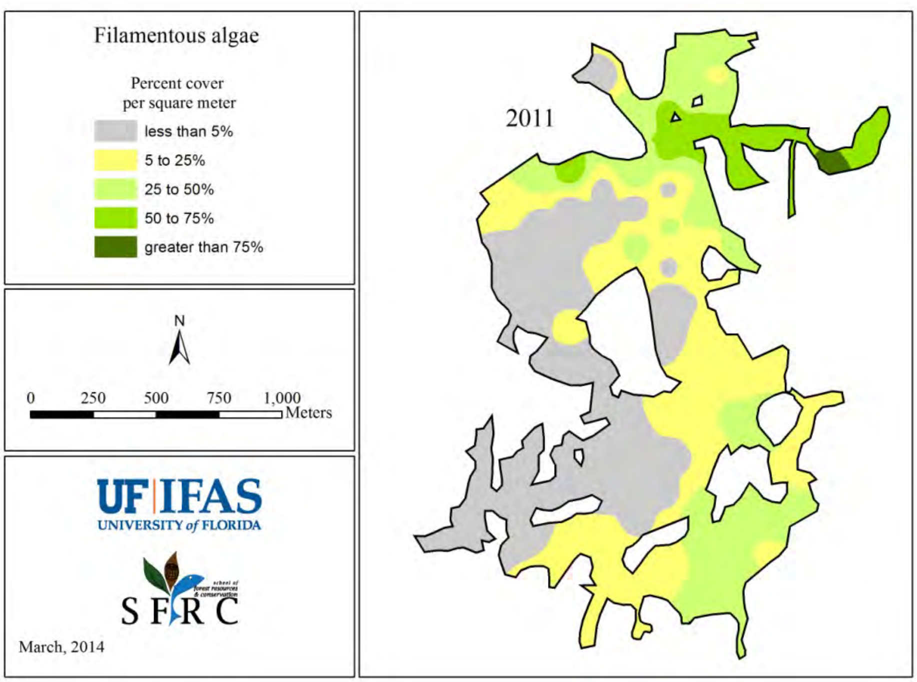
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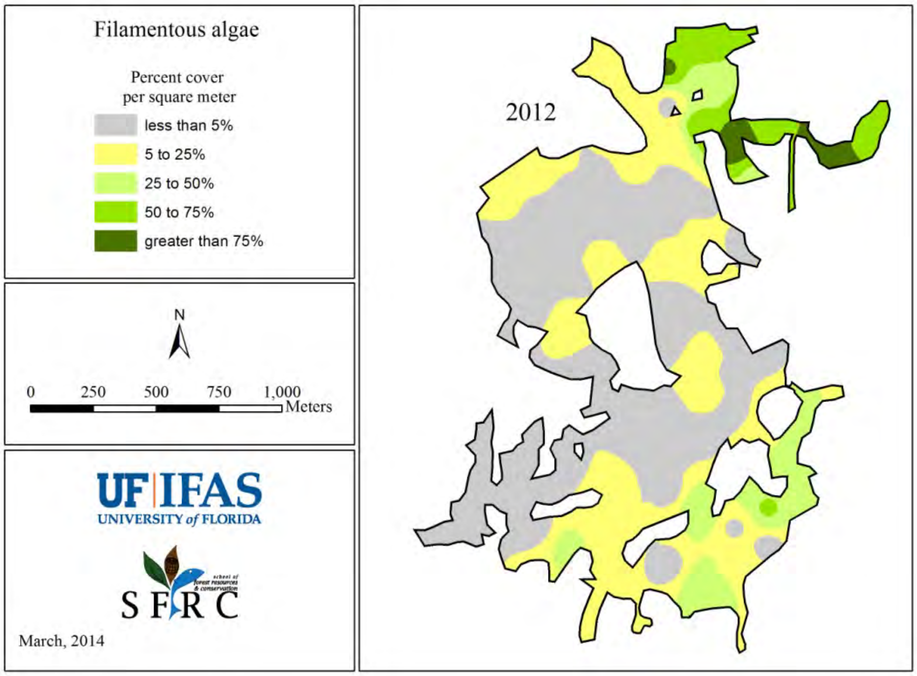
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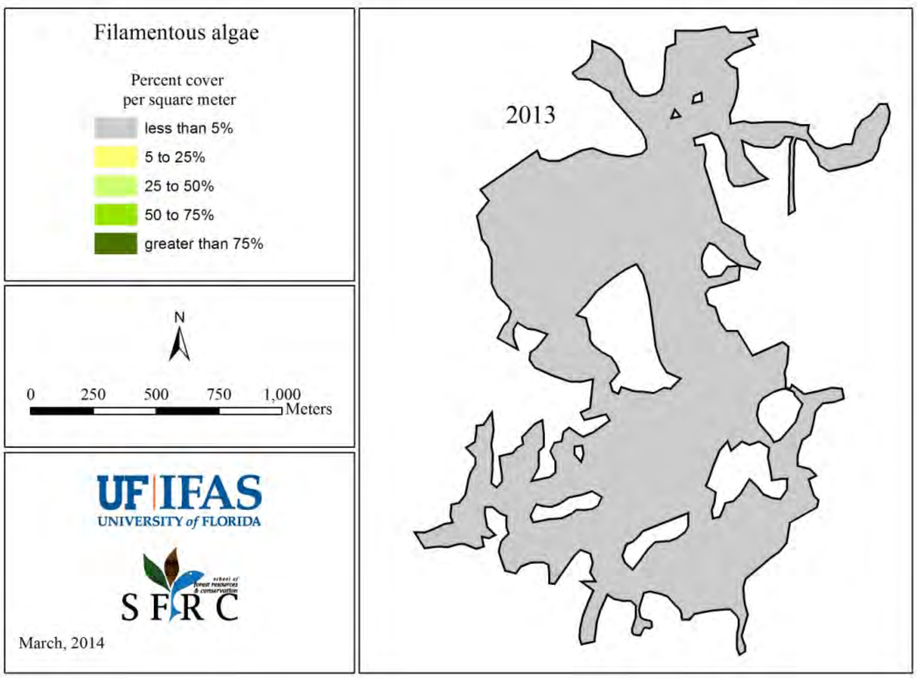
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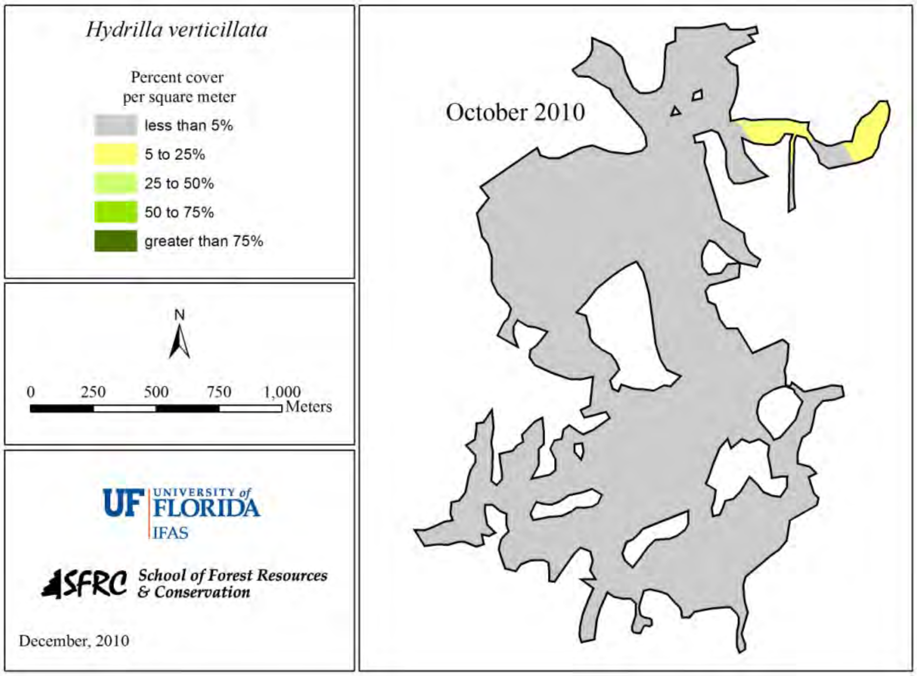
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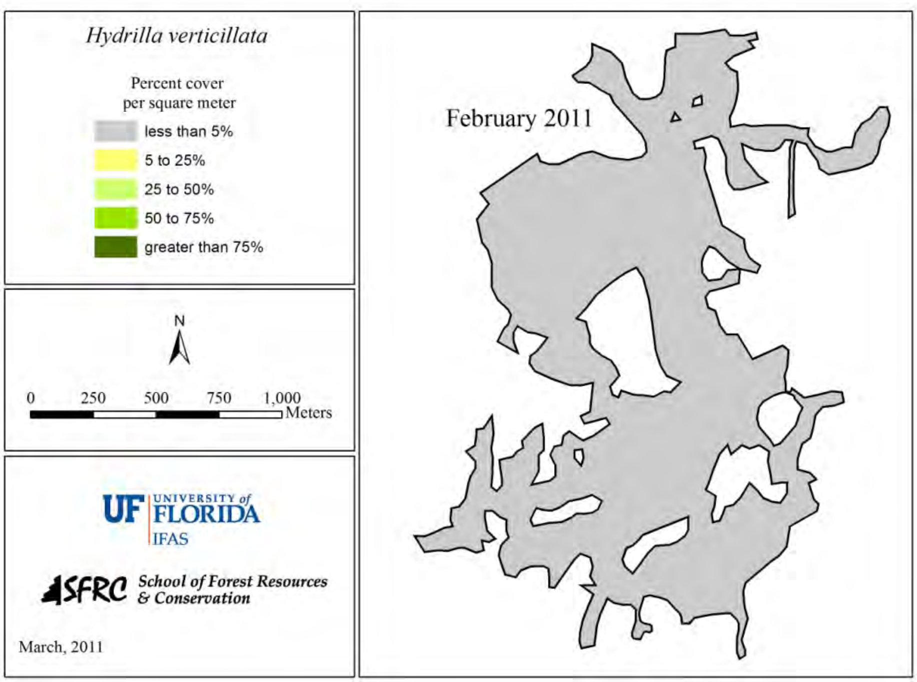
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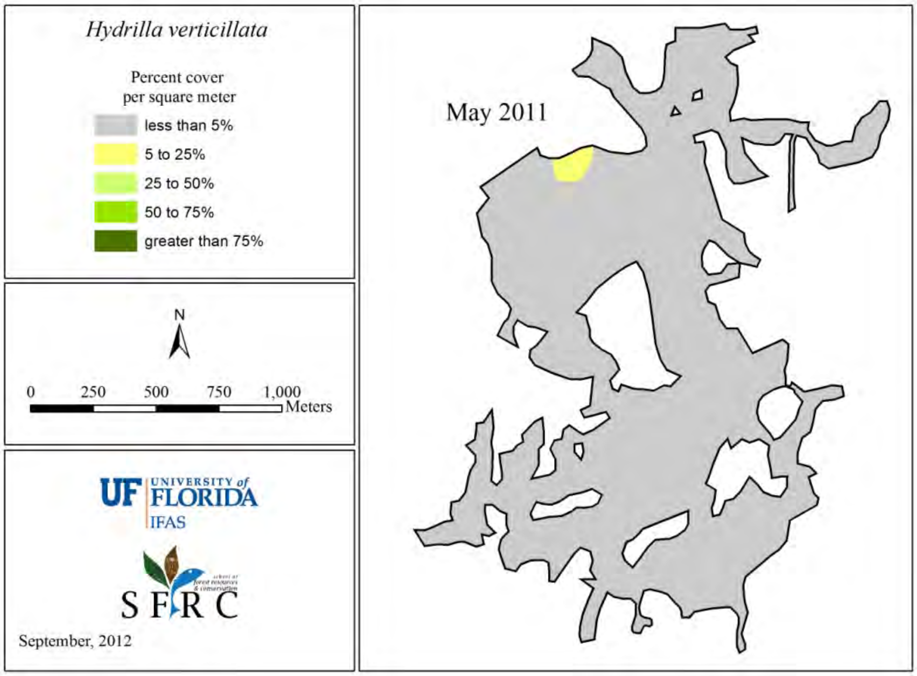
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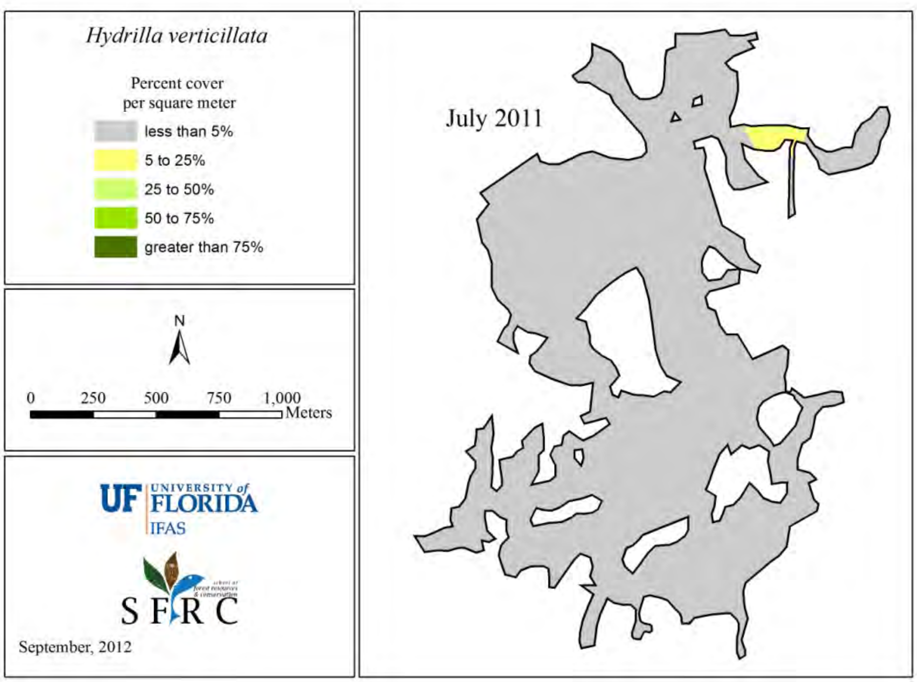
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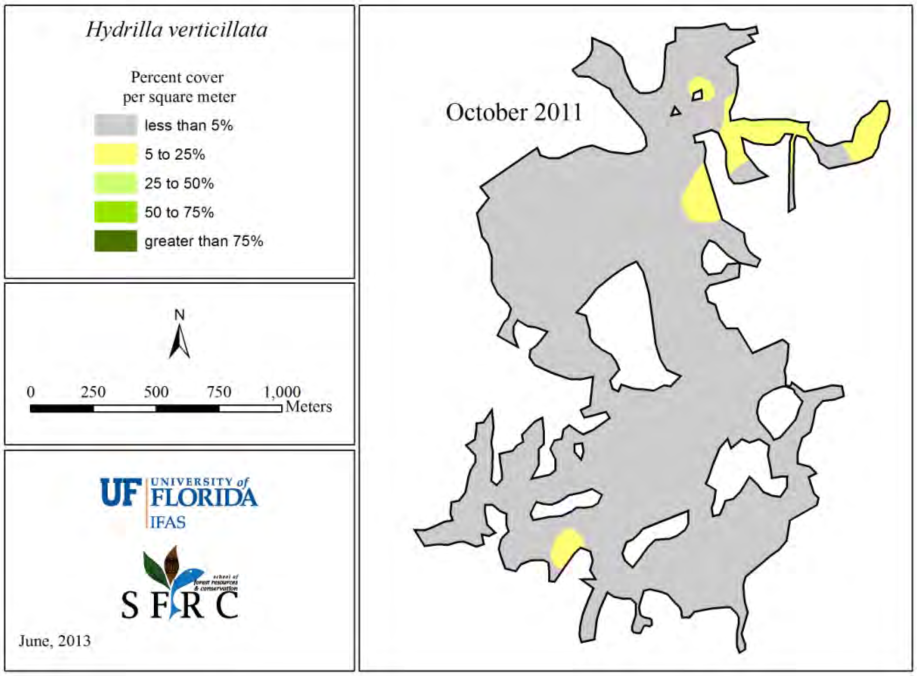
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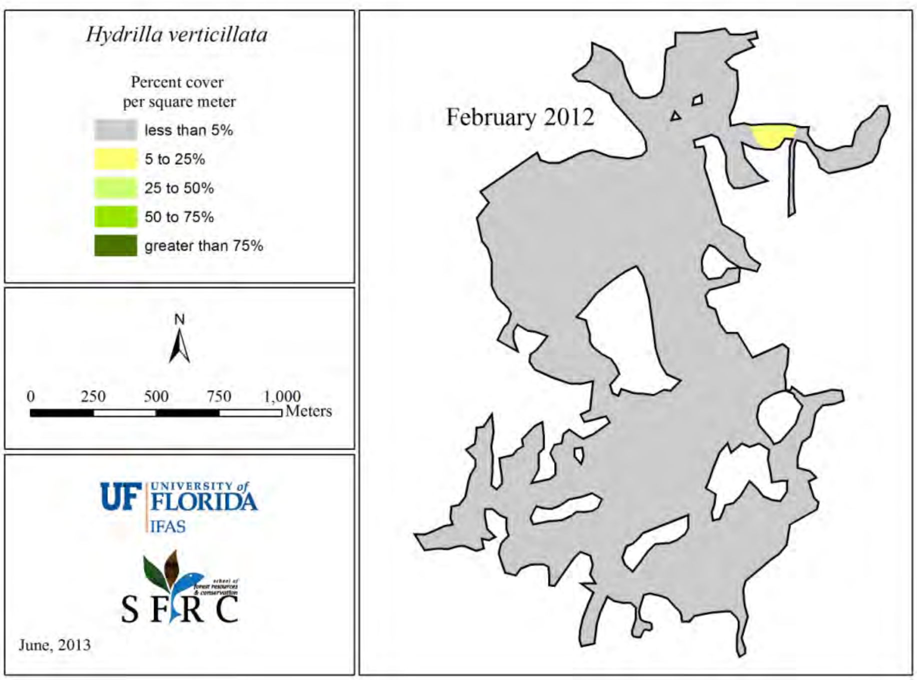
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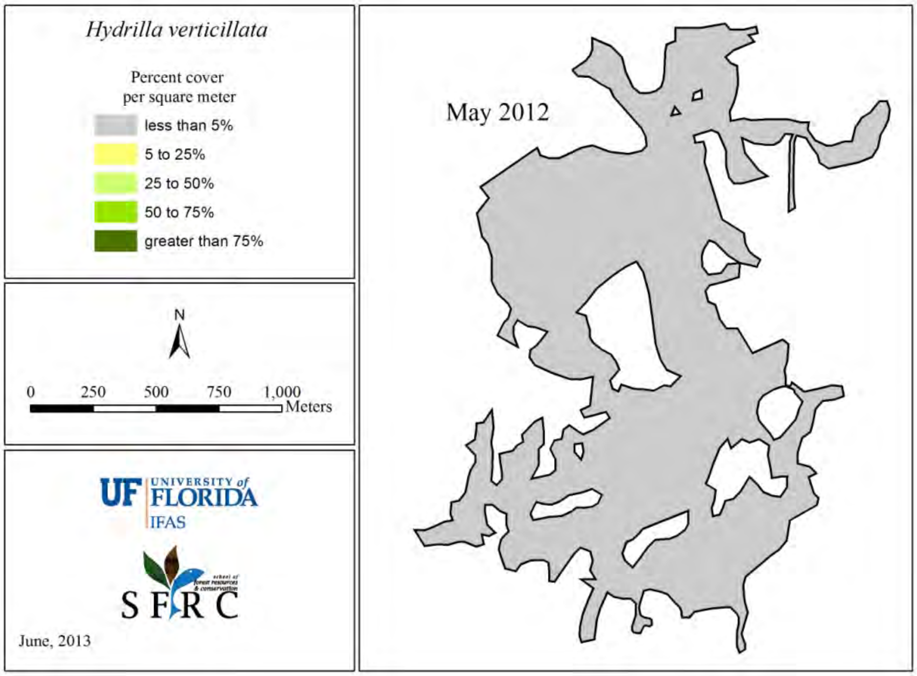
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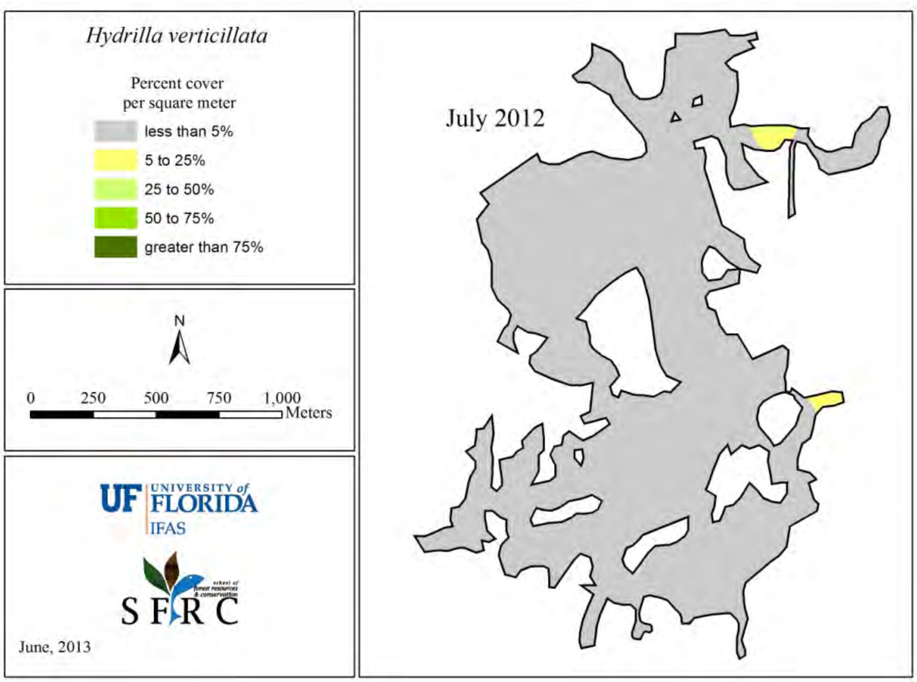
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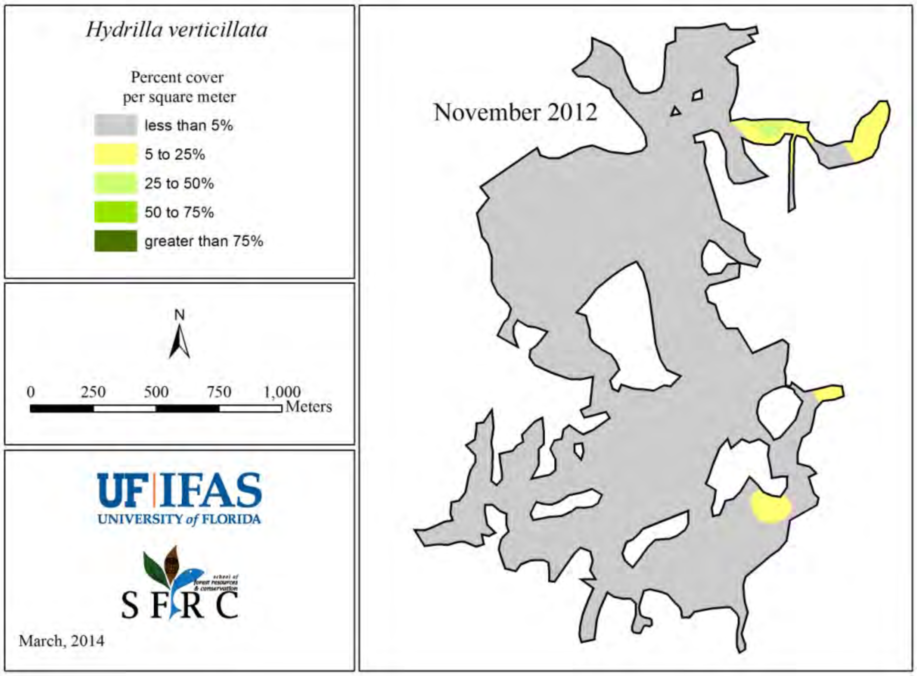
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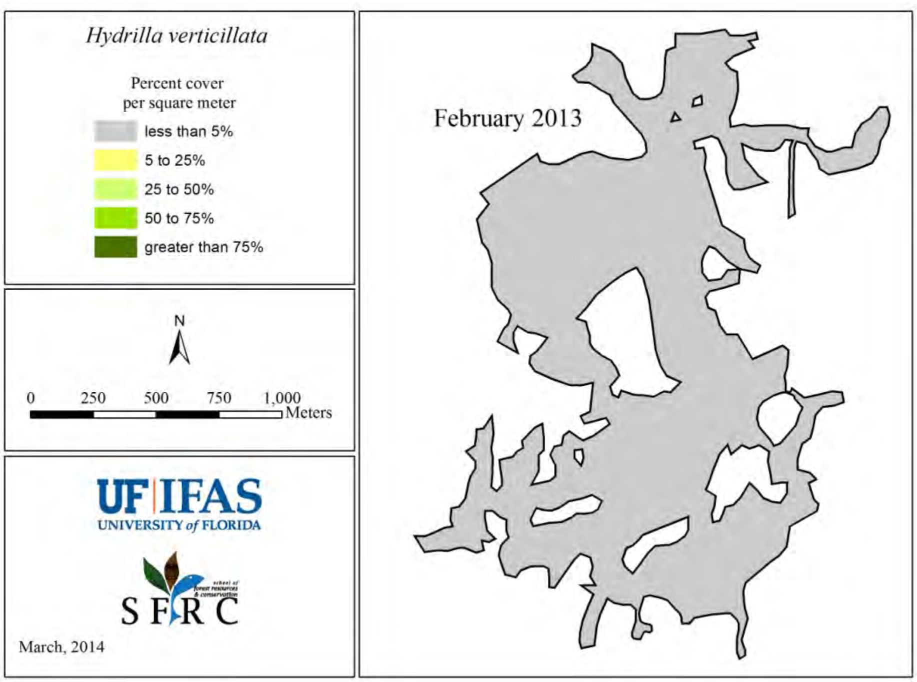
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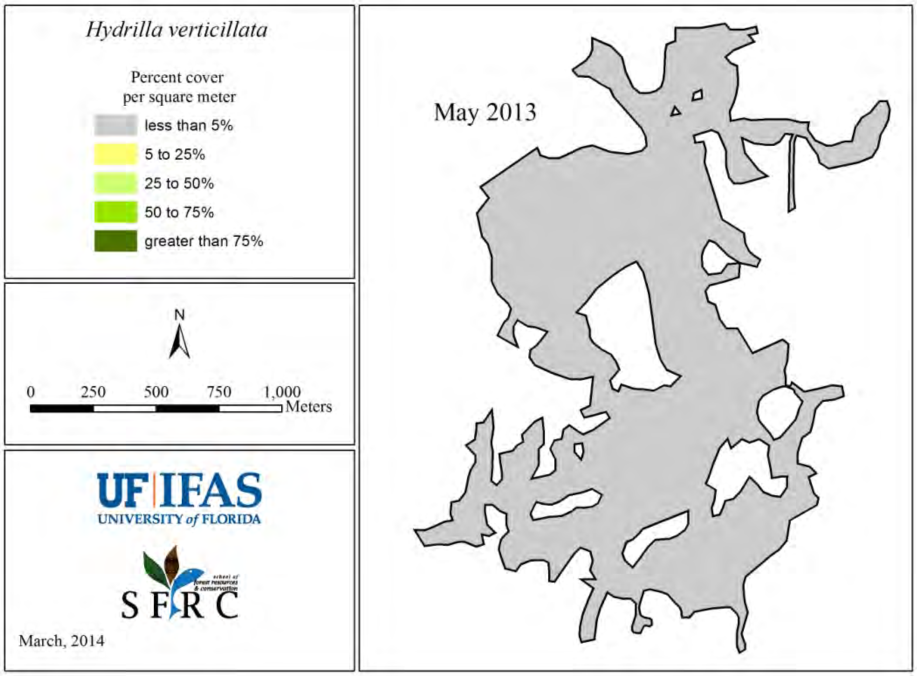
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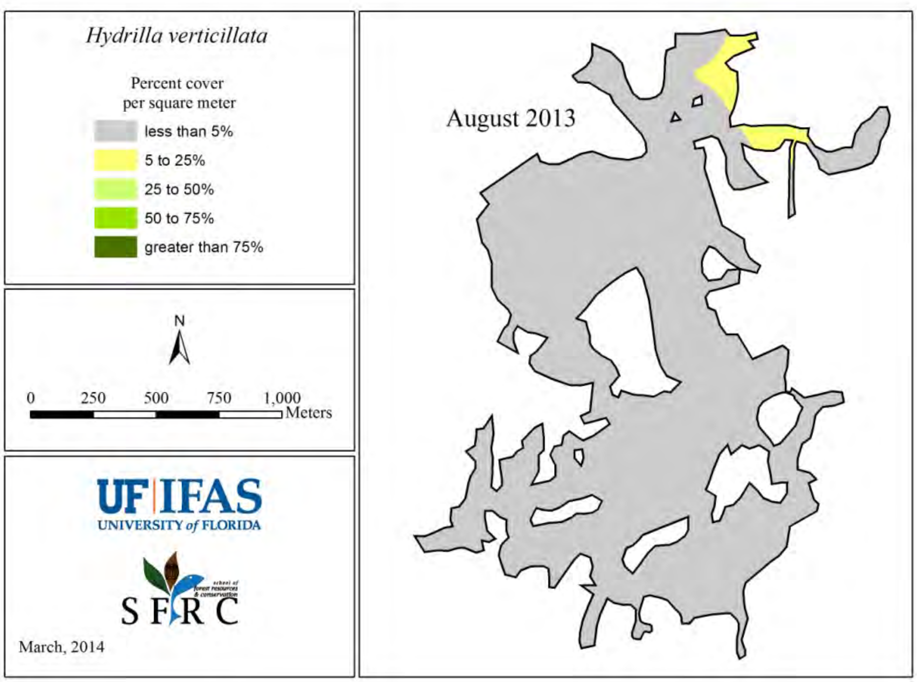
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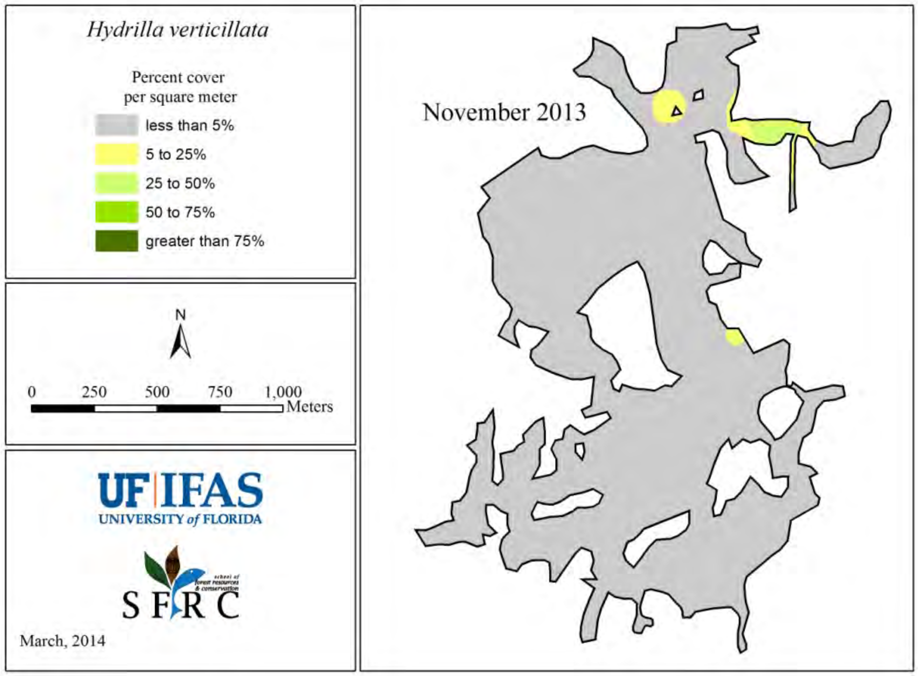
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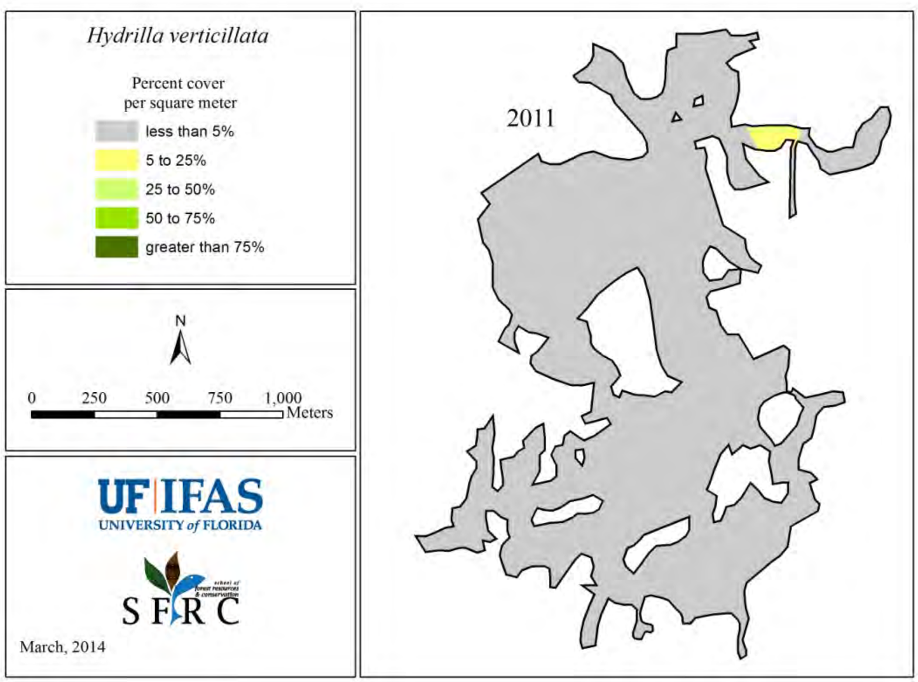
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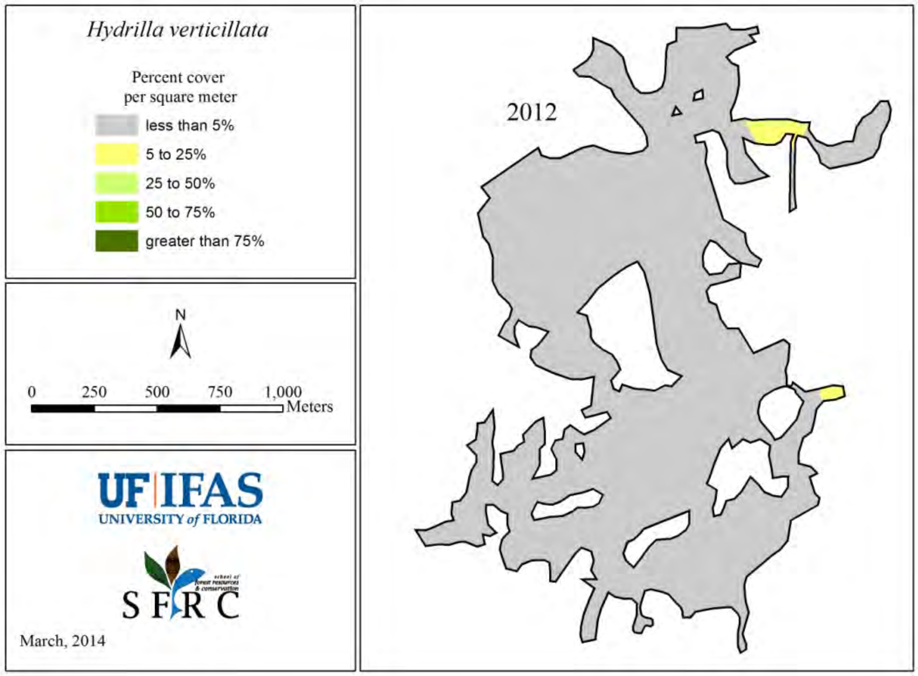
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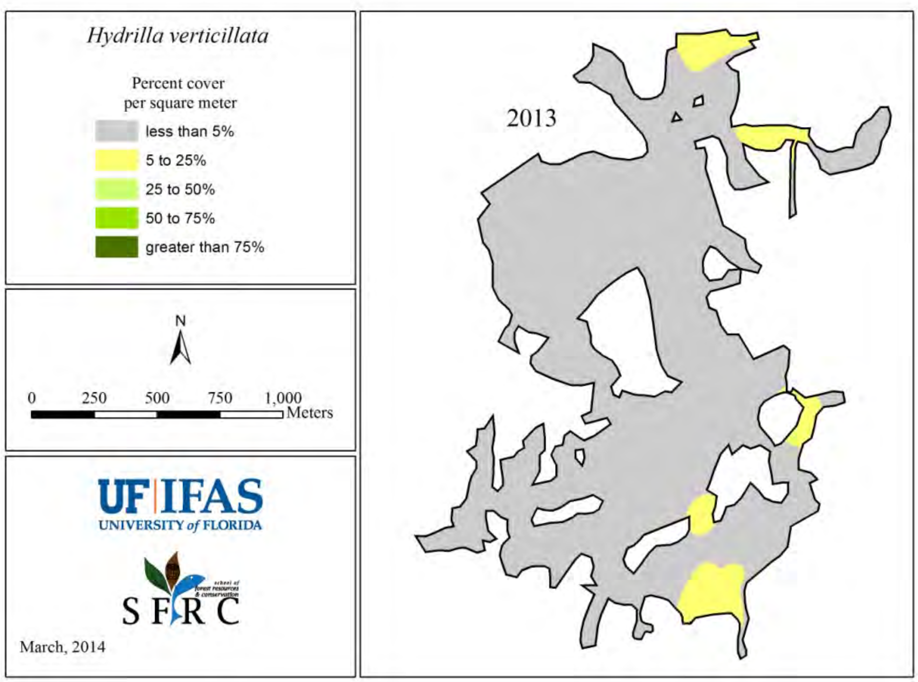
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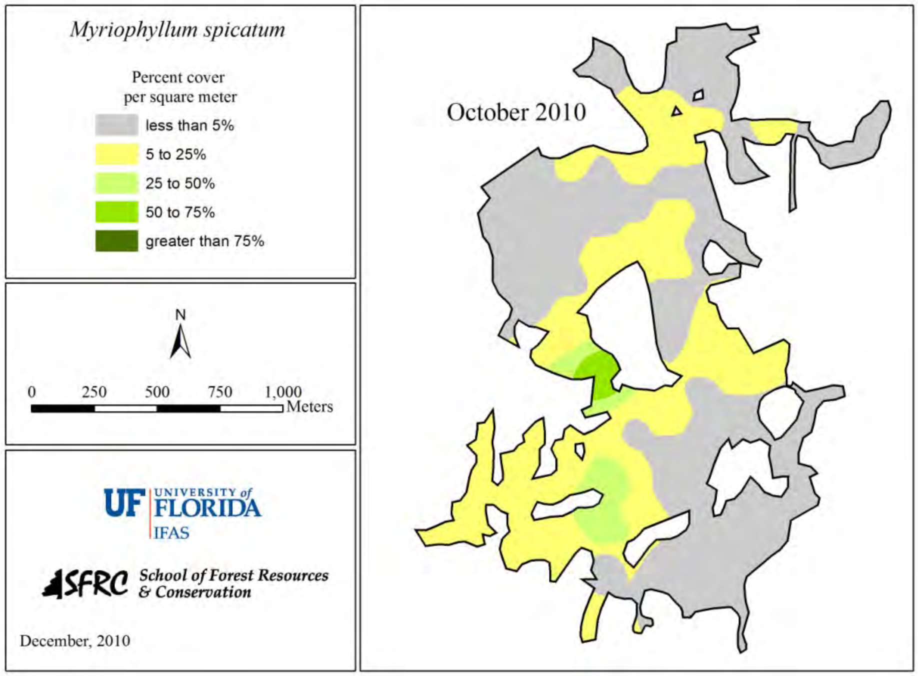
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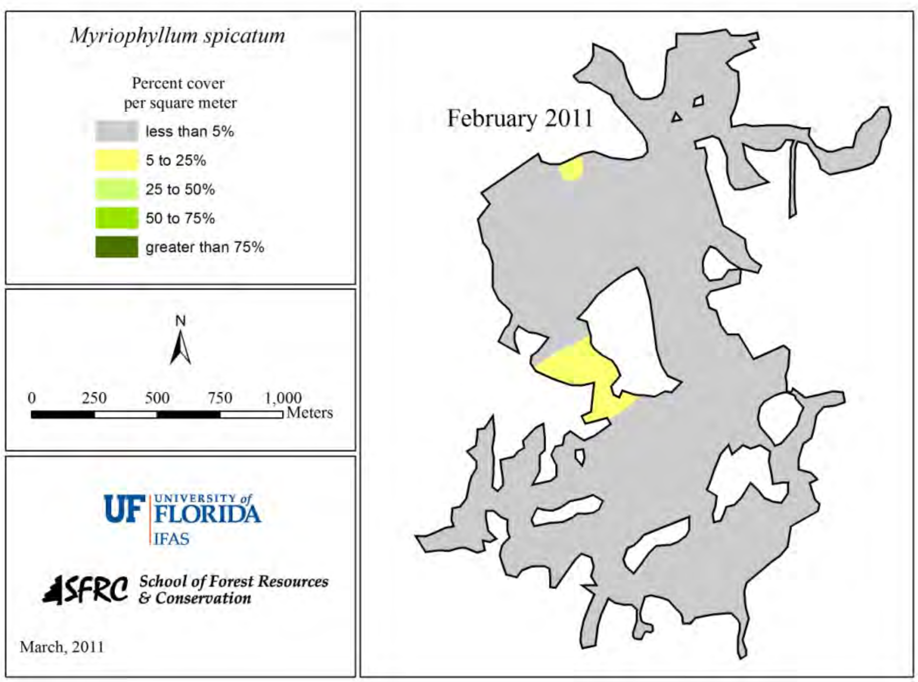
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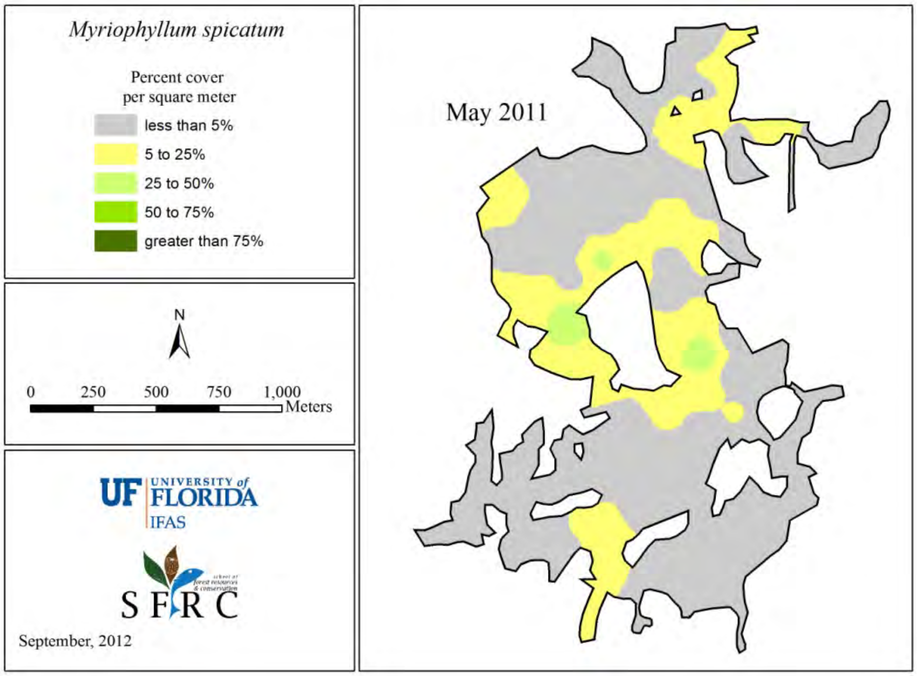
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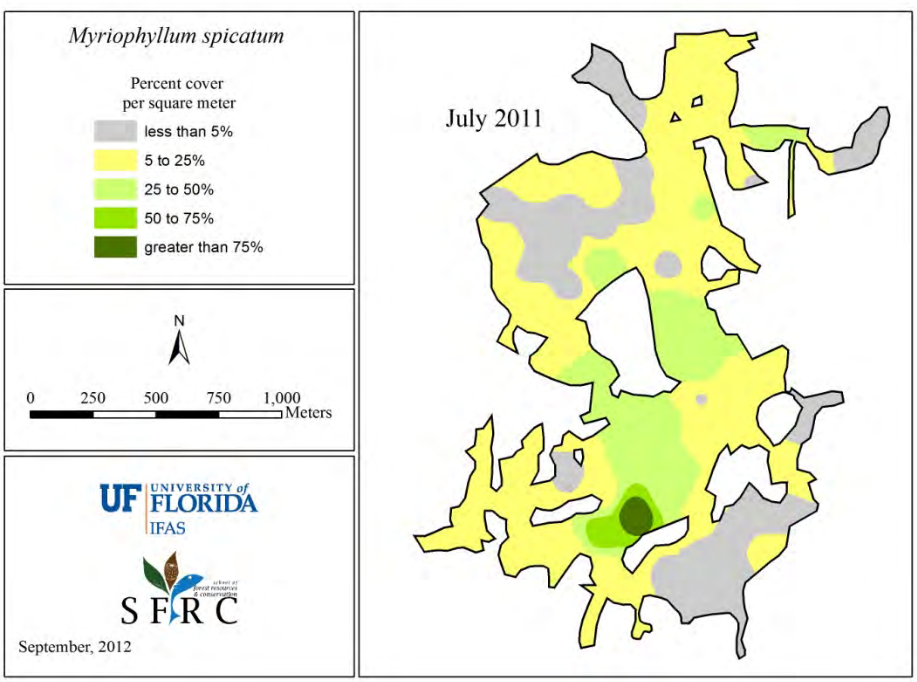
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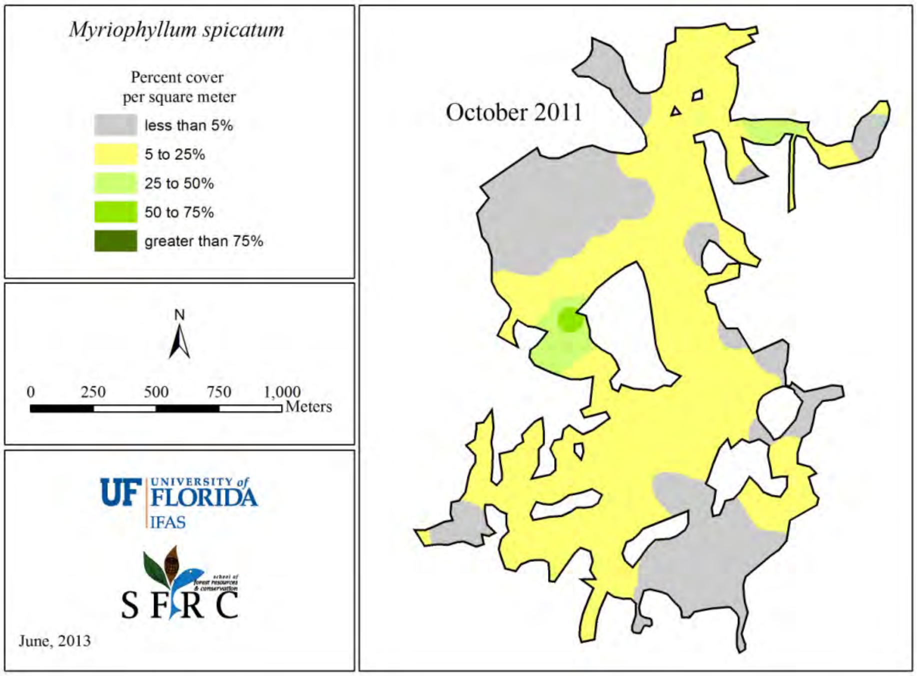
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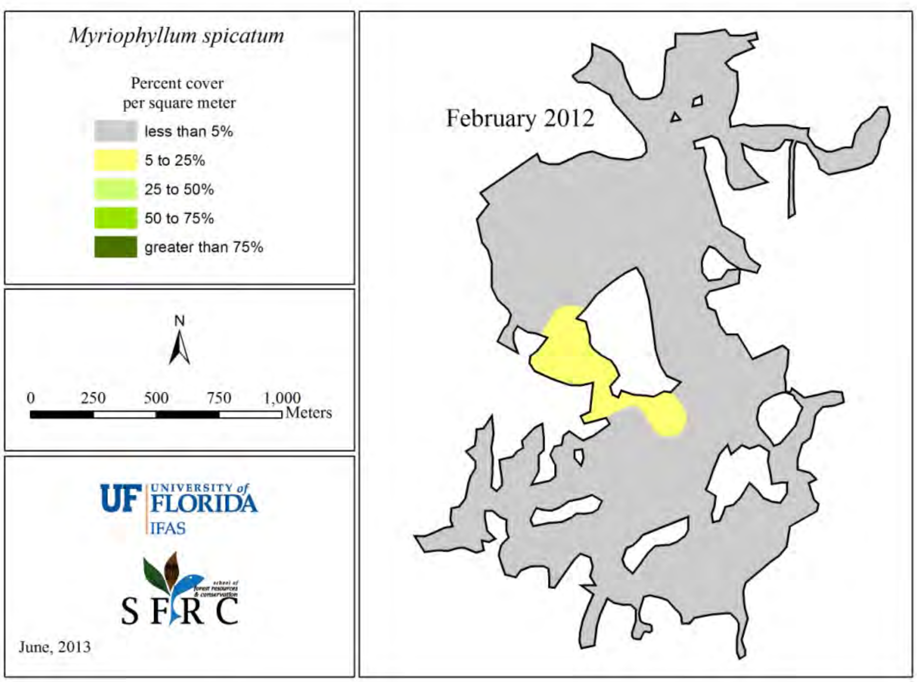
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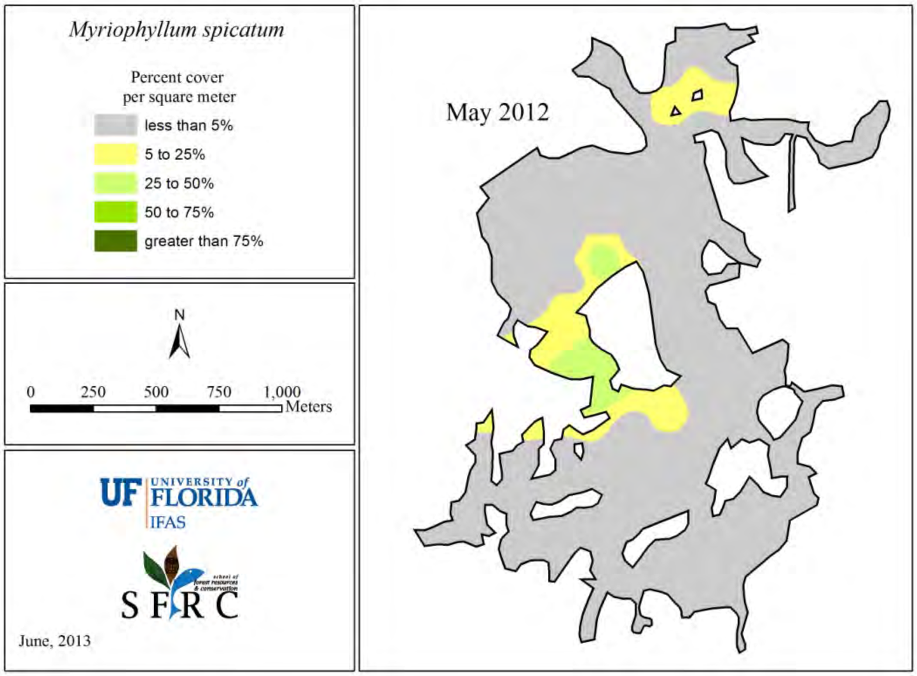
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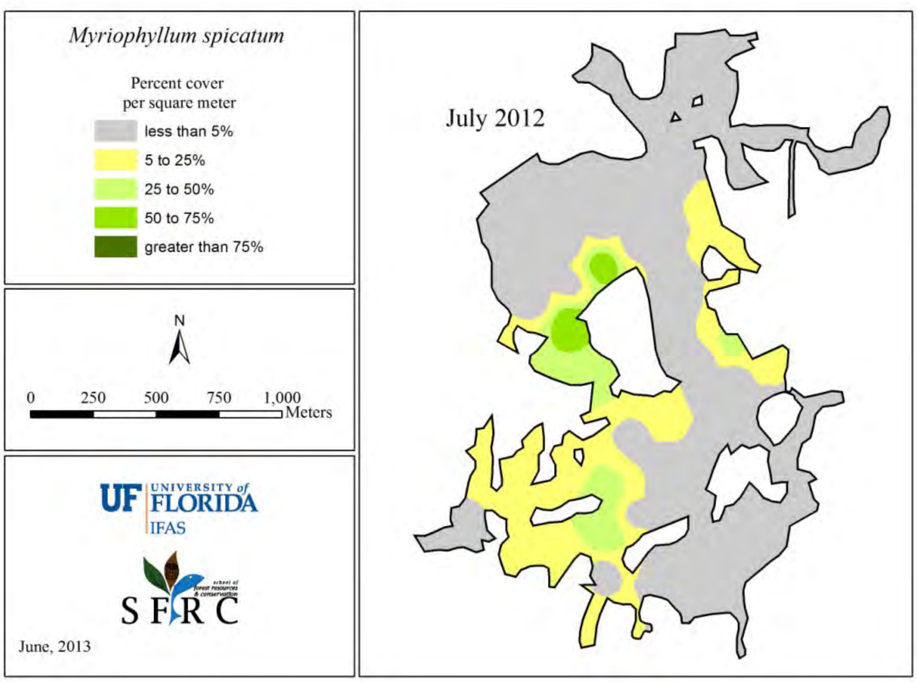
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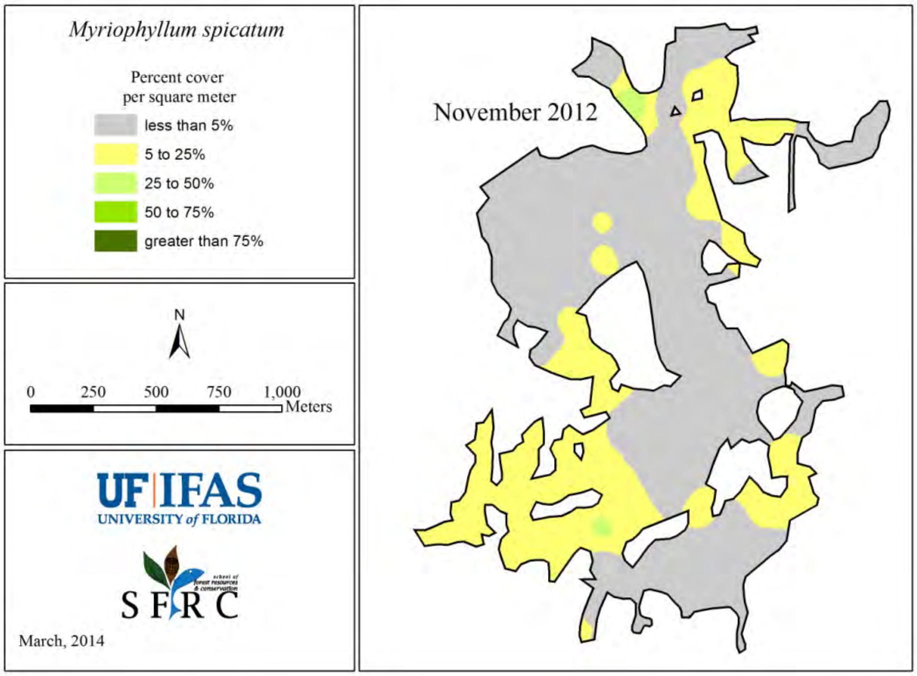
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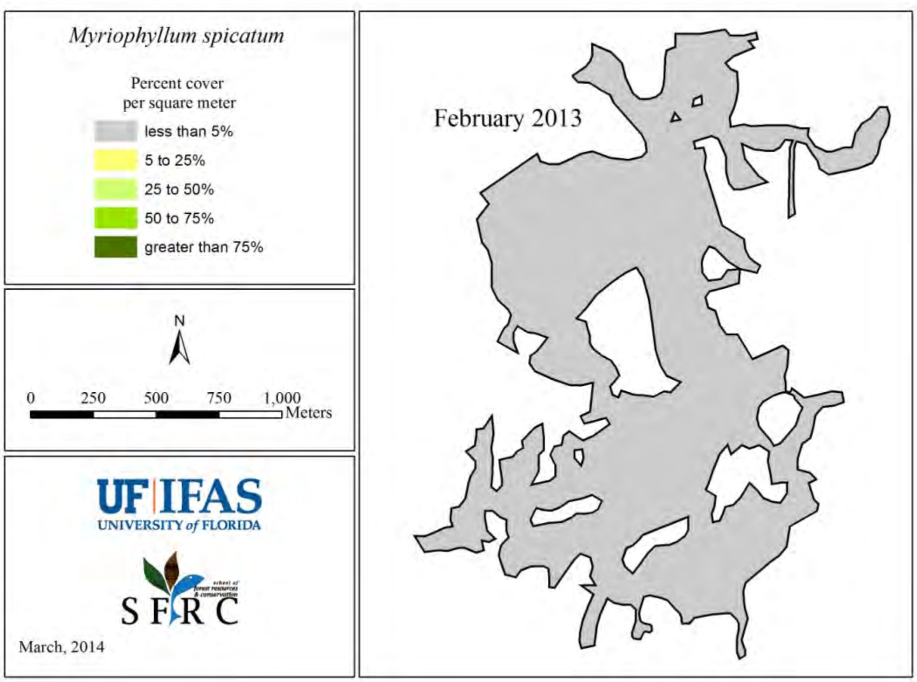
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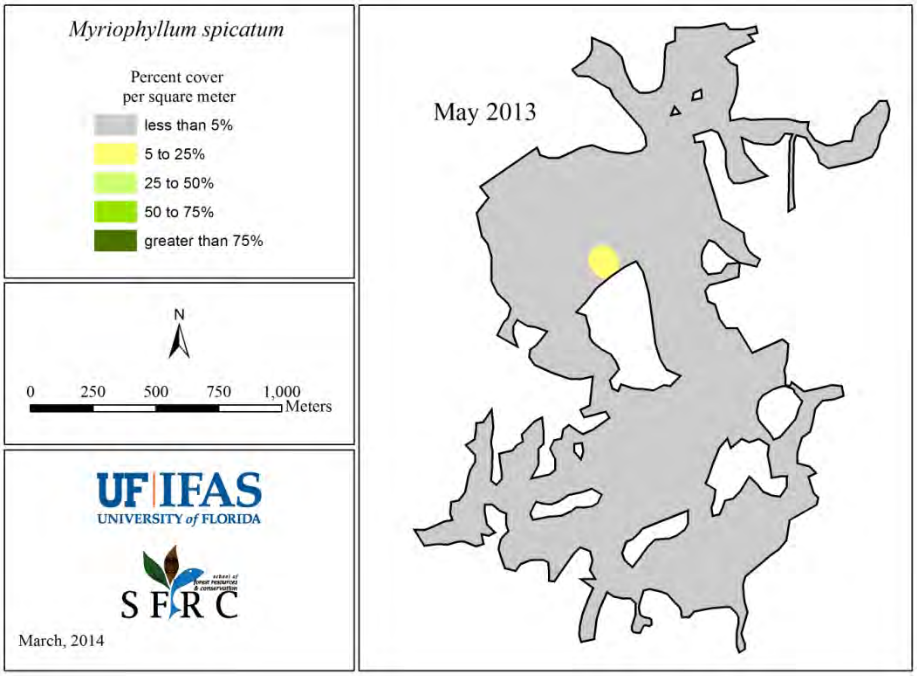
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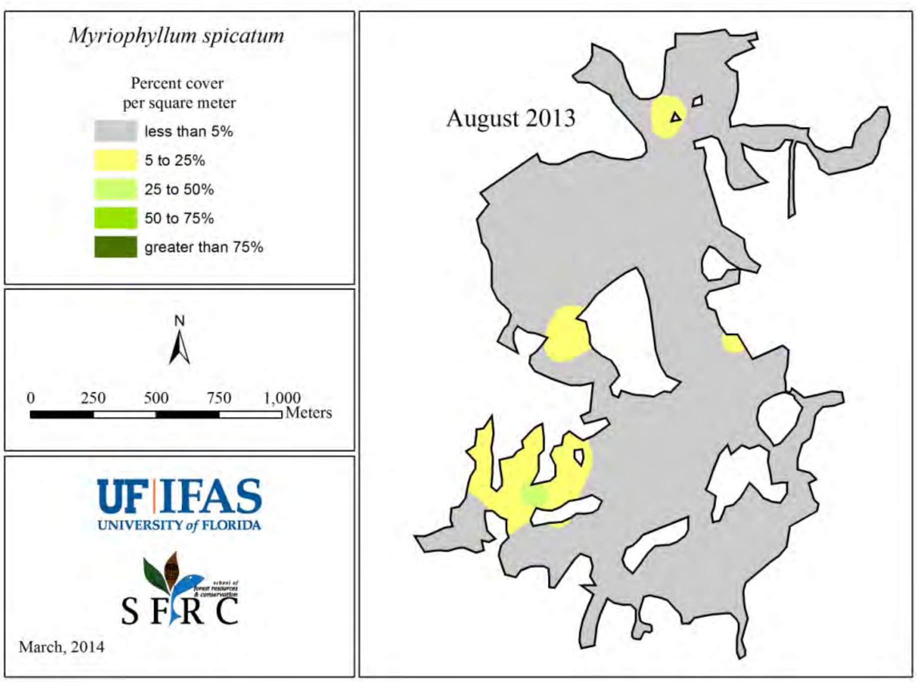
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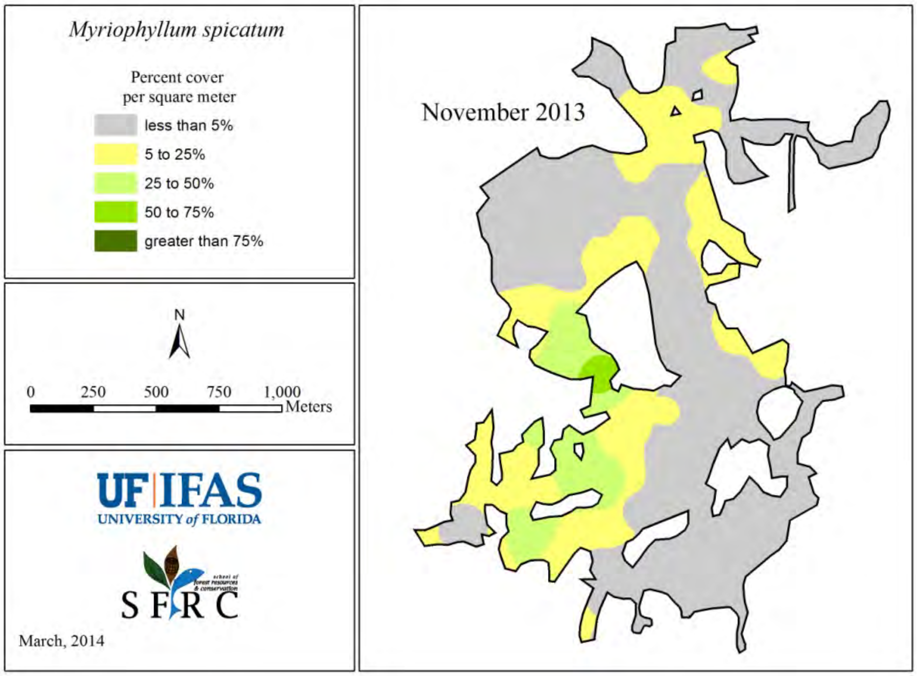
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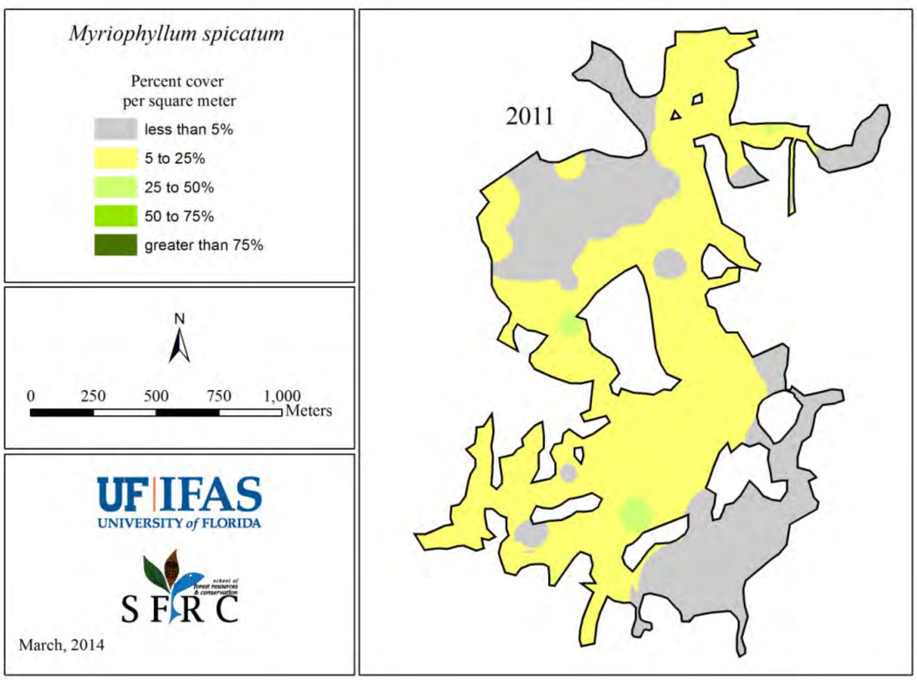
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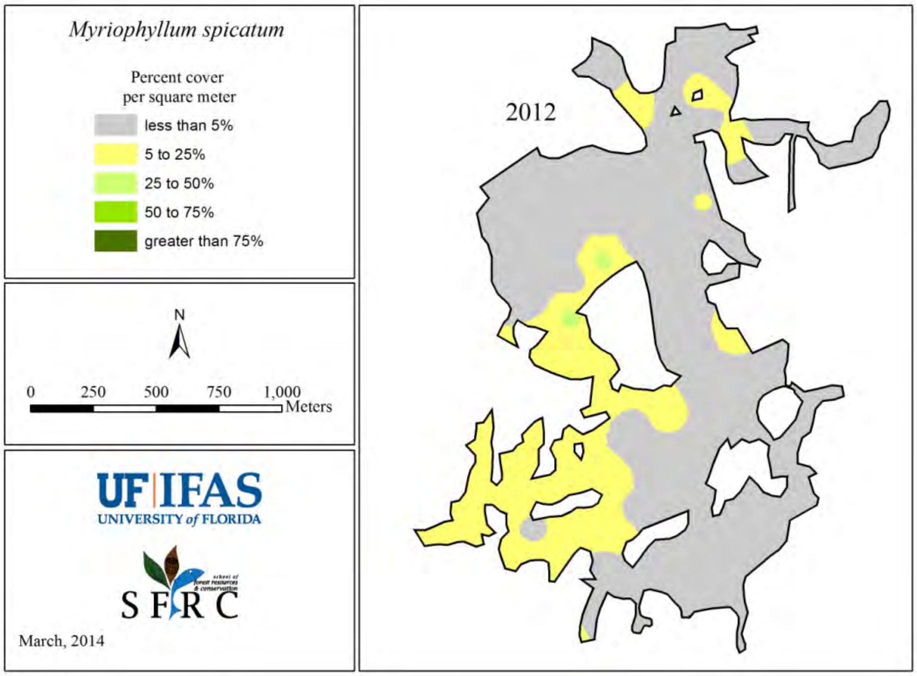
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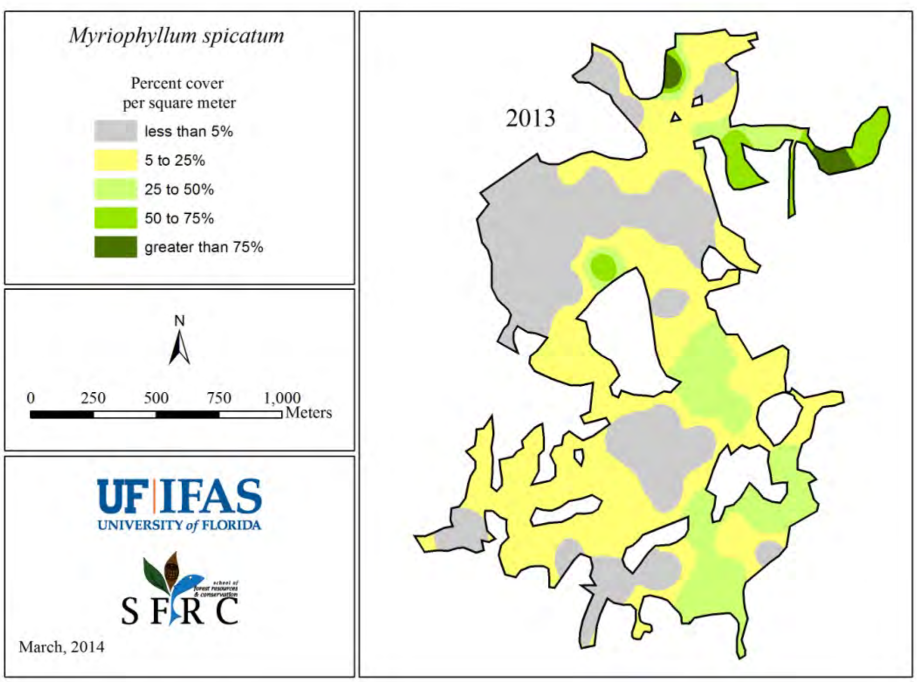
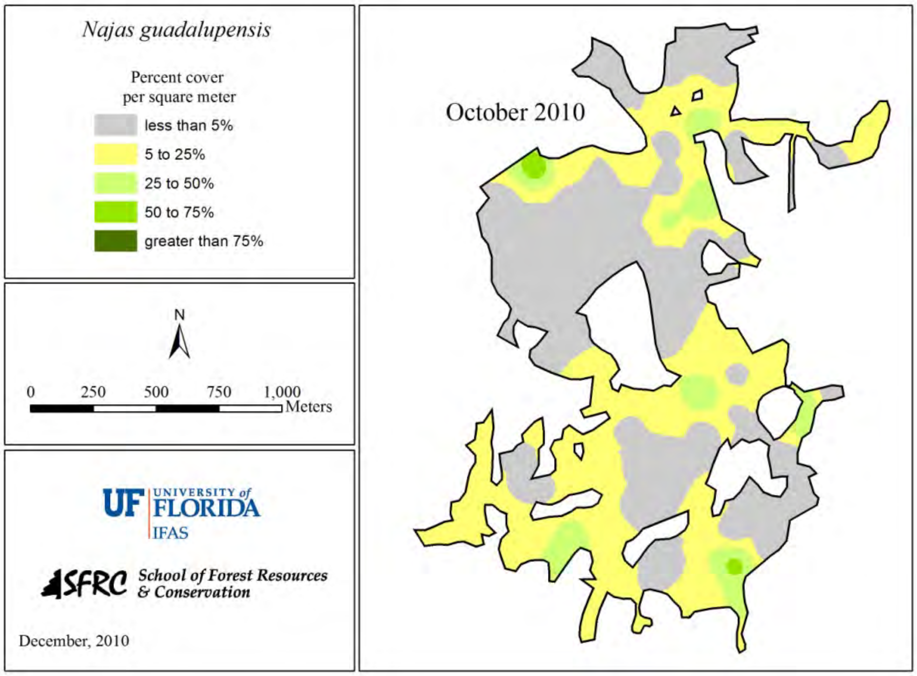
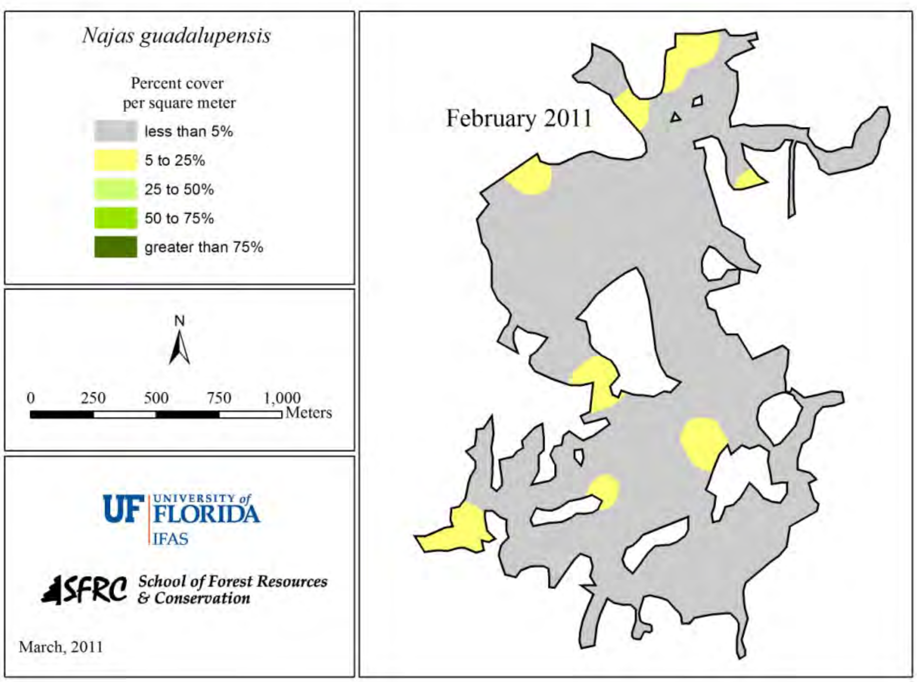

Myriophyllum spicatum
Percent cover
per square meter
less than 5%
5 to 25%
25 to 50%
50 to 75%
greater than 75%
N
0 250 500 750 1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2013


Najas guadalupensis
Percent cover per square meter
less than 5%
5 to 25%
25 to 50%
50 to 75%
greater than 75%
N
0 250 500 750 1,000 Meters
UF UNIVERSITY of FLORIDA IFAS
SFRC School of Forest Resources & Conservation
December, 2010
October 2010


Najas guadalupensis
Percent cover per square meter
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UF UNIVERSITY of FLORIDA IFAS
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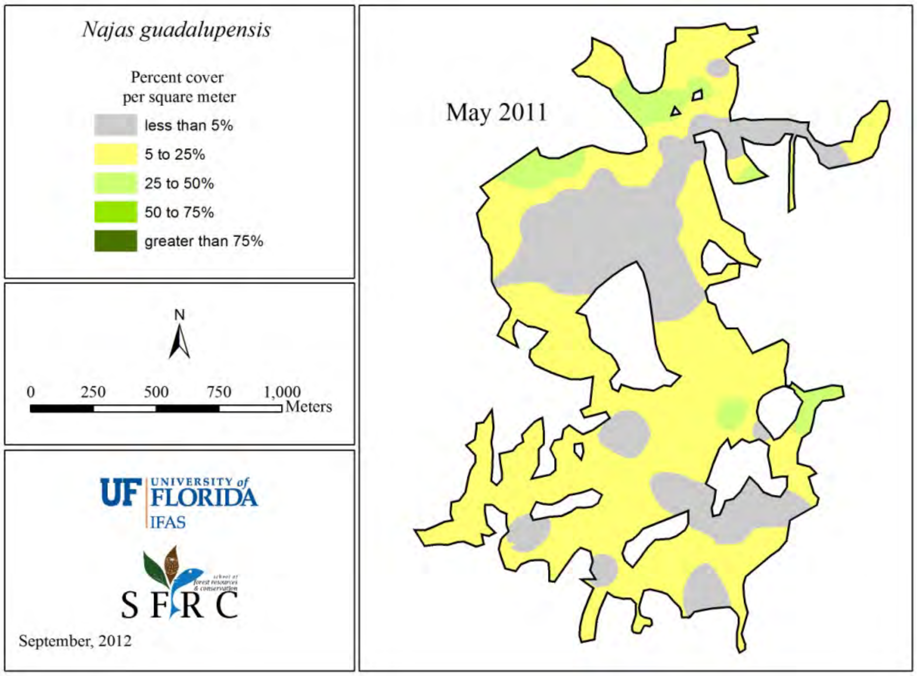
March, 2011
February 2011


Najas guadalupensis
Percent cover
per square meter
less than 5%
5 to 25%
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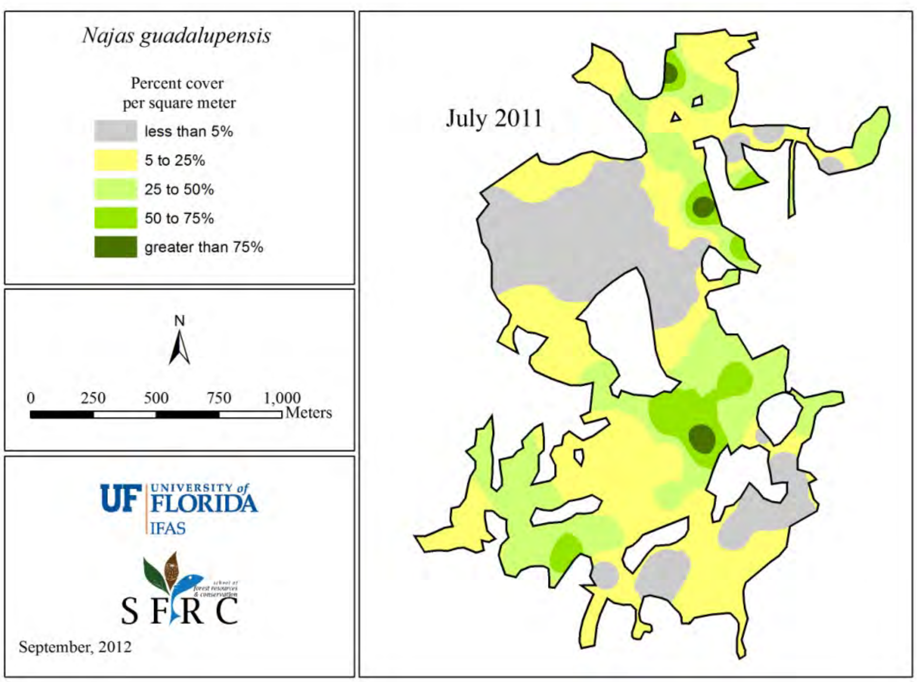
250
500
750
1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC
September, 2012
May 2011


Najas guadalupensis
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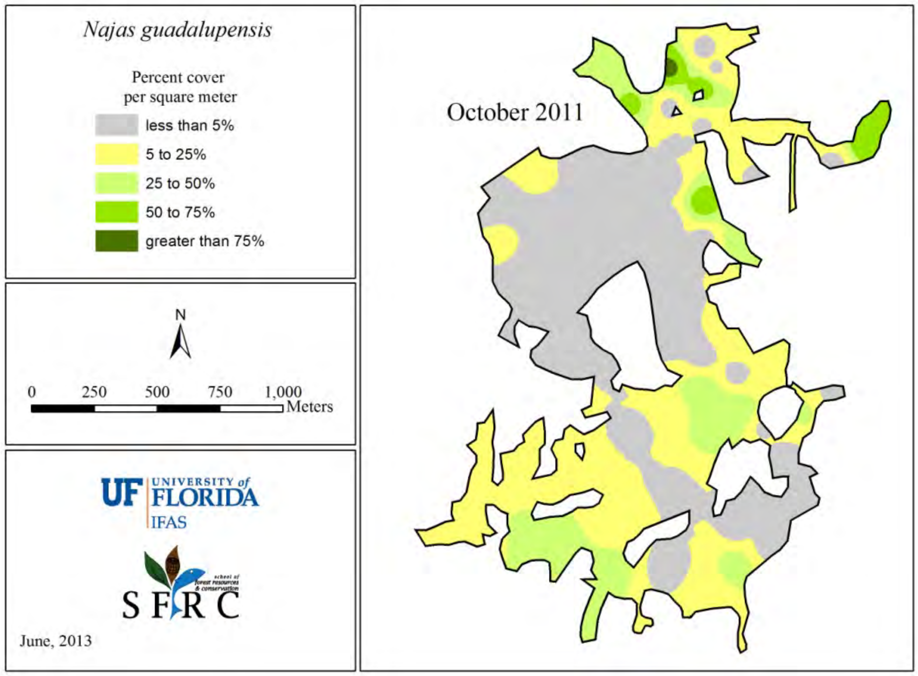
SFRC
September, 2012
July 2011


Najas guadalupensis
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UF UNIVERSITY of FLORIDA
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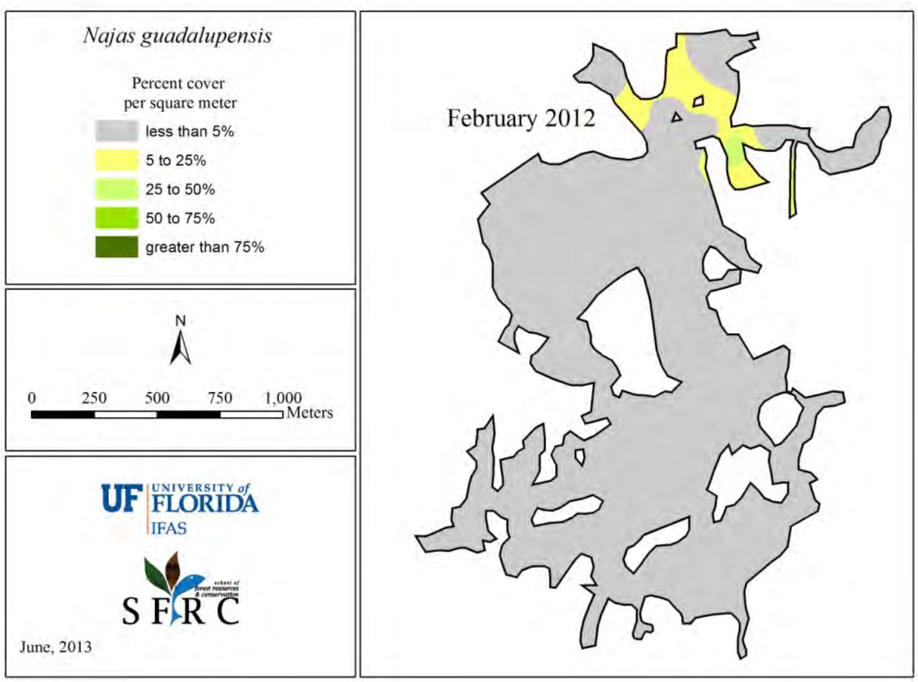
June, 2013
October 2011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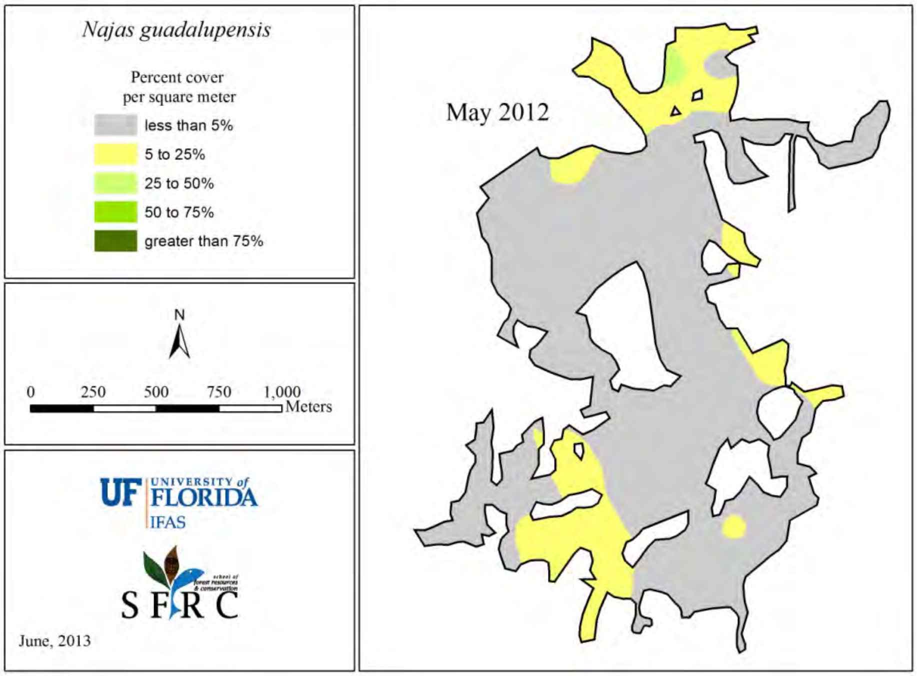
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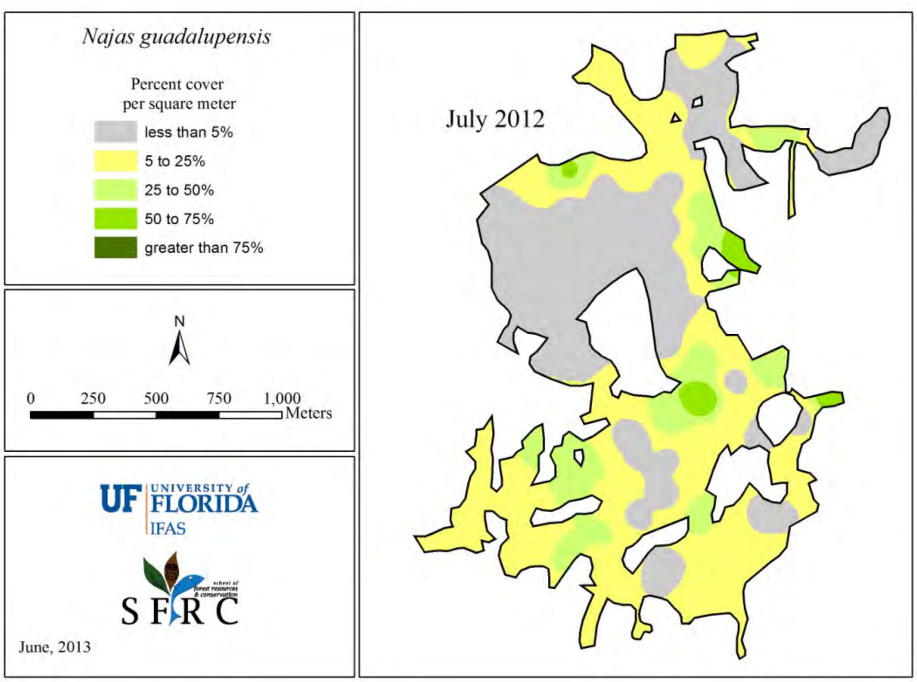
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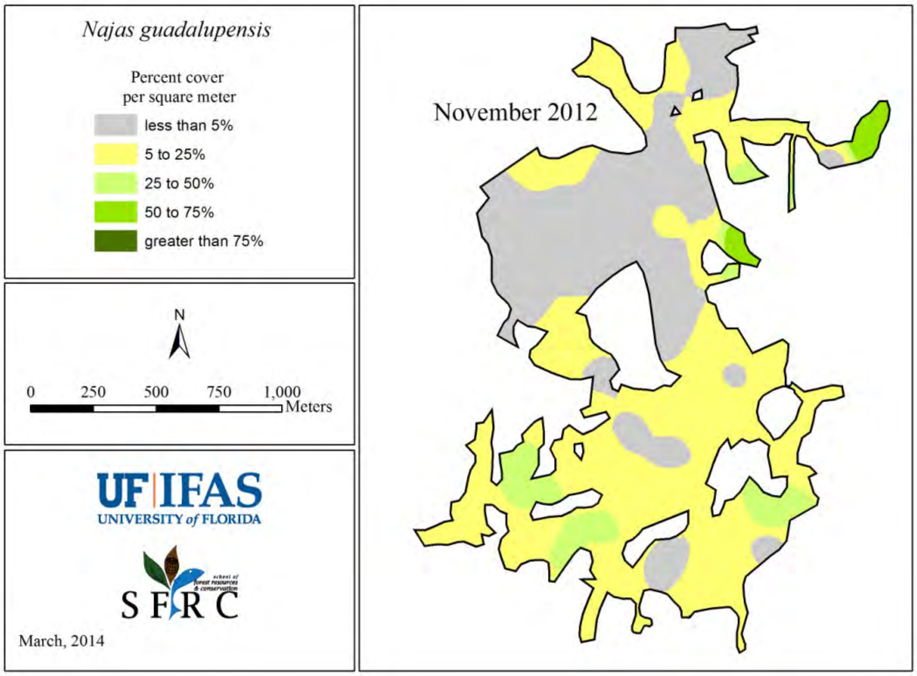
July 2012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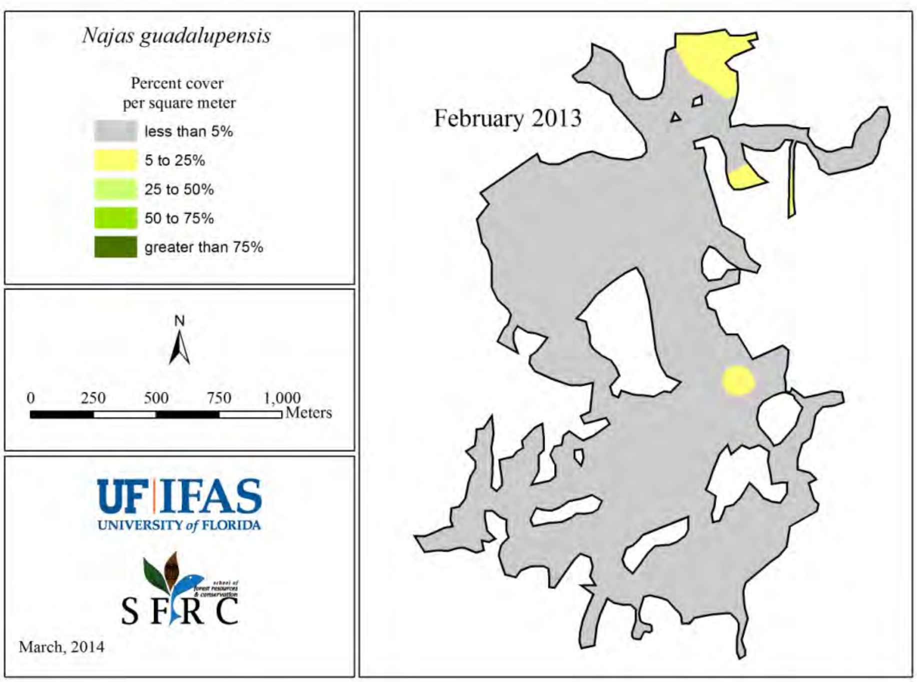
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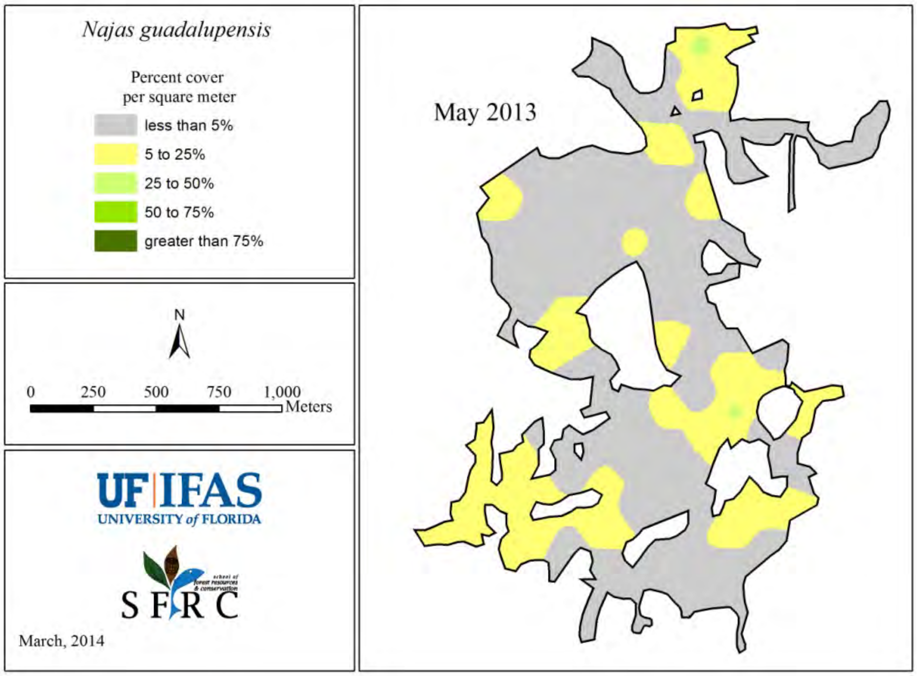
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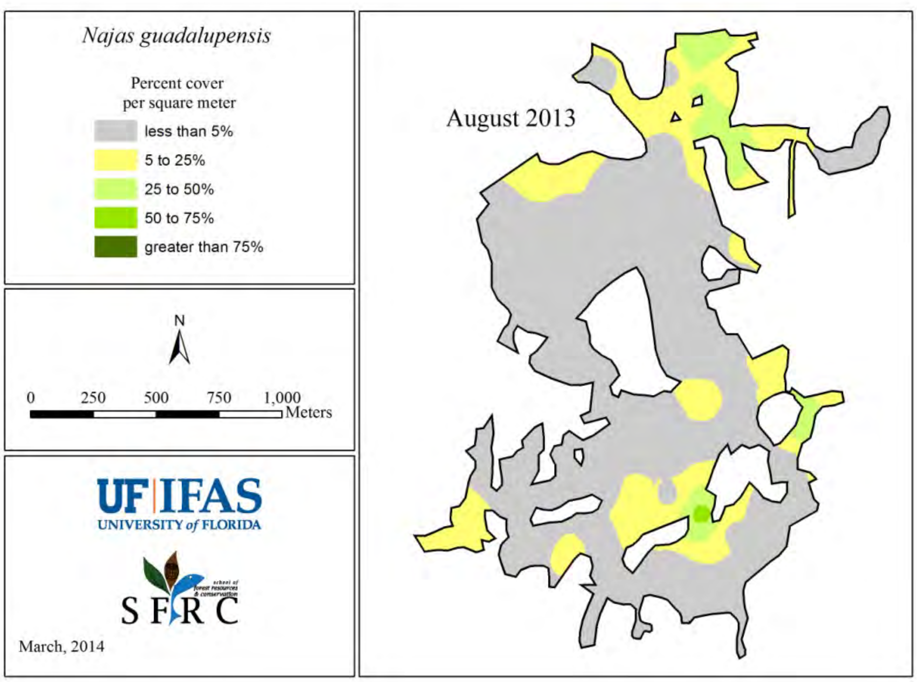
March, 2014
May 2013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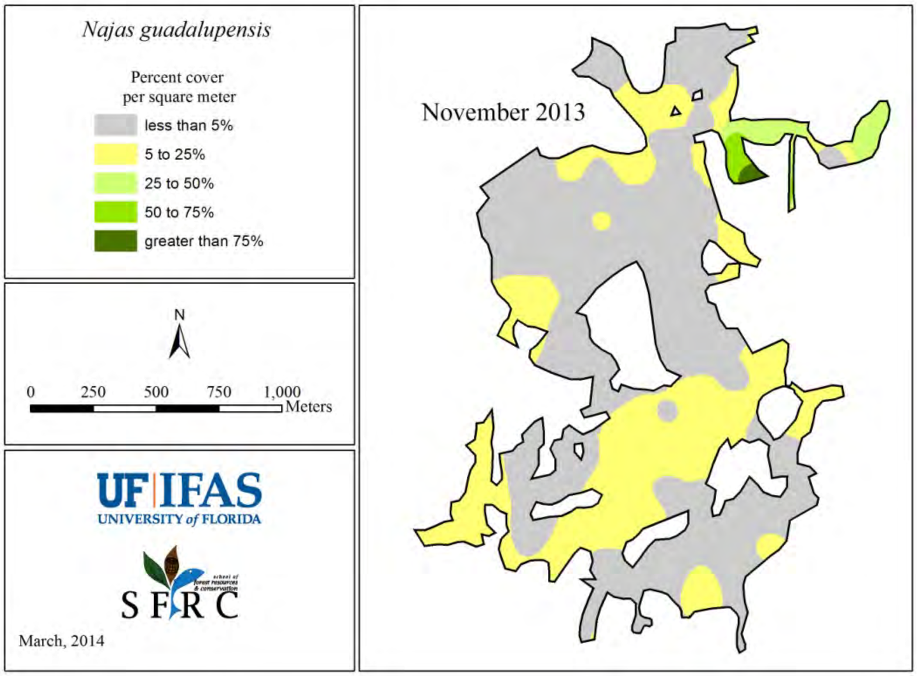
S F R C
March, 2014
August 2013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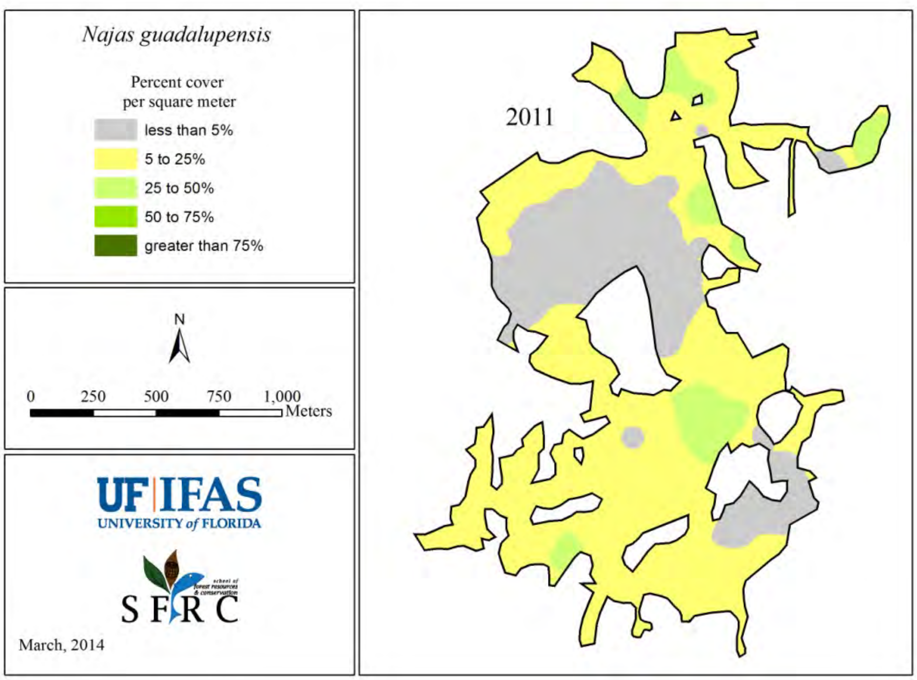
November 2013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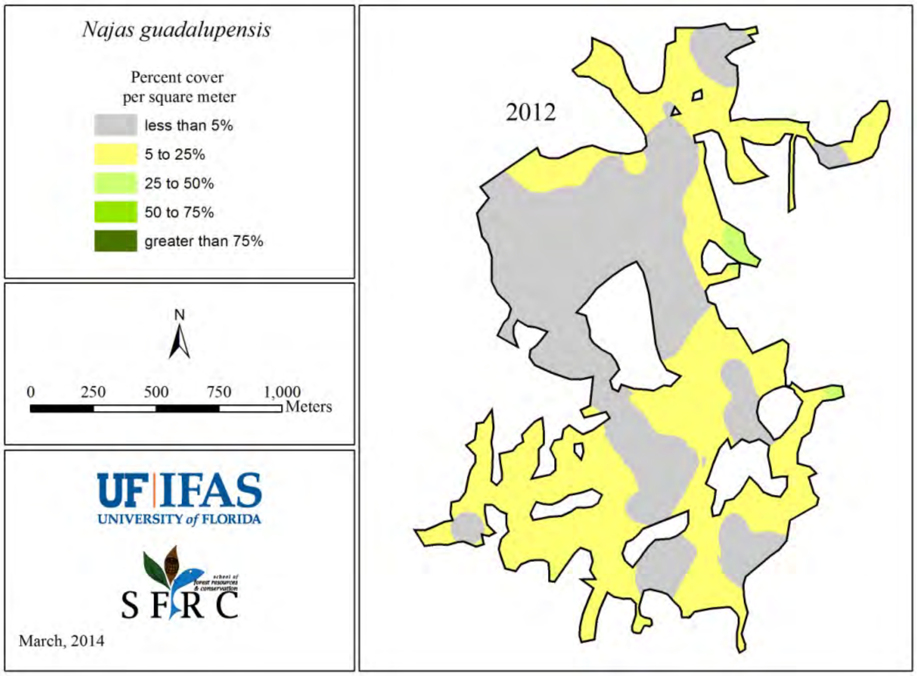
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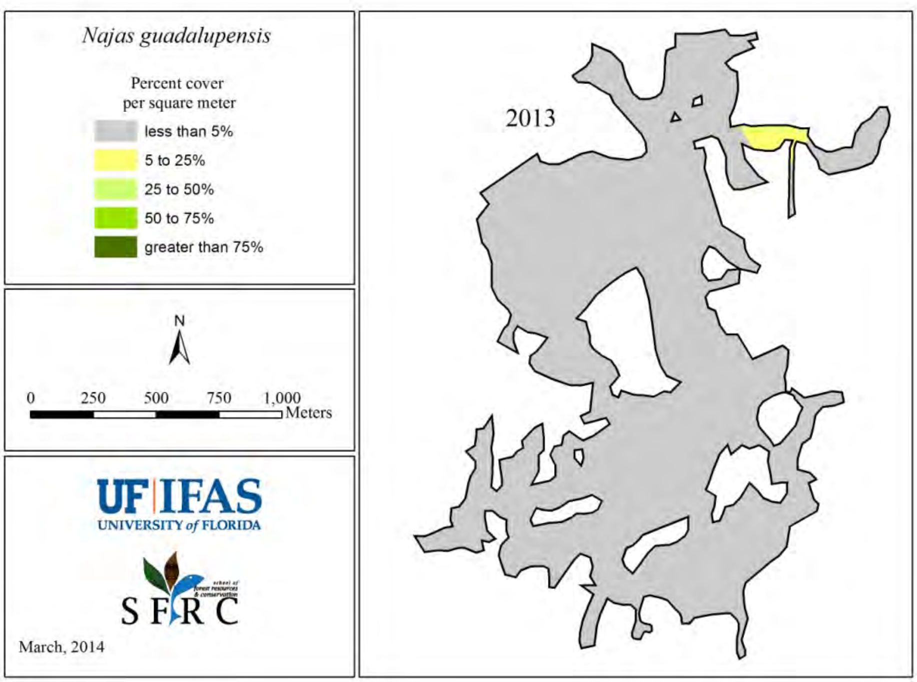
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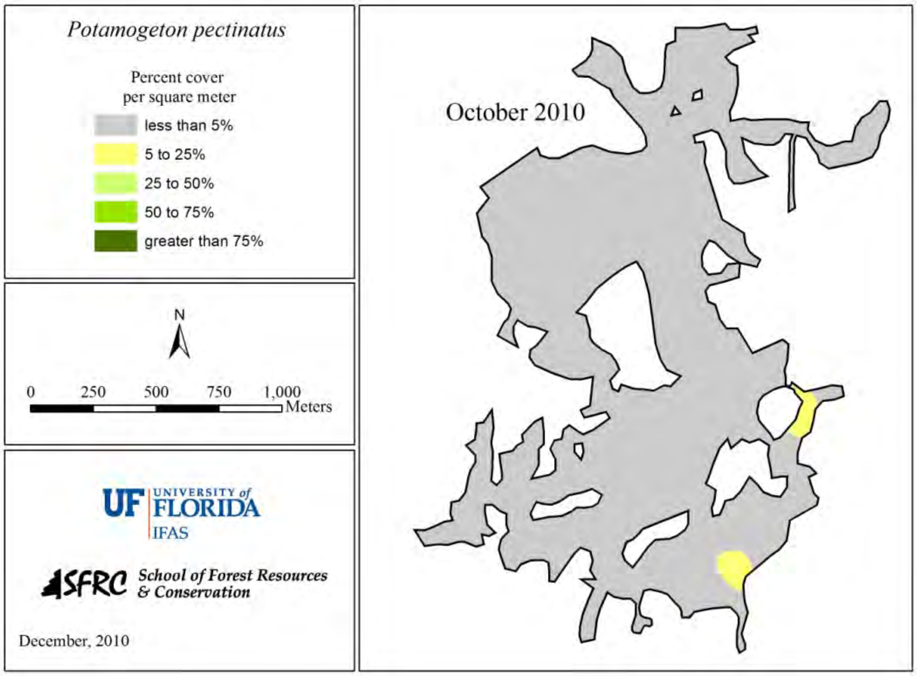
Potamogeton pectinatus
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UF UNIVERSITY of FLORIDA IFAS
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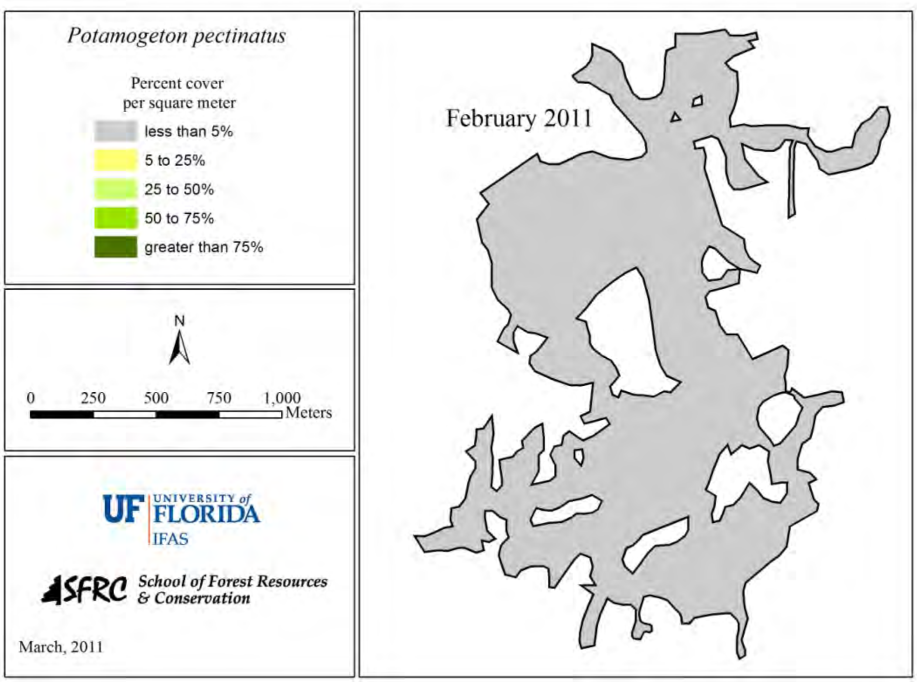
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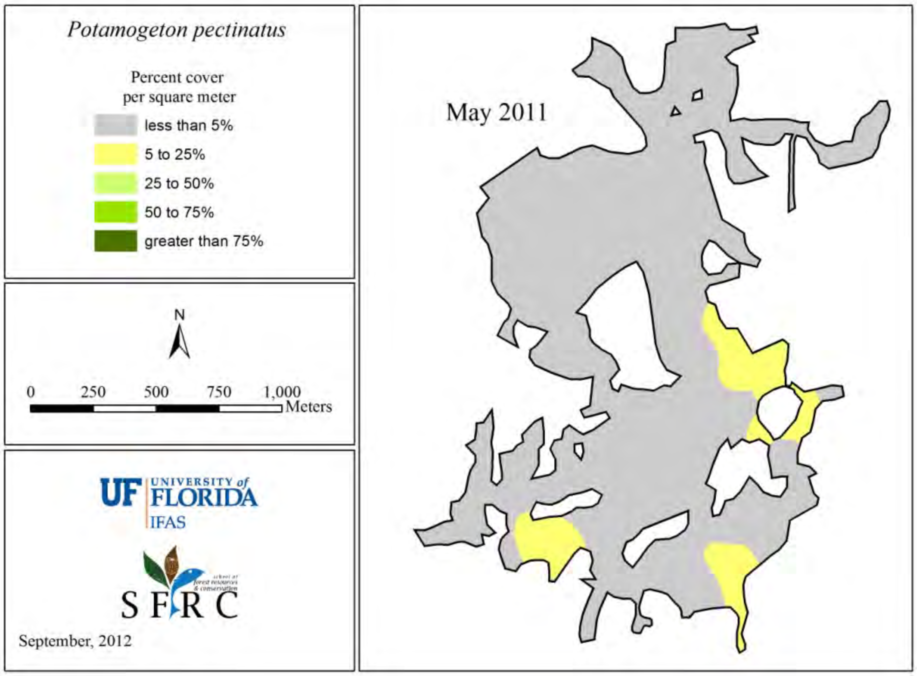
Potamogeton pectinatus
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UF UNIVERSITY of FLORIDA
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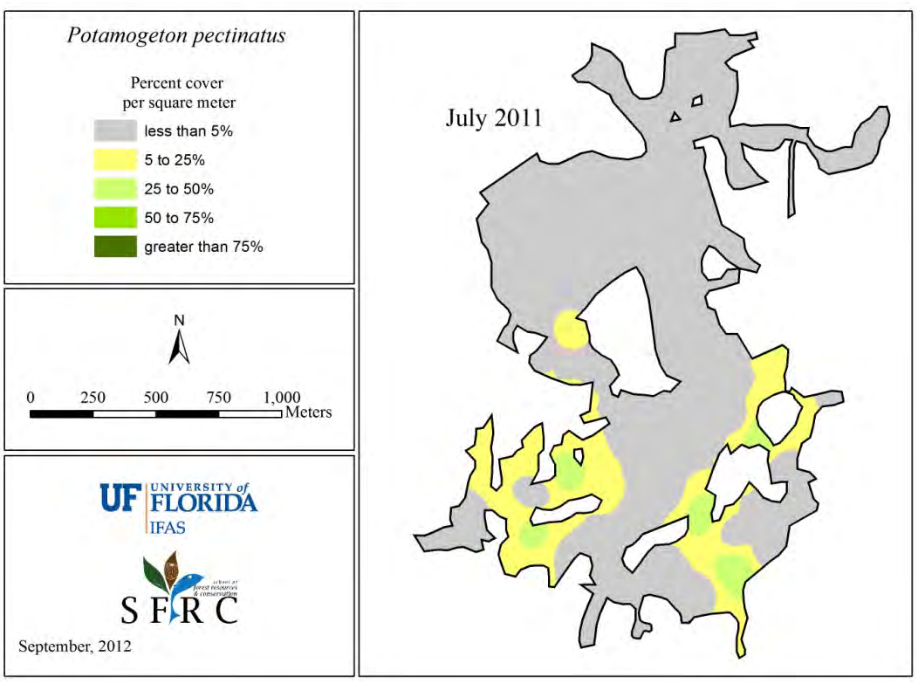
S F R C
September, 2012
May 2011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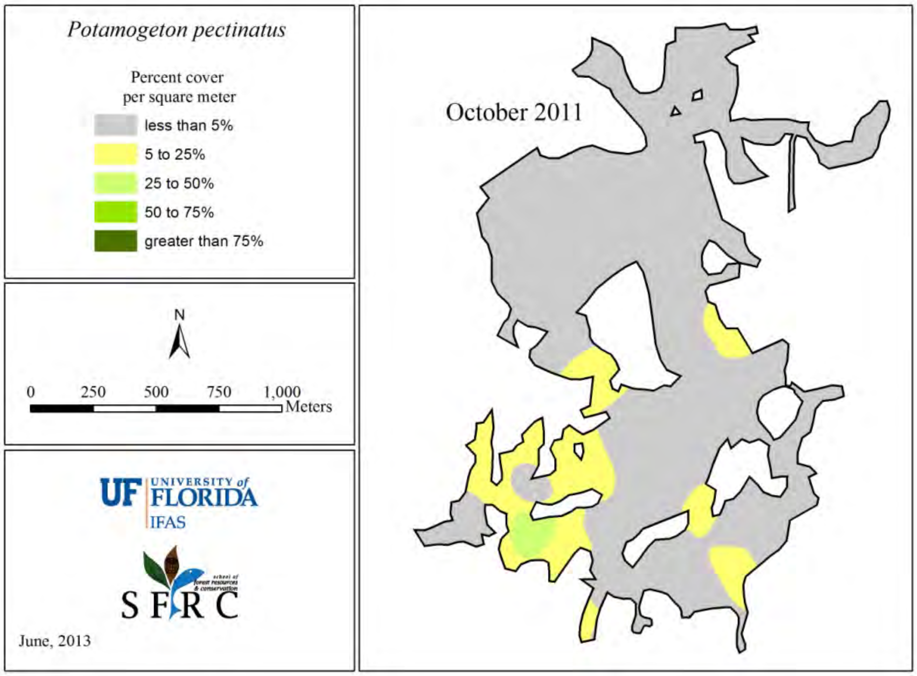
September, 2012
July 2011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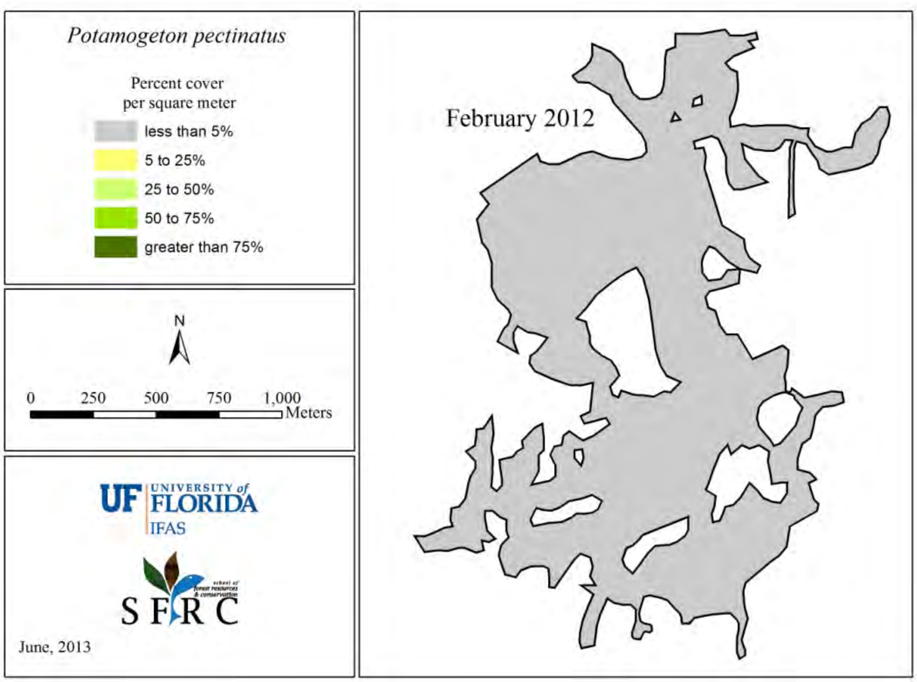
October 2011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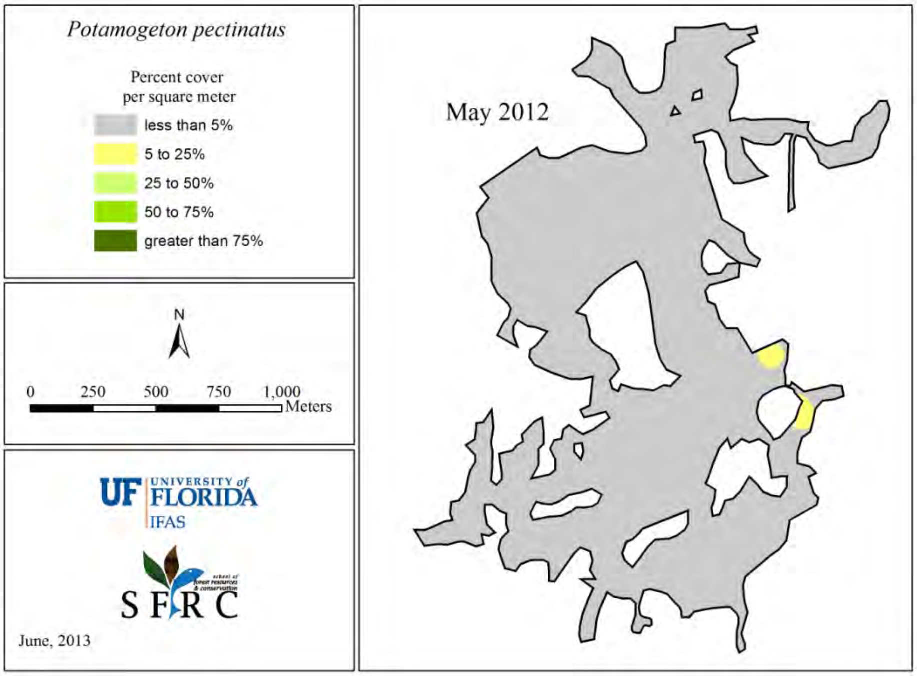
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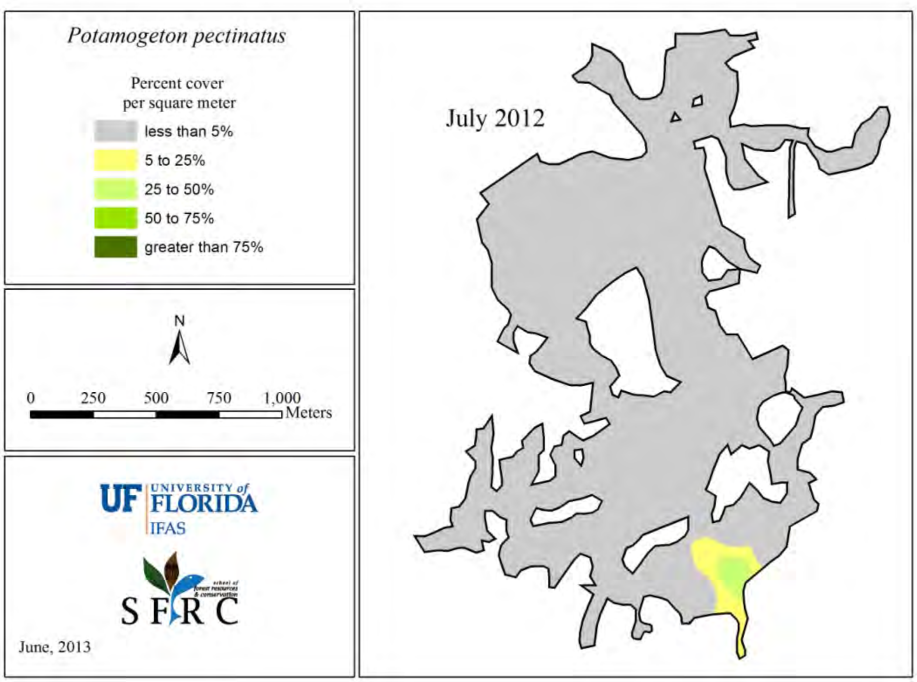
June, 2013
May 2012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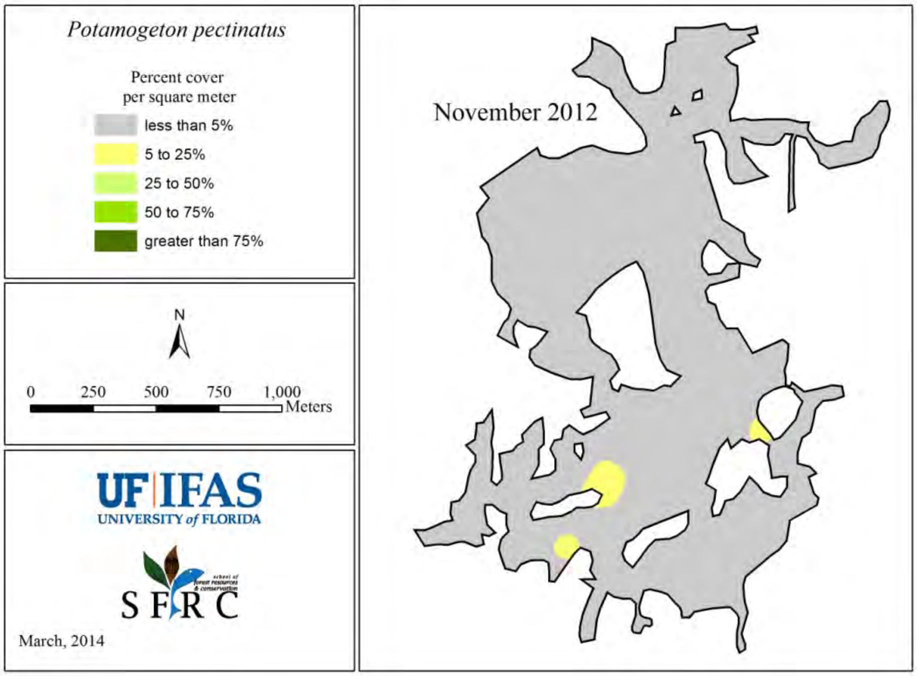
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UF IFAS
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S F R C
March, 2014
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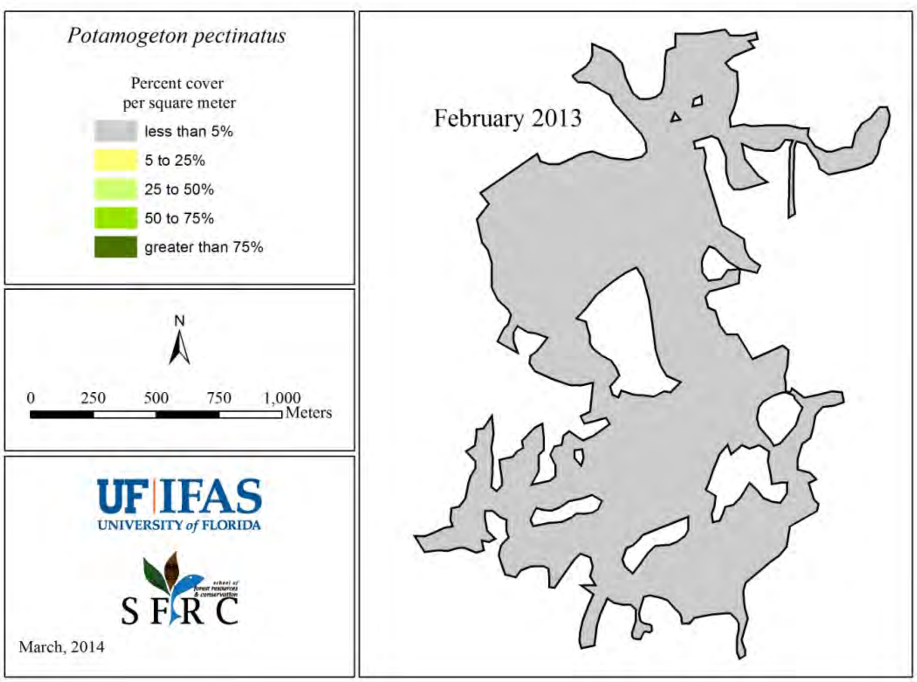
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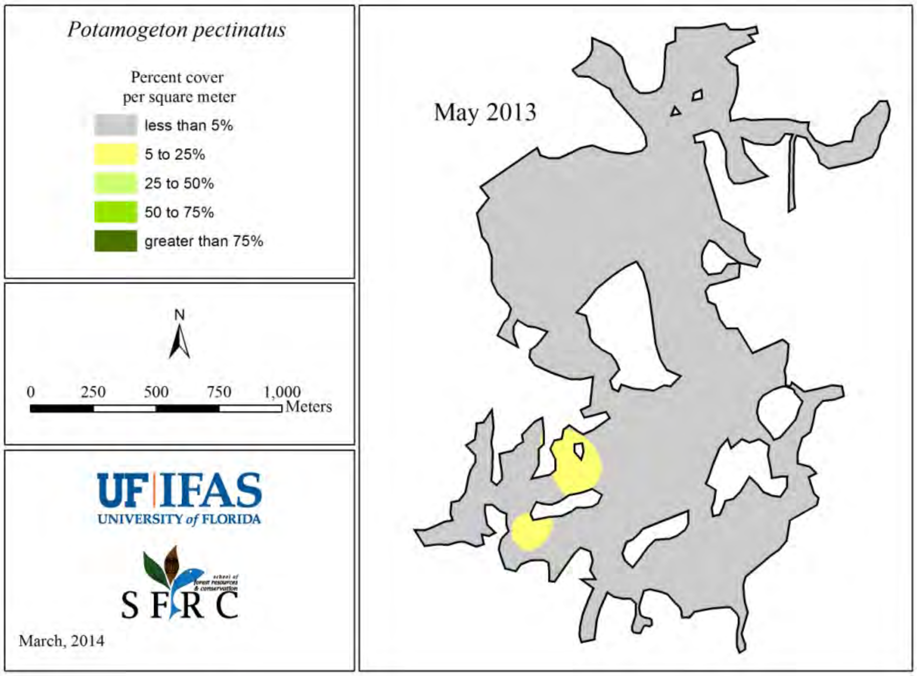
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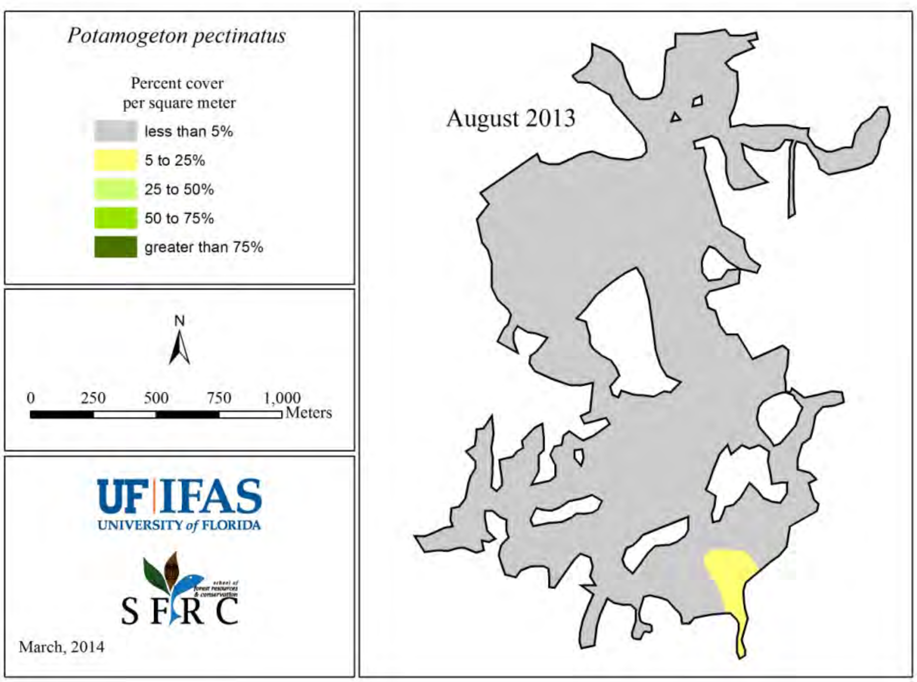
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March, 2014
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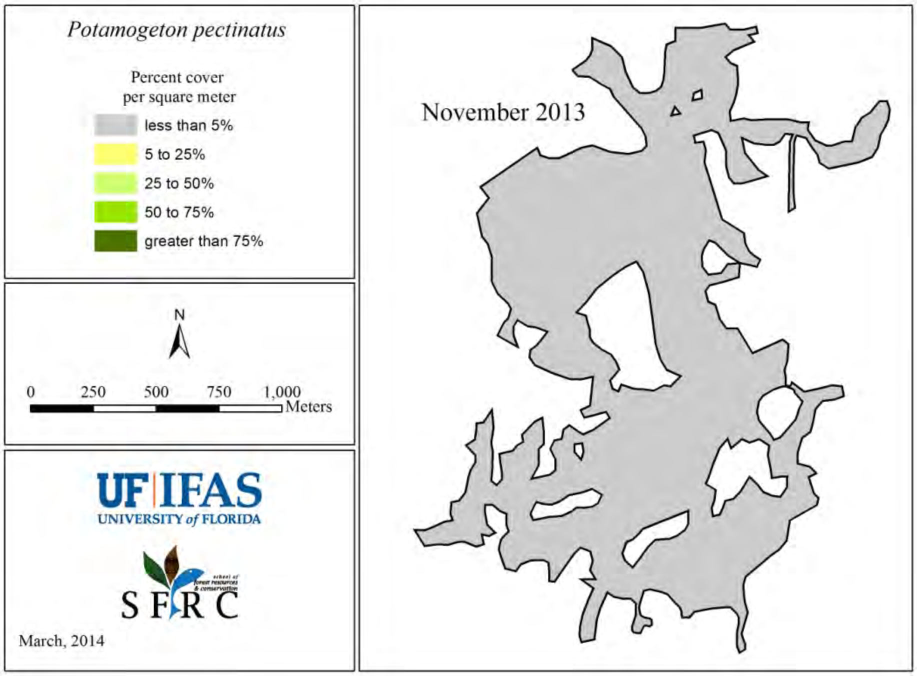
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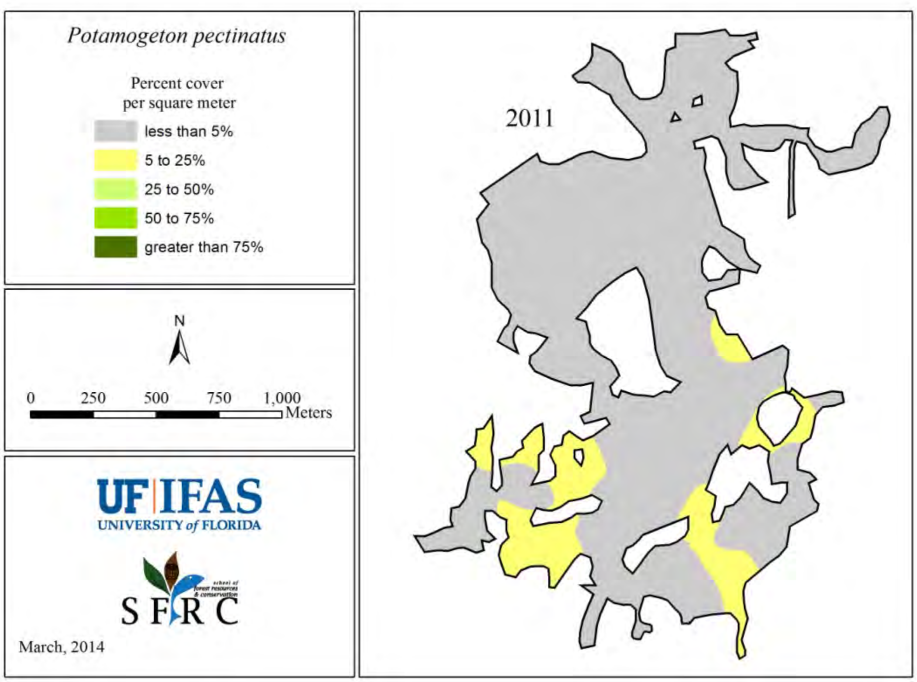
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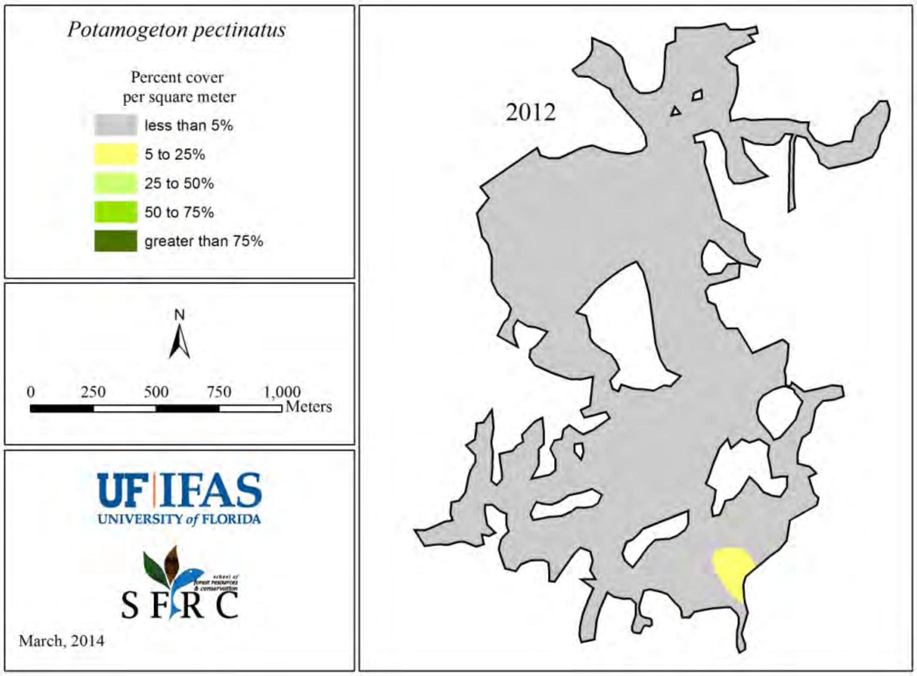
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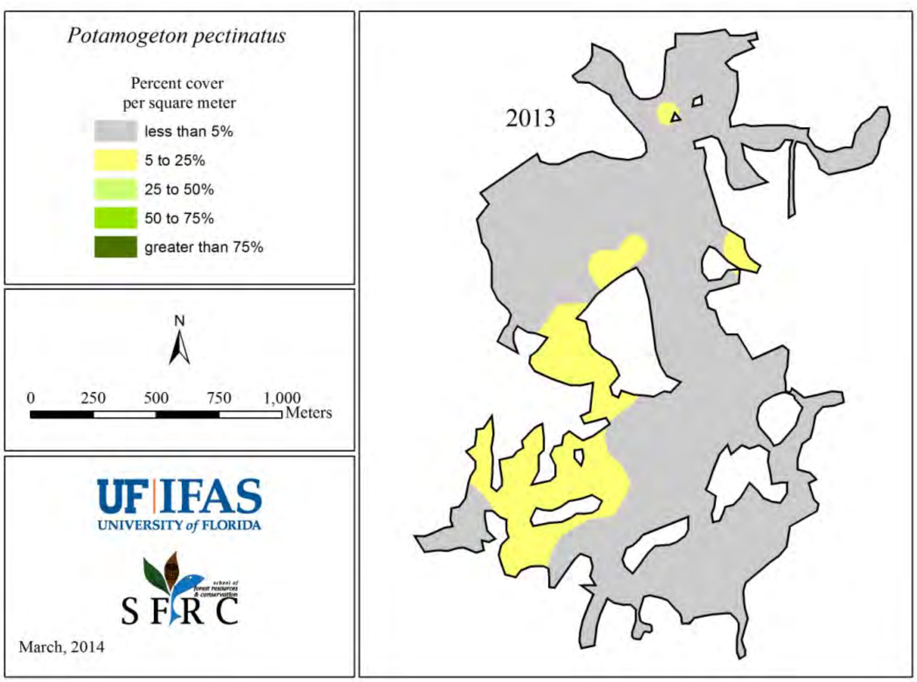
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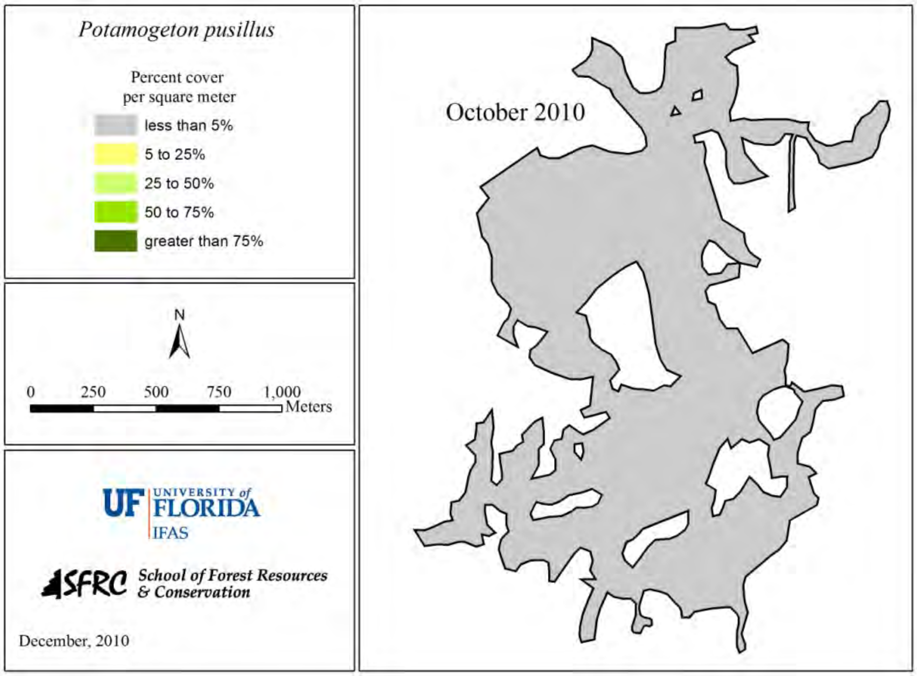
Potamogeton pusillus
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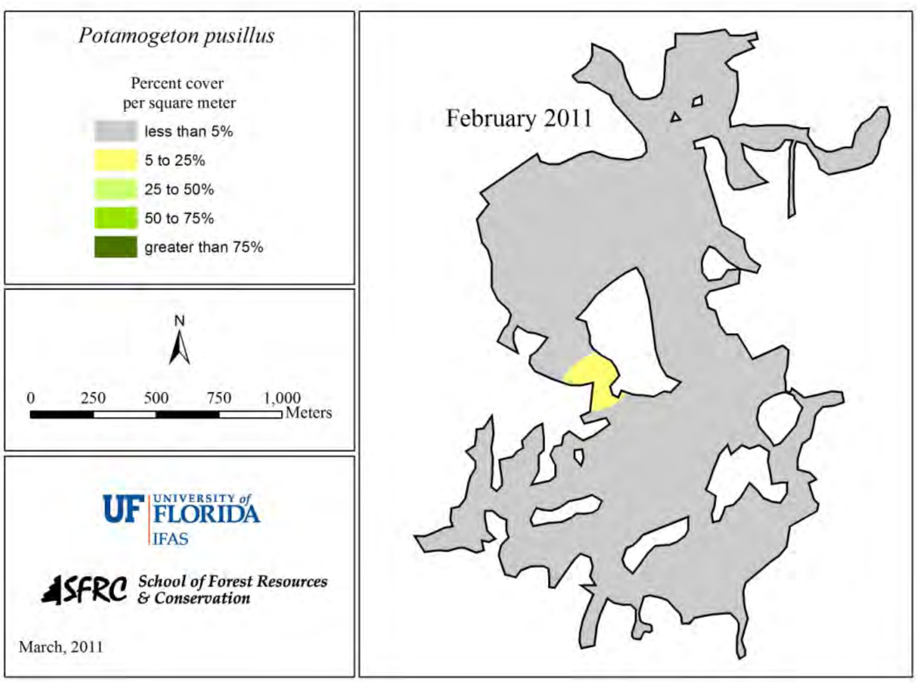
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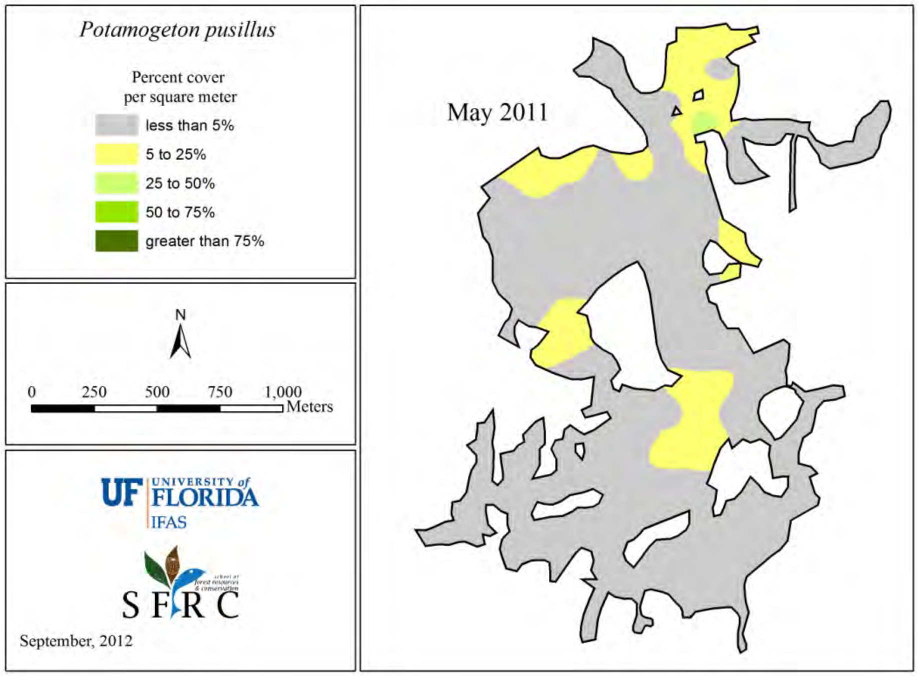
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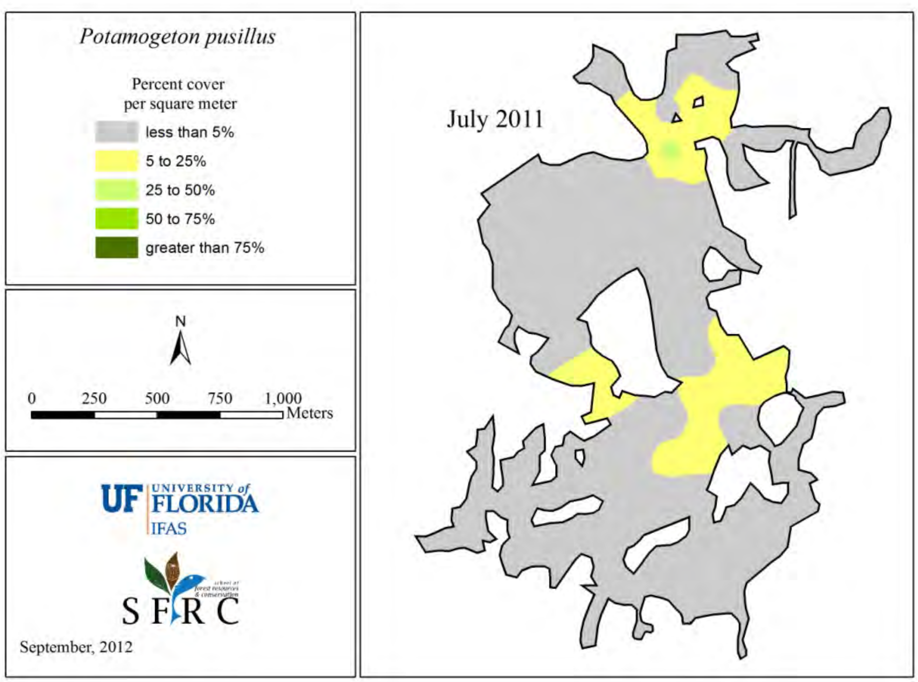
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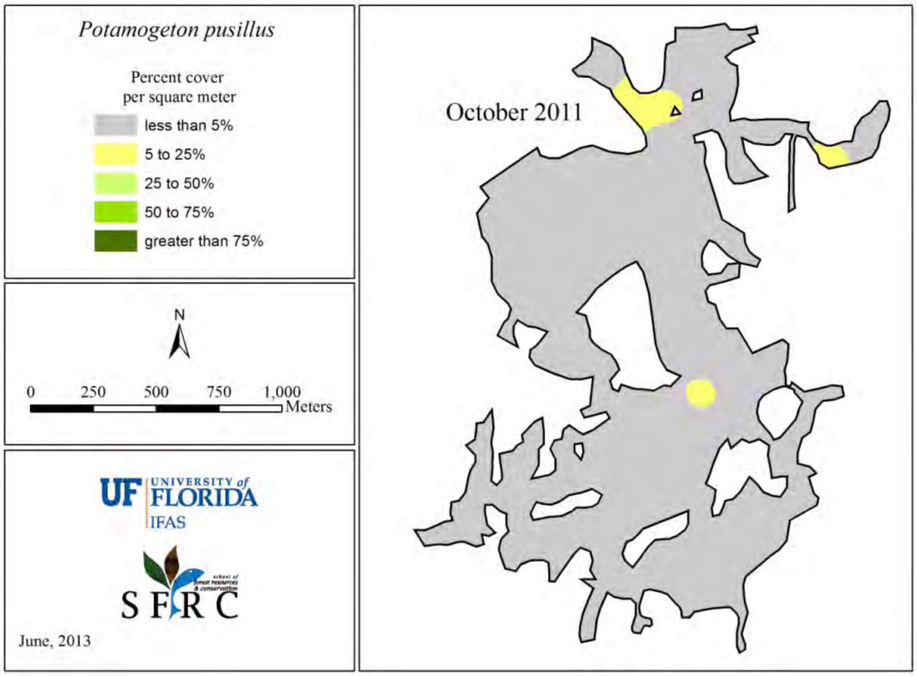
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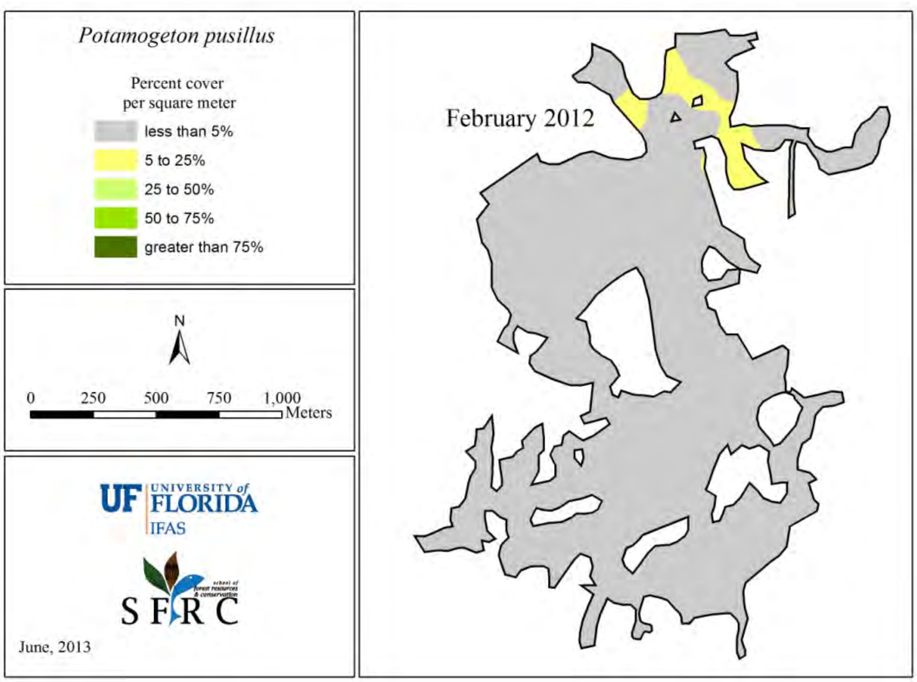
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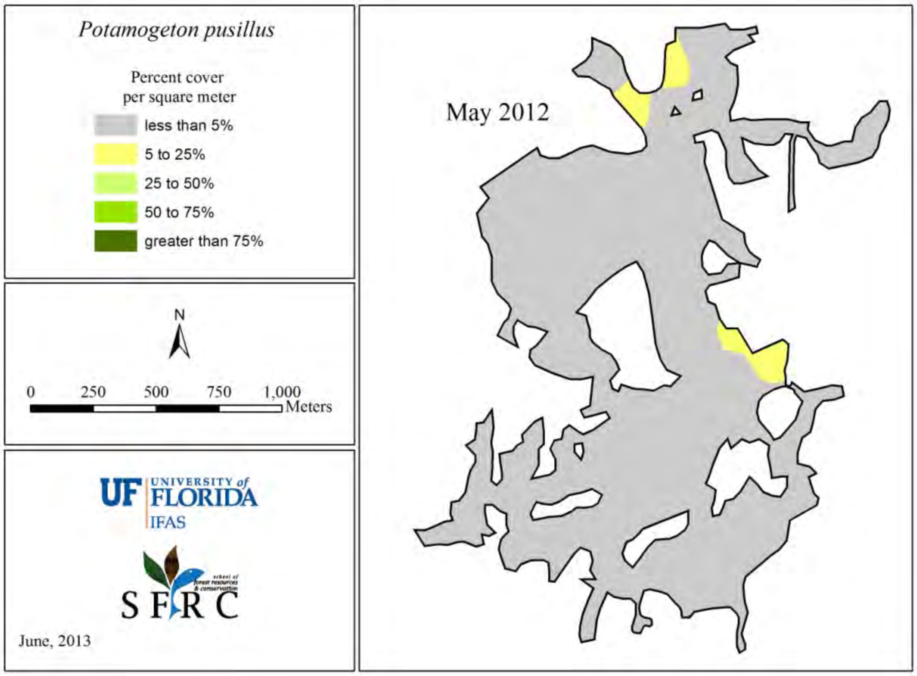
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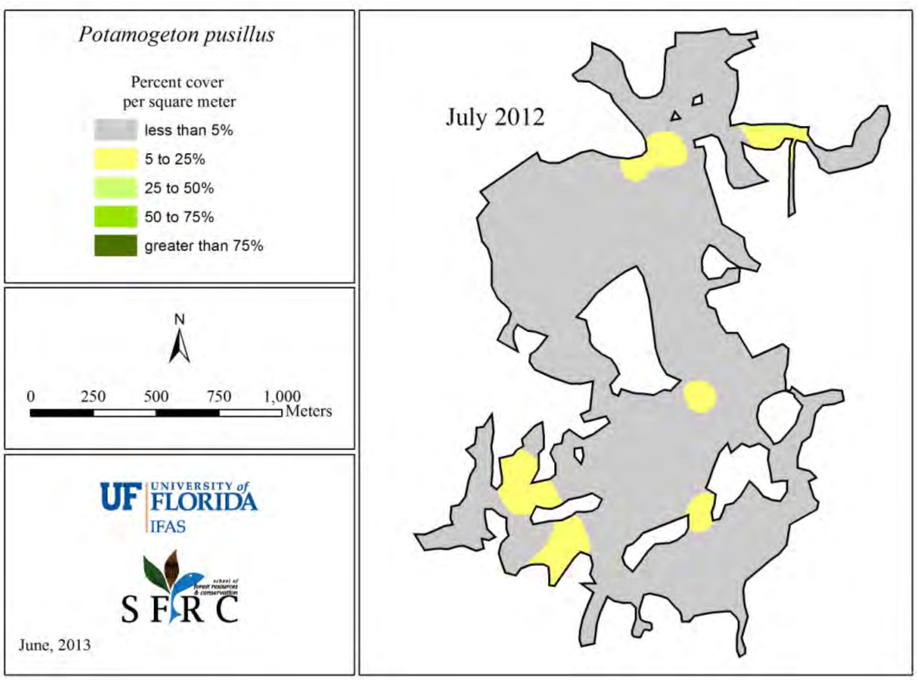
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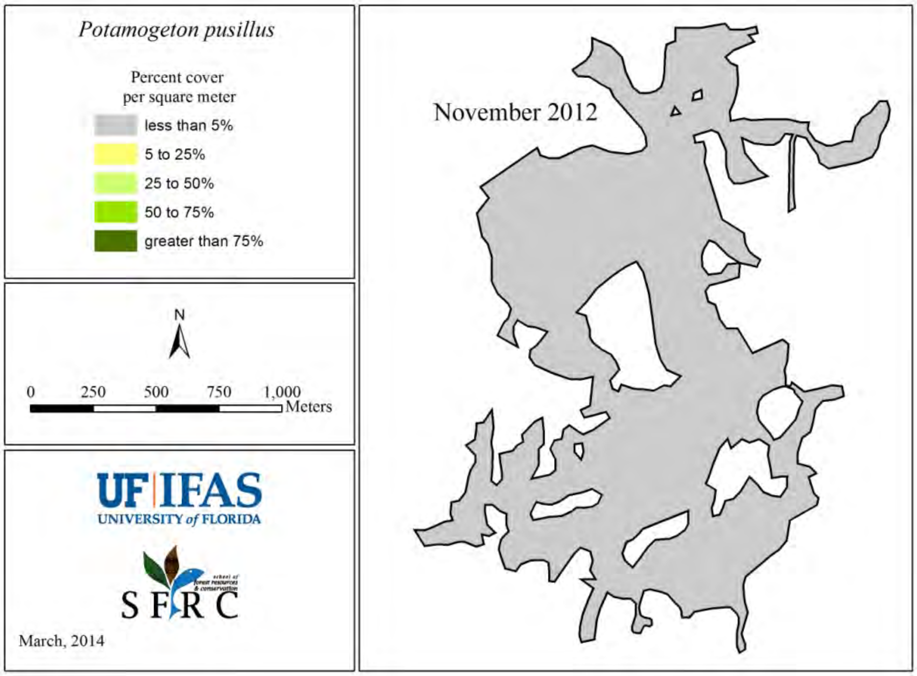
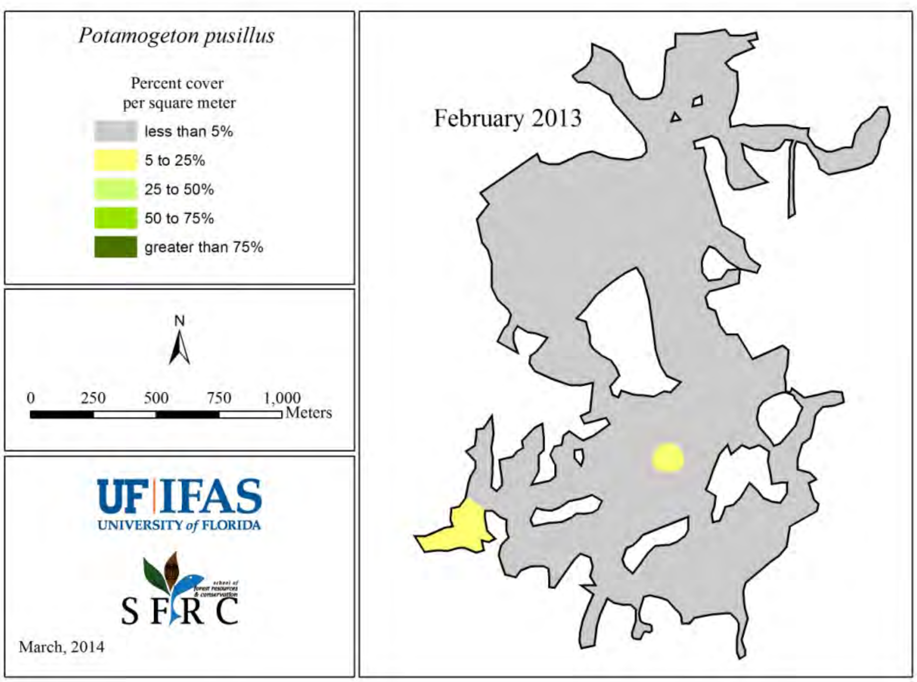
June, 2013
July 2012


Potamogeton pusillus
Percent cover
per square meter
less than 5%
5 to 25%
25 to 50%
50 to 75%
greater than 75%
N
0 250 500 750 1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
S F R C
March, 2014
November 2012


Potamogeton pusillus
Percent cover
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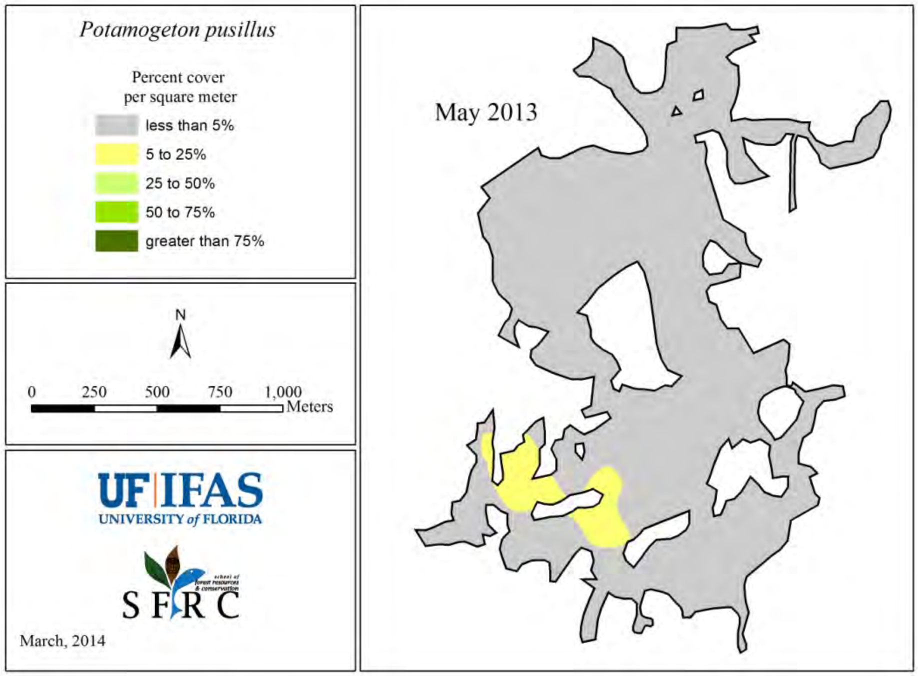
Meters
UF IFAS
UNIVERSITY of FLORIDA
S F R C
March, 2014
February 2013


Potamogeton pusillus
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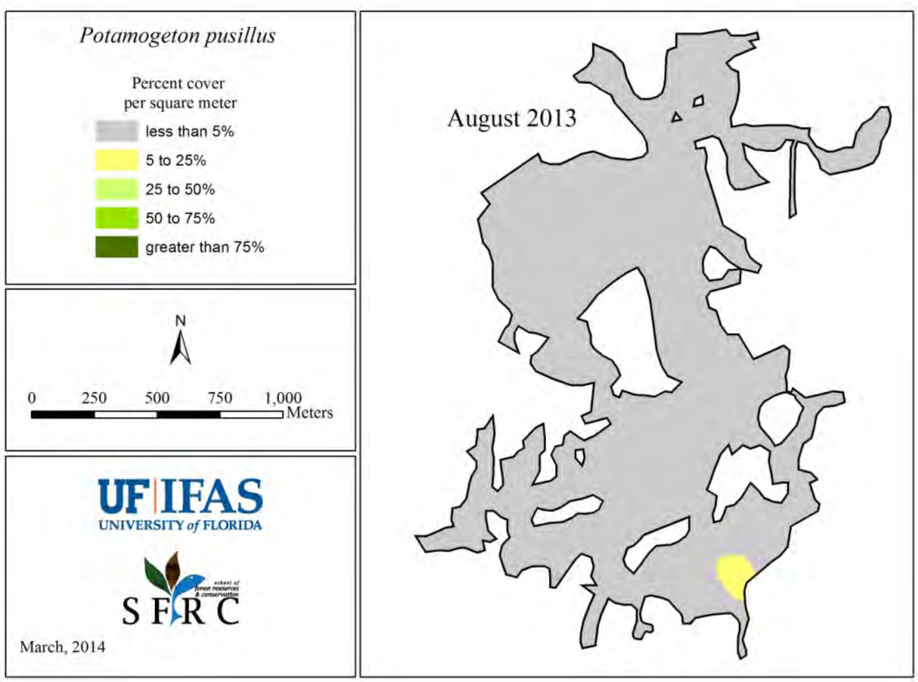
UF IFAS
UNIVERSITY of FLORIDA
S F R C
March, 2014
May 2013


Potamogeton pusillus
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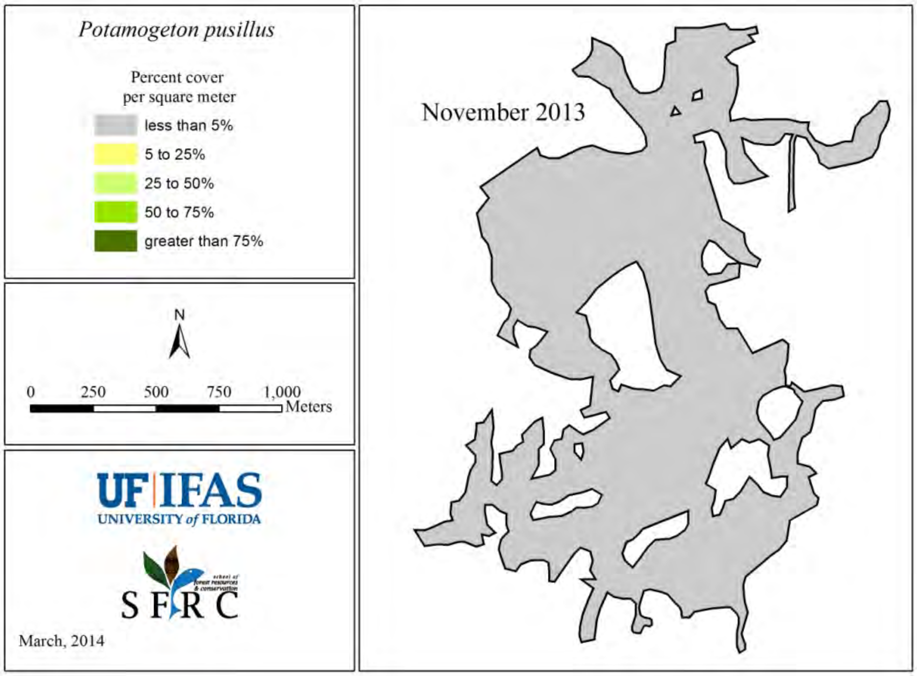
UNIVERSITY of FLORIDA
S F R C
March, 2014
August 2013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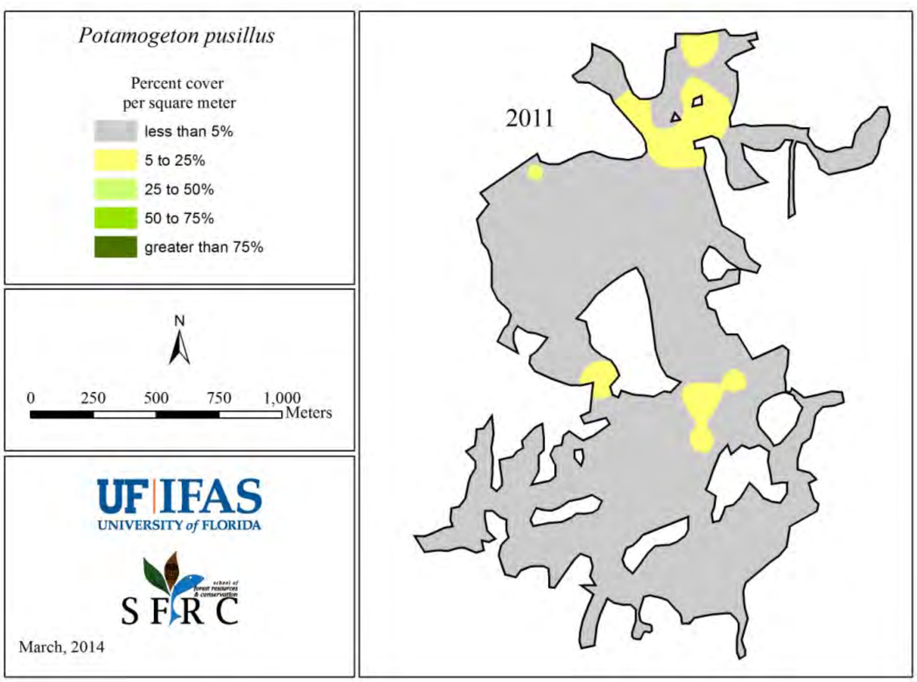
March, 2014
November 2013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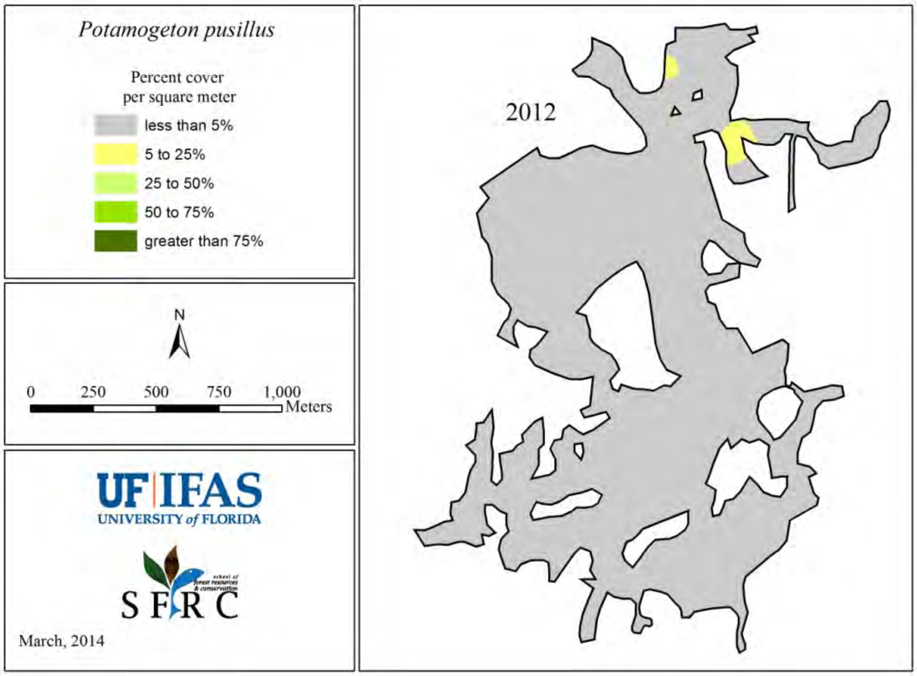
SFRC
March, 2014
2011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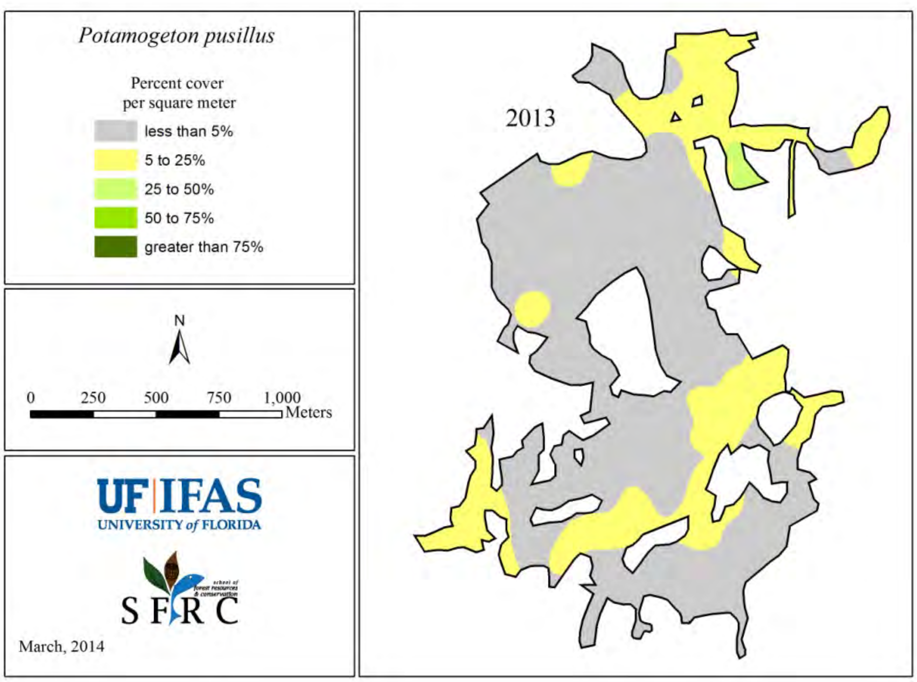
S F R C
March, 2014
2012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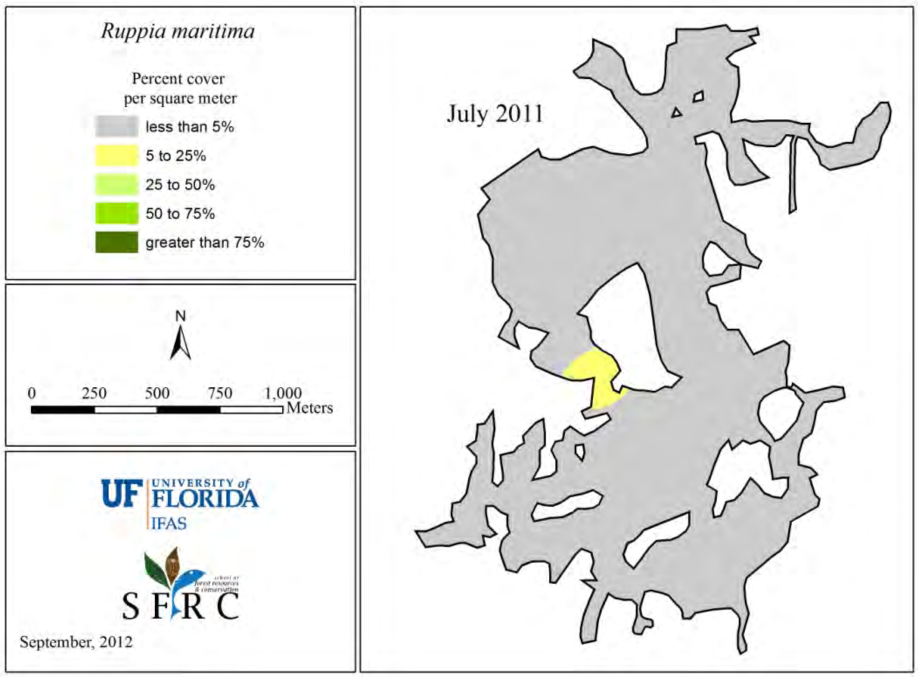
Meters
UF IFAS
UNIVERSITY of FLORIDA
S F R C
March, 2014
2013

Ruppia maritima was not found in any quadrat in October 2010

Ruppia maritima was not found in any quadrat in February 2011

Ruppia maritima was not found in any quadrat in May 2011



Ruppia maritima was not found in any quadrat in October 2011

Ruppia maritima was not found in any quadrat in February 2012

Ruppia maritima was not found in any quadrat in May 2012

Ruppia maritima was not found in any quadrat in July 2012

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Ruppia maritima was not found in any quadrat in February 2013

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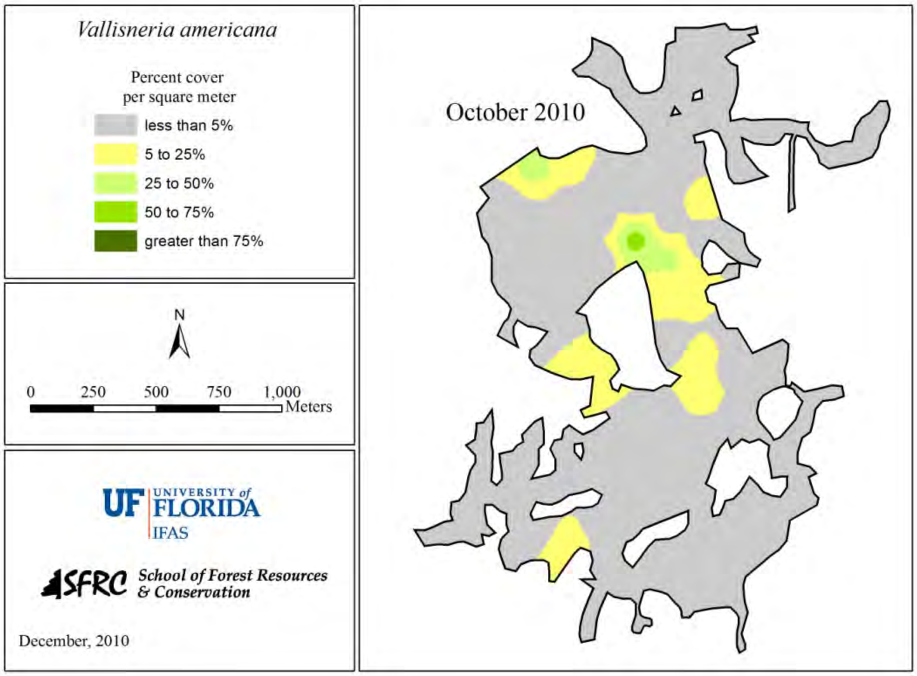
Ruppia maritima was not found in any quadrat in August 2013

Ruppia maritima was not found in any quadrat in November 2013


Vallisneria americana
Percent cover
per square meter
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5 to 25%
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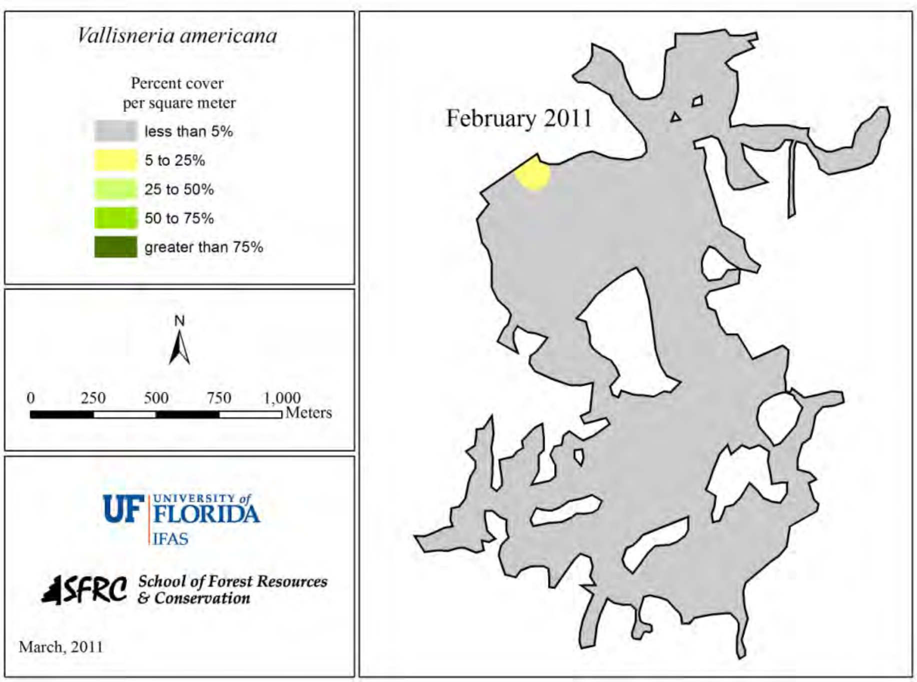
750
1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC School of Forest Resources & Conservation
December, 2010
October 2010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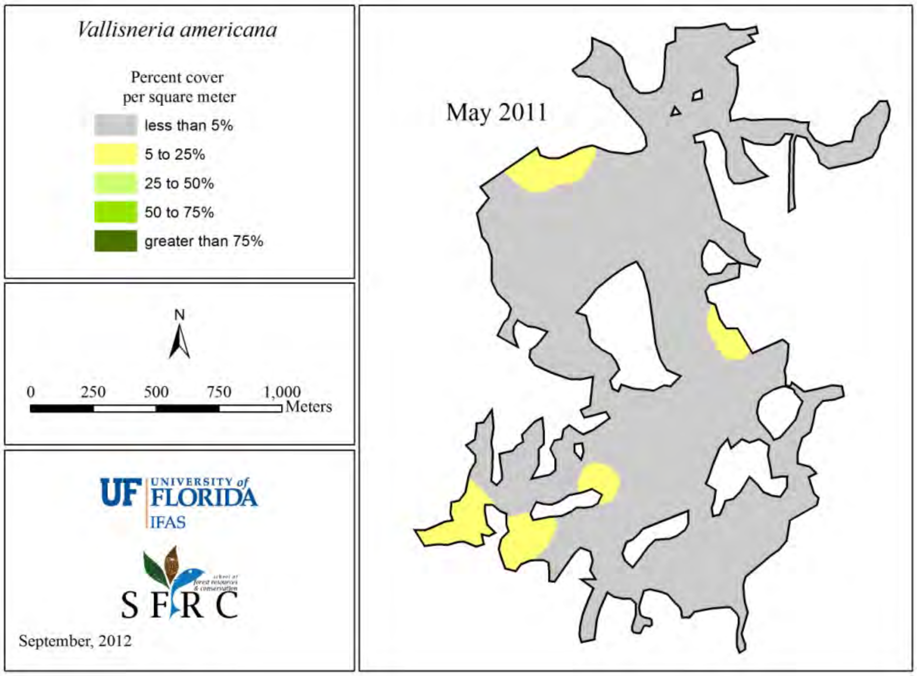
March, 2011
February 2011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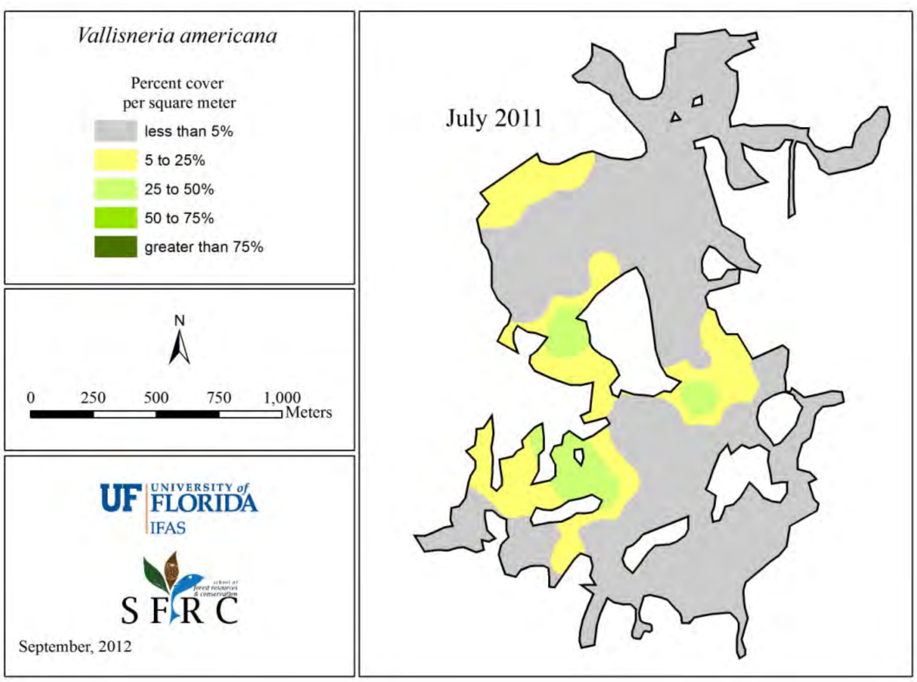
UF UNIVERSITY of FLORIDA
IFAS
S F R C
September, 2012
May 2011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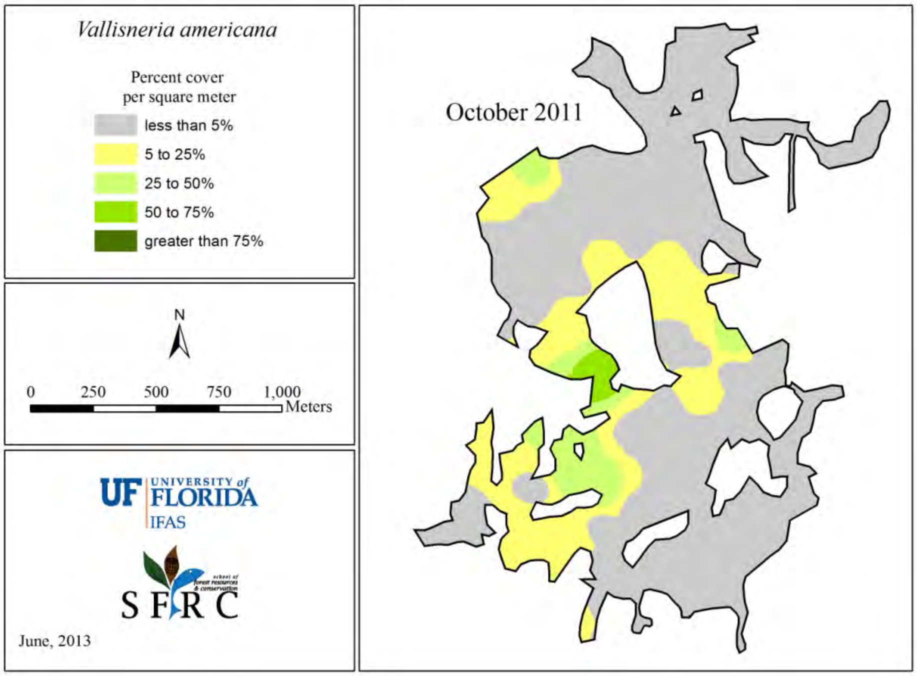
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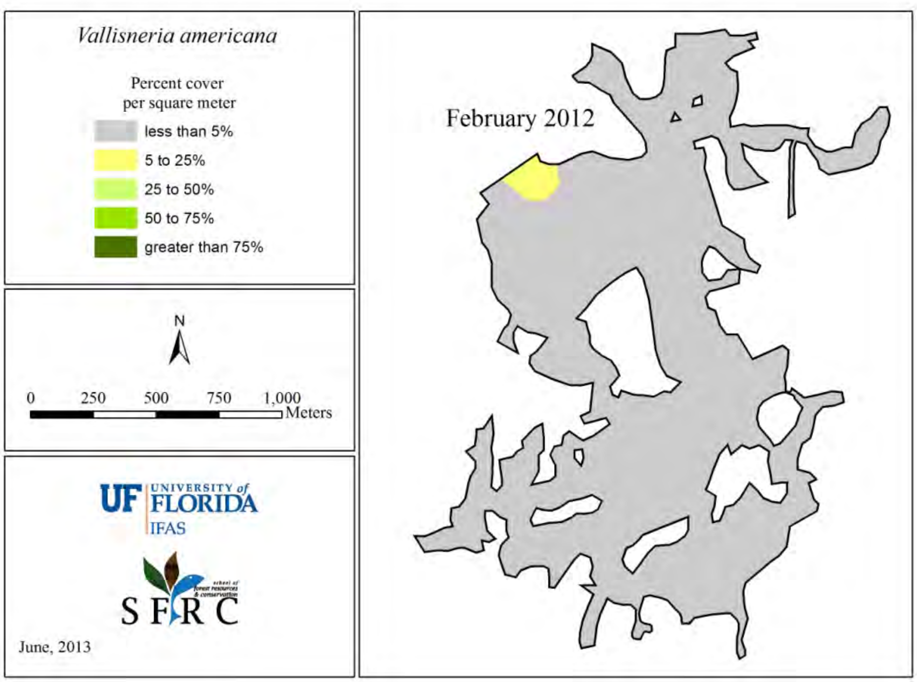
SFRC
June, 2013
October 2011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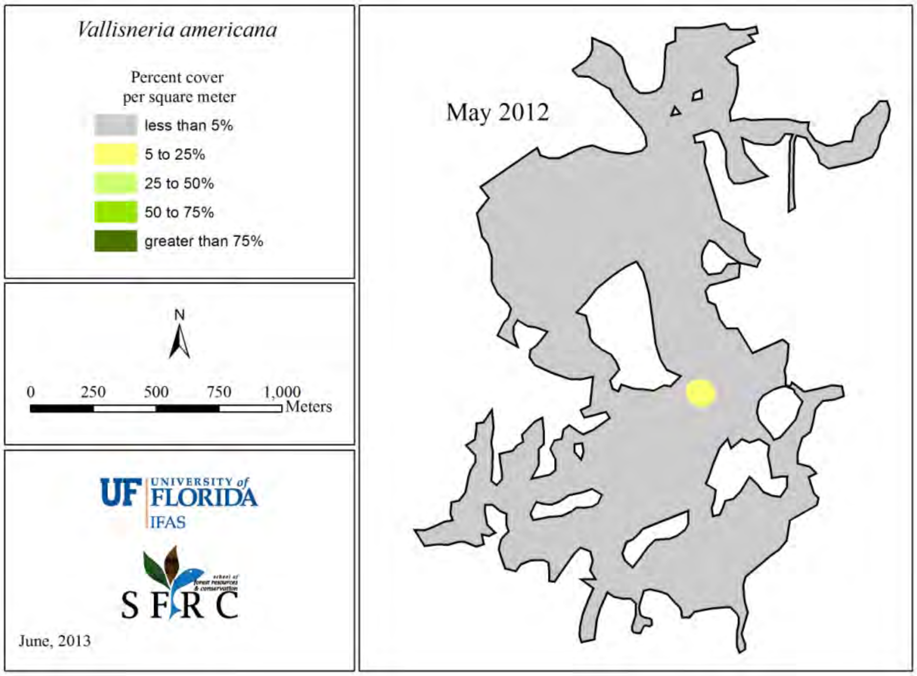
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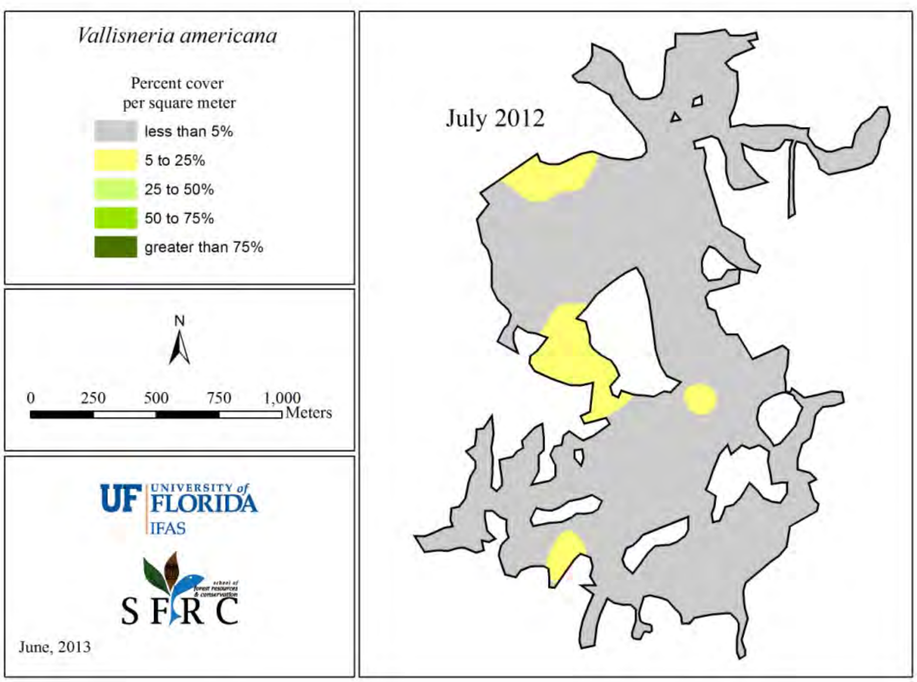
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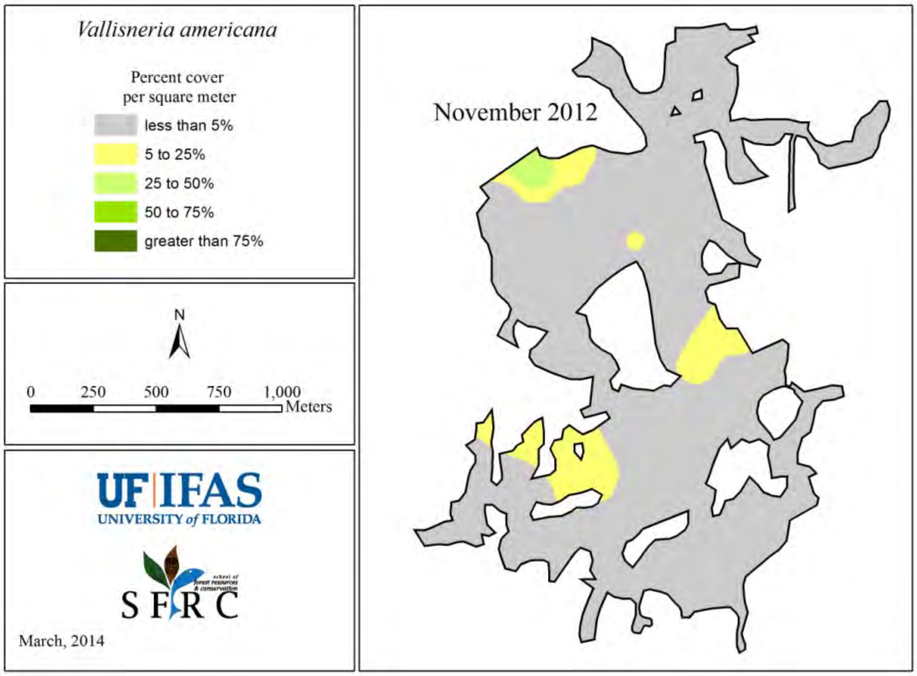

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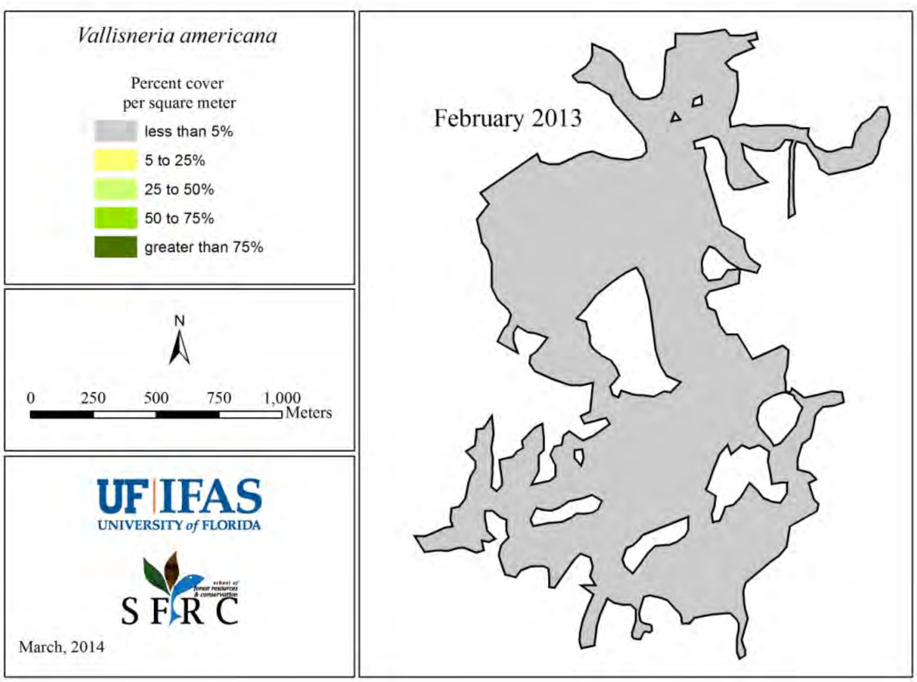
SFRC
March, 2014
November 2012



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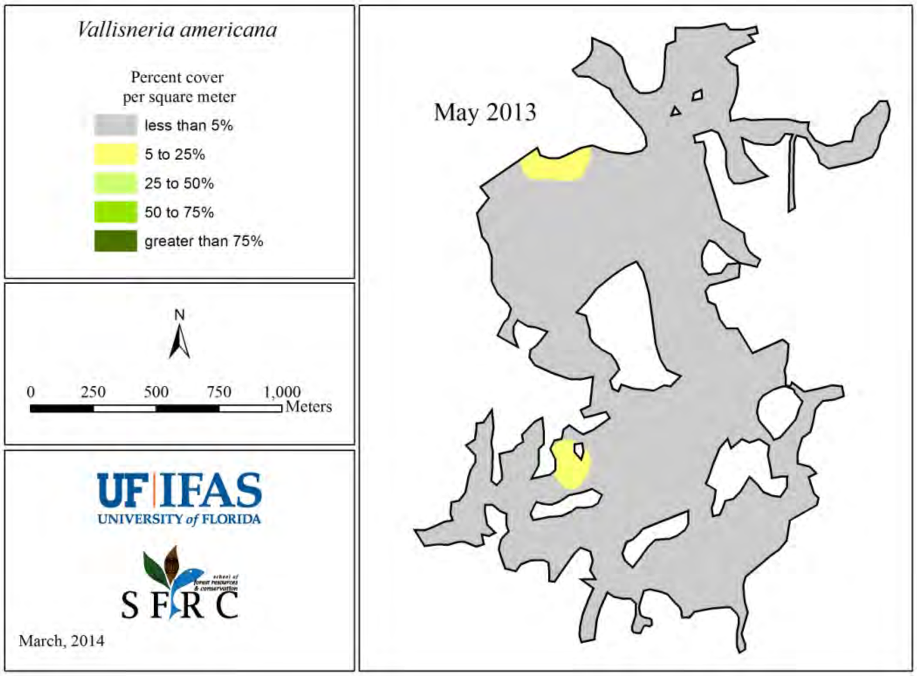
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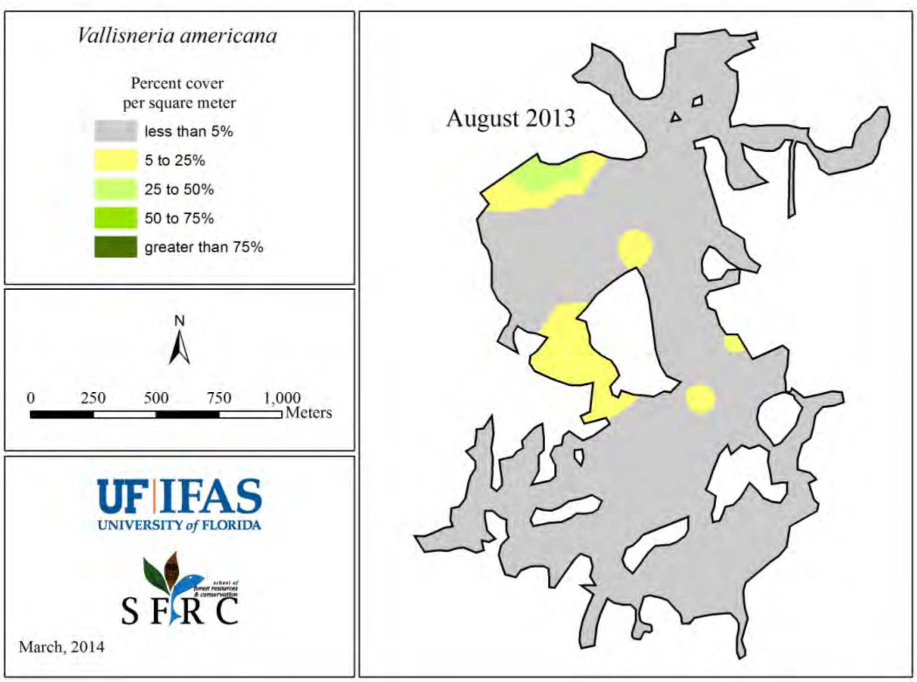
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March, 2014
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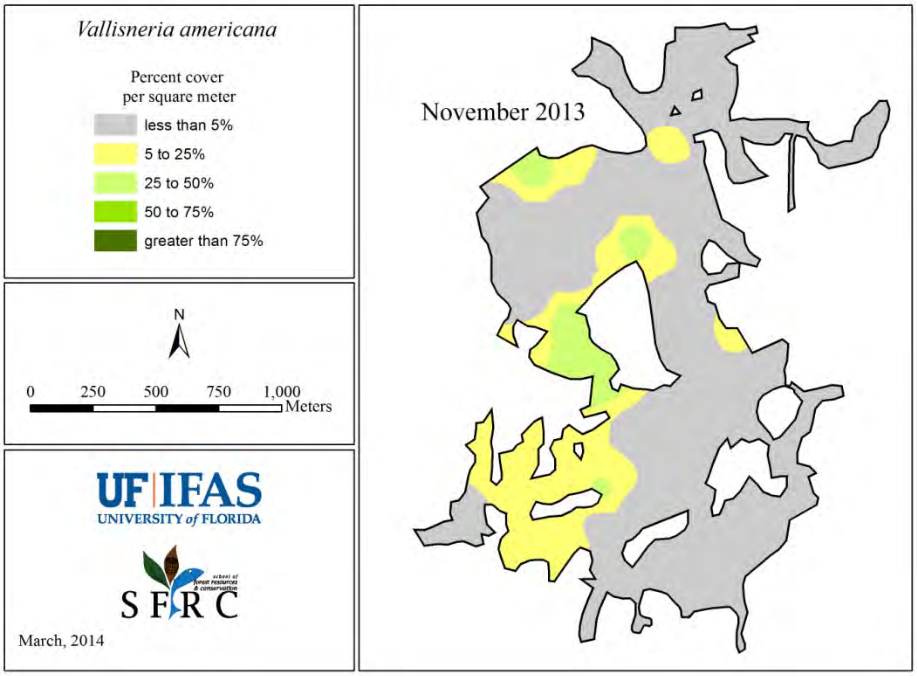
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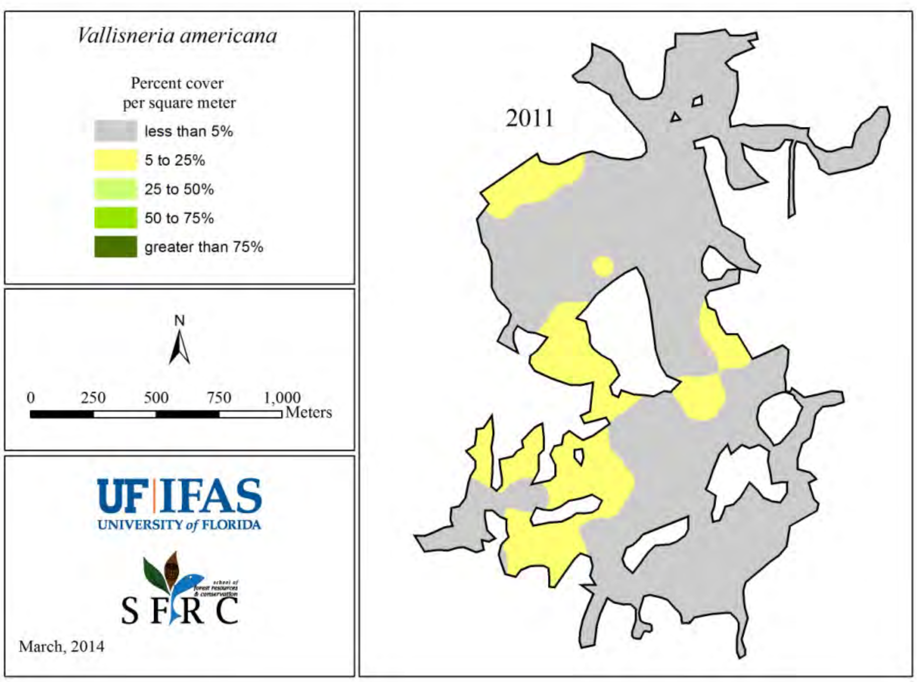
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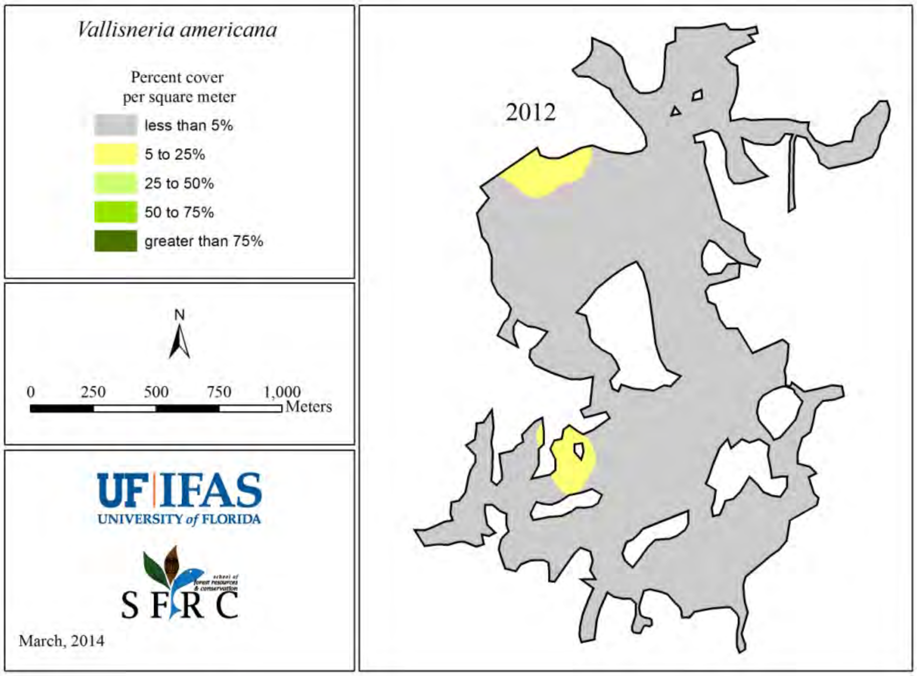
S F R C
March, 2014
2011



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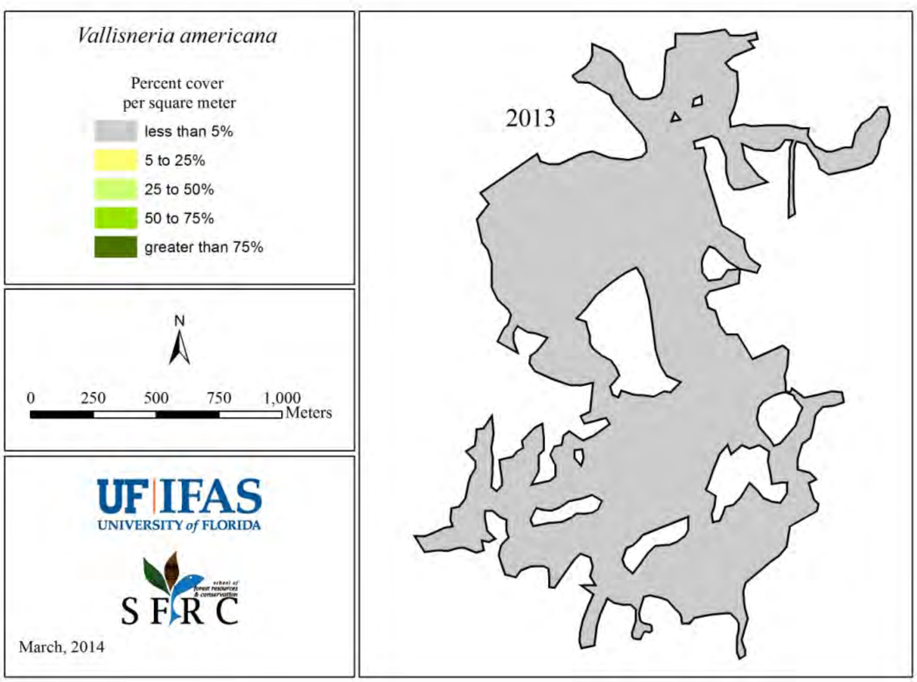
S F R C
March, 2014
2012



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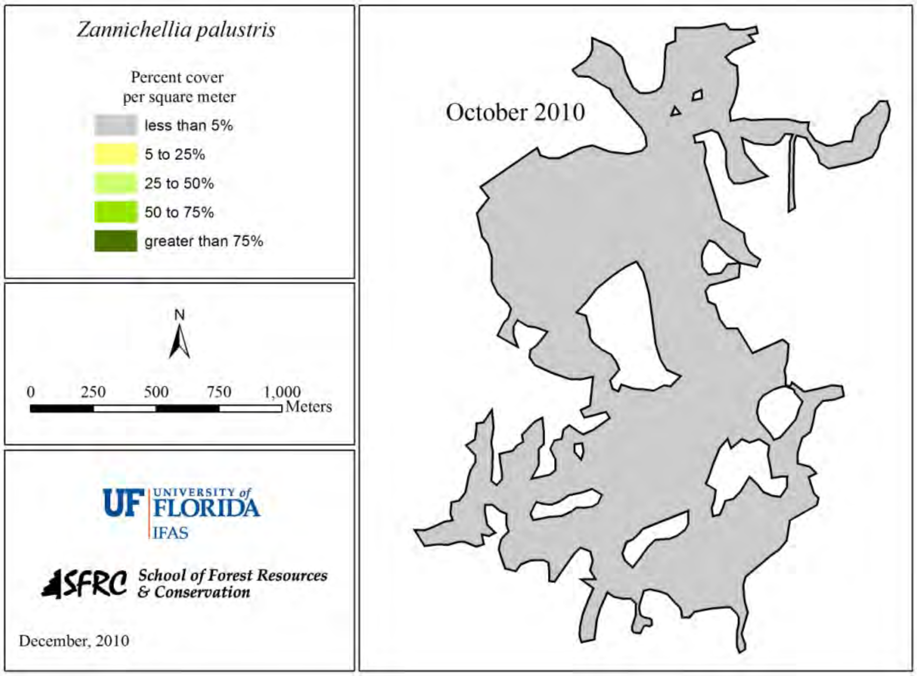
UF IFAS
UNIVERSITY of FLORIDA
S F R C
March, 2014
2013


Zannichellia palustris
Percent cover
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25 to 50%
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UF UNIVERSITY of FLORIDA
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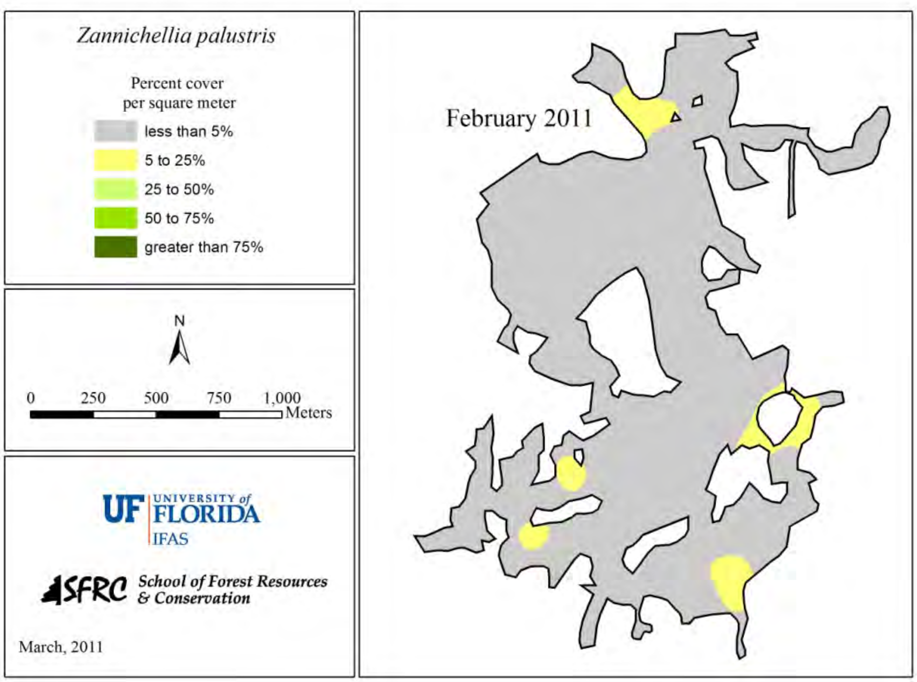
December, 2010
October 2010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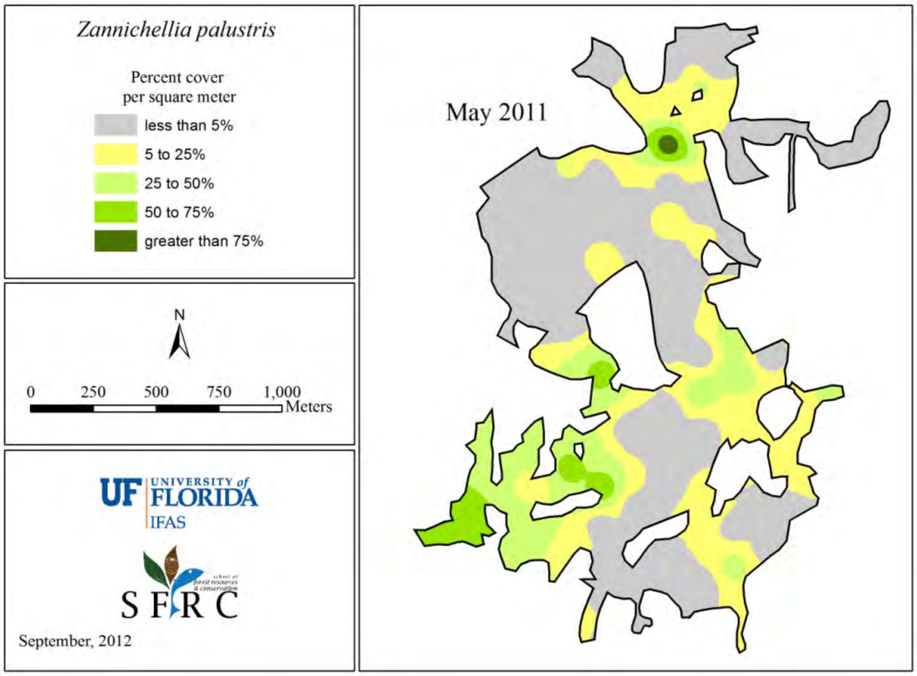
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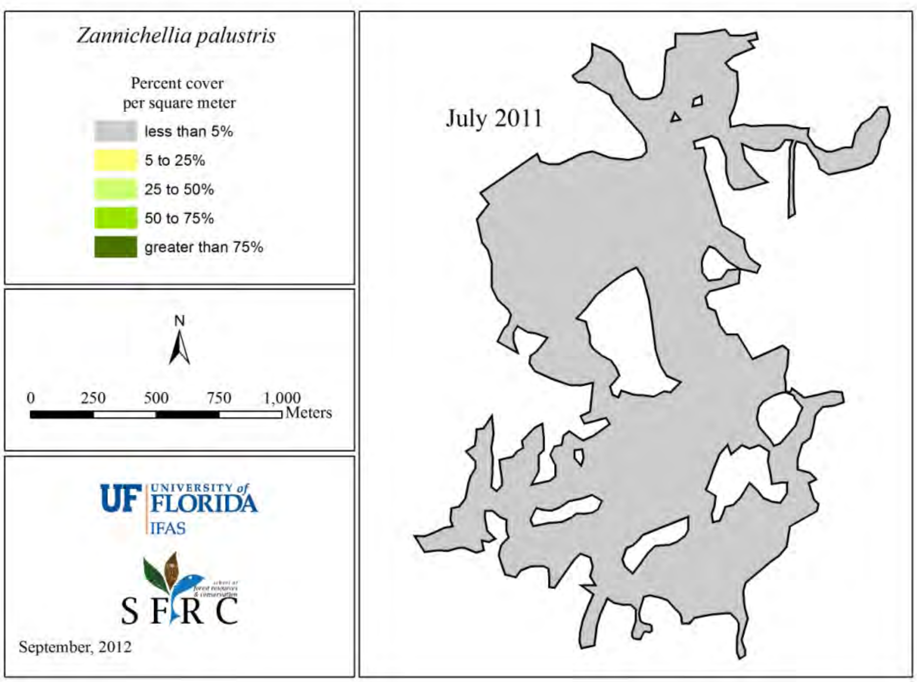
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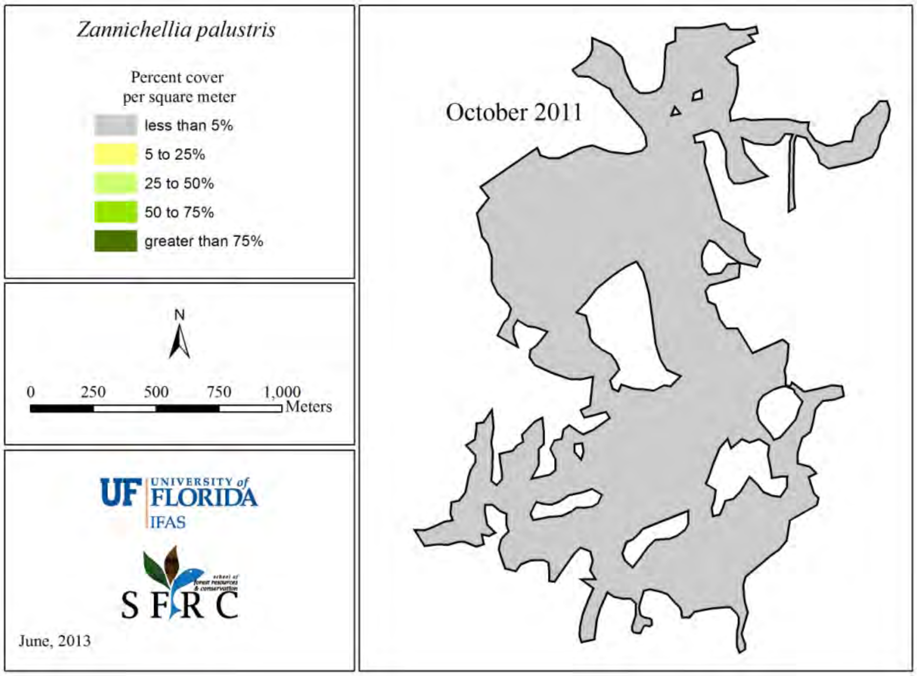
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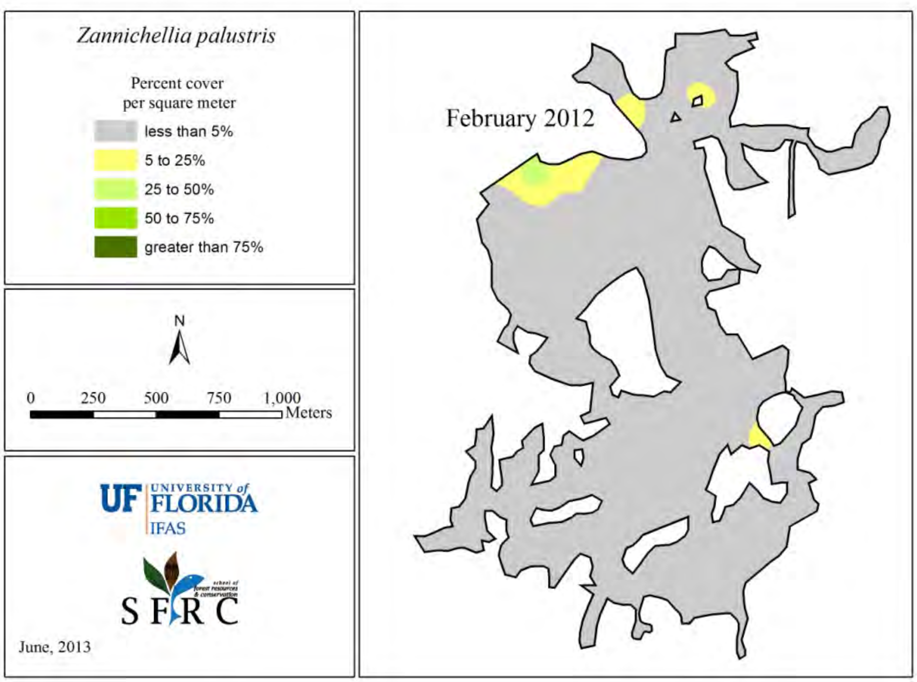
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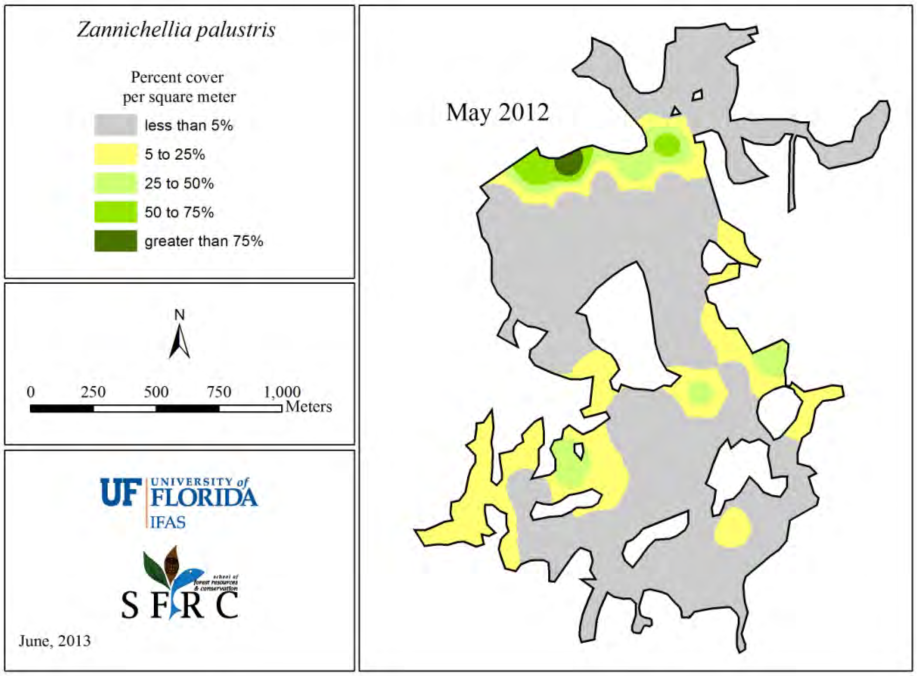

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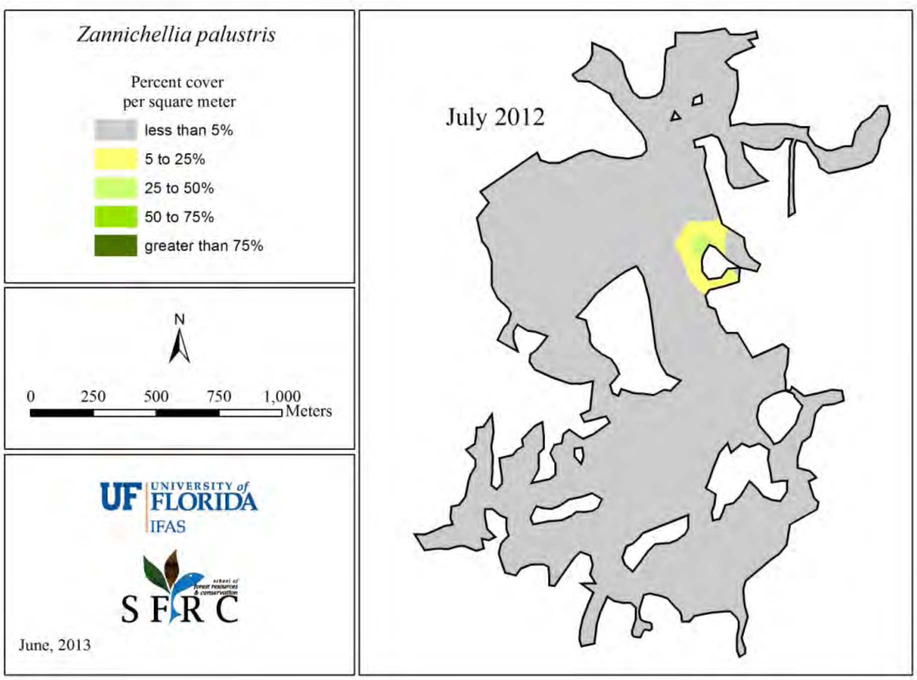

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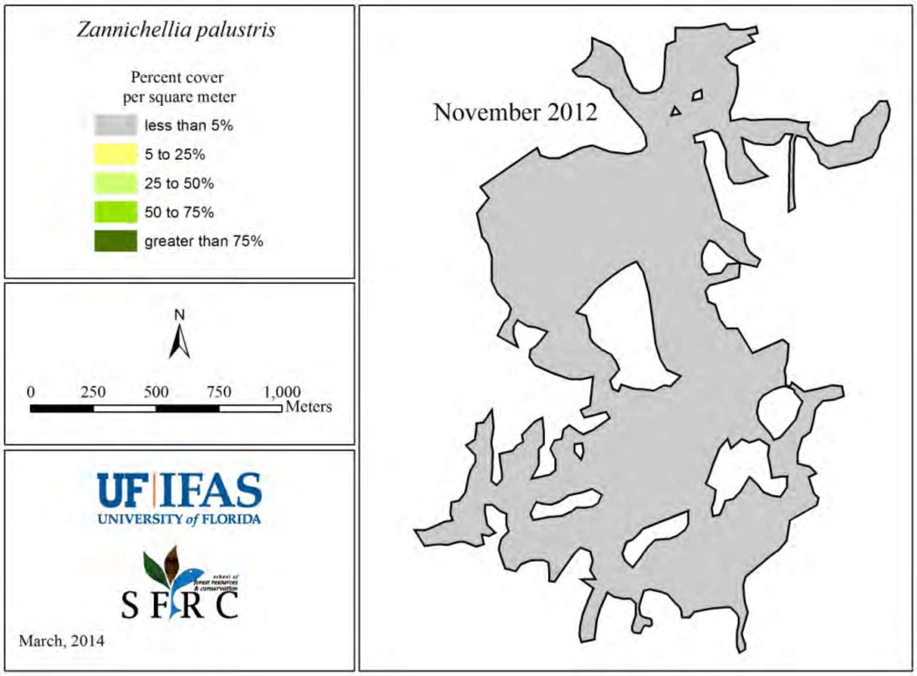

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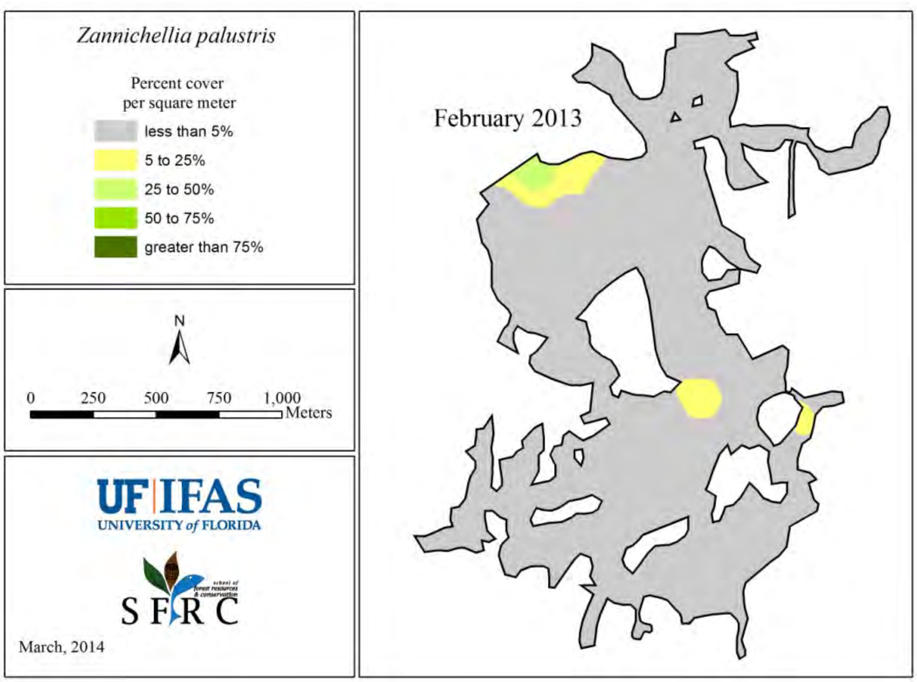

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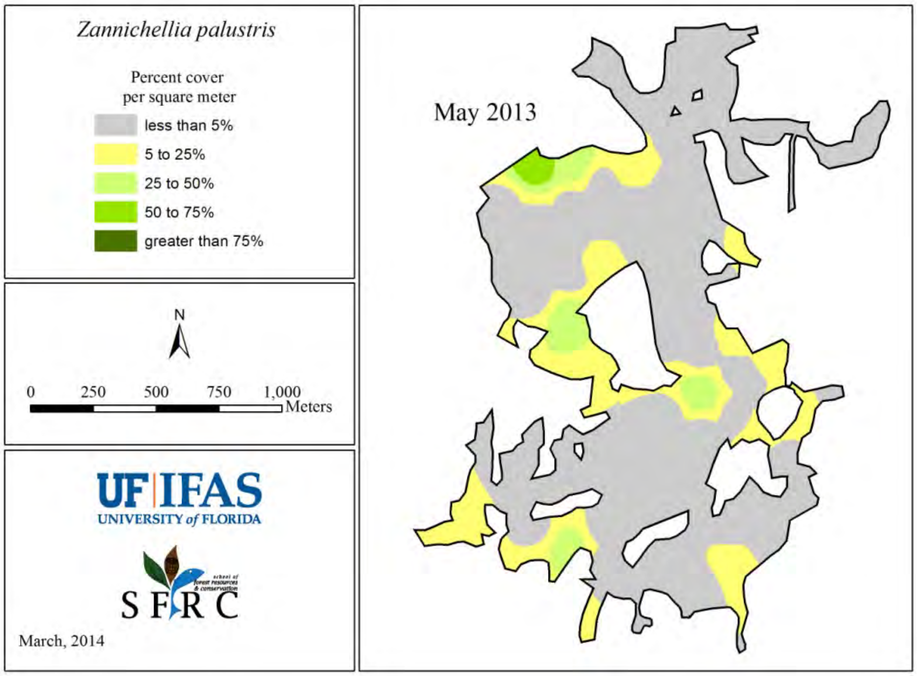
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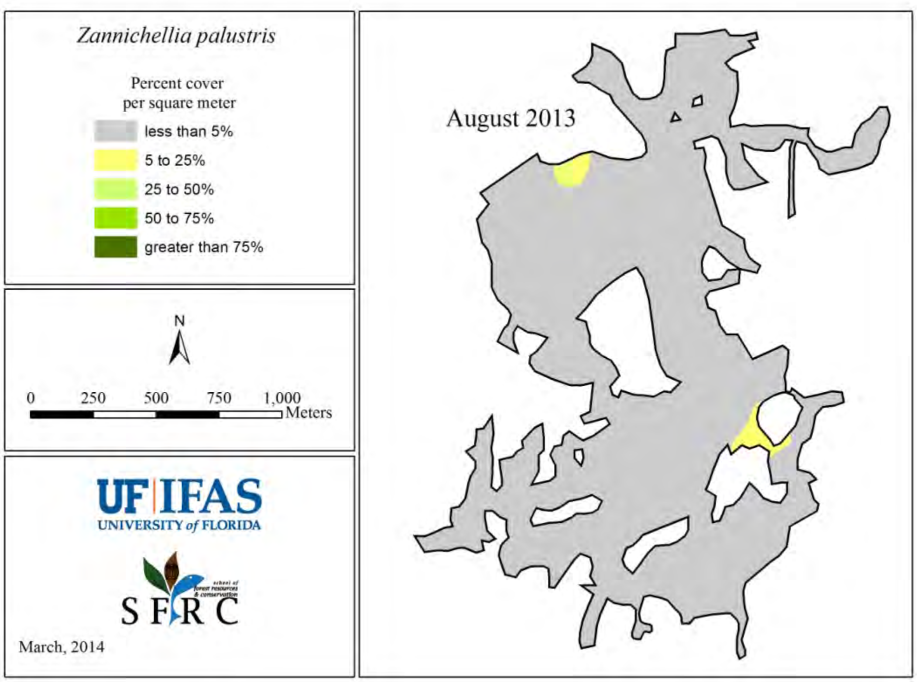
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S F R C
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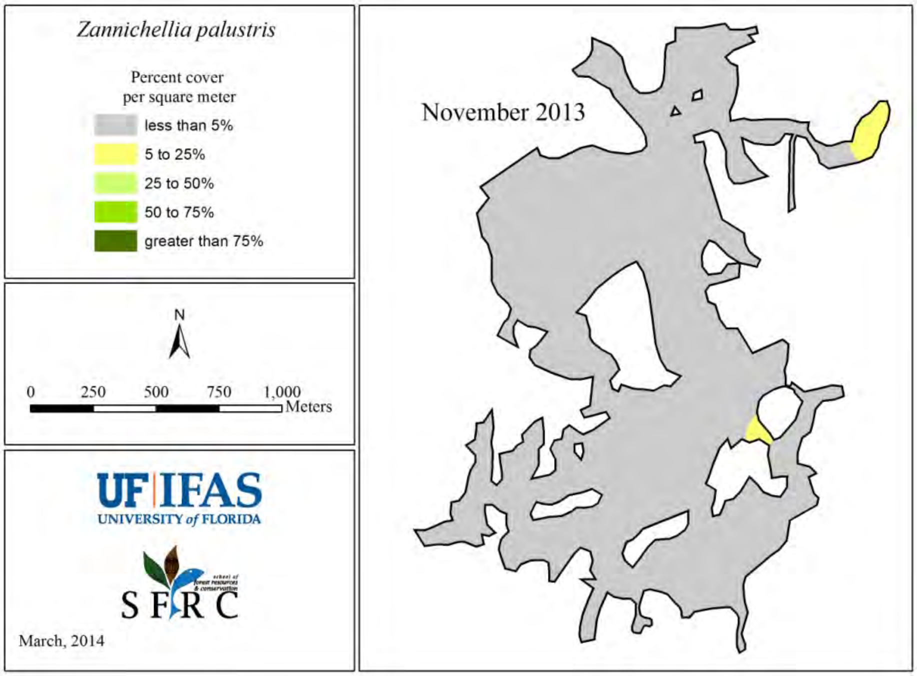
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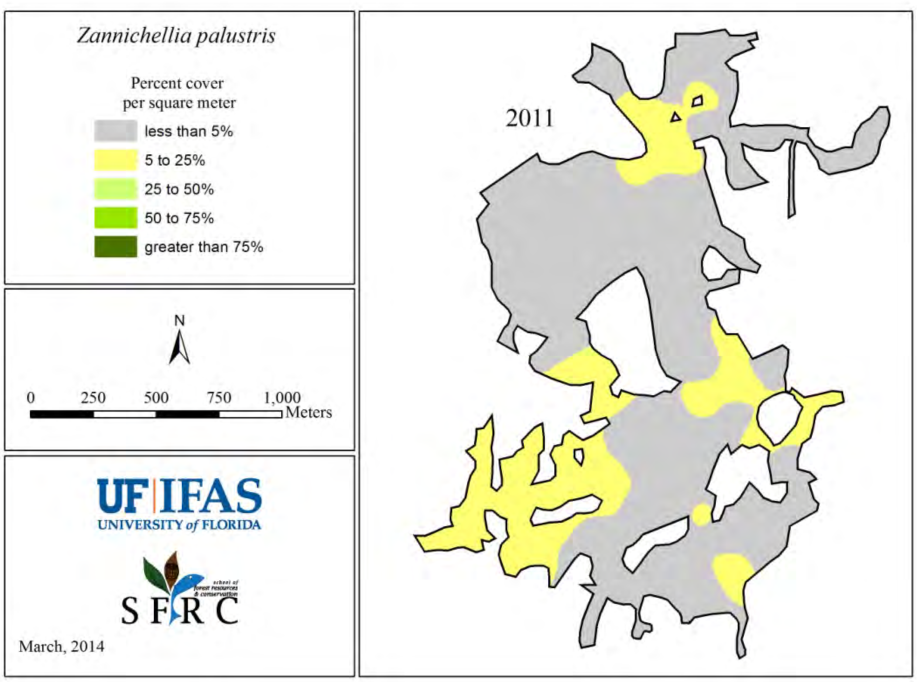
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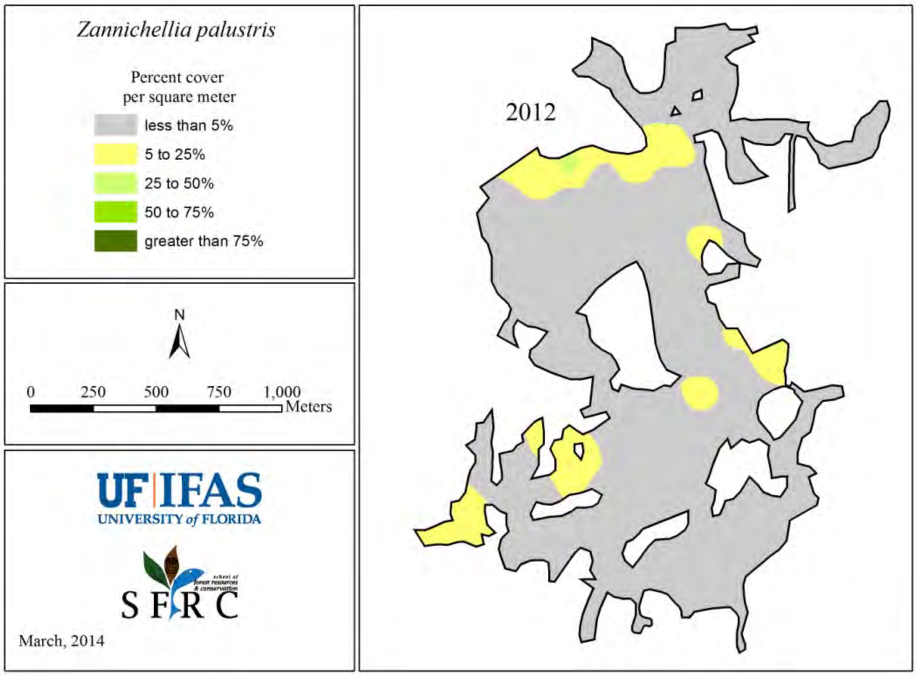
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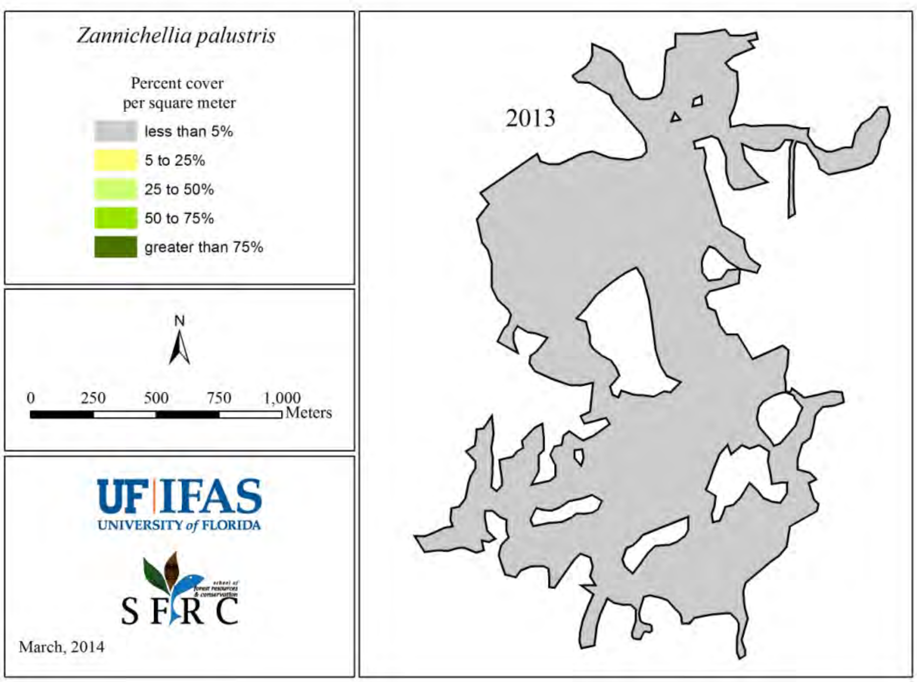
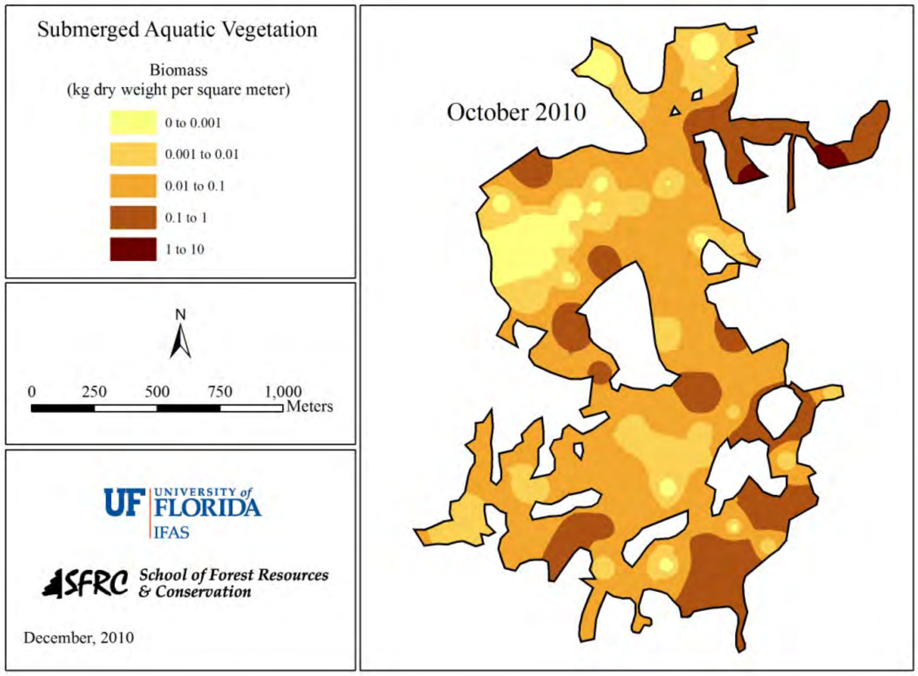
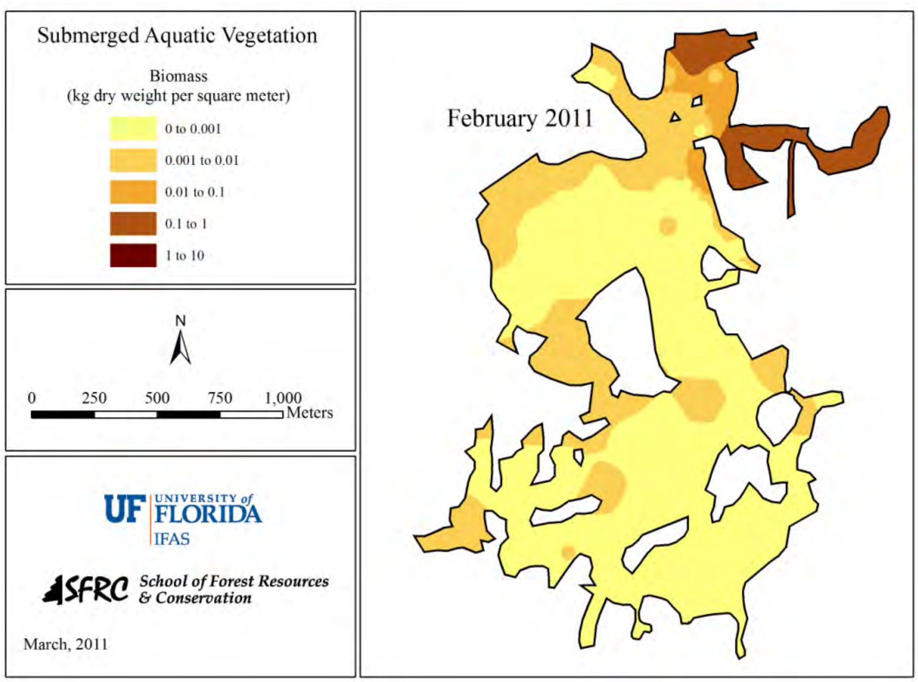
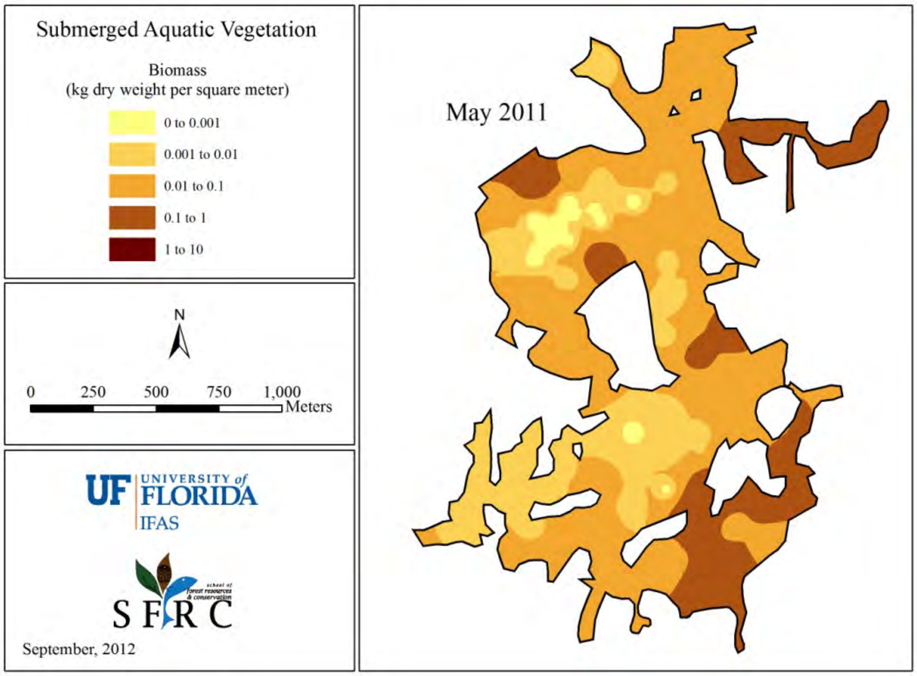
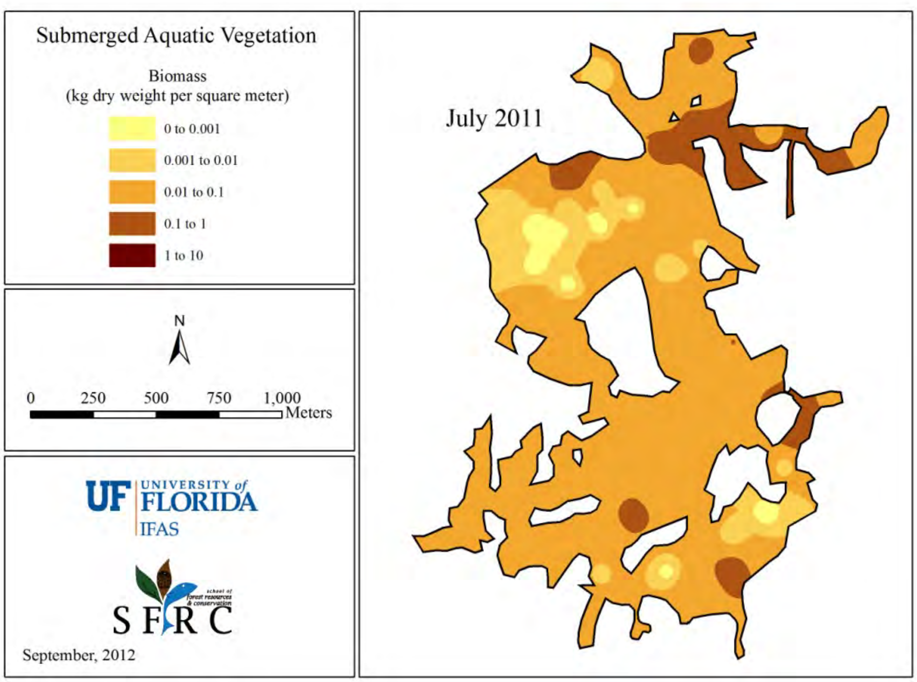
March, 2014
2012


Zannichellia palustris
Percent cover
per square meter
less than 5%
5 to 25%
25 to 50%
50 to 75%
greater than 75%
N
0 250 500 750 1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
S F R C
March, 2014
2013


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UF UNIVERSITY of FLORIDA IFAS
SFRC School of Forest Resources & Conservation
December, 2010
October 2010


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UF UNIVERSITY of FLORIDA IFAS
SFRC School of Forest Resources & Conservation
March, 2011
February 2011


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UNIVERSITY of FLORIDA
IFAS
S F R C
September, 2012
May 2011


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
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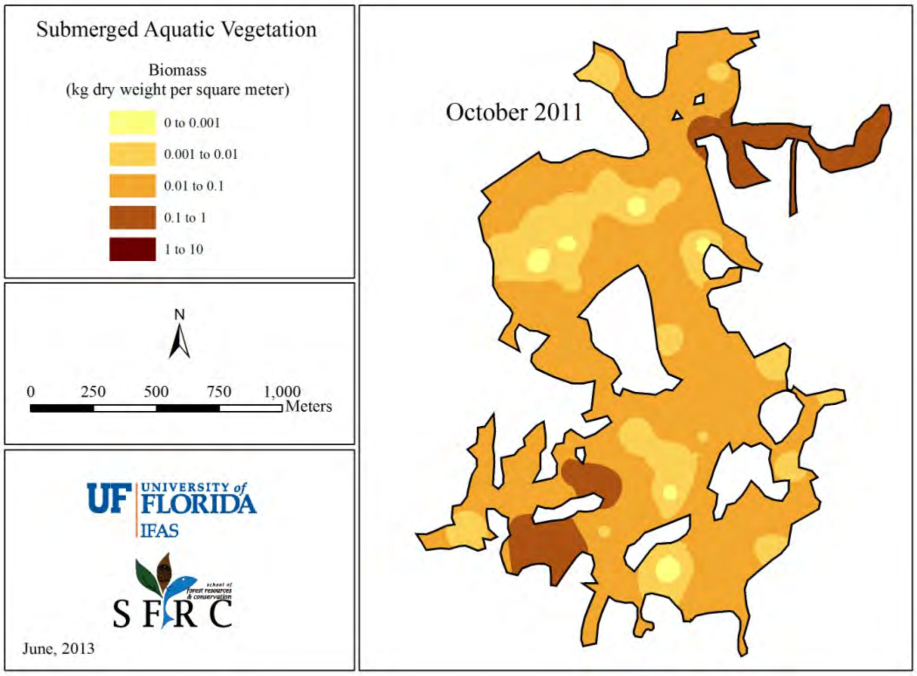
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UNIVERSITY of FLORIDA
IFAS
S F R C
September, 2012
July 2011


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
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0.001 to 0.01
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0.1 to 1
1 to 10
N
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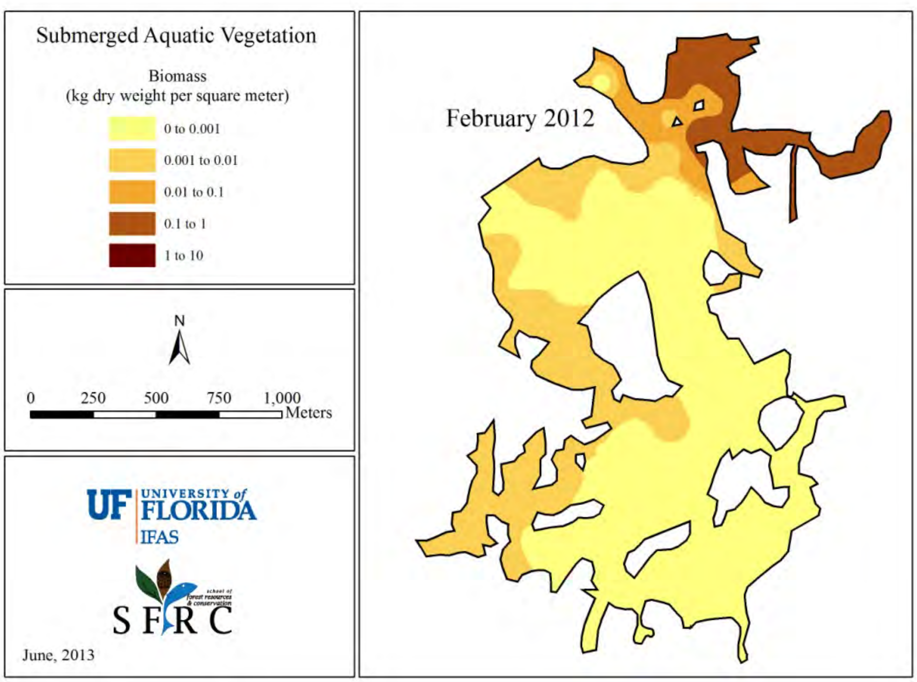
Meters
UF UNIVERSITY of FLORIDA
IFAS
S F R C
June, 2013
October 2011


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
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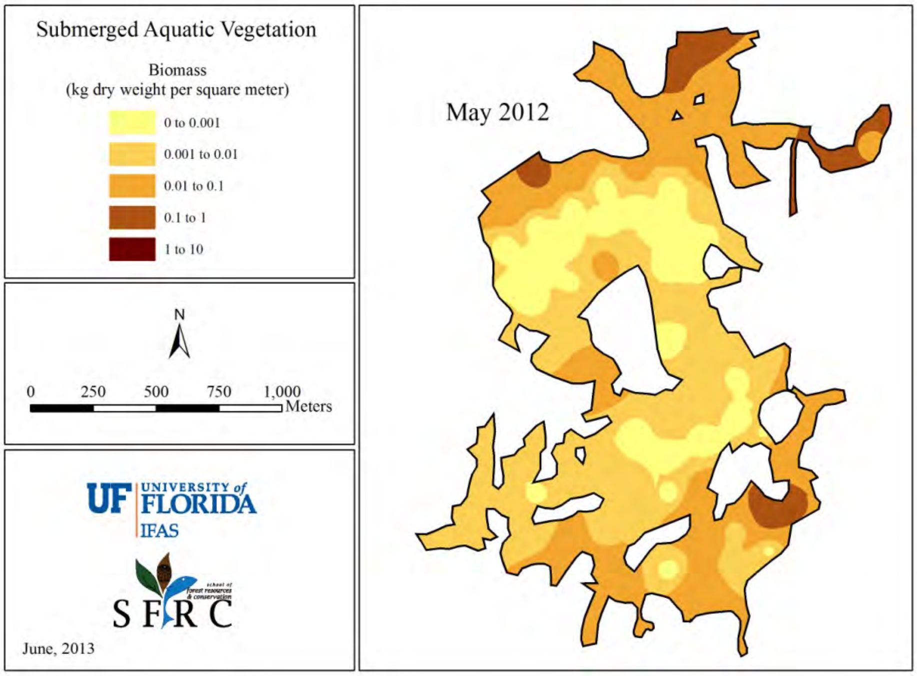
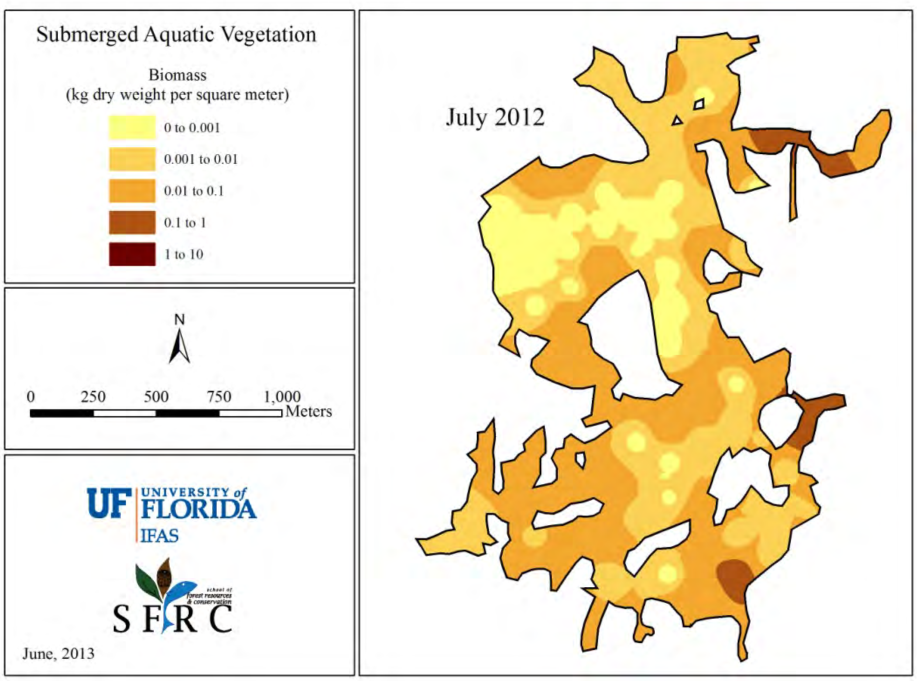
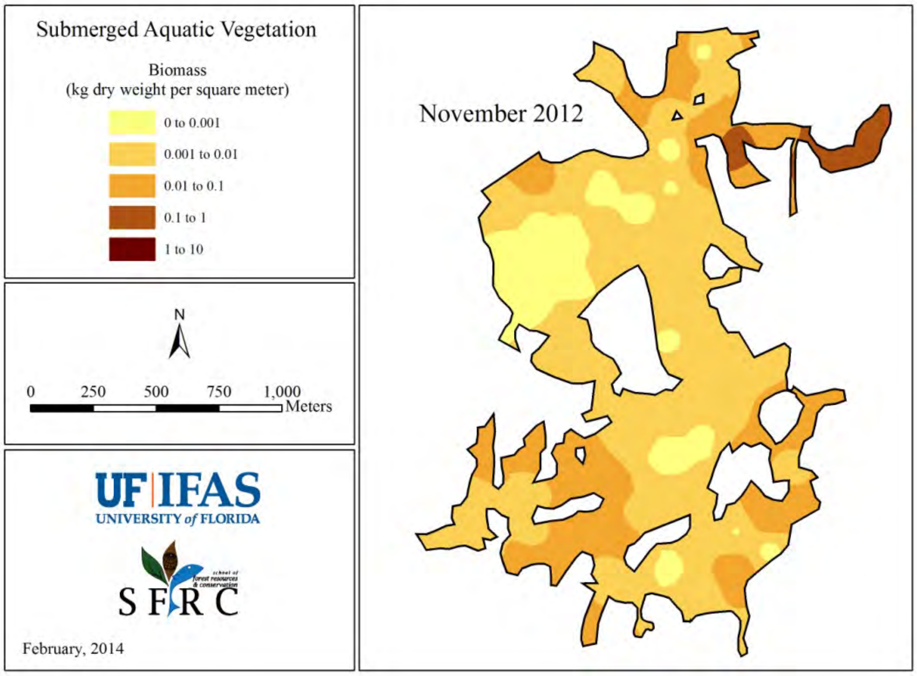
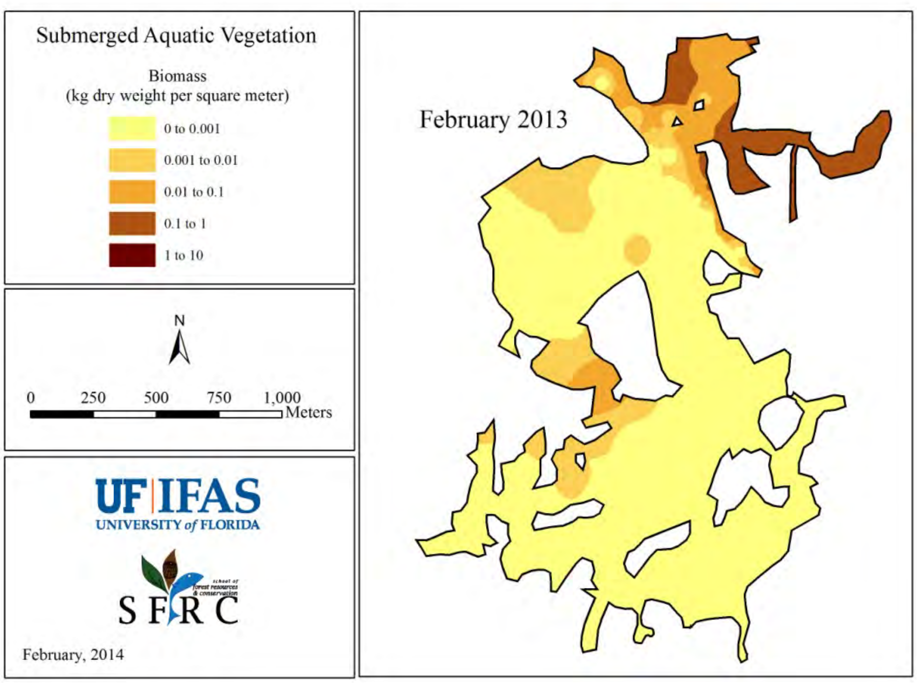
Meters
UF UNIVERSITY of FLORIDA
IFAS
S F R C
June, 2013
February 2012


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
June, 2013
May 2012


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
June, 2013
July 2012


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
November 2012


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
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0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
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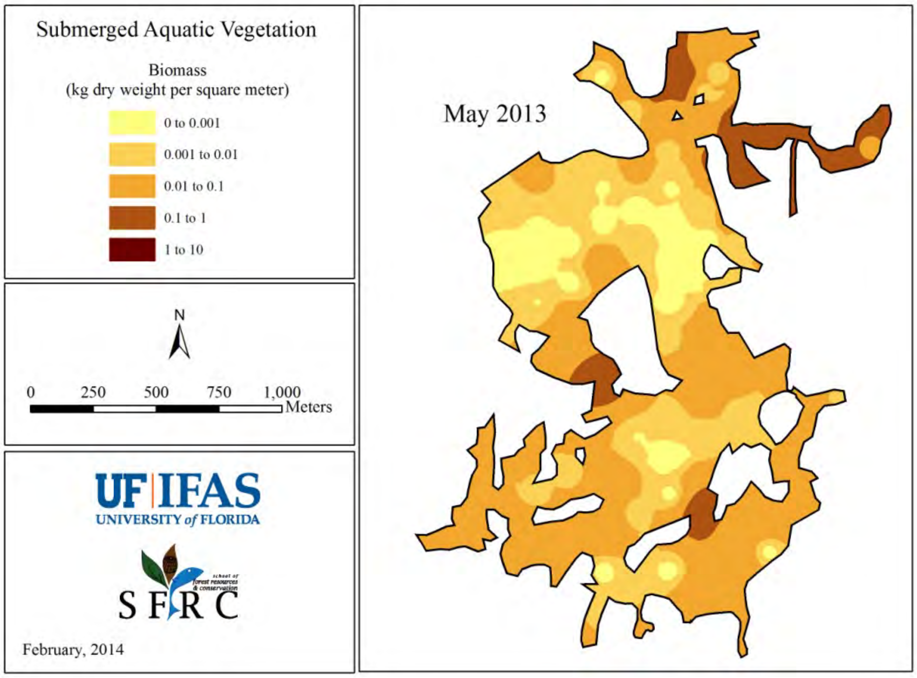
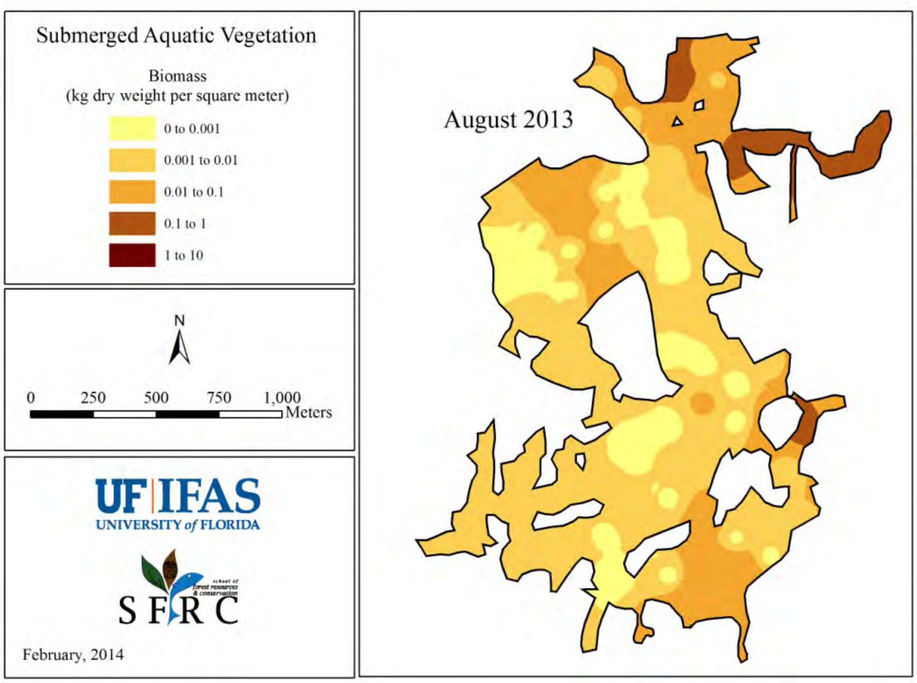
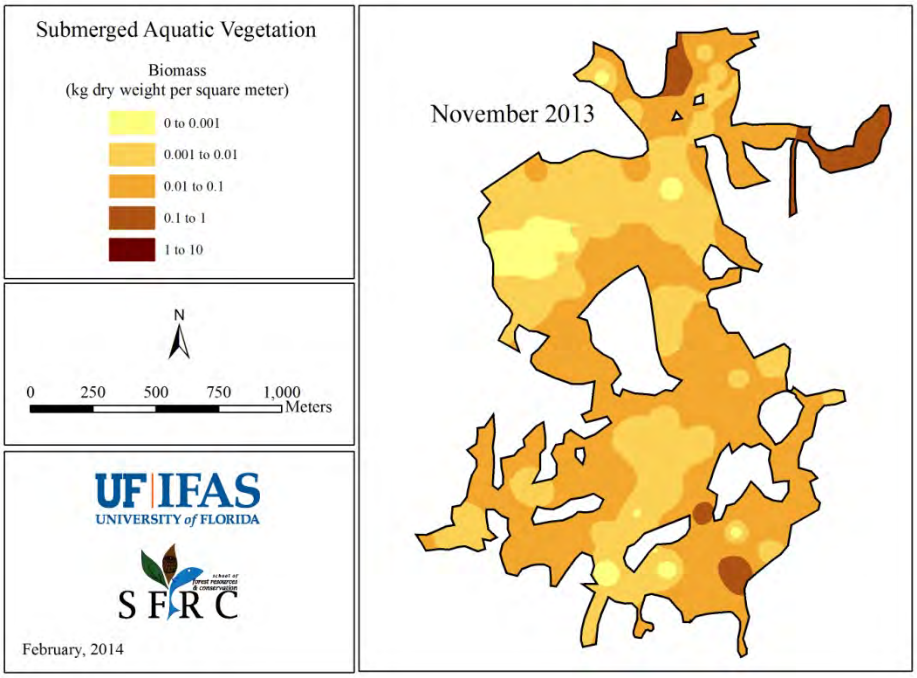
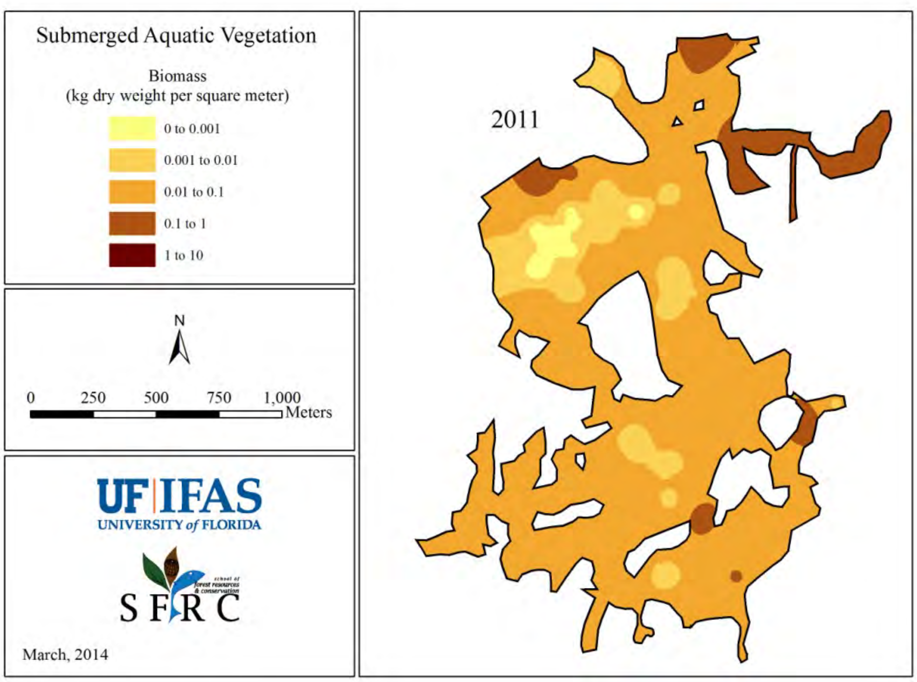
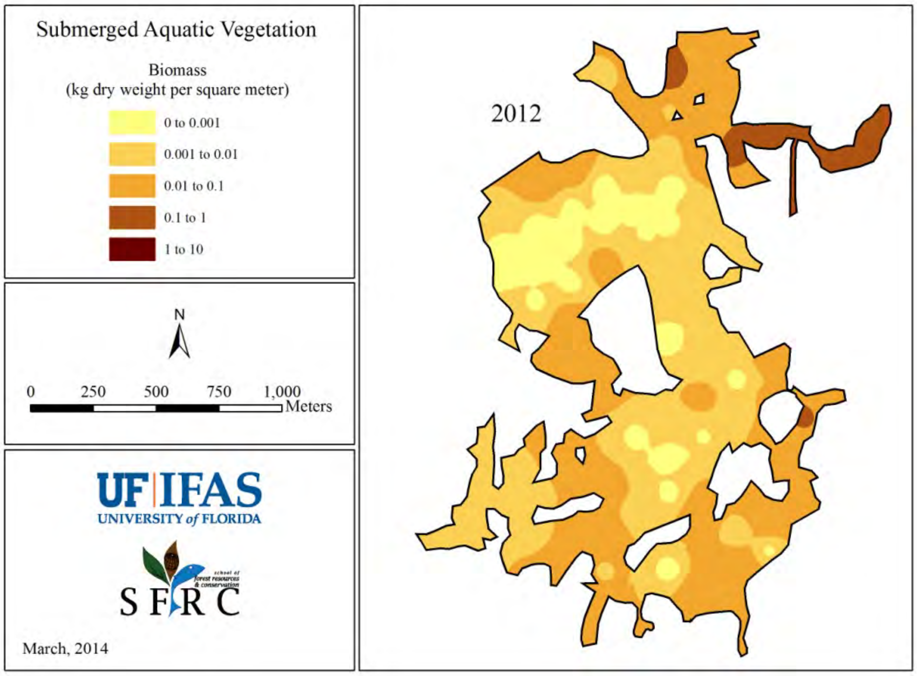
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
February 2013


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
May 2013


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
August 2013


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
November 2013


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2011


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
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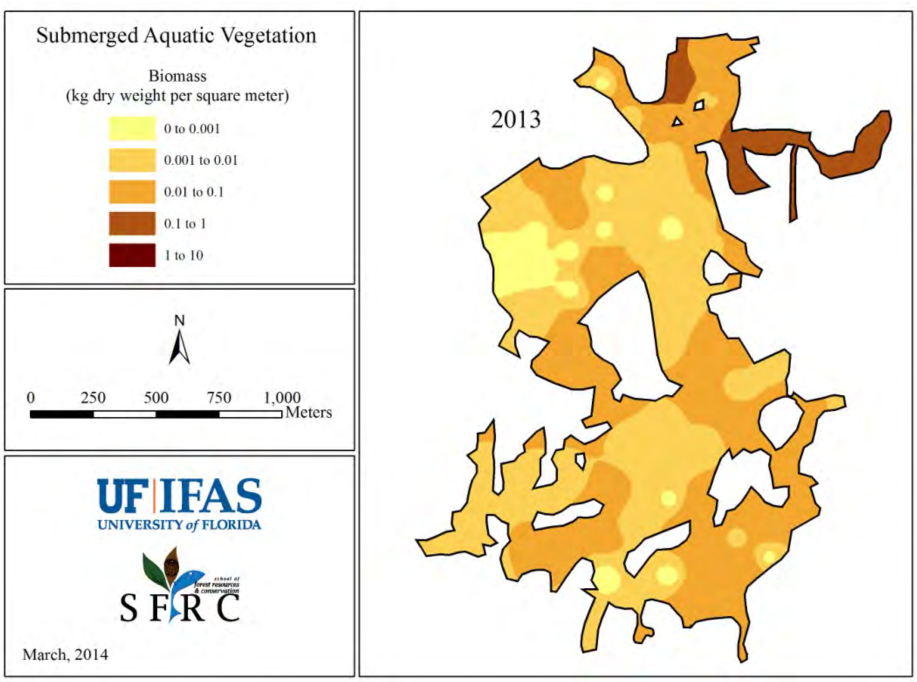
Meters
UF IFAS
UNIVERSITY of FLORIDA
S F R C
March, 2014
2012


Submerged Aquatic Vegetation
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
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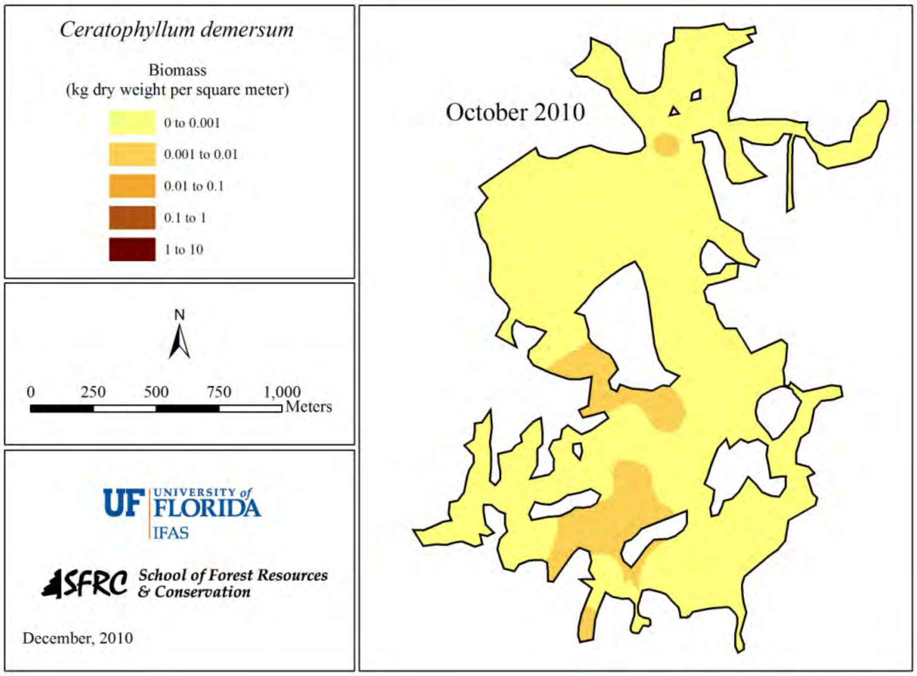
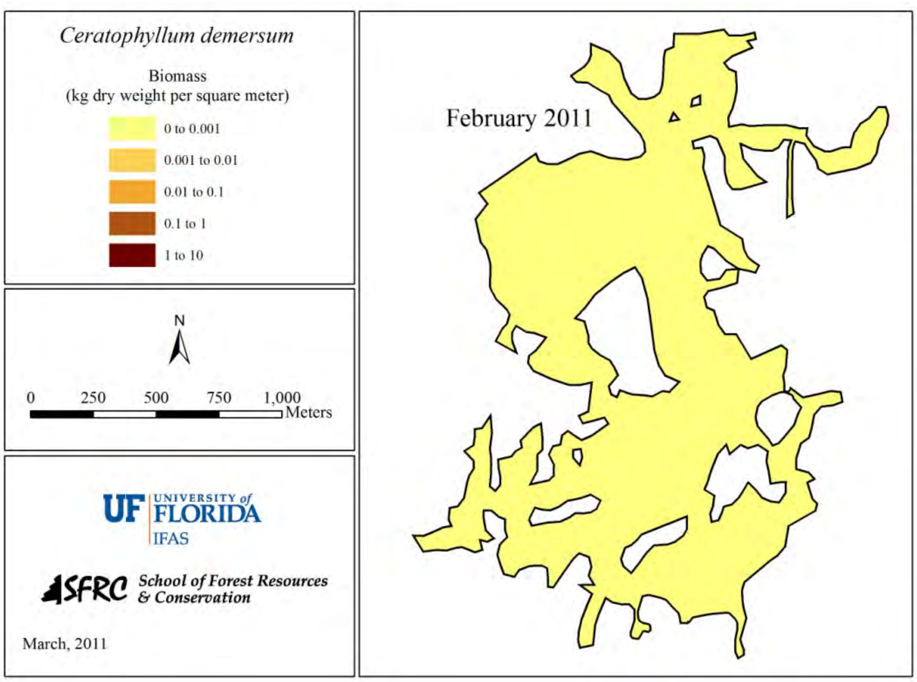
0 250 500 750 1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
S F R C
March, 2014
2013



Ceratophyllum demersum
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0
250
500
750
1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC School of Forest Resources & Conservation
December, 2010
October 2010



Ceratophyllum demersum
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
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250
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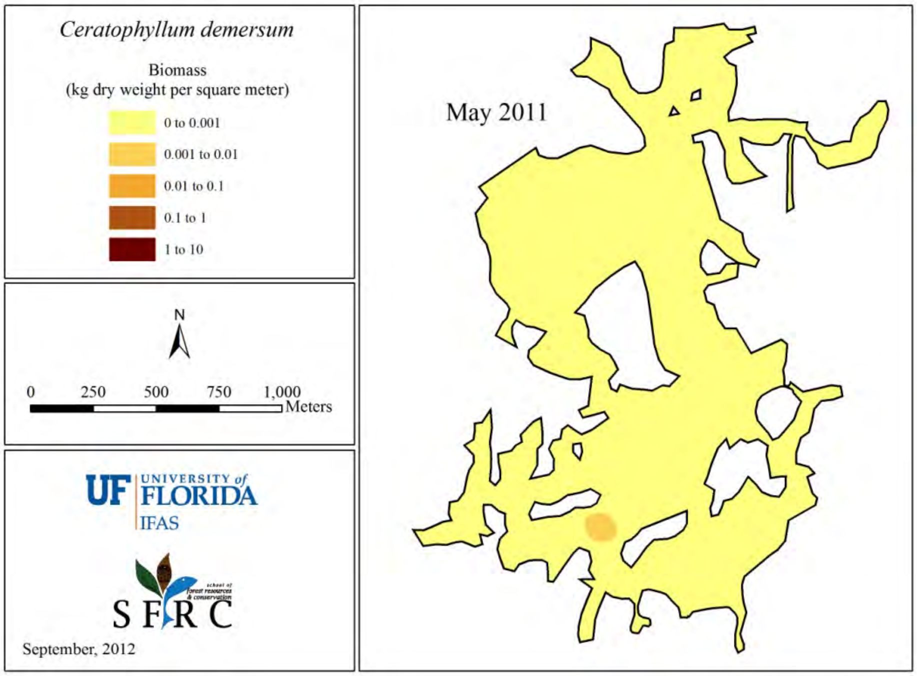
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC School of Forest Resources & Conservation
March, 2011
February 2011


Ceratophyllum demersum
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
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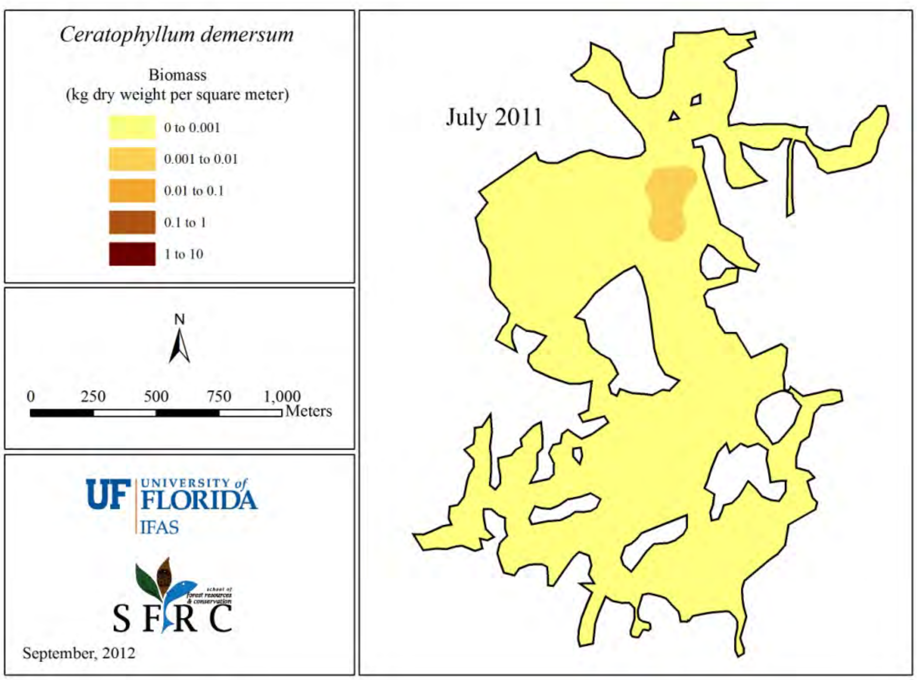
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC
September, 2012
May 2011


Ceratophyllum demersum
Biomass
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0 to 0.001
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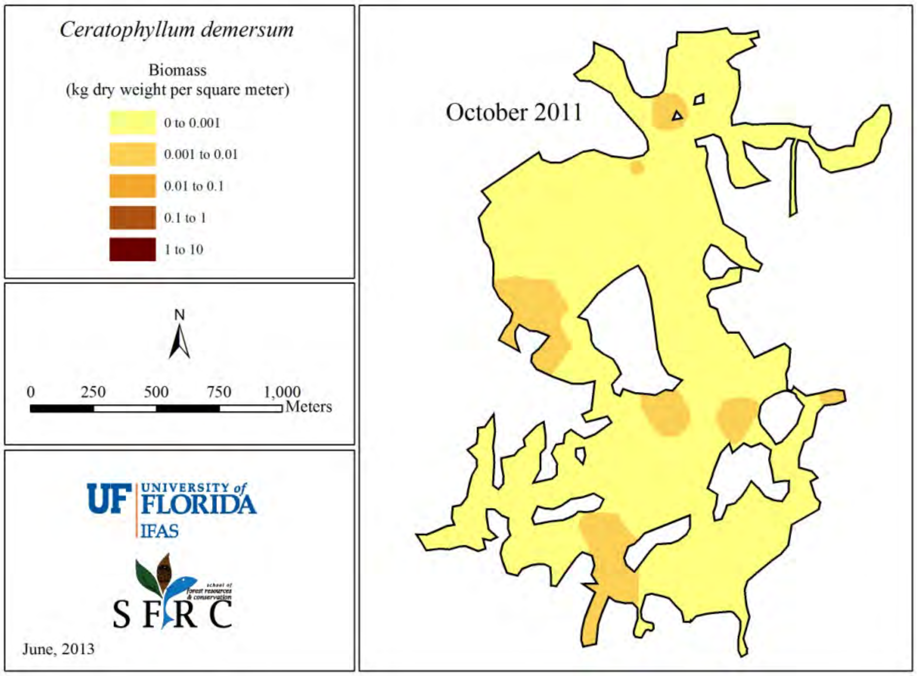
N
0 250 500 750 1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC
September, 2012
July 2011


Ceratophyllum demersum
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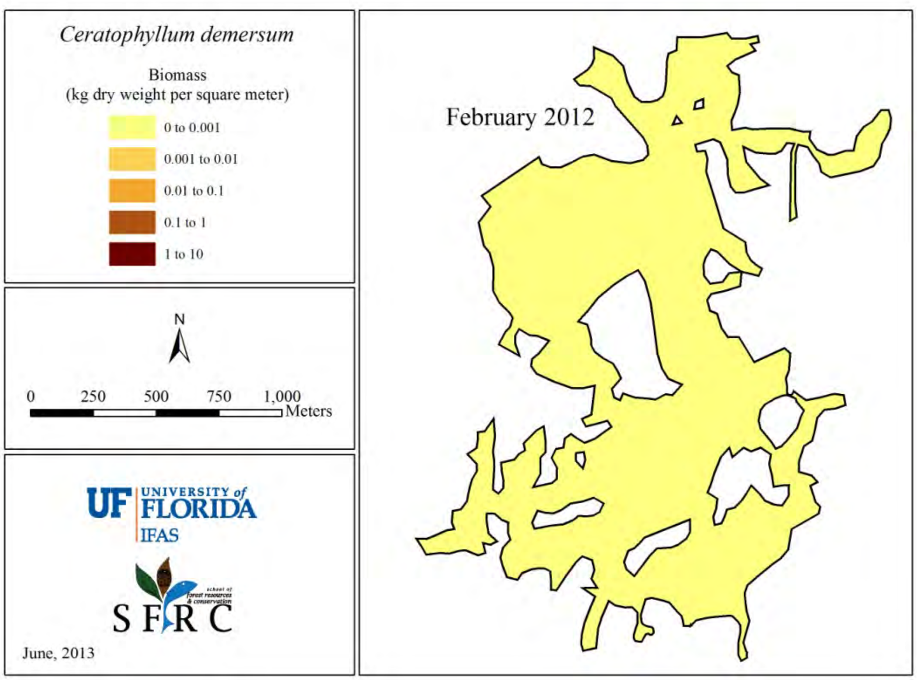
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC
June, 2013
October 2011


Ceratophyllum demersum
Biomass
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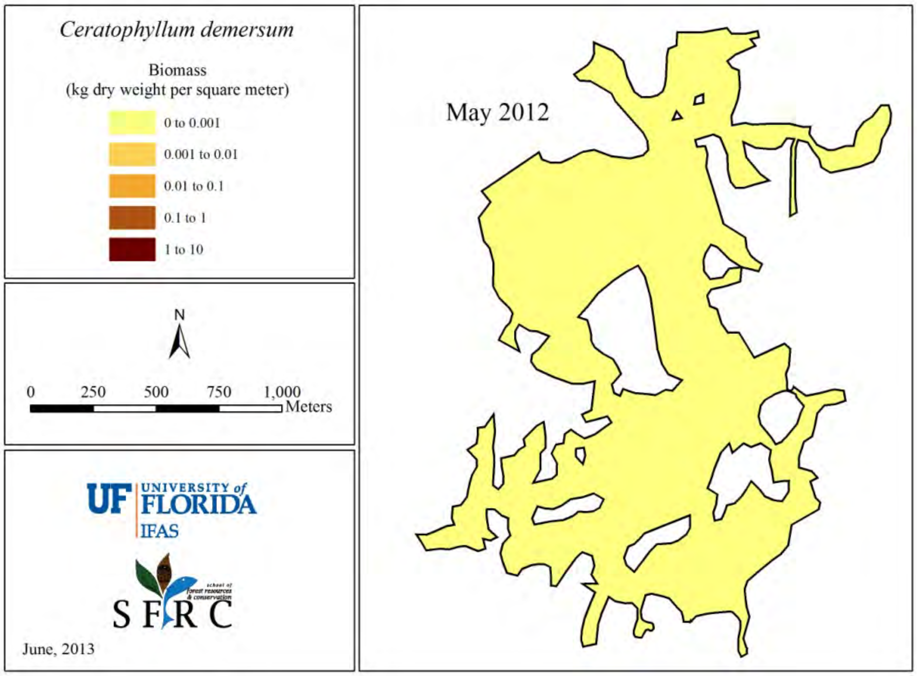
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC
June, 2013
February 2012


Ceratophyllum demersum
Biomass
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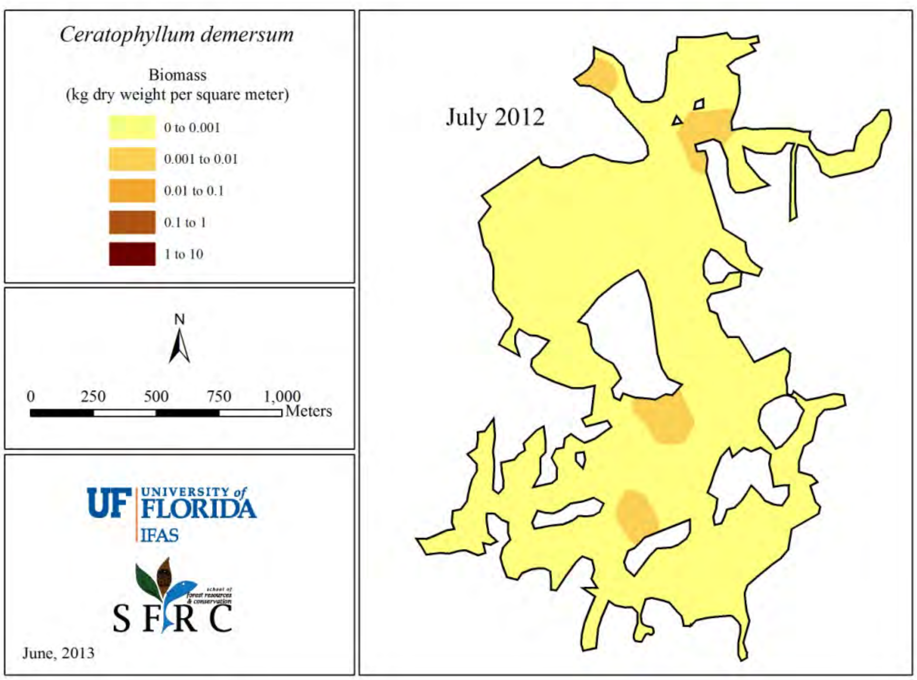
0 250 500 750 1,000 Meters
UF UNIVERSITY of FLORIDA IFAS
S F R C
June, 2013
May 2012


Ceratophyllum demersum
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
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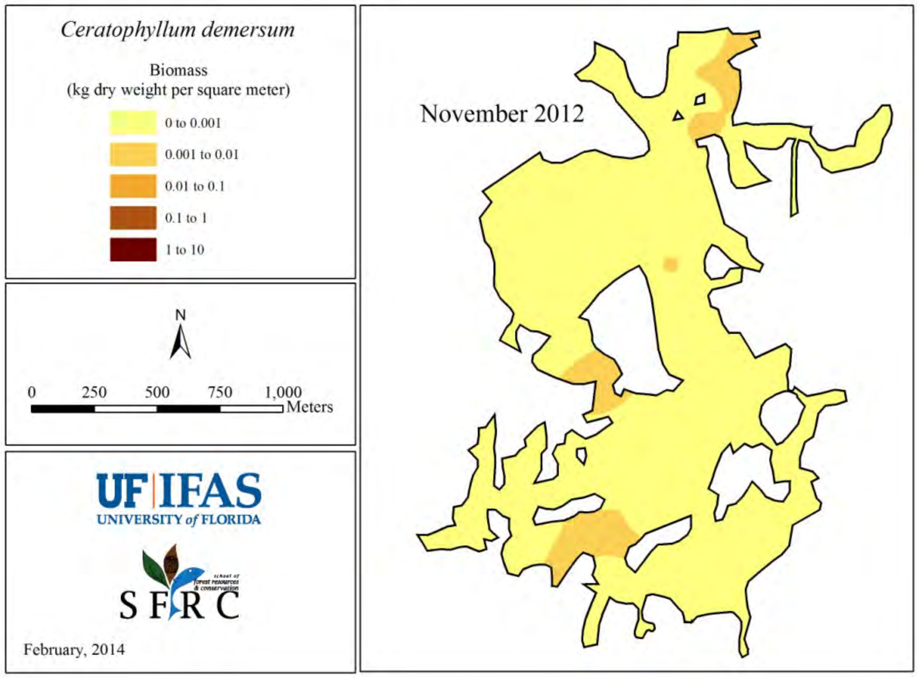
UF UNIVERSITY of FLORIDA IFAS
S F R C
June, 2013
July 2012



Ceratophyllum demersum
Biomass
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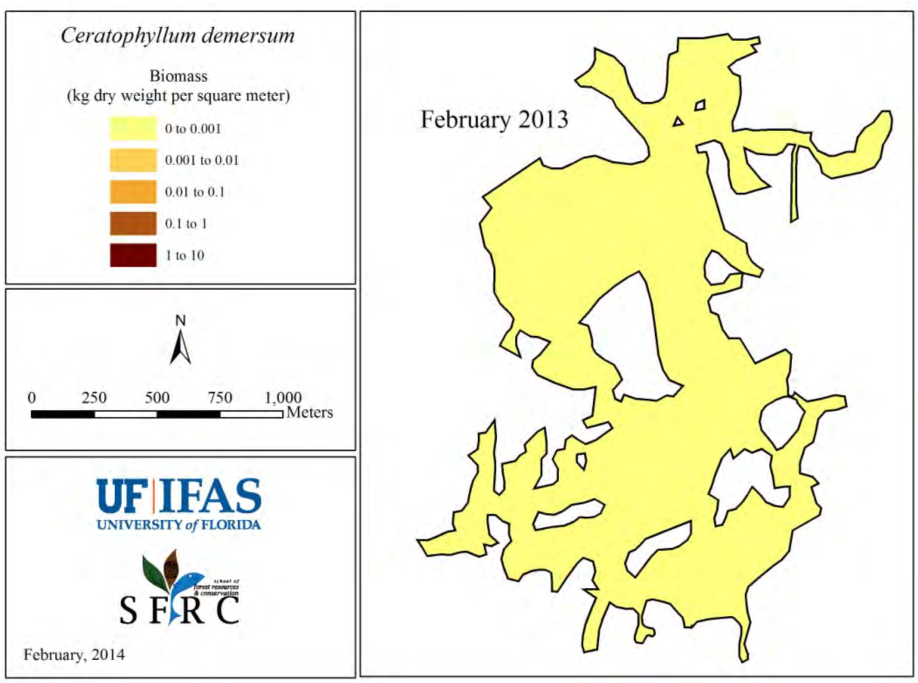
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
November 2012



Ceratophyllum demersum
Biomass
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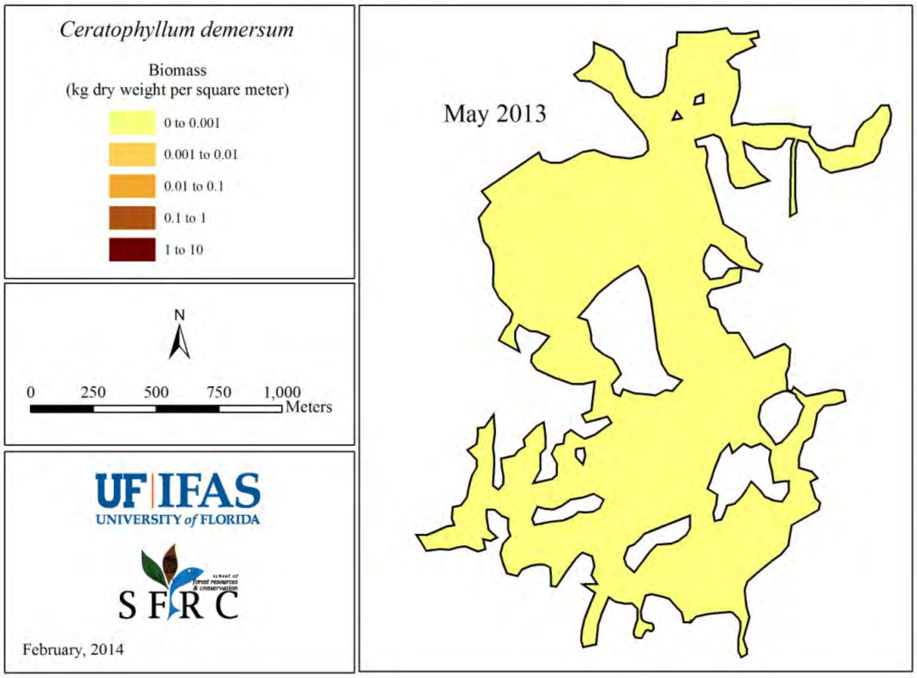
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
February 2013



Ceratophyllum demersum
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
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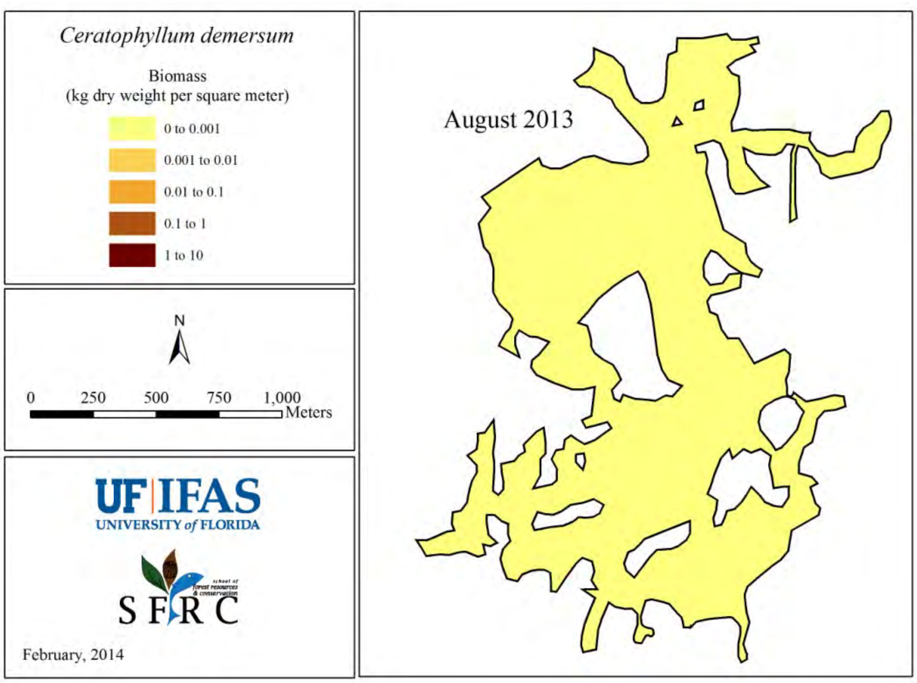
N
0 250 500 750 1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
May 2013



Ceratophyllum demersum
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
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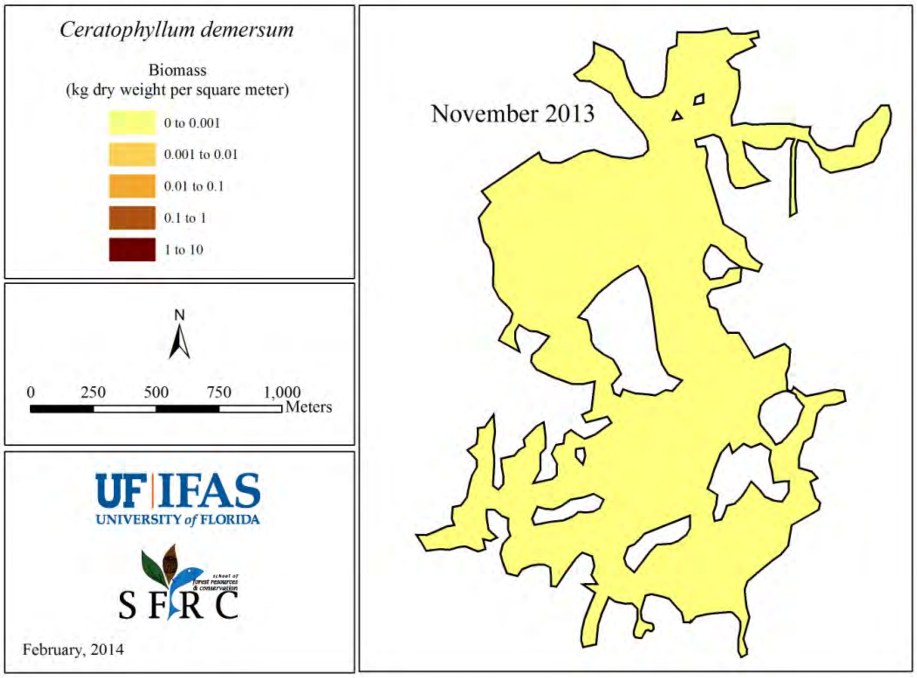
0 250 500 750 1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
August 2013


Ceratophyllum demersum
Biomass
(kg dry weight per square meter)
0 to 0.001
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250
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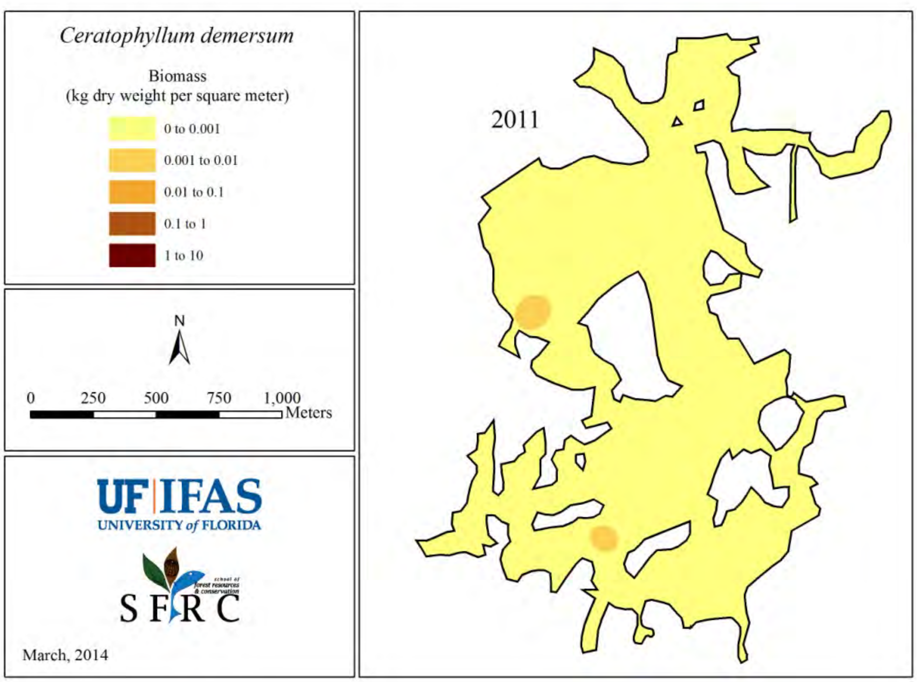
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
November 2013


Ceratophyllum demersum
Biomass
(kg dry weight per square meter)
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1 to 10
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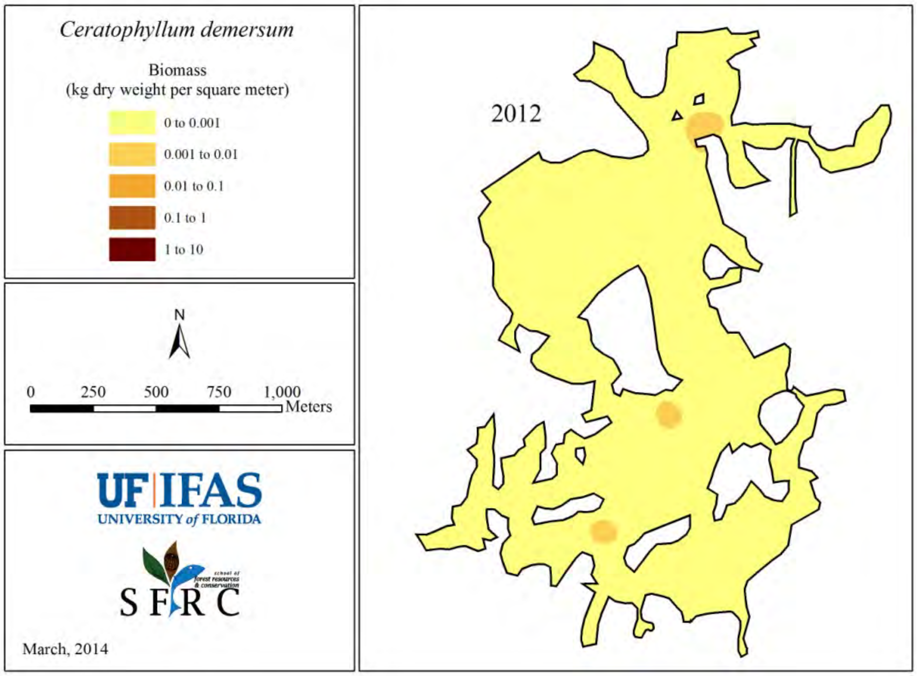
250
500
750
1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2011


Ceratophyllum demersum
Biomass
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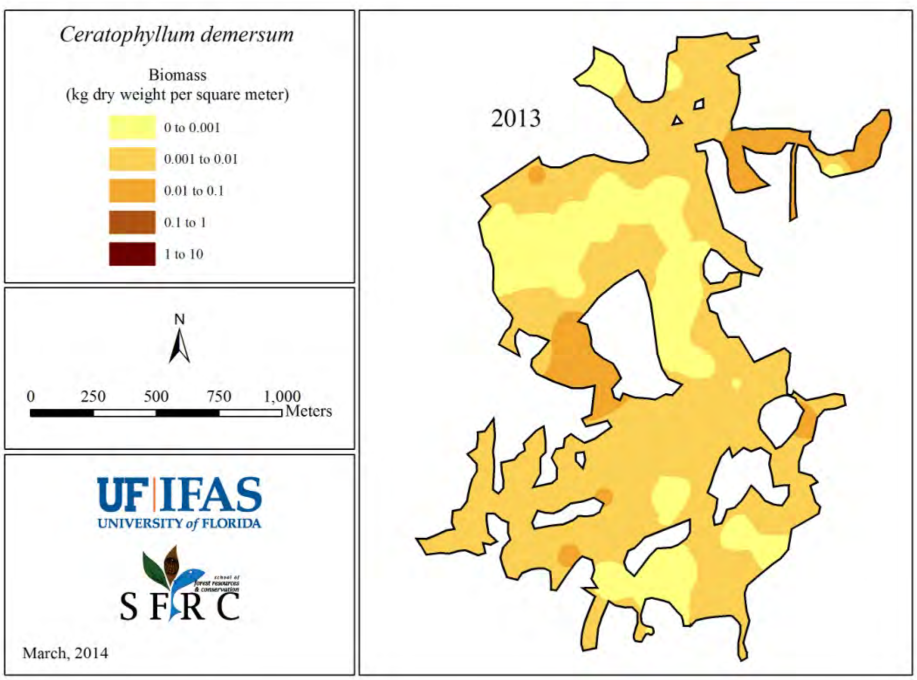
UF IFAS
UNIVERSITY of FLORIDA
S F R C
March, 2014
2012


Ceratophyllum demersum
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UNIVERSITY of FLORIDA
S F R C
March, 2014
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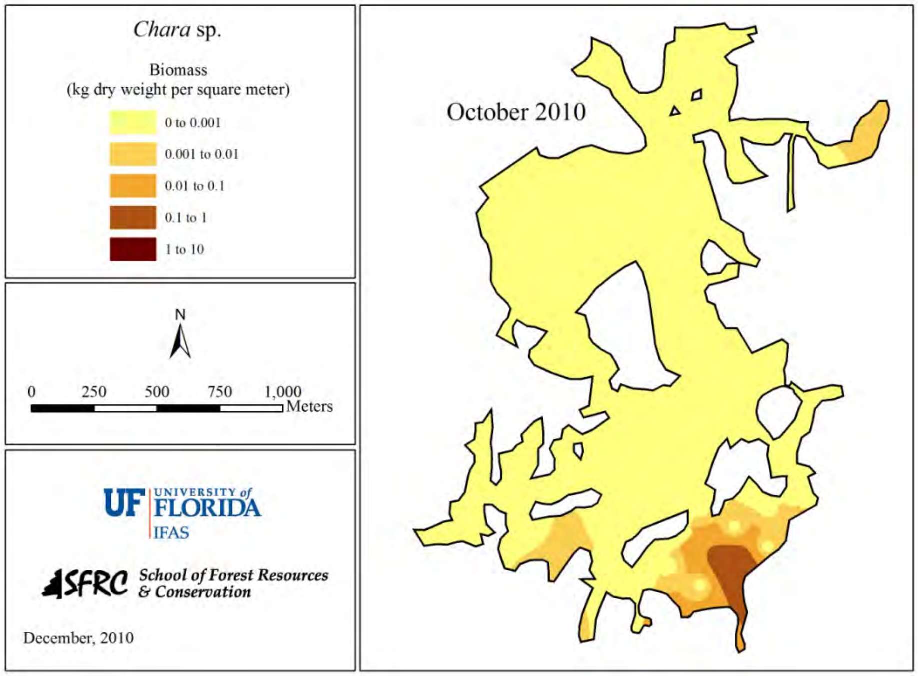
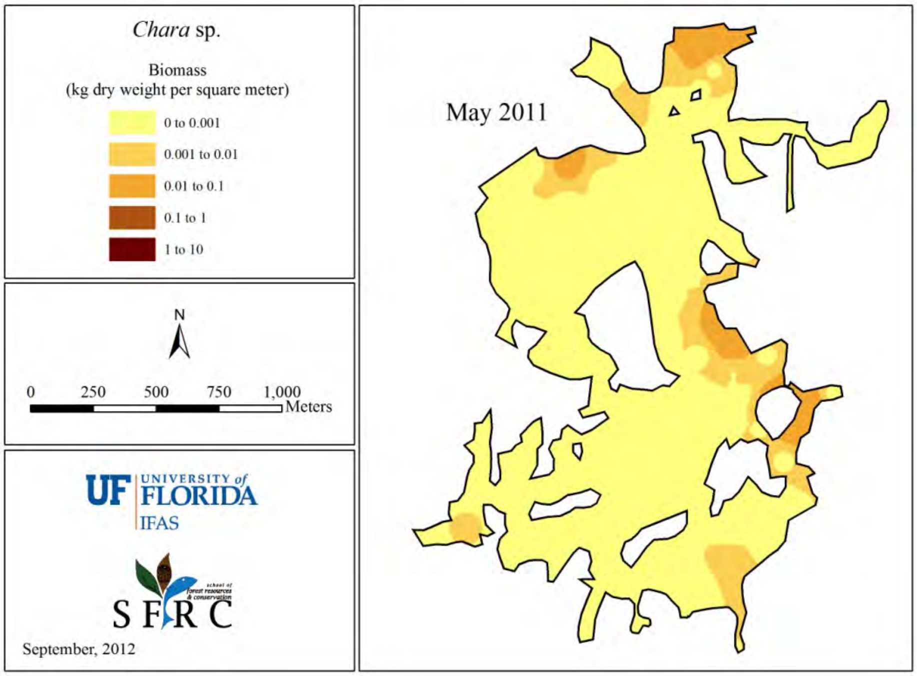


Chara sp. was not found in any quadrat in February 2011


Chara sp.
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
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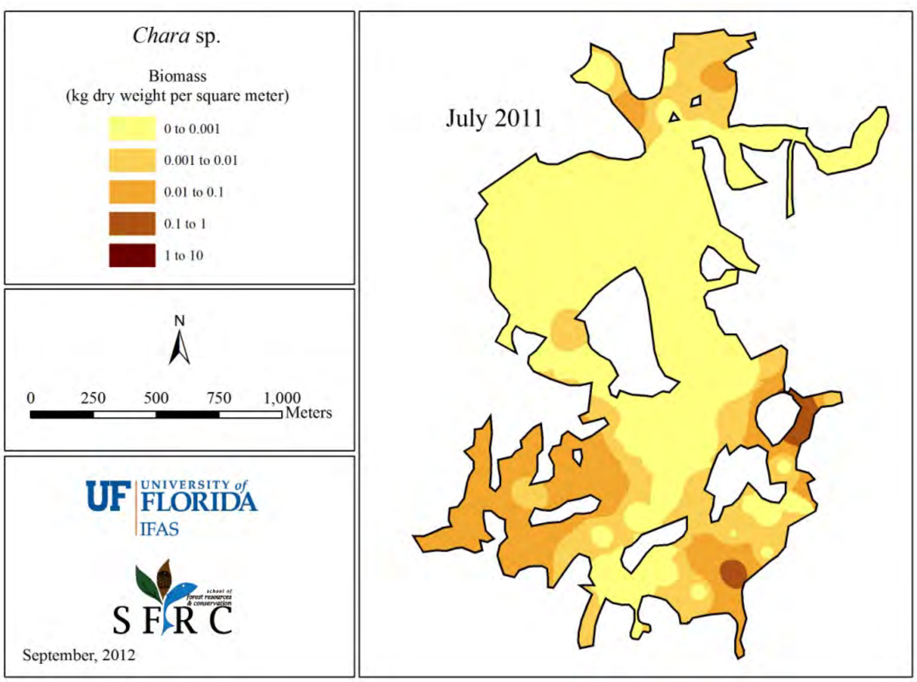
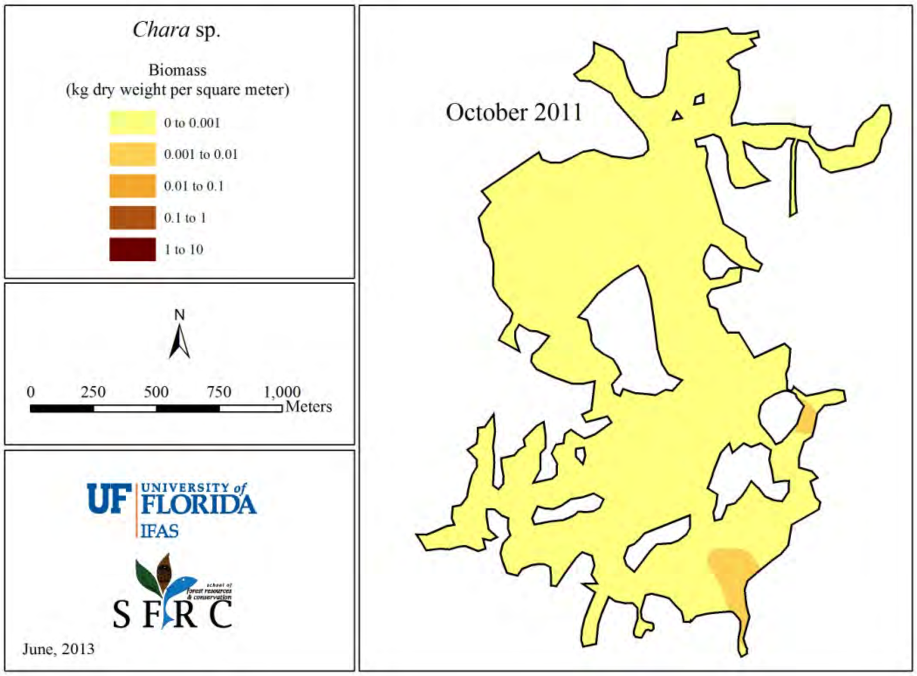
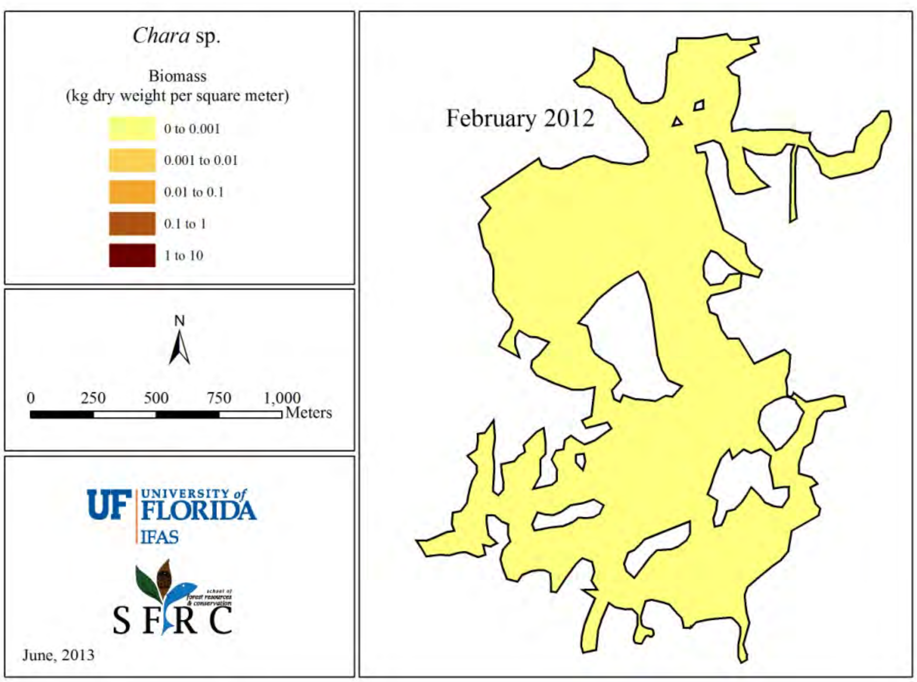
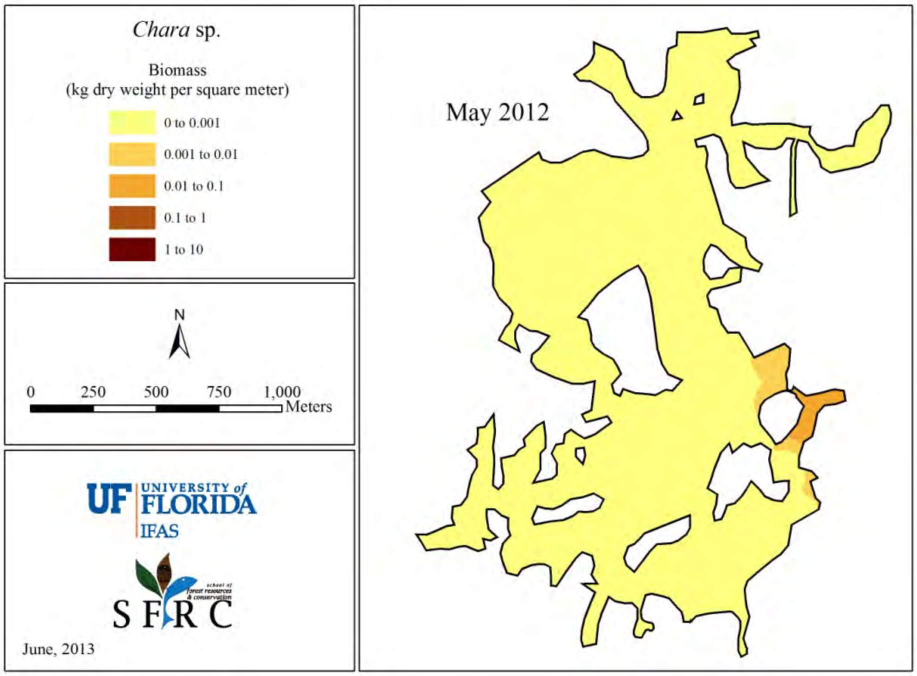
0 250 500 750 1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
S F R C
September, 2012
May 2011


Chara sp.
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
S F R C
September, 2012
July 2011


Chara sp.
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
June, 2013
October 2011


Chara sp.
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
June, 2013
February 2012


Chara sp.
Biomass
(kg dry weight per square meter)
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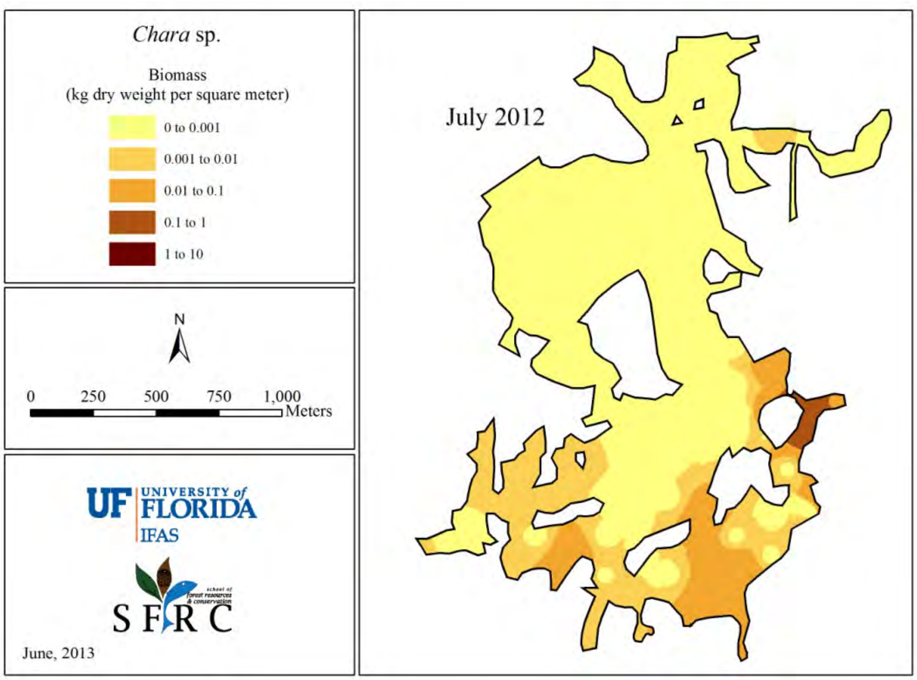
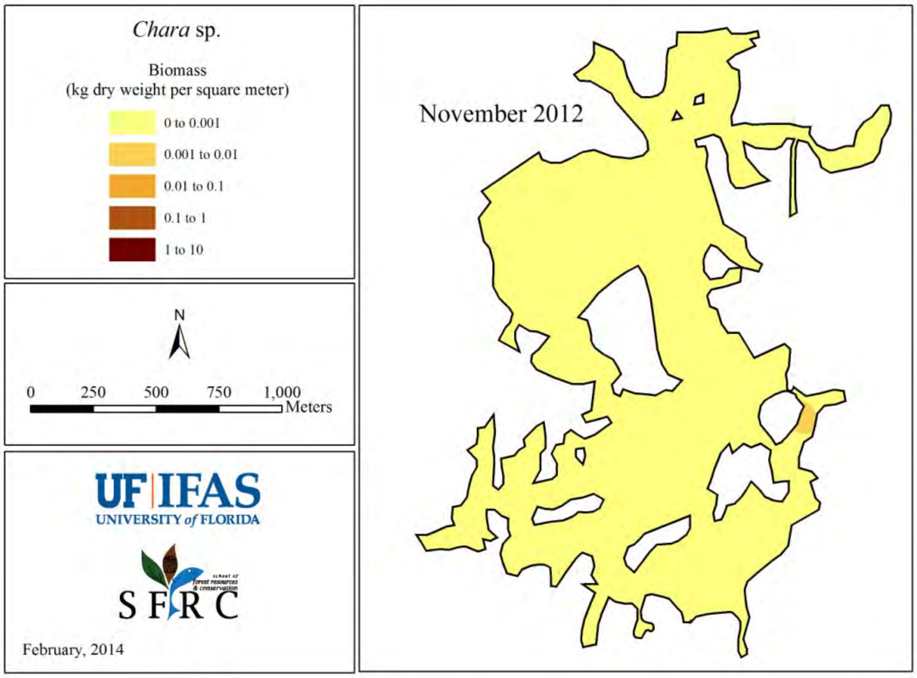
1 to 10
N
0 250 500 750 1,000 Meters
UF UNIVERSITY of FLORIDA IFAS
S F R C
June, 2013
May 2012


Chara sp.
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UF UNIVERSITY of FLORIDA IFAS
S F R C
June, 2013
July 2012


Chara sp.
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
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750
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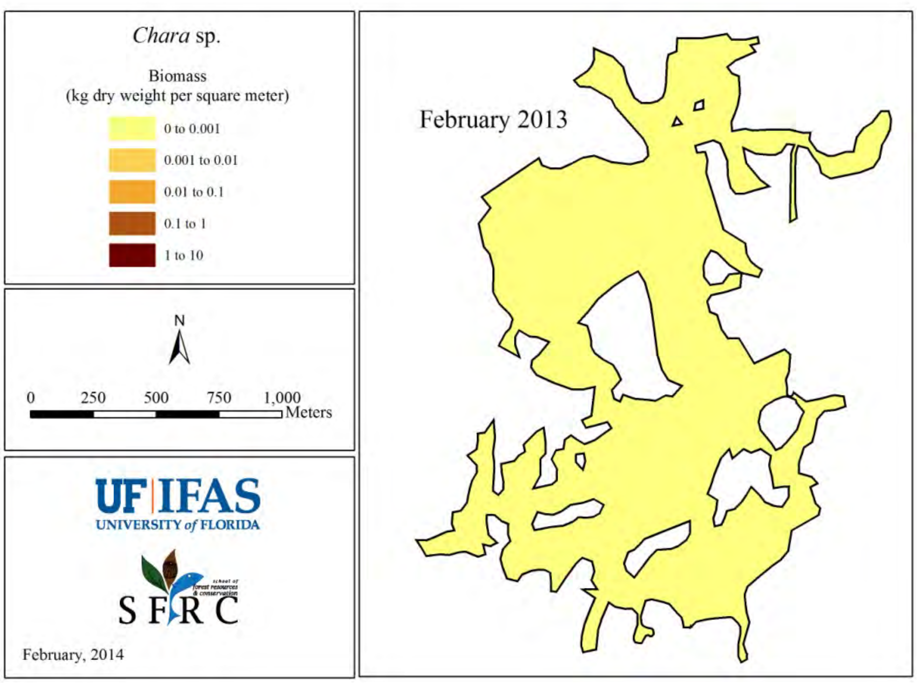
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
November 2012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Meters
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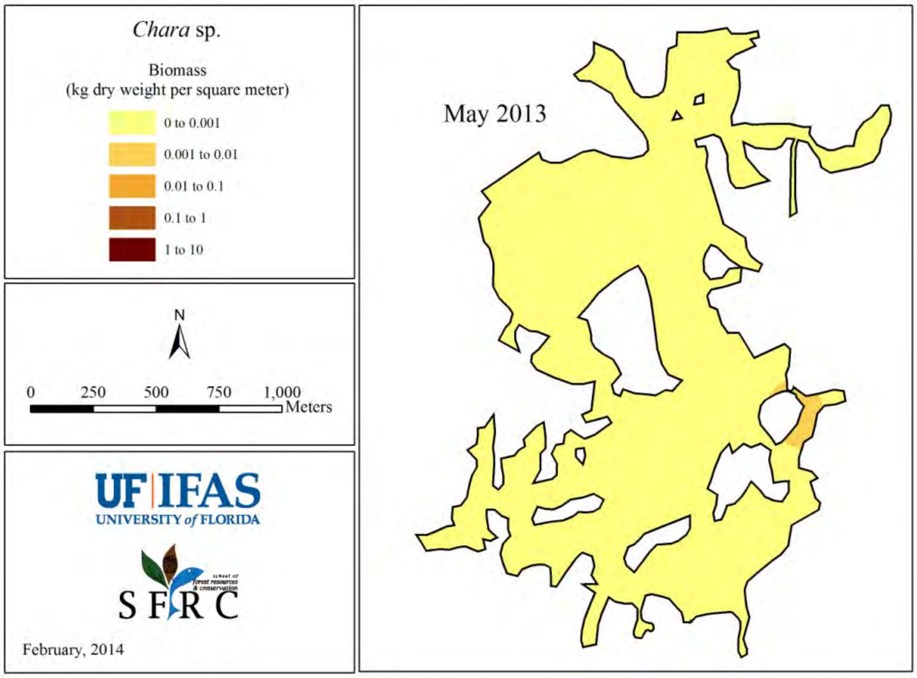
UNIVERSITY of FLORIDA
SFRC
February, 2014
February 2013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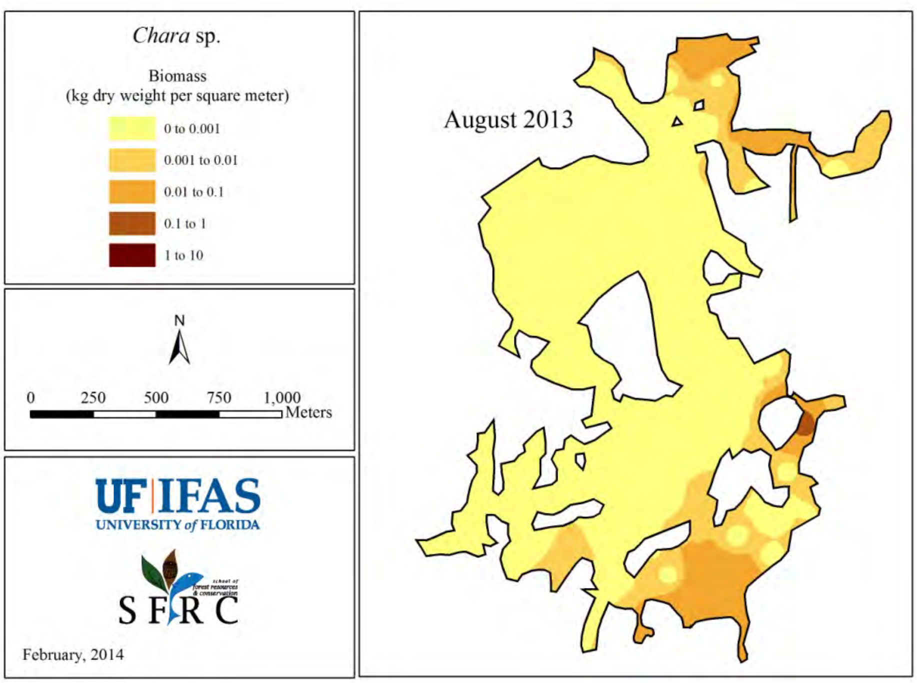
UNIVERSITY of FLORIDA
SFRC
February, 2014
May 2013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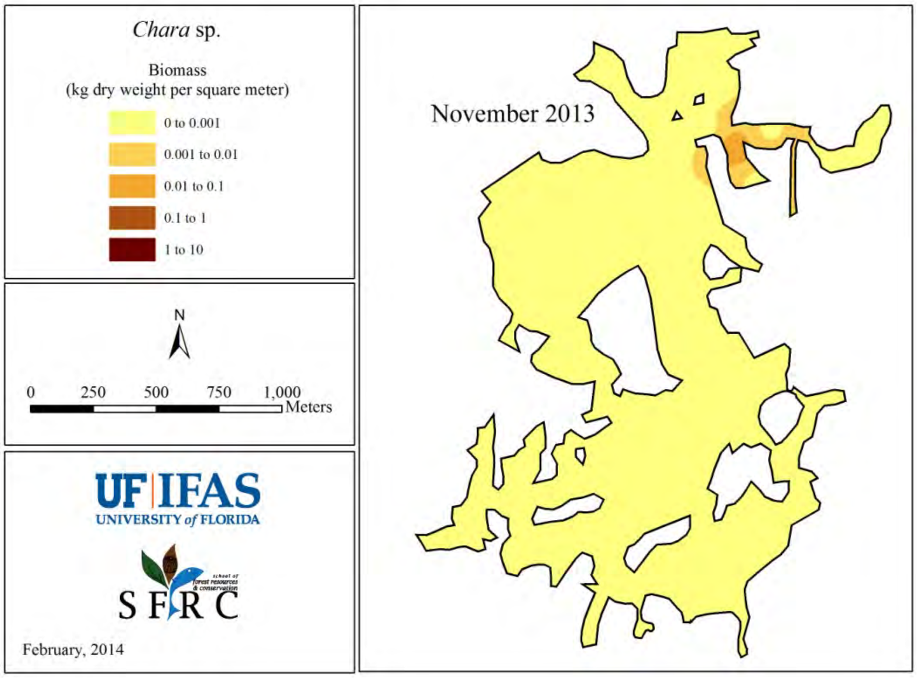
UNIVERSITY of FLORIDA
SFRC
February, 2014
August 2013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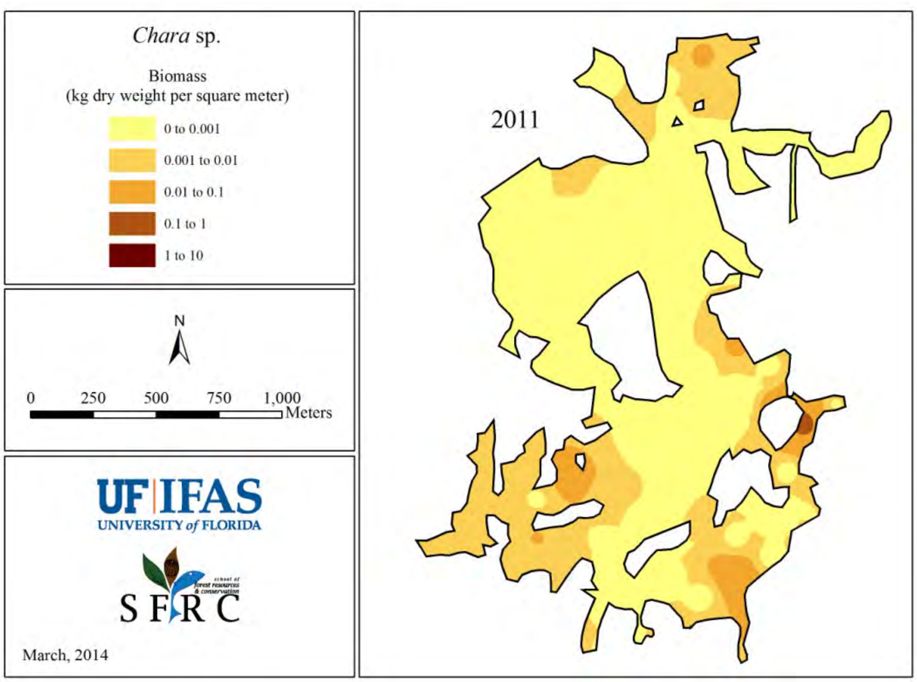
school of forest resources & conservation
SFRC
February, 2014
November 2013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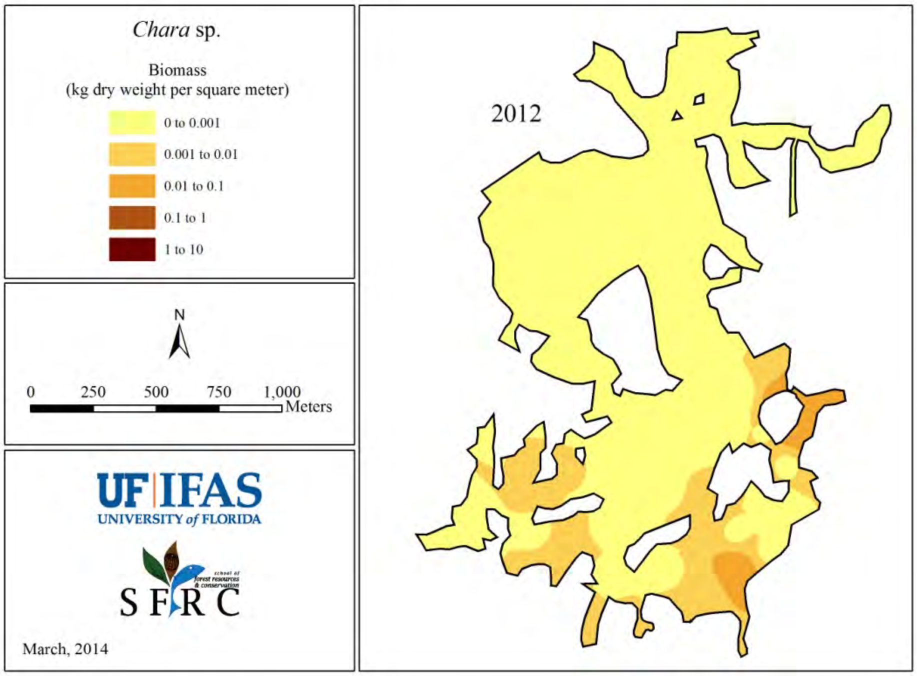
SFRC
March, 2014
2011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March, 2014
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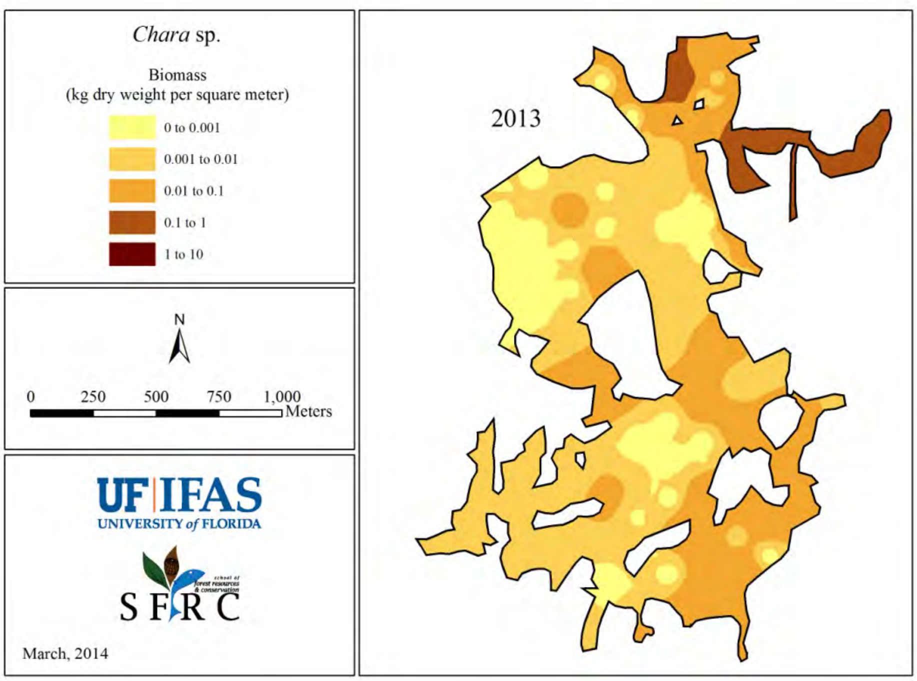
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March, 2014
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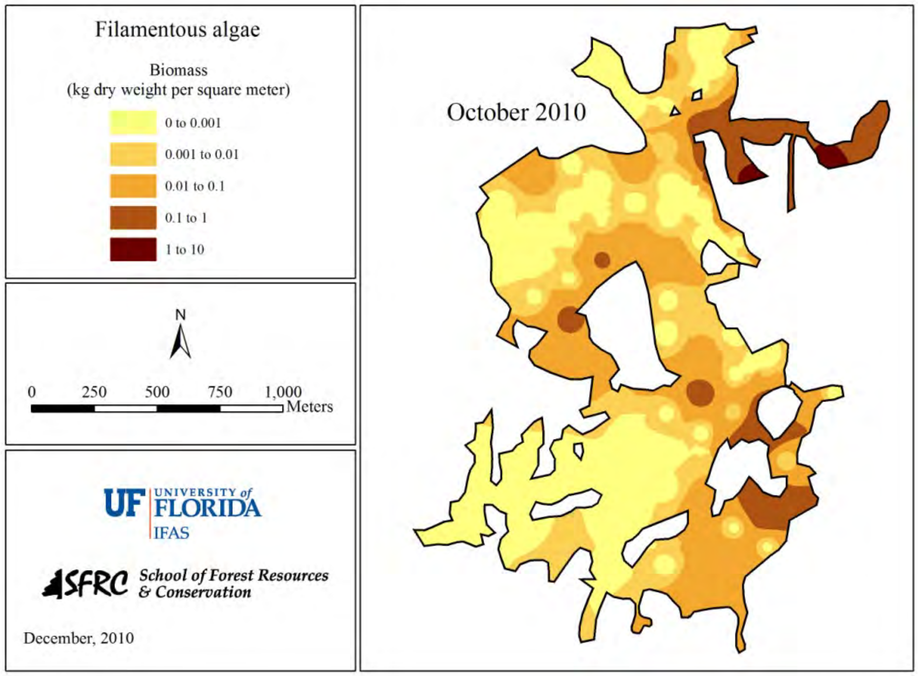
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Biomass
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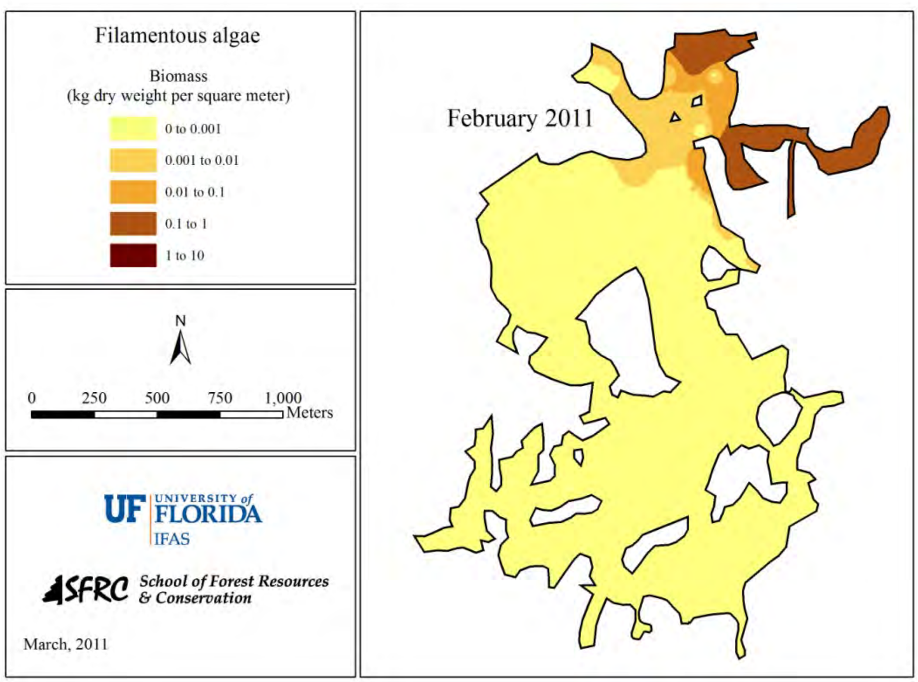
UF UNIVERSITY of FLORIDA IFAS
SFRC School of Forest Resources & Conservation
December, 2010
October 2010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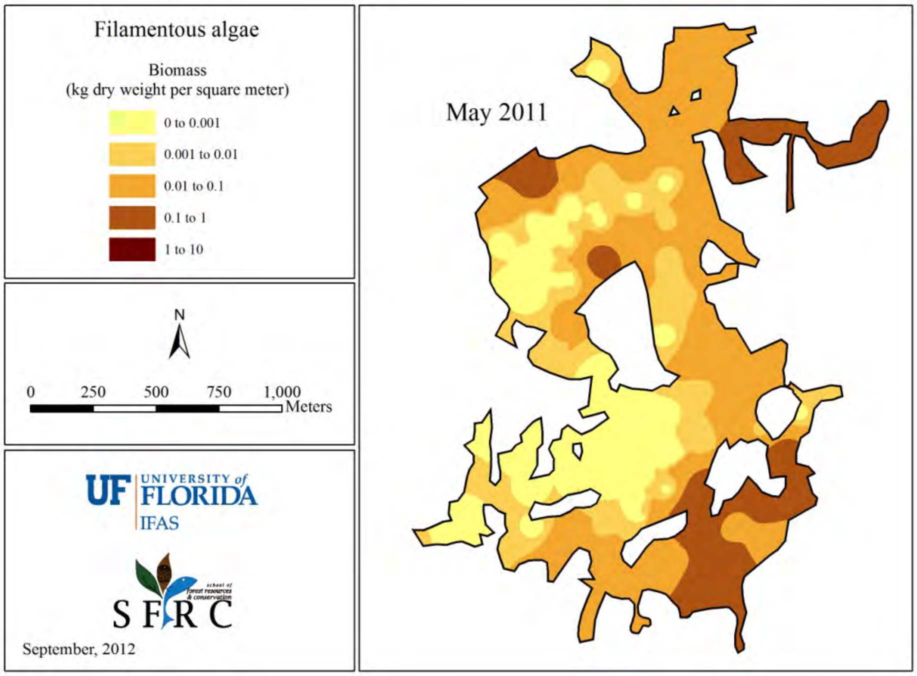
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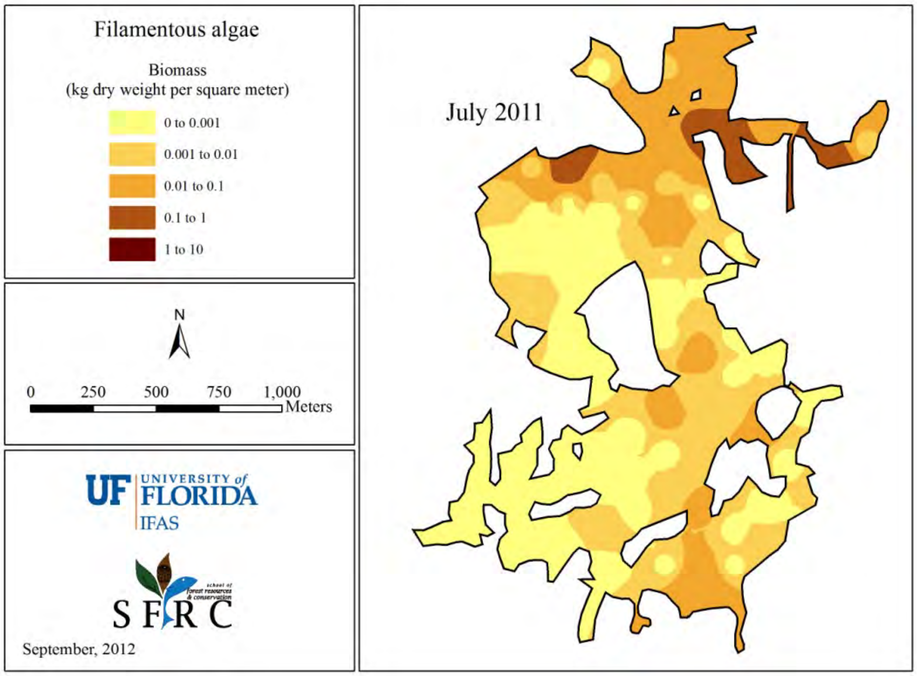
UF UNIVERSITY of FLORIDA
IFAS
SFRC
September, 2012
May 2011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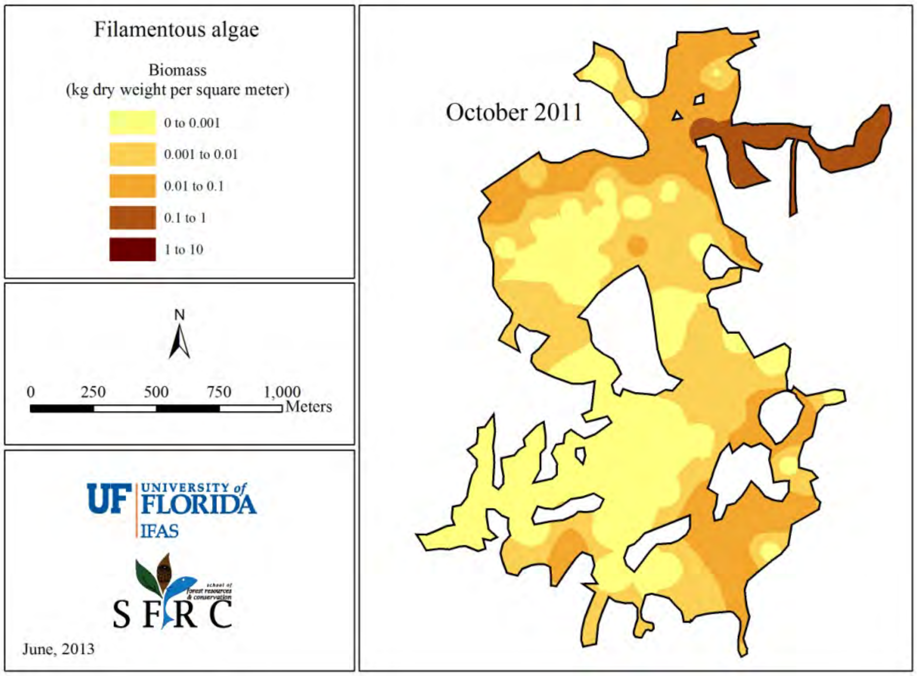
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UF UNIVERSITY of FLORIDA
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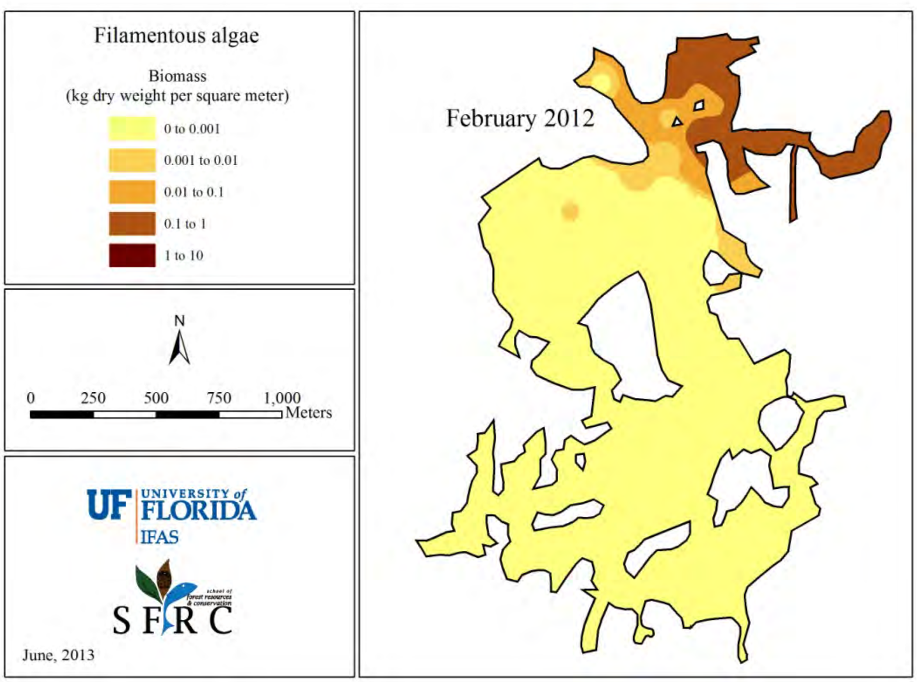
June, 2013
October 2011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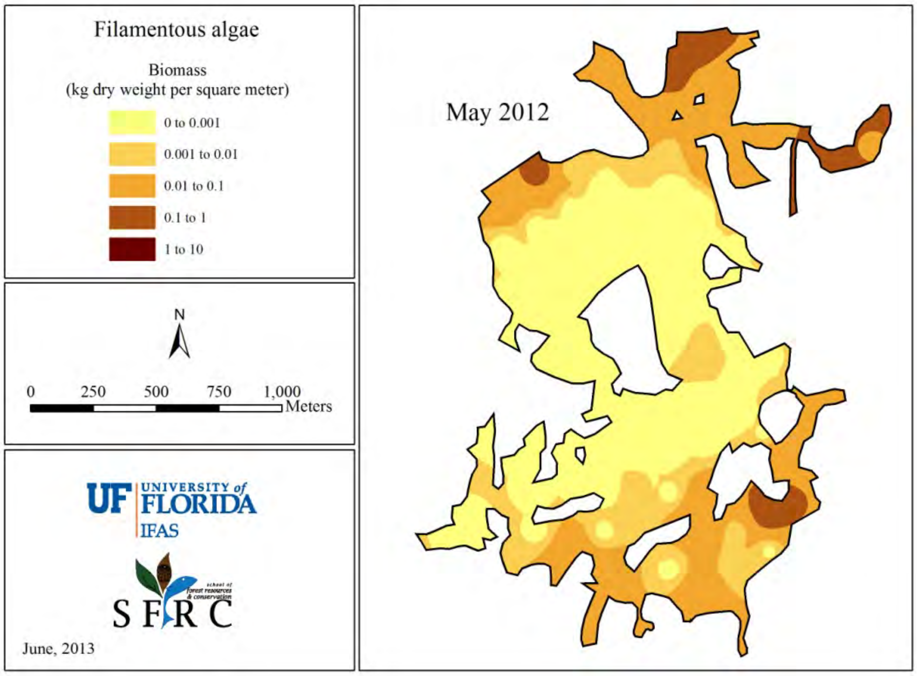
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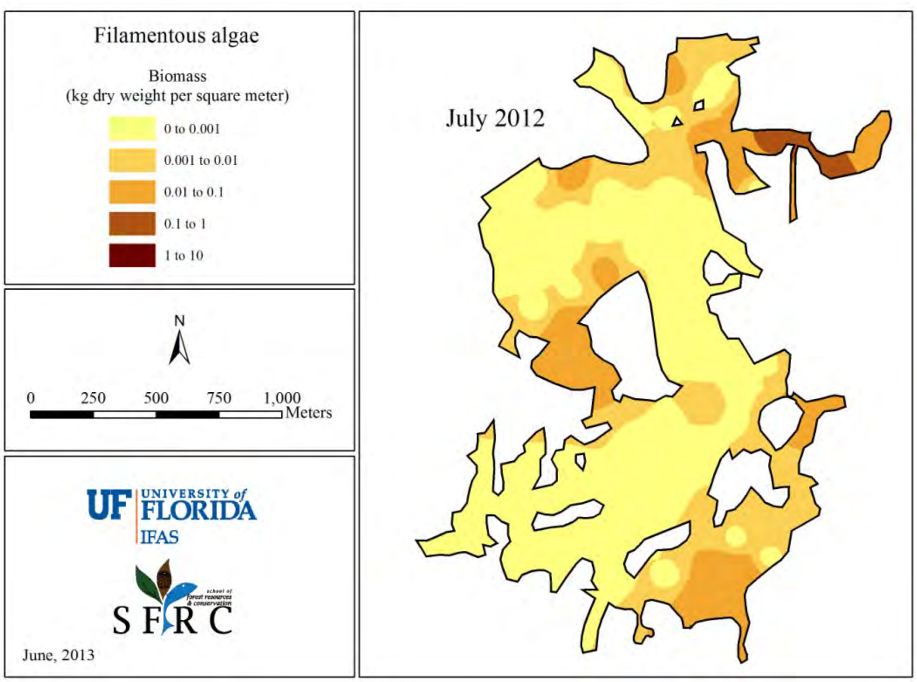
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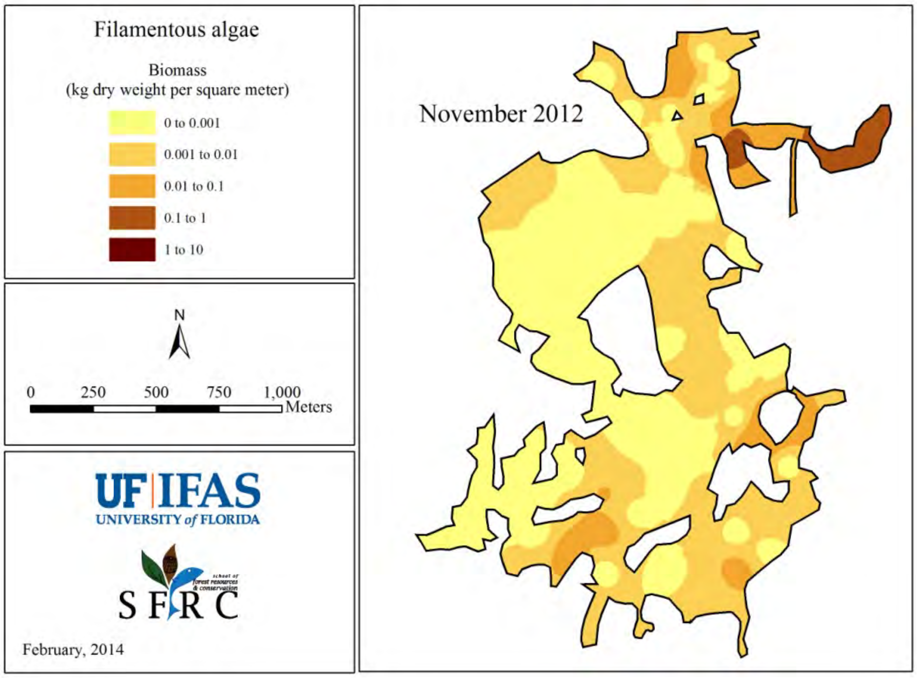
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UF IFAS
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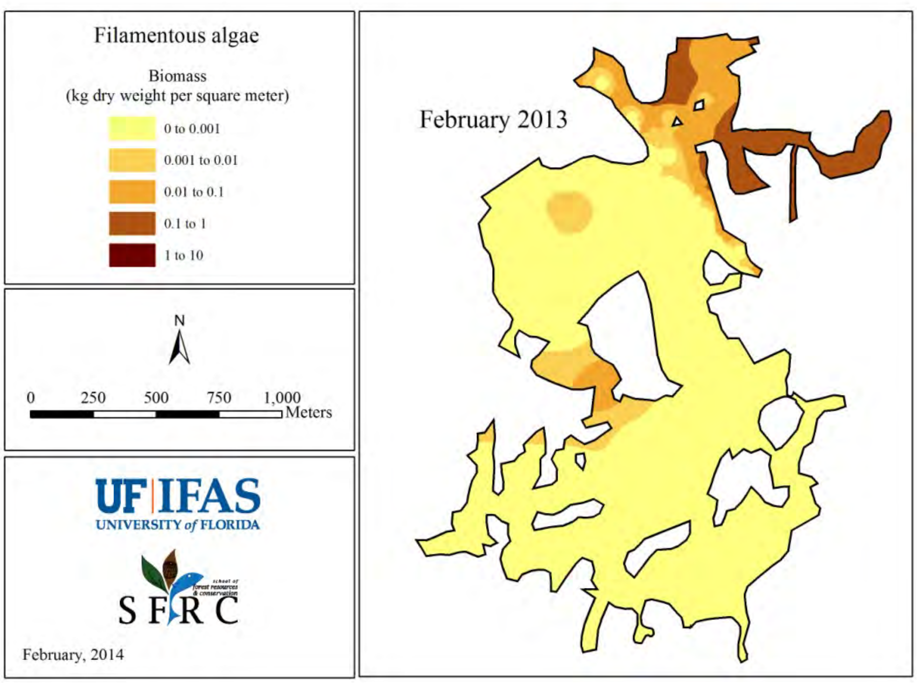
February, 2014
November 2012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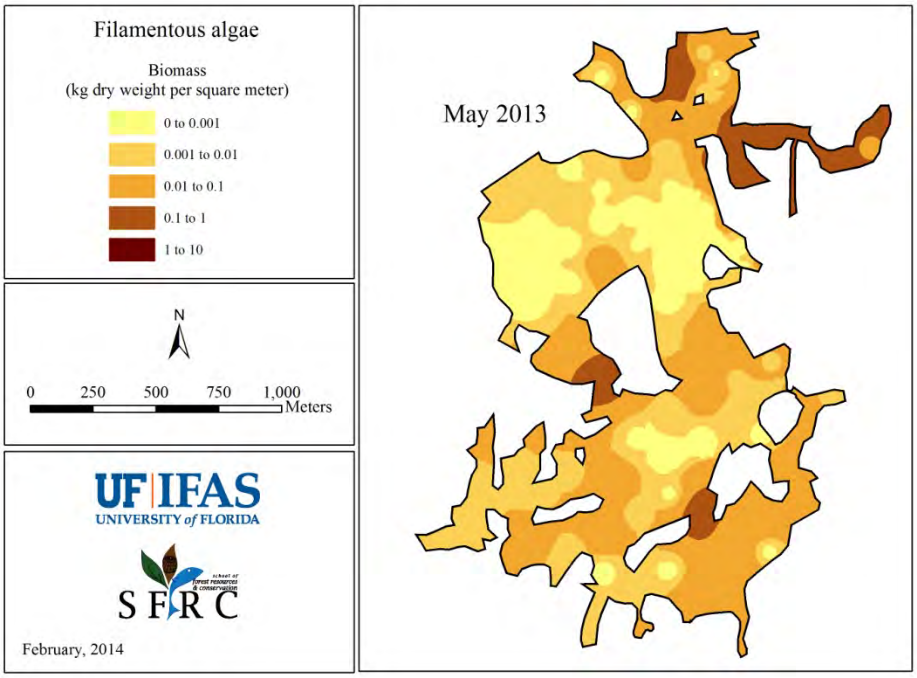
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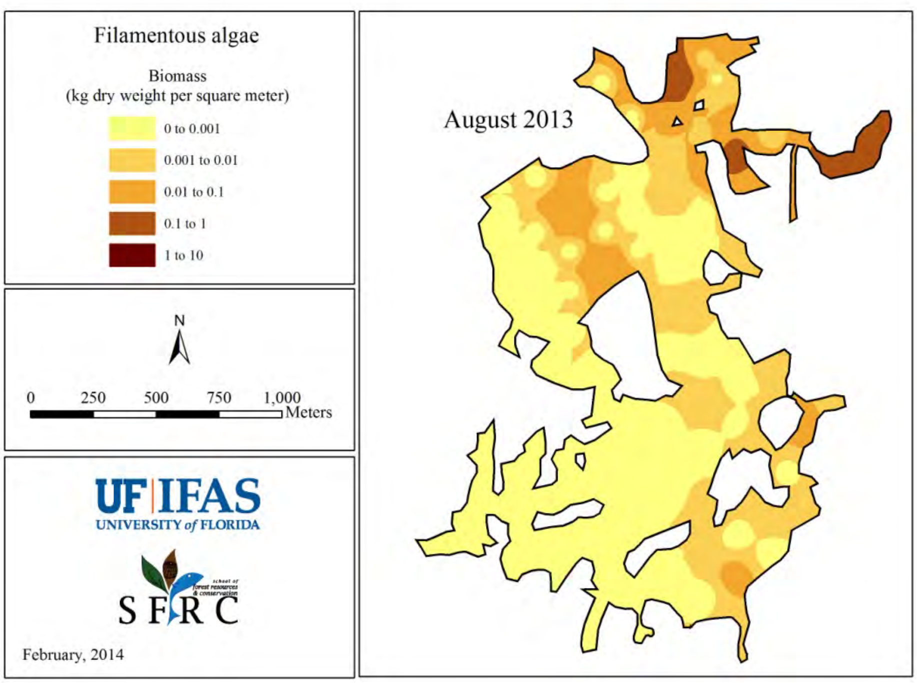
February, 2014
May 2013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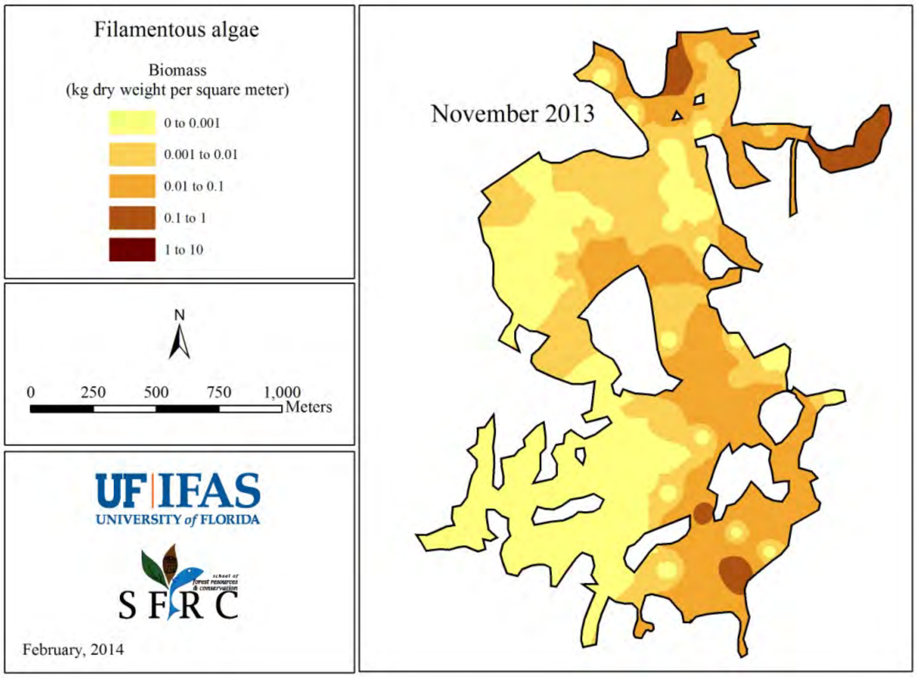
SFRC
February, 2014
August 2013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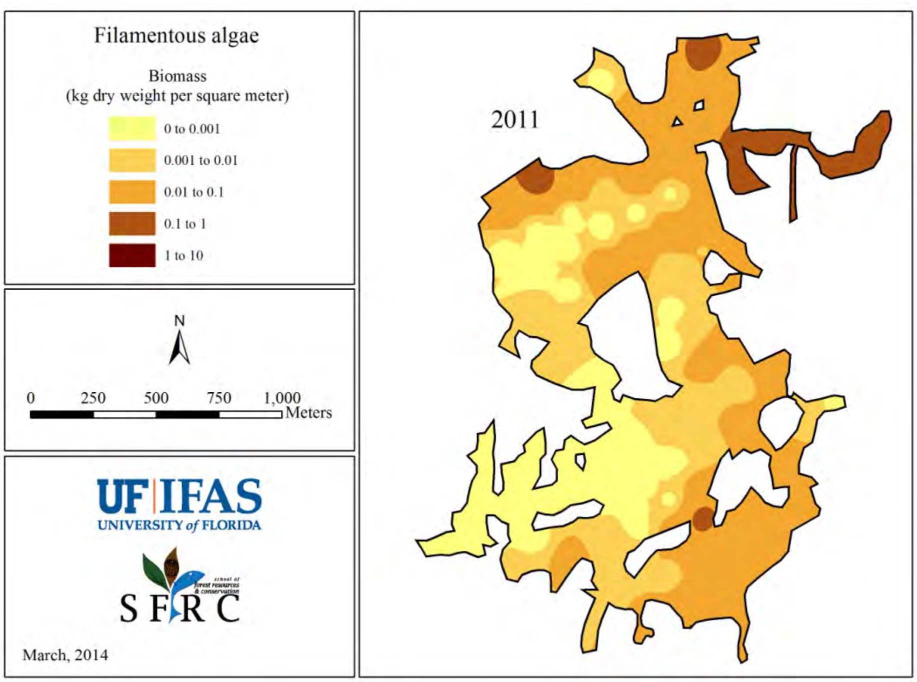
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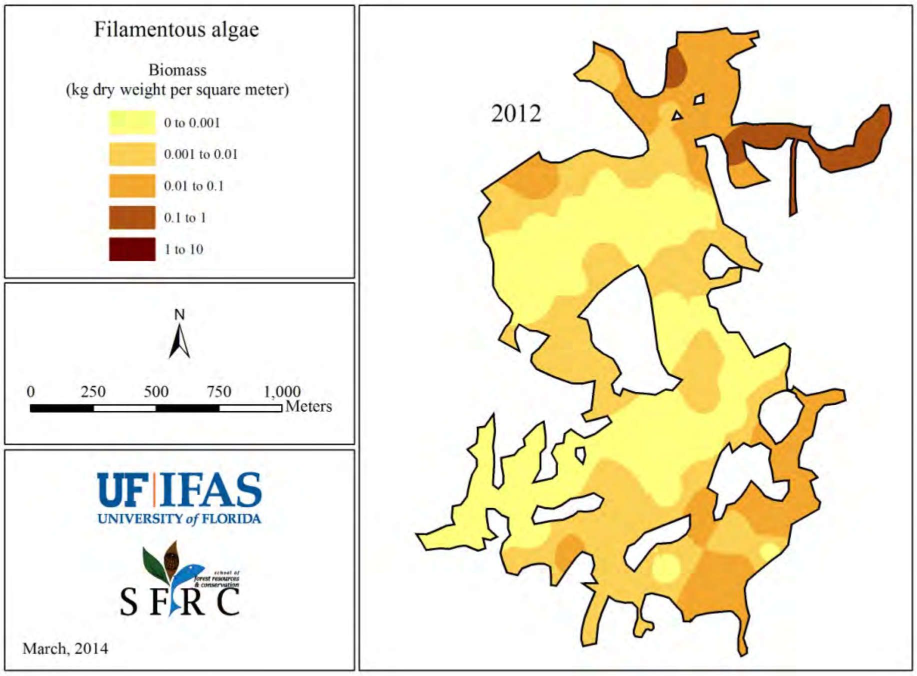
SFRC
March, 2014
2011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March, 2014
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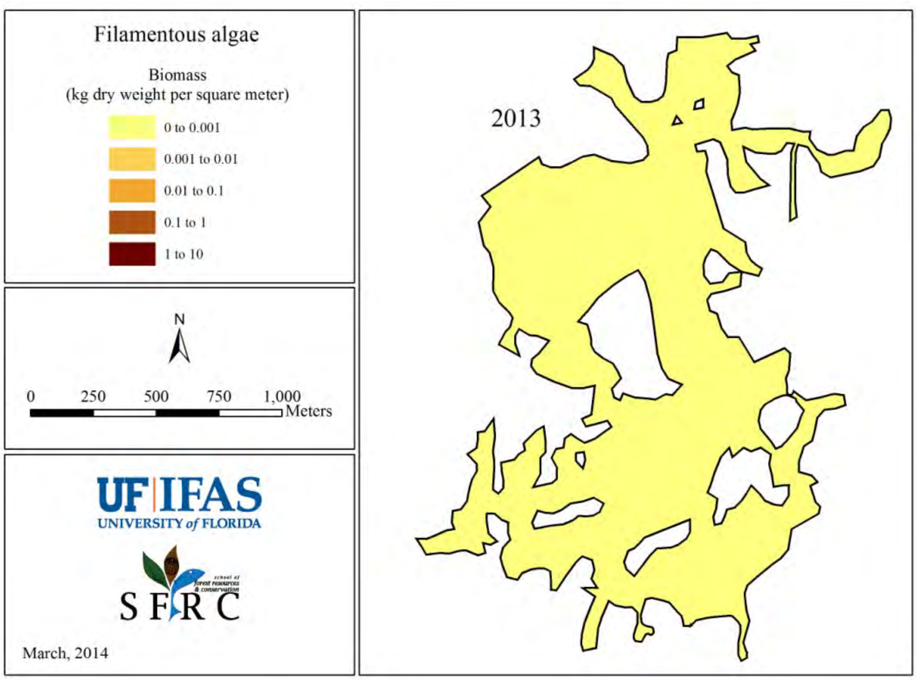
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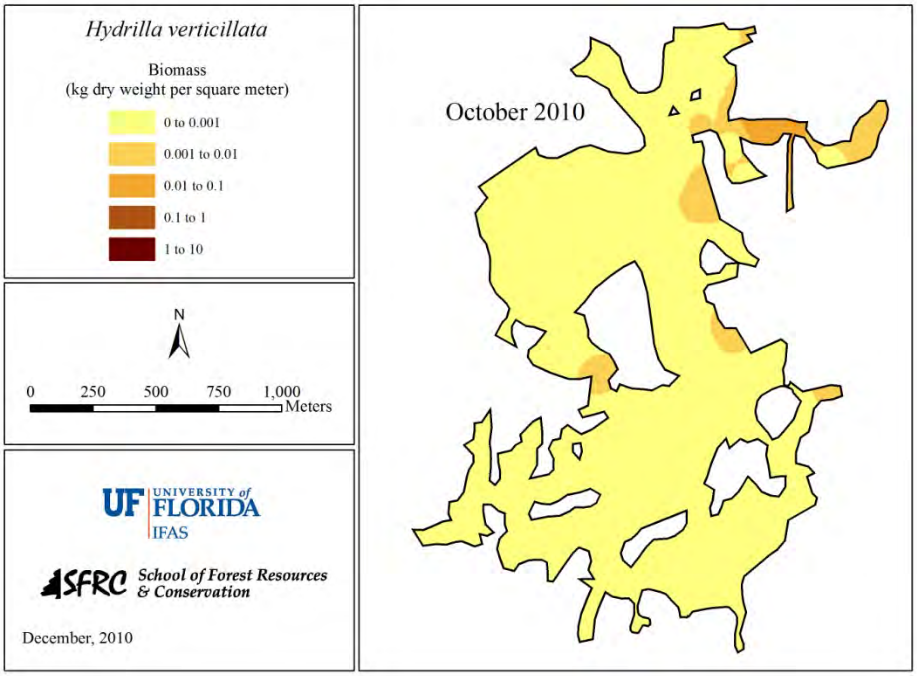
Hydrilla verticillata
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UF UNIVERSITY of FLORIDA IFAS
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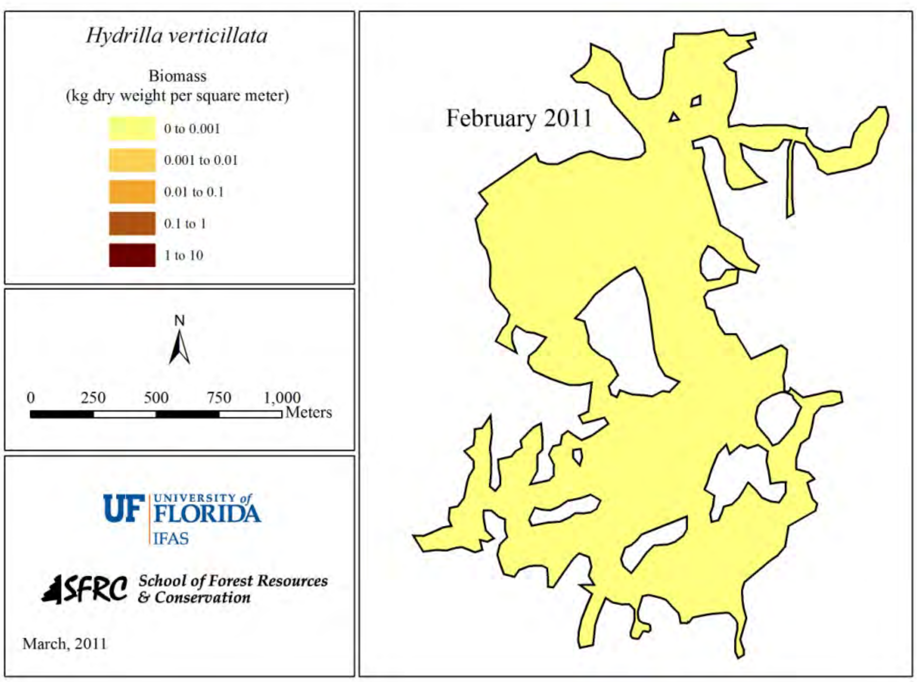
December, 2010
October 2010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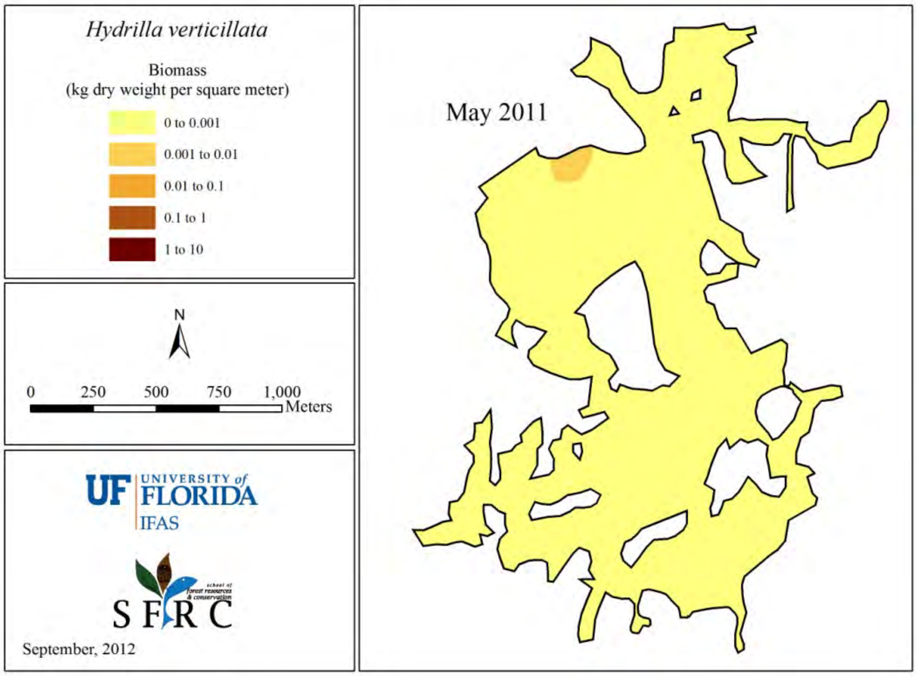
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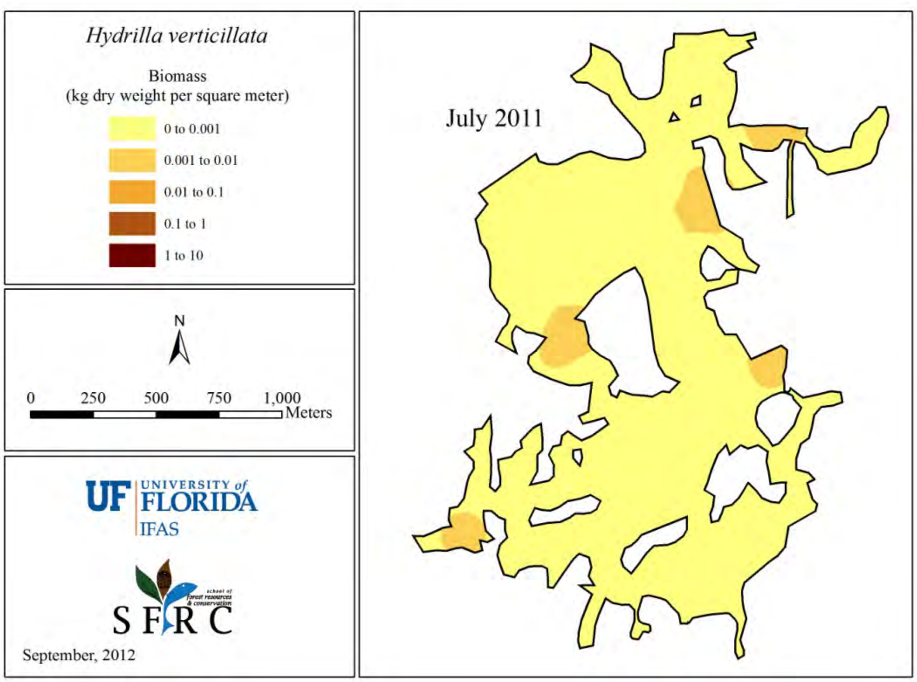
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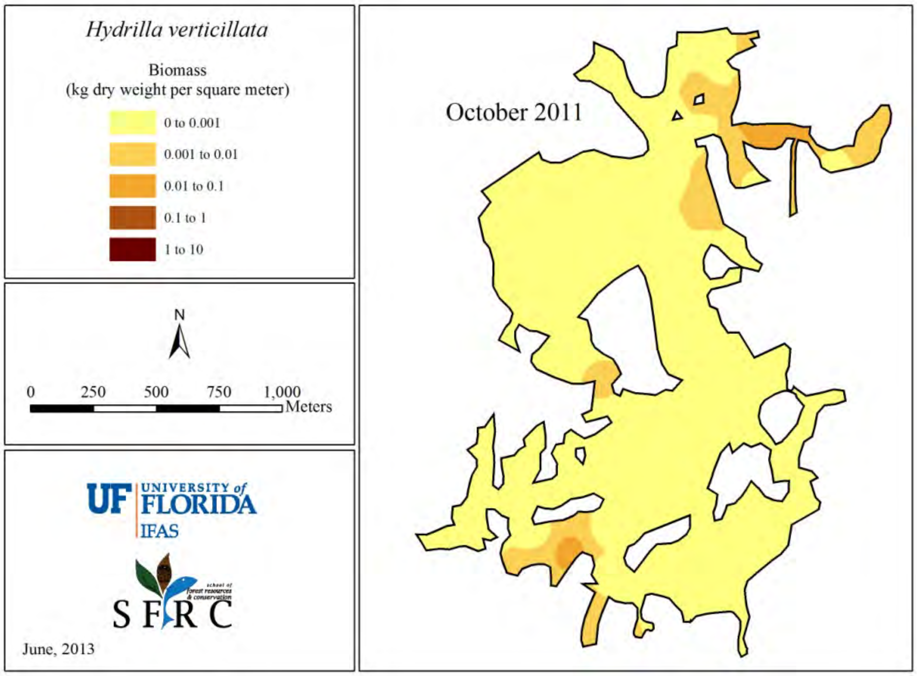

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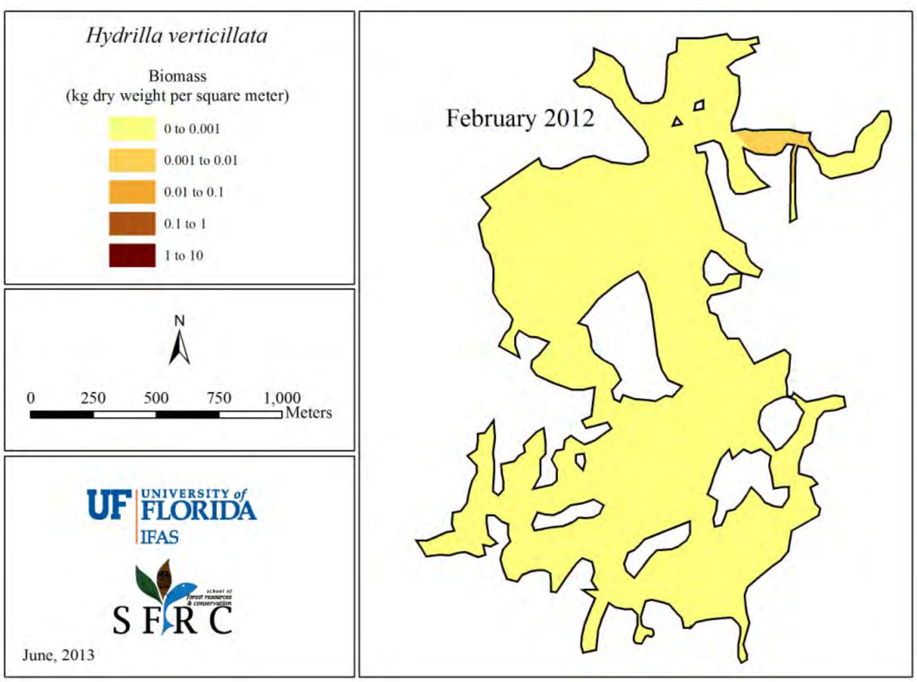

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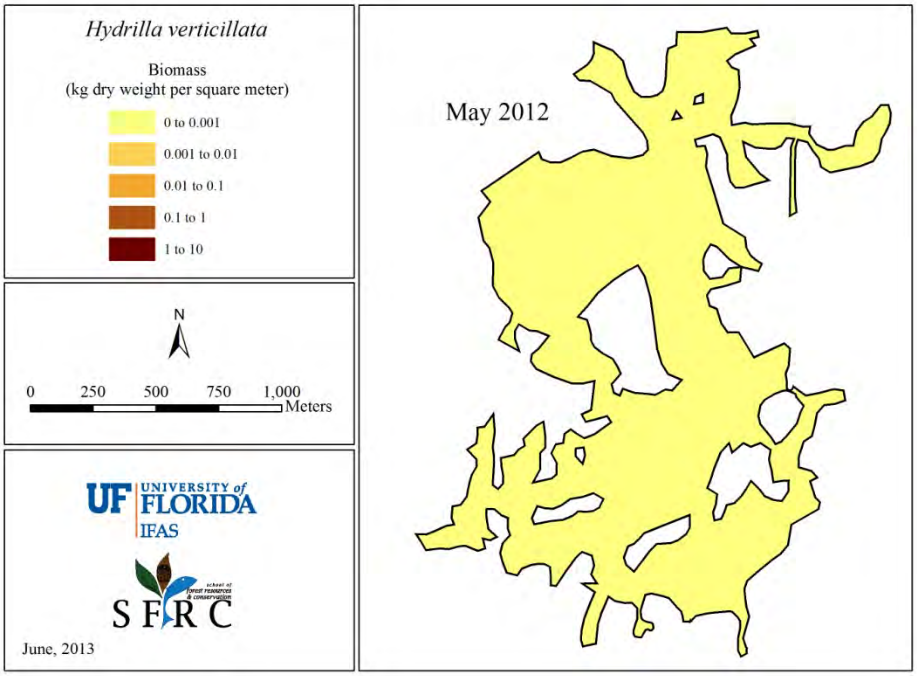
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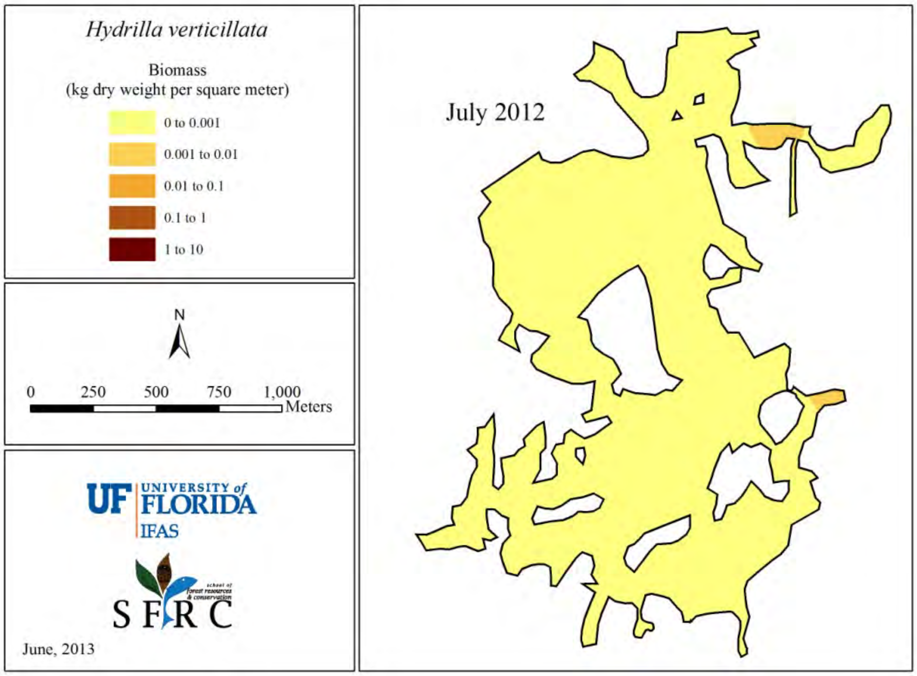
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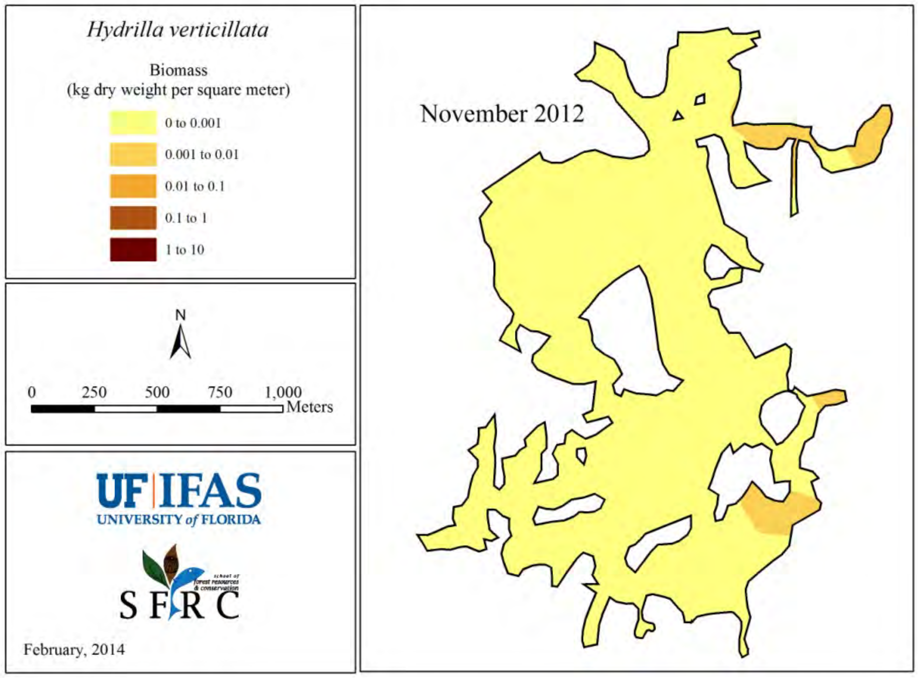
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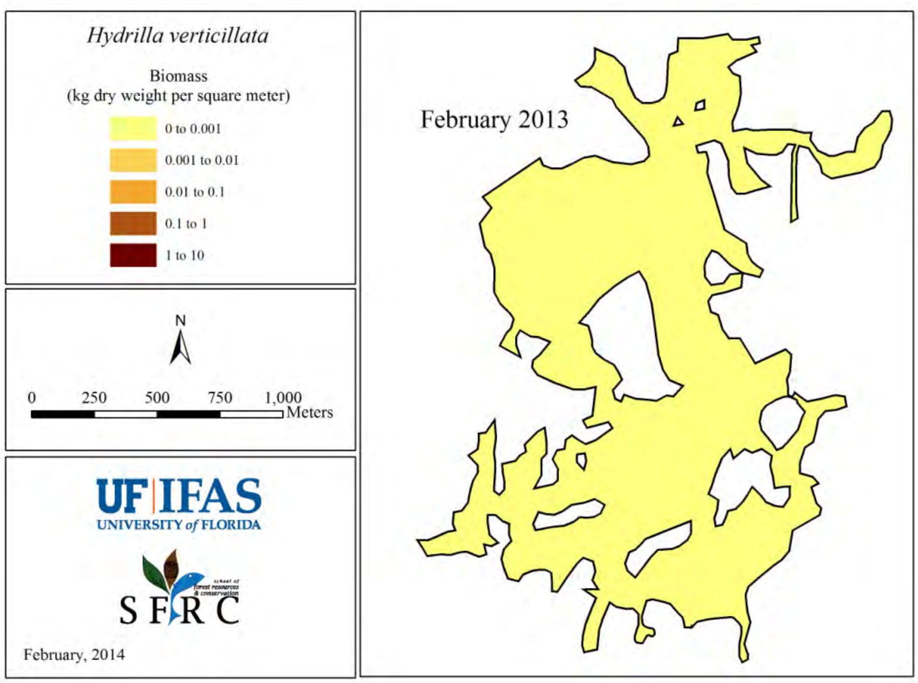
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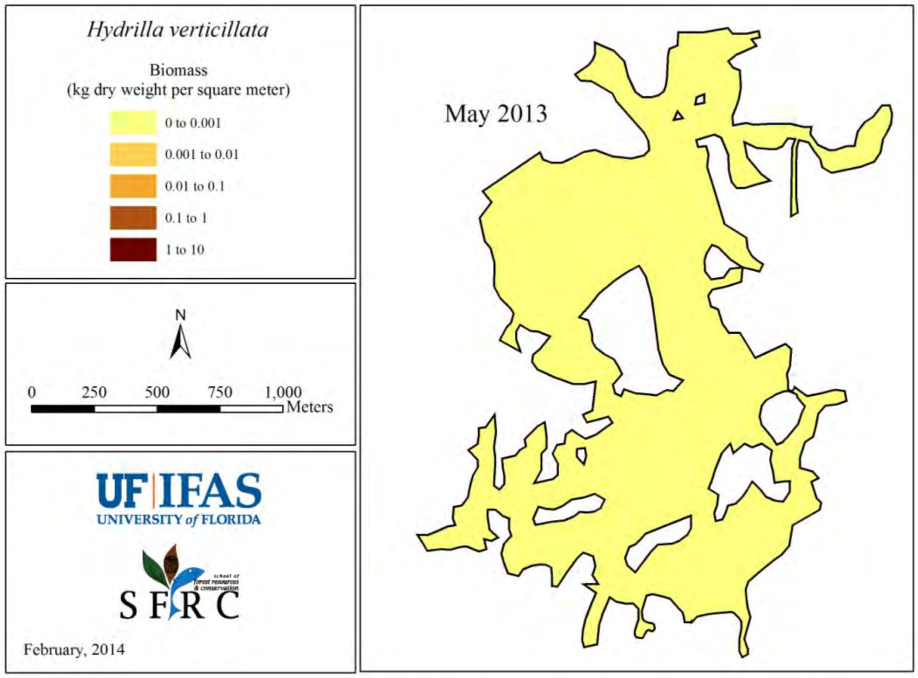
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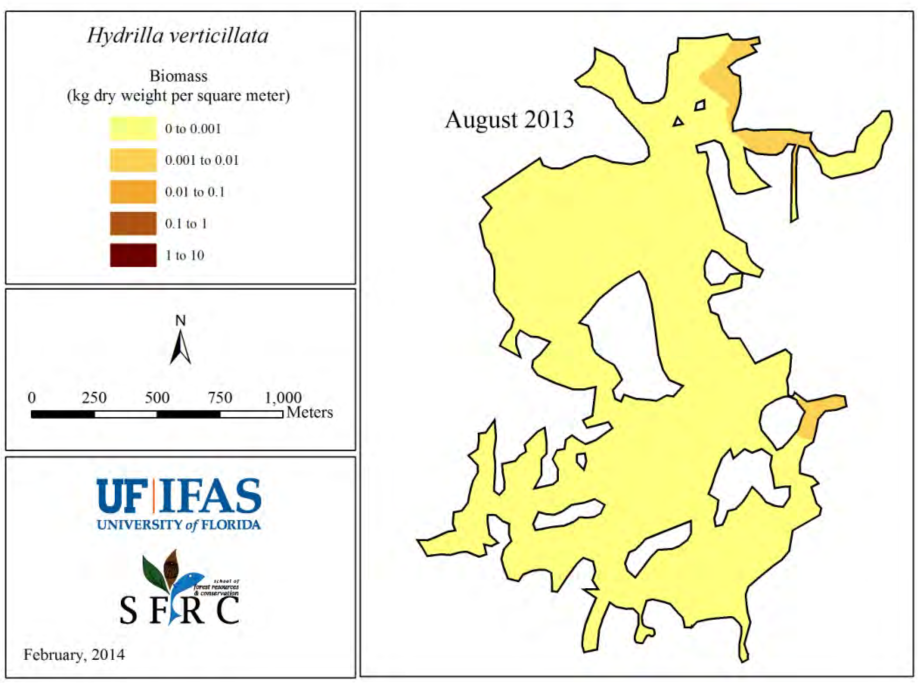
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UNIVERSITY of FLORIDA
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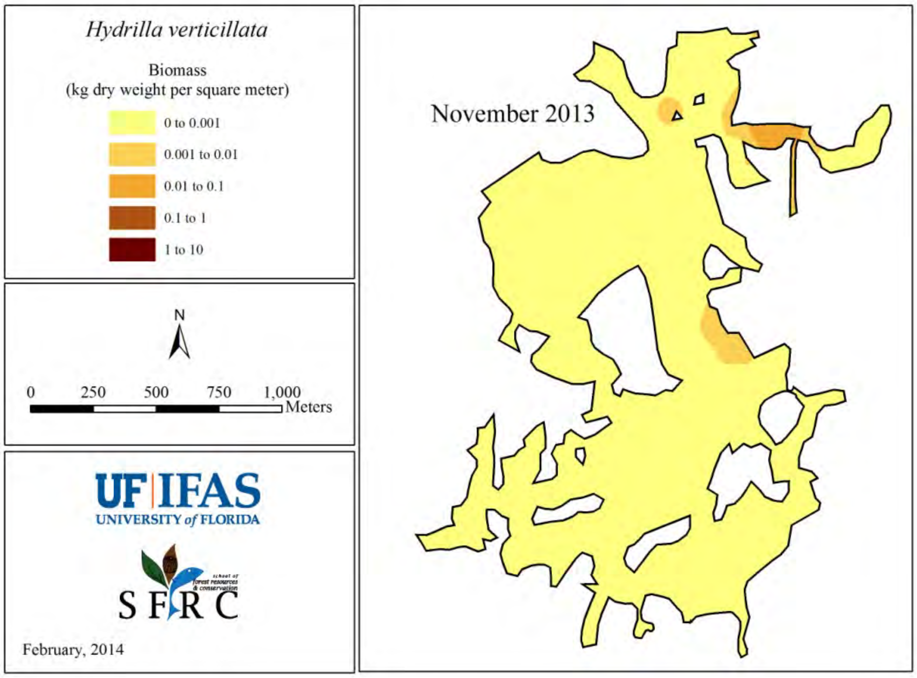
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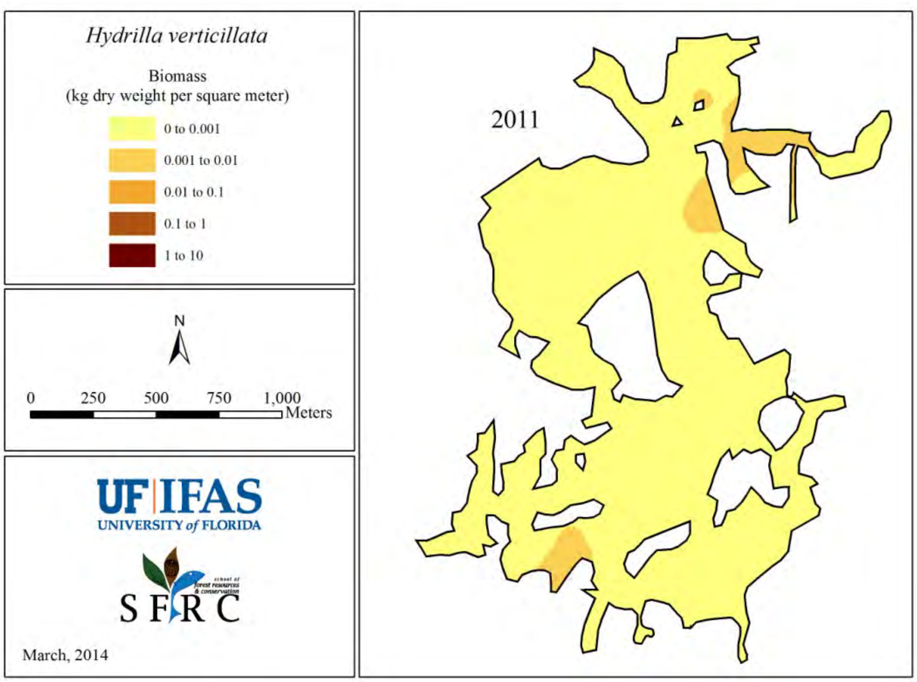
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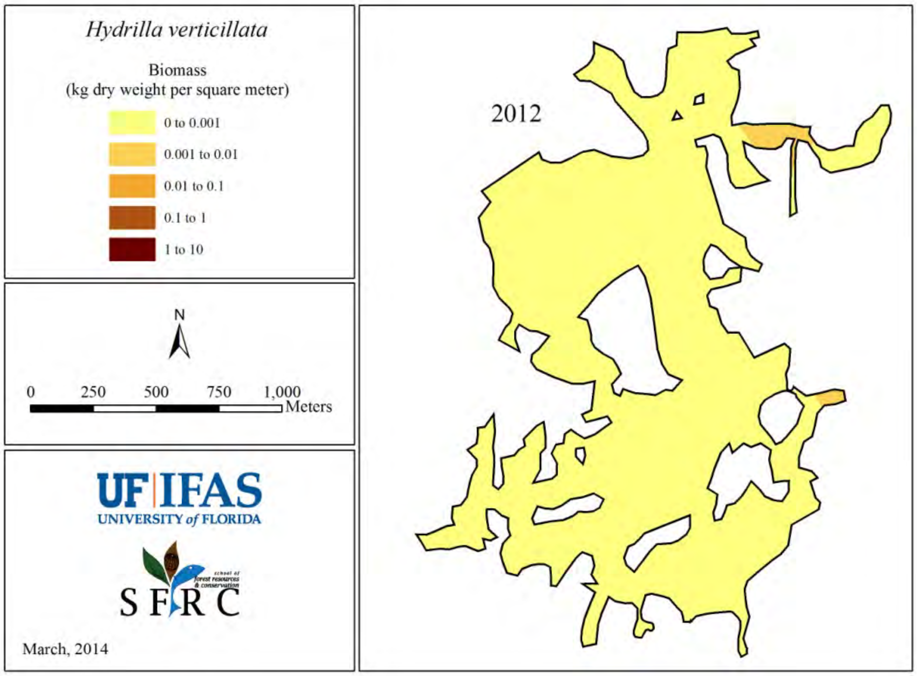
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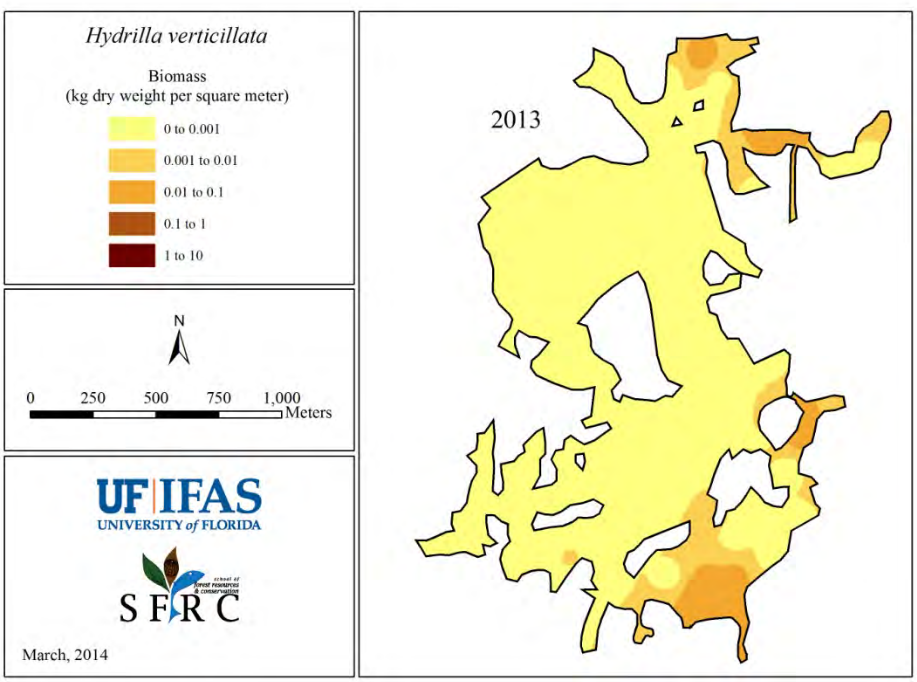
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2012


Hydrilla verticillata
Biomass
(kg dry weight per square meter)
0 to 0.001
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Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
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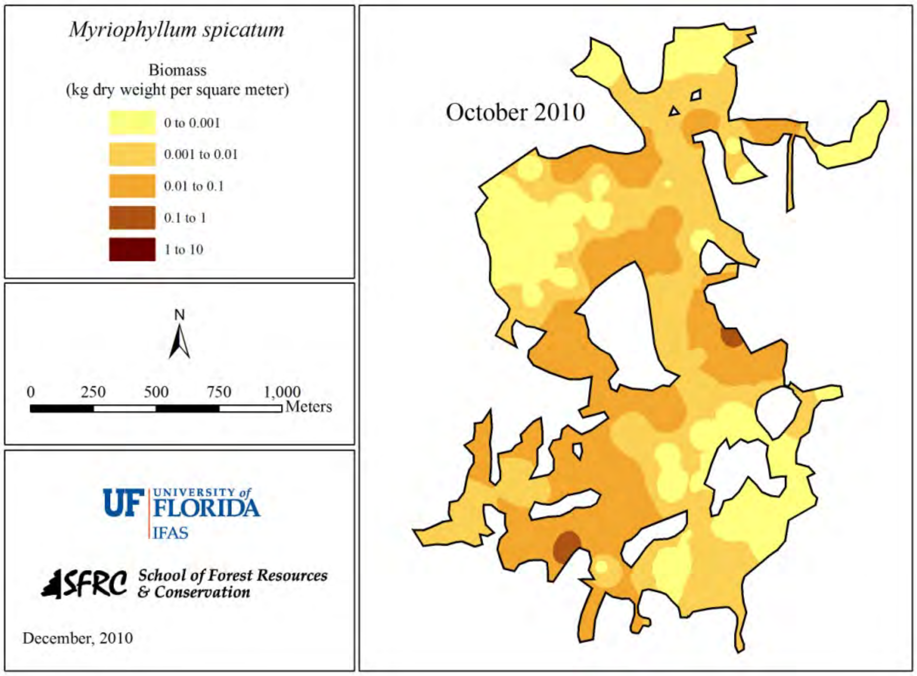
Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
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0.1 to 1
1 to 10
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750
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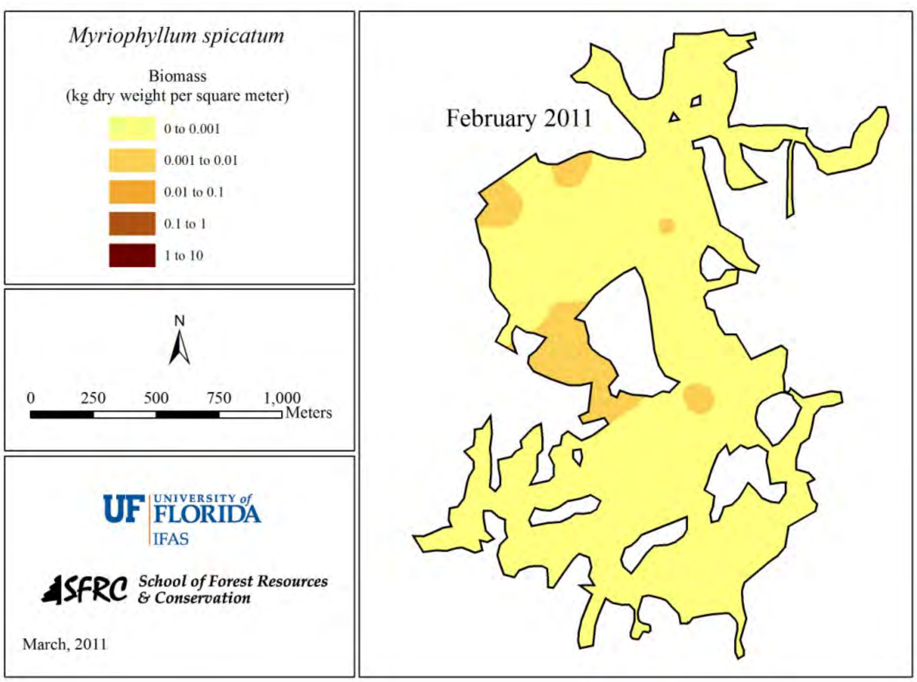
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC School of Forest Resources & Conservation
December, 2010
October 2010


Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
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0.1 to 1
1 to 10
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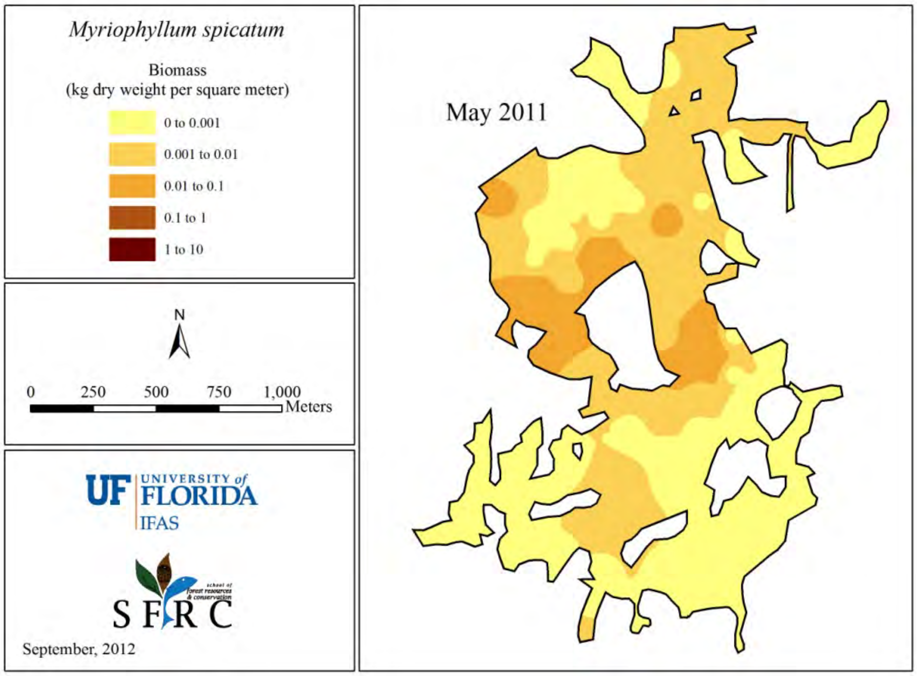
March, 2011
February 2011


Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
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Meters
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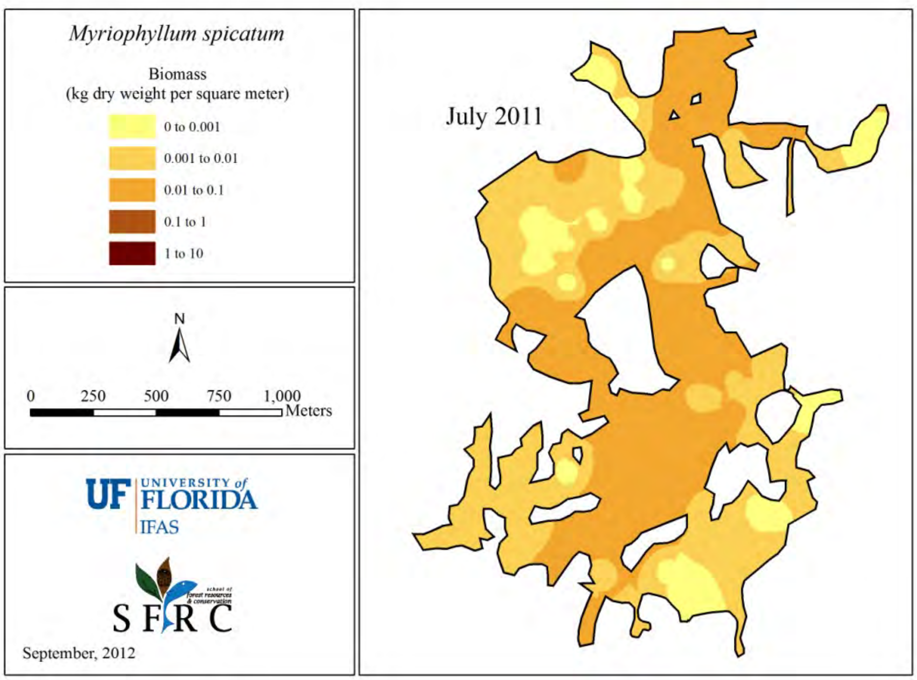
IFAS
SFRC
September, 2012
May 2011


Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
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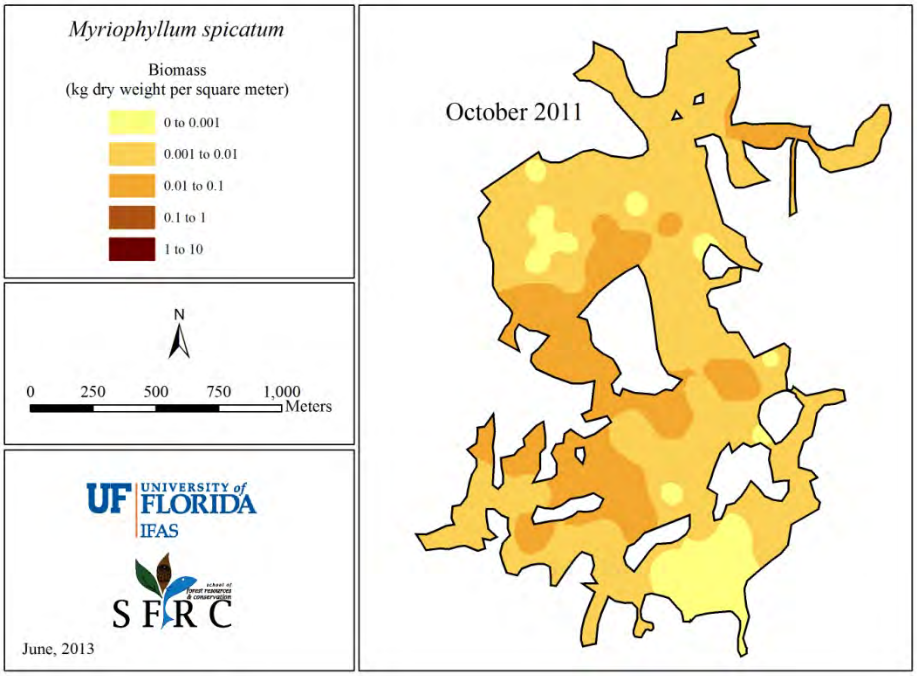
IFAS
SFRC
September, 2012
July 2011


Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
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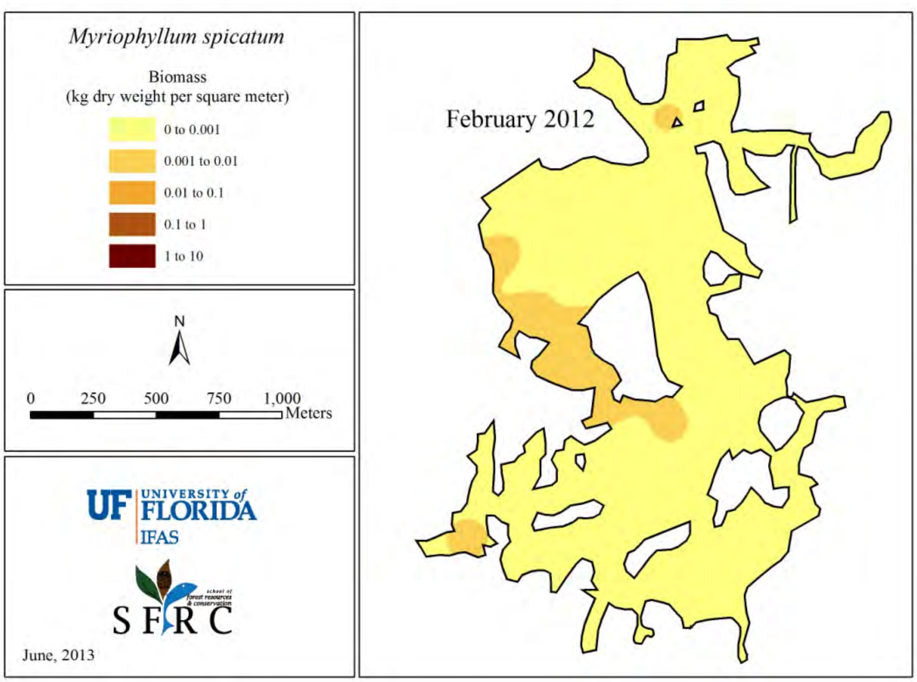
June, 2013
October 2011


Myriophyllum spicatum
Biomass
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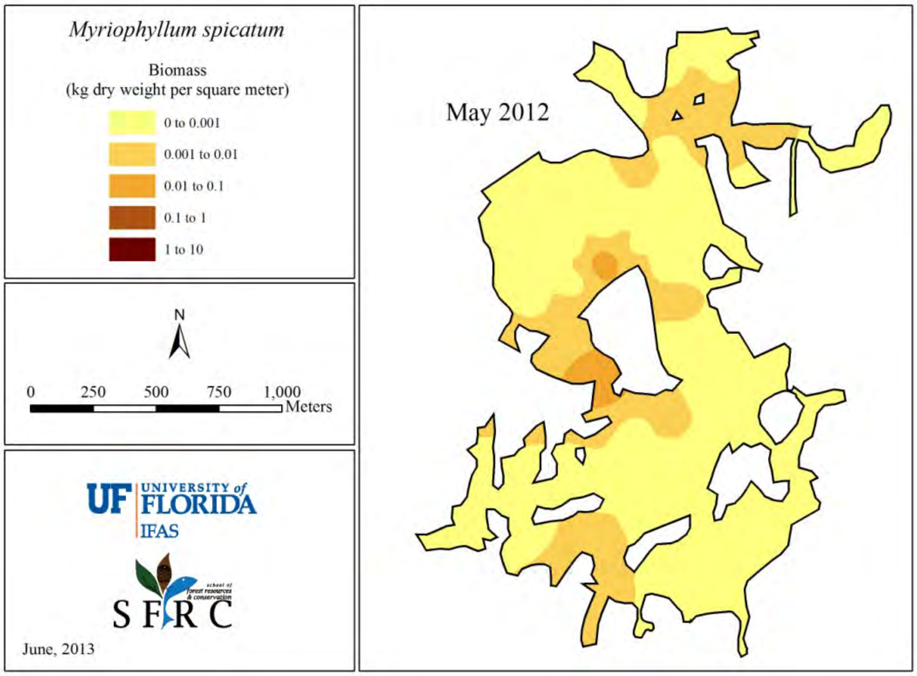
February 2012


Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
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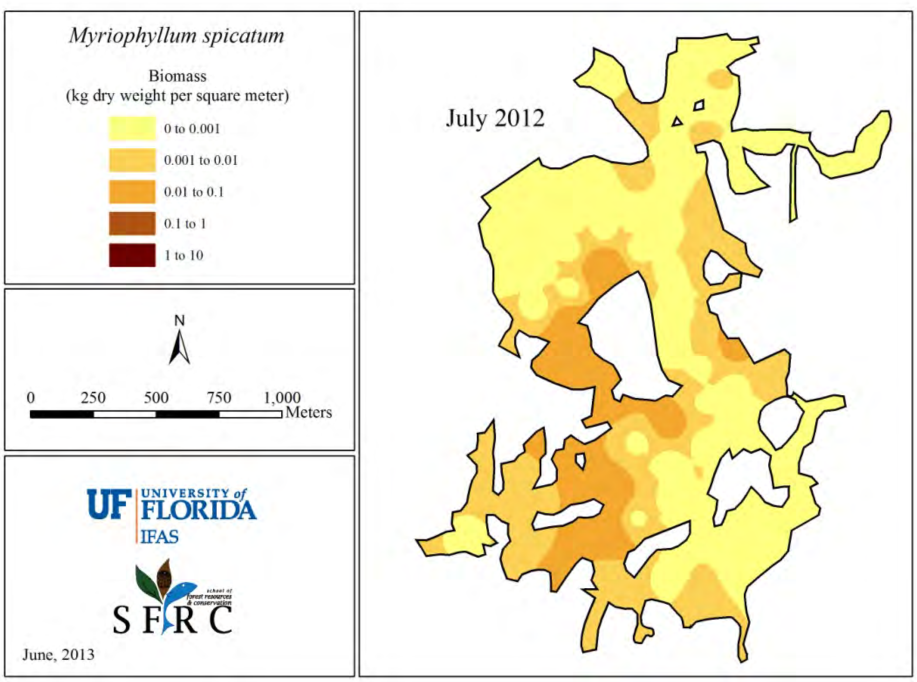
S F R C
June, 2013
May 2012


Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
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UF UNIVERSITY of FLORIDA
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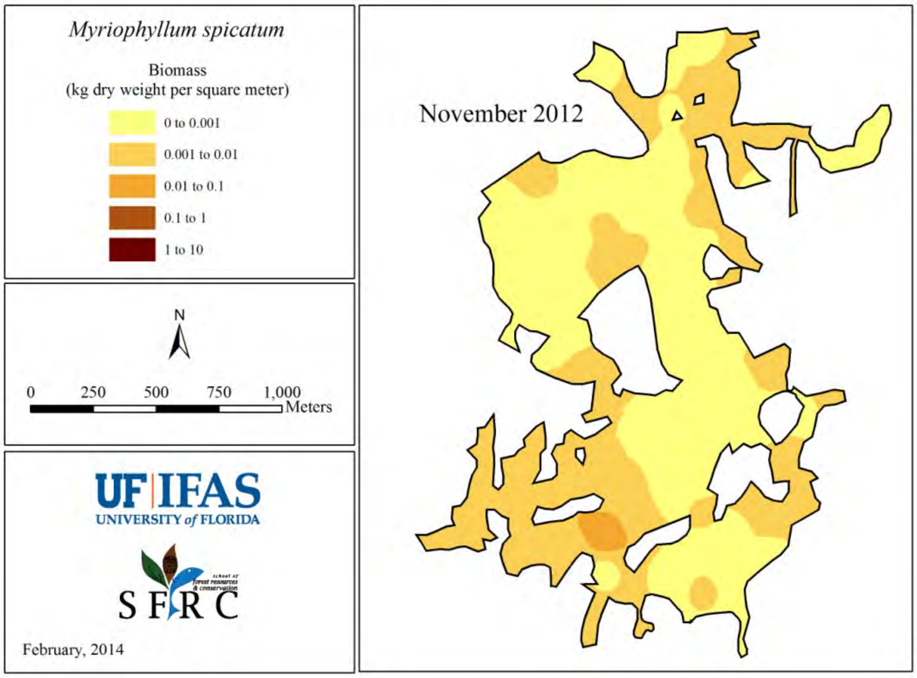
June, 2013
July 2012


Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
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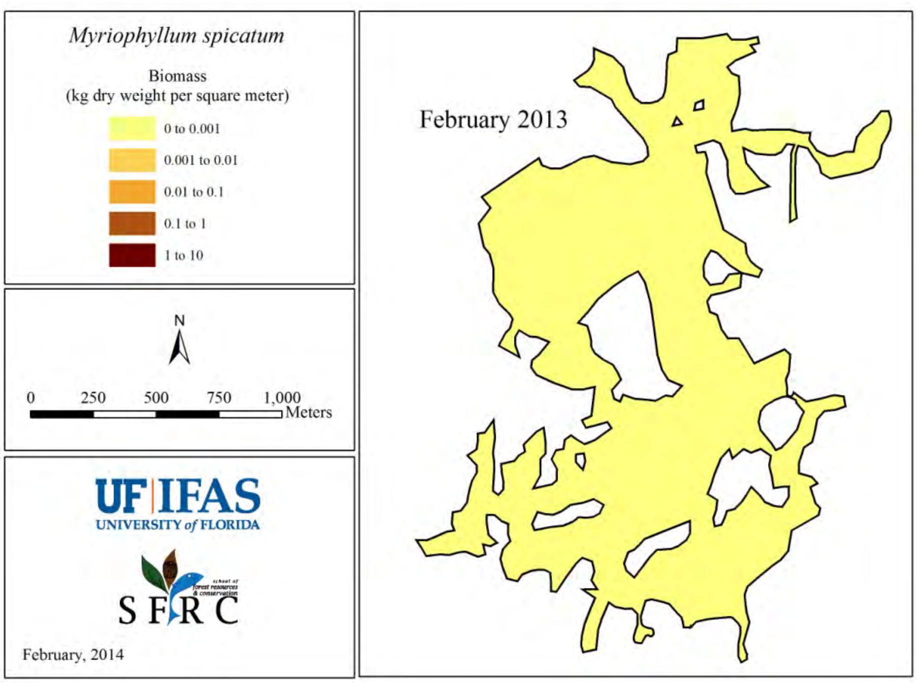
Meters
February, 2014
November 2012


Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
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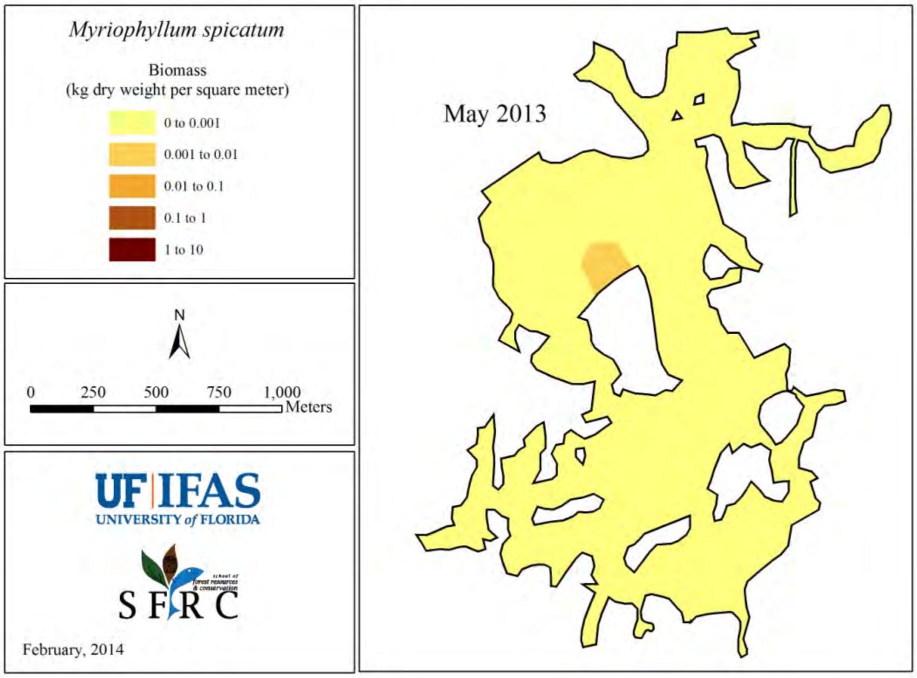
Meters
February, 2014
February 2013


Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
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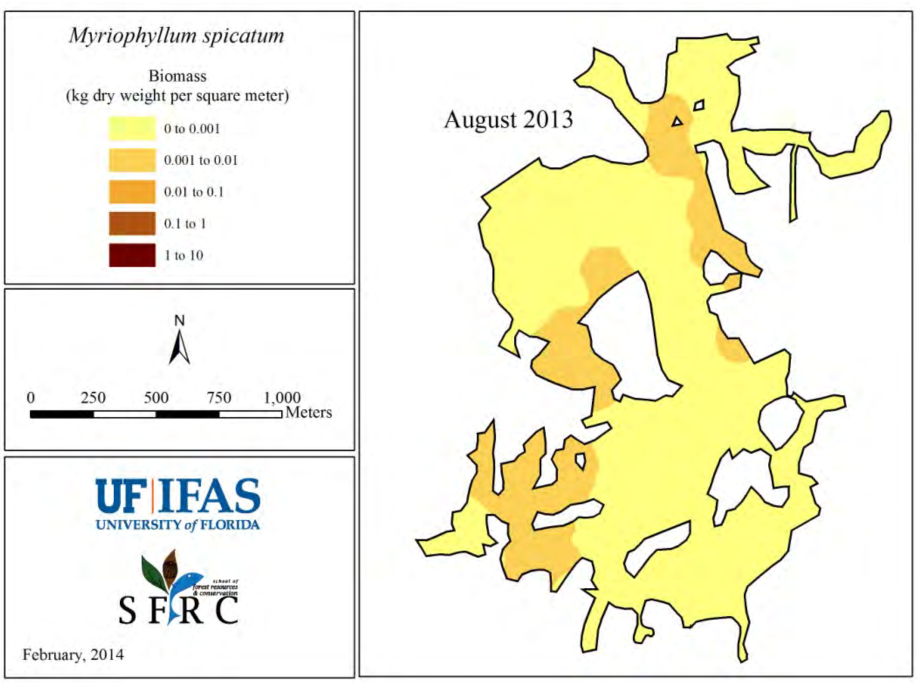
SFRC
February, 2014
May 2013


Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
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Meters
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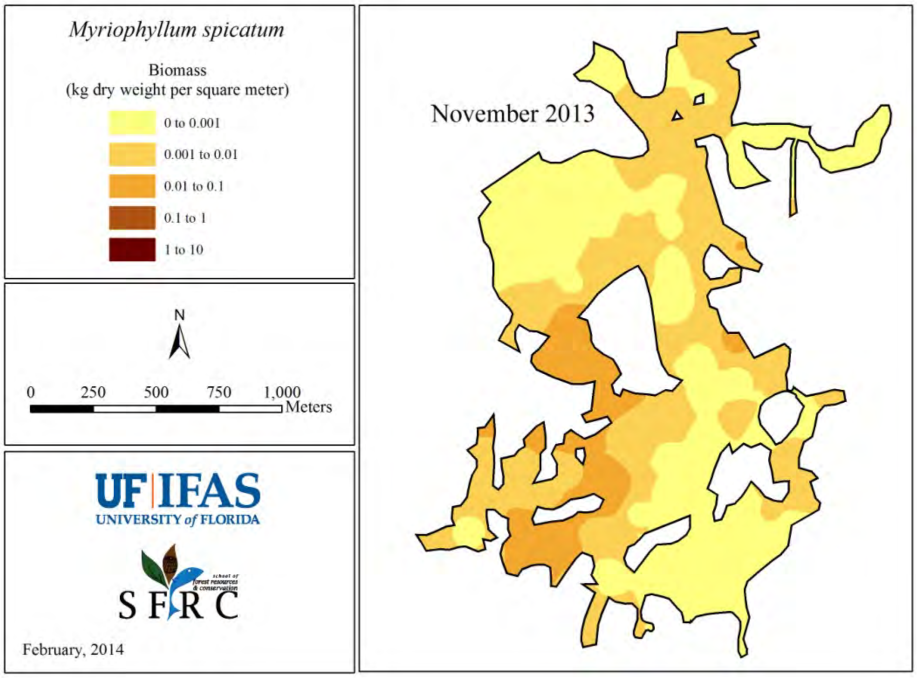
UNIVERSITY of FLORIDA
SFRC
February, 2014
August 2013


Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
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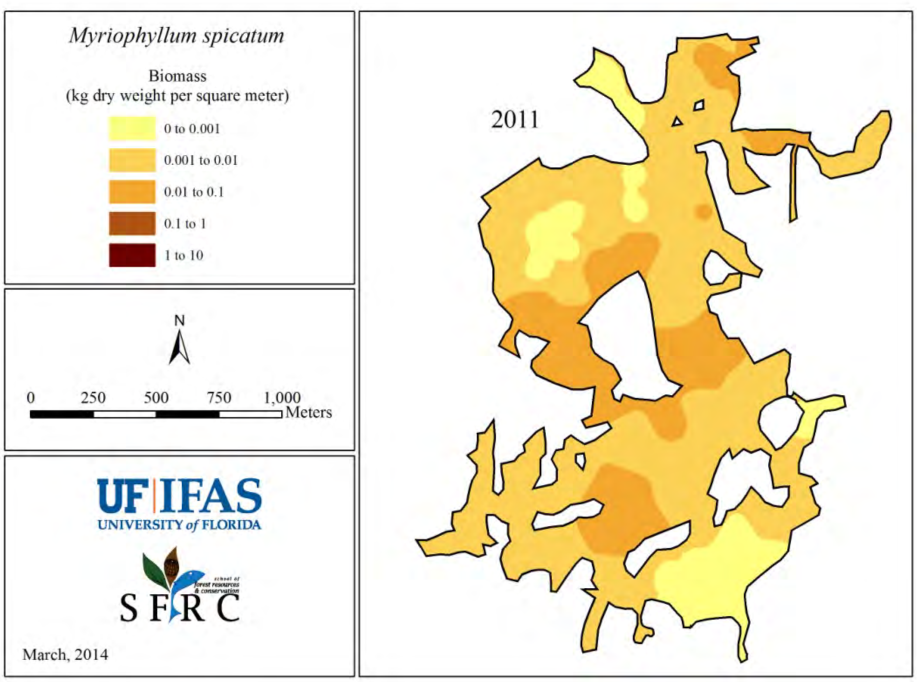
UNIVERSITY of FLORIDA
SFRC
February, 2014
November 2013


Myriophyllum spicatum
Biomass
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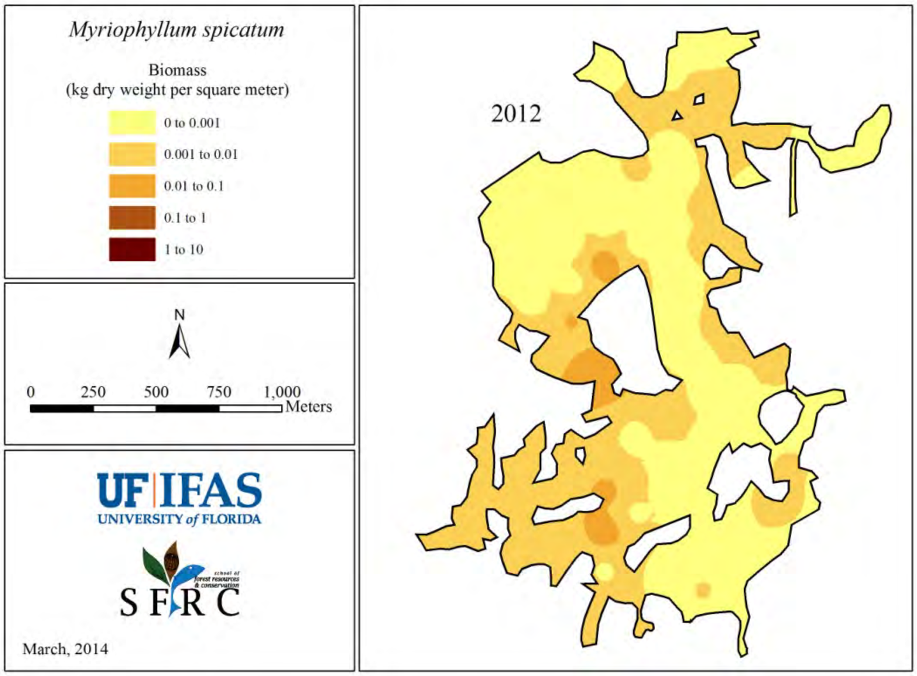
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2011



Myriophyllum spicatum
Biomass
(kg dry weight per square meter)
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March, 2014
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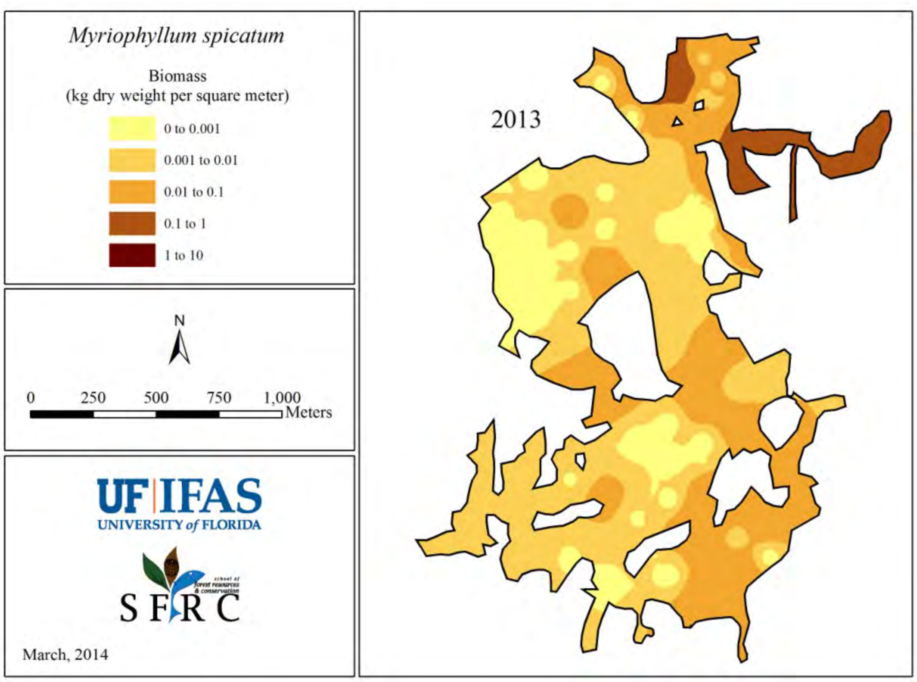

Myriophyllum spicatum
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UF IFAS
UNIVERSITY of FLORIDA
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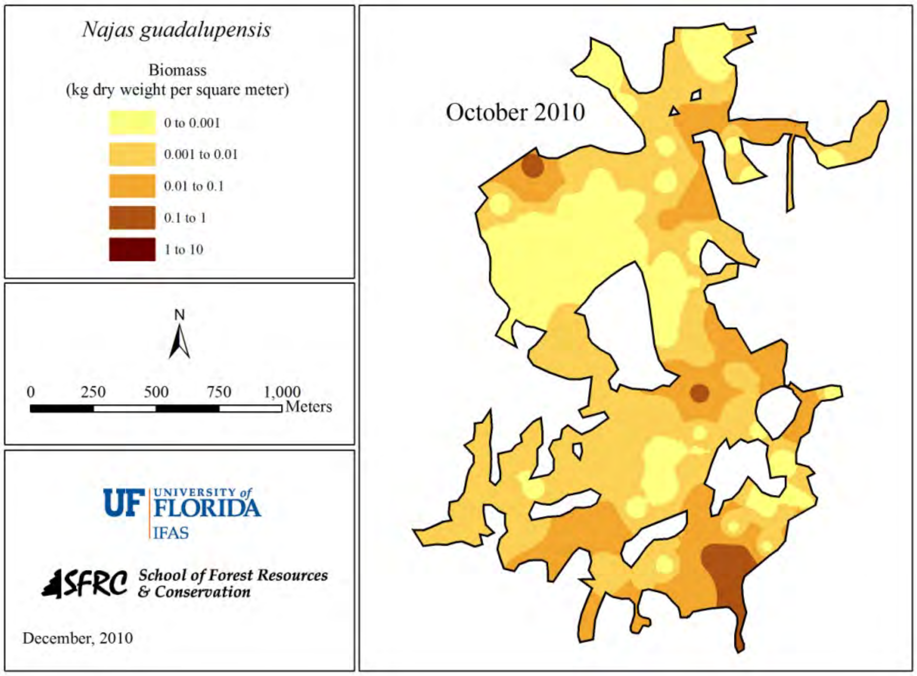
Najas guadalupensis
Biomass
(kg dry weight per square meter)
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0.1 to 1
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Meters
UF UNIVERSITY of FLORIDA
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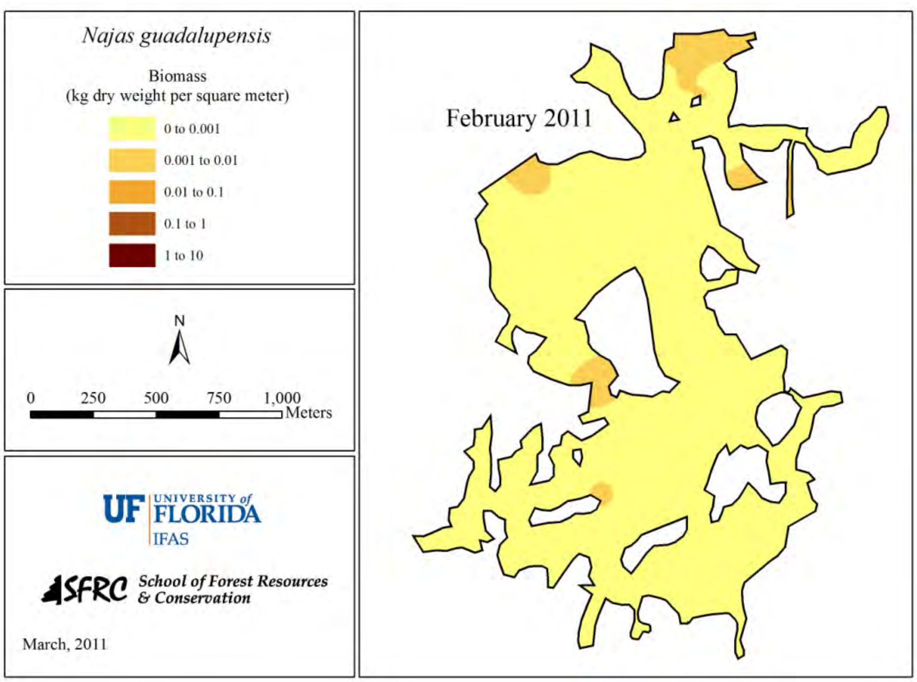
December, 2010
October 2010


Najas guadalupensis
Biomass
(kg dry weight per square meter)
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UF UNIVERSITY of FLORIDA
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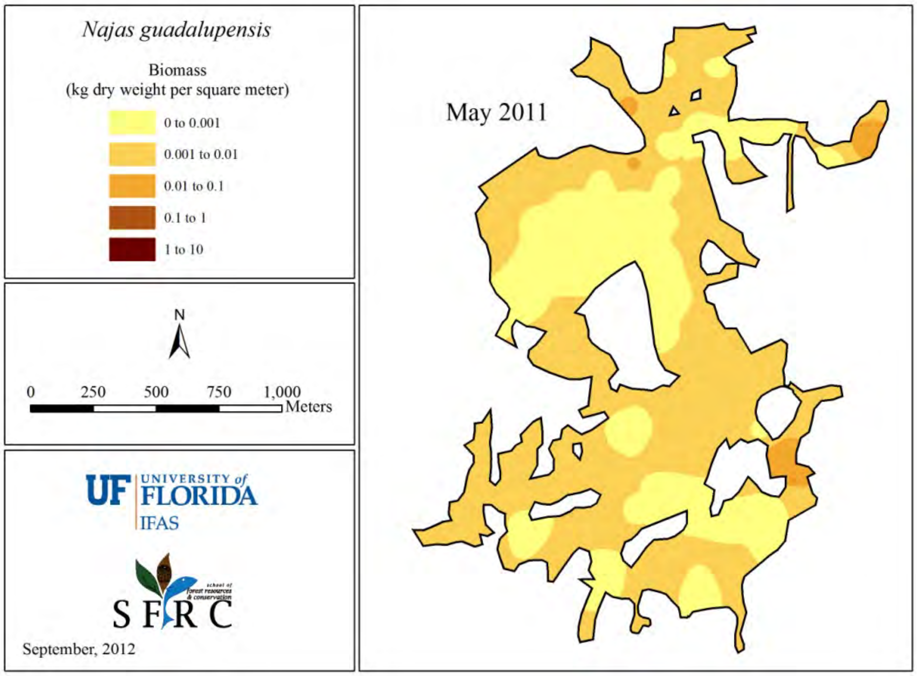
February 2011


Najas guadalupensis
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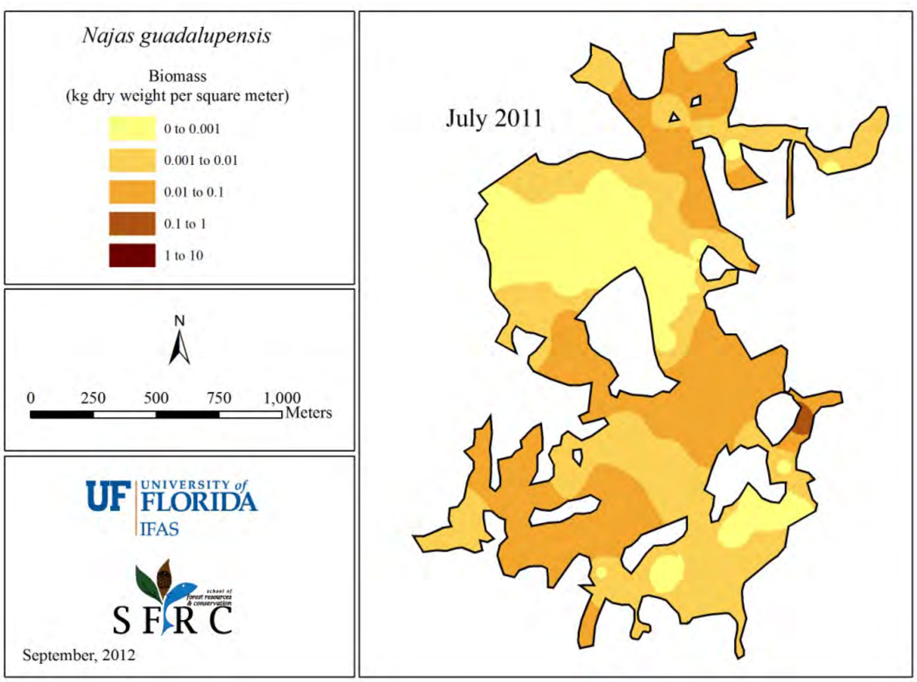
SFRC
September, 2012
May 2011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SFRC
September, 2012
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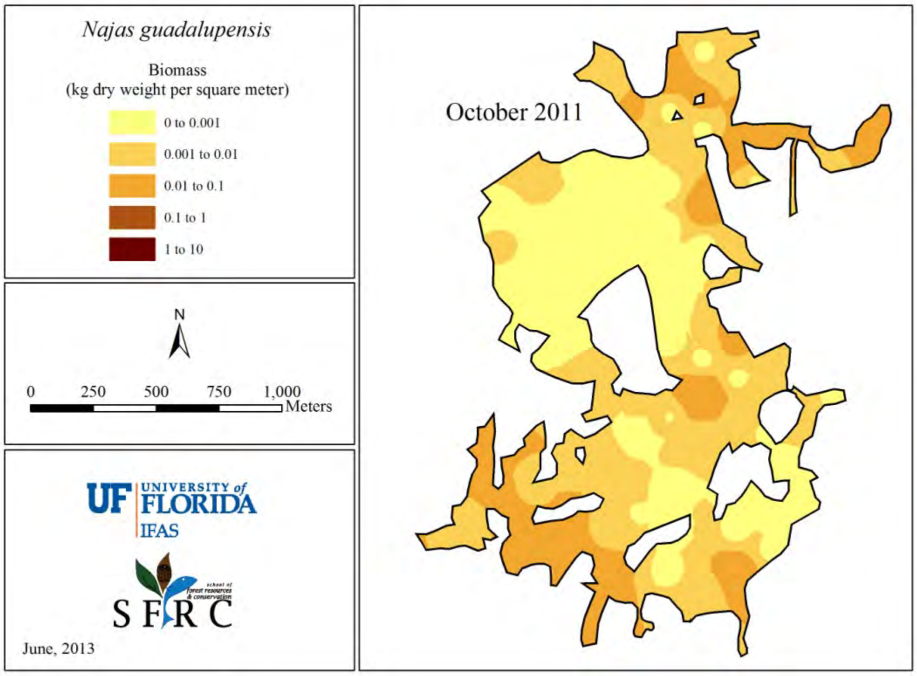

Najas guadalupensis
Biomass
(kg dry weight per square meter)
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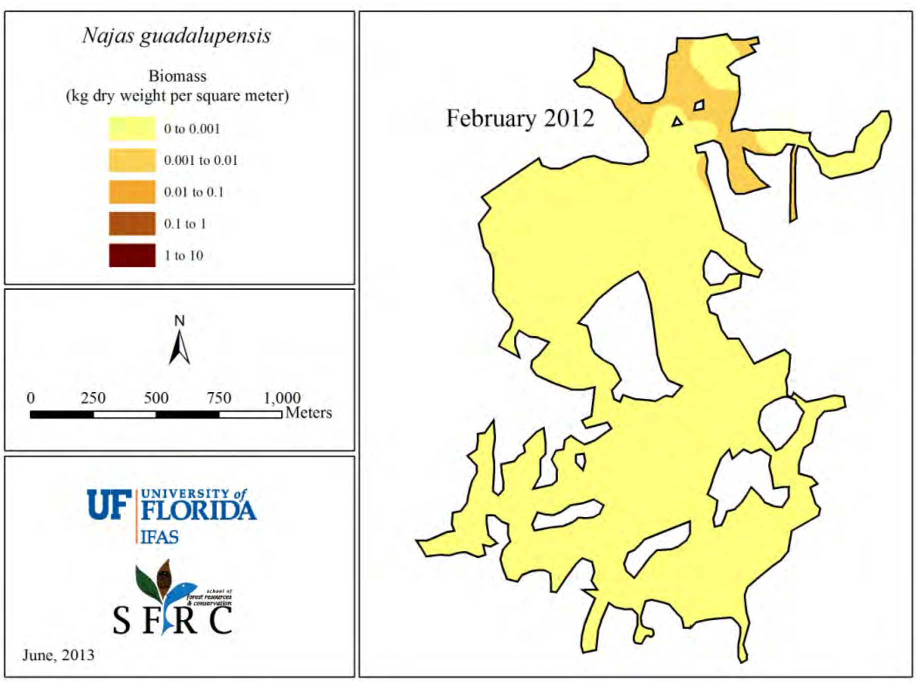
June, 2013
October 2011



Najas guadalupensis
Biomass
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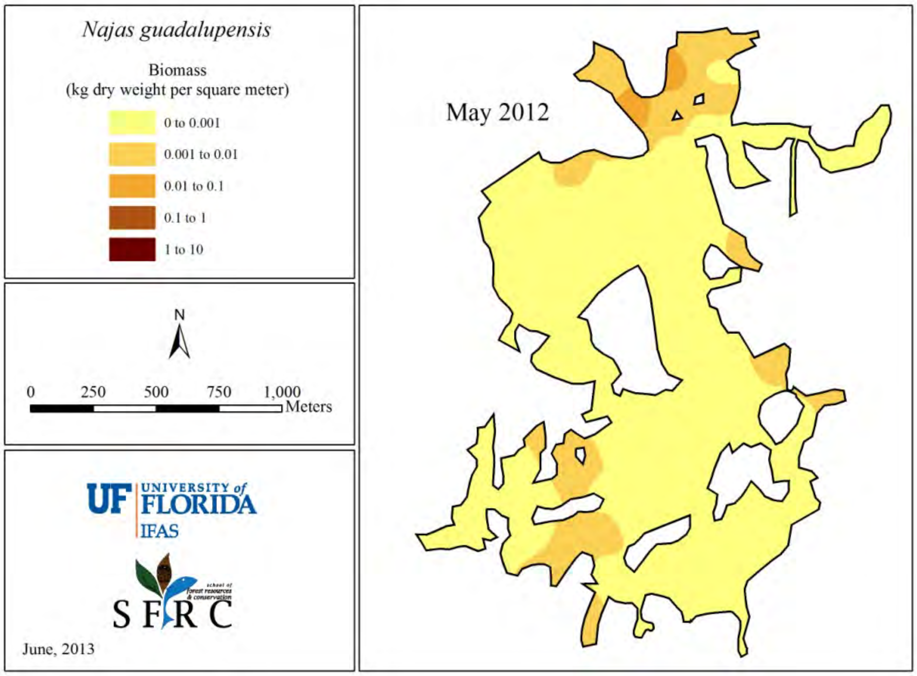
February 2012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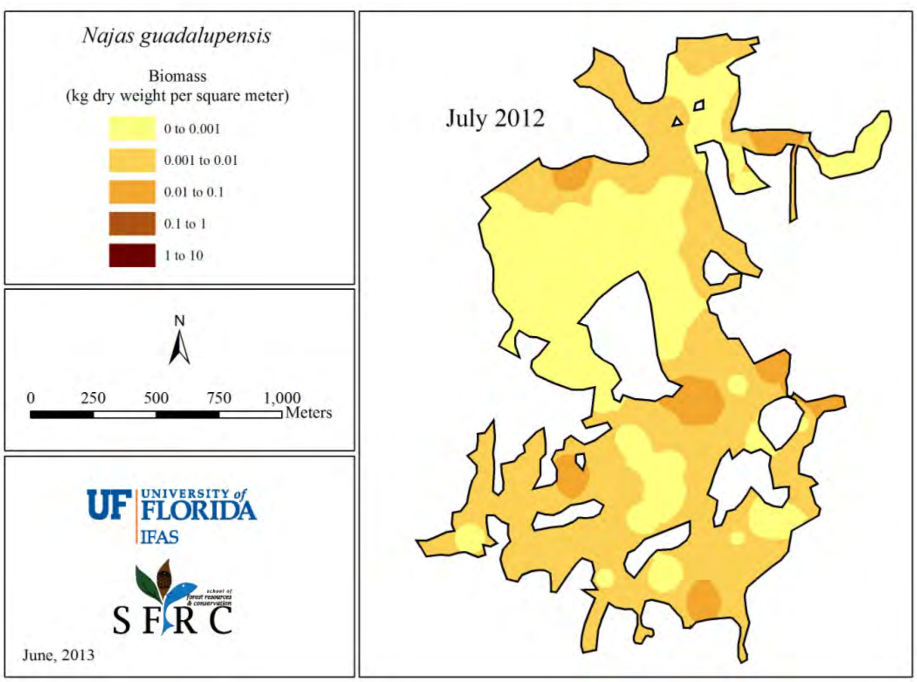
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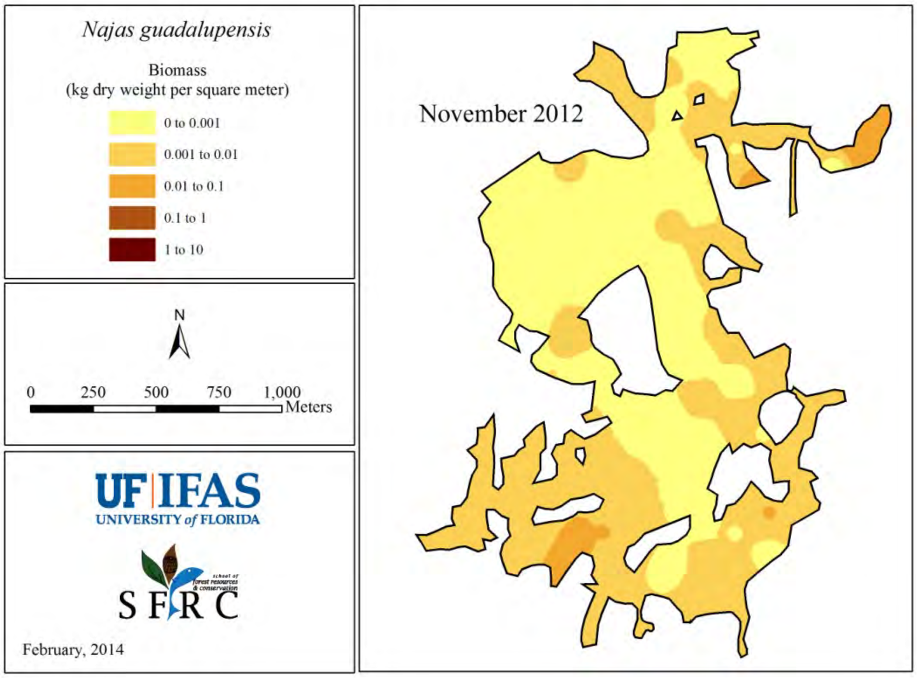
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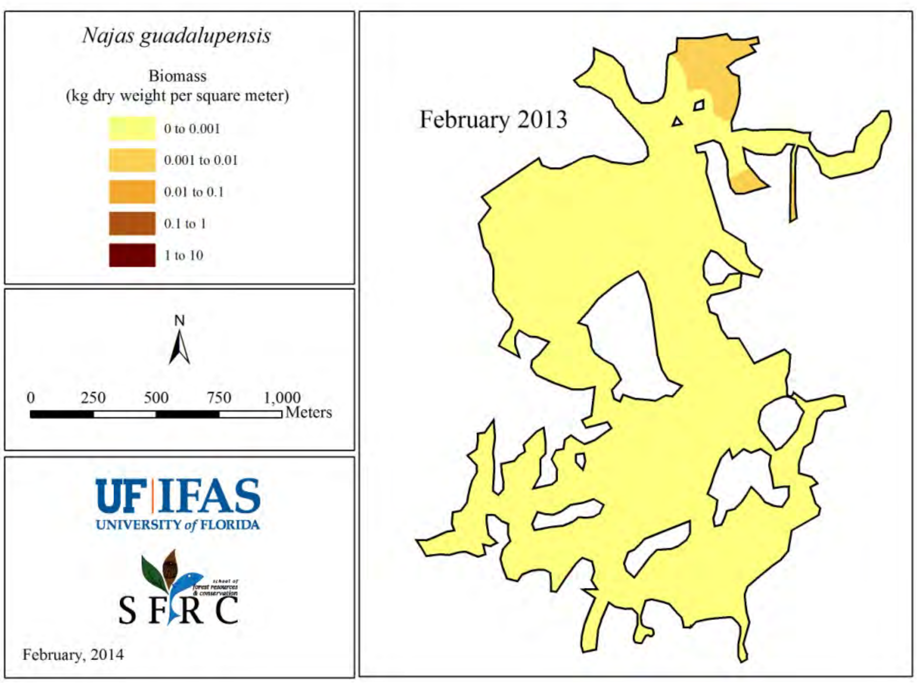
November 2012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February, 2014
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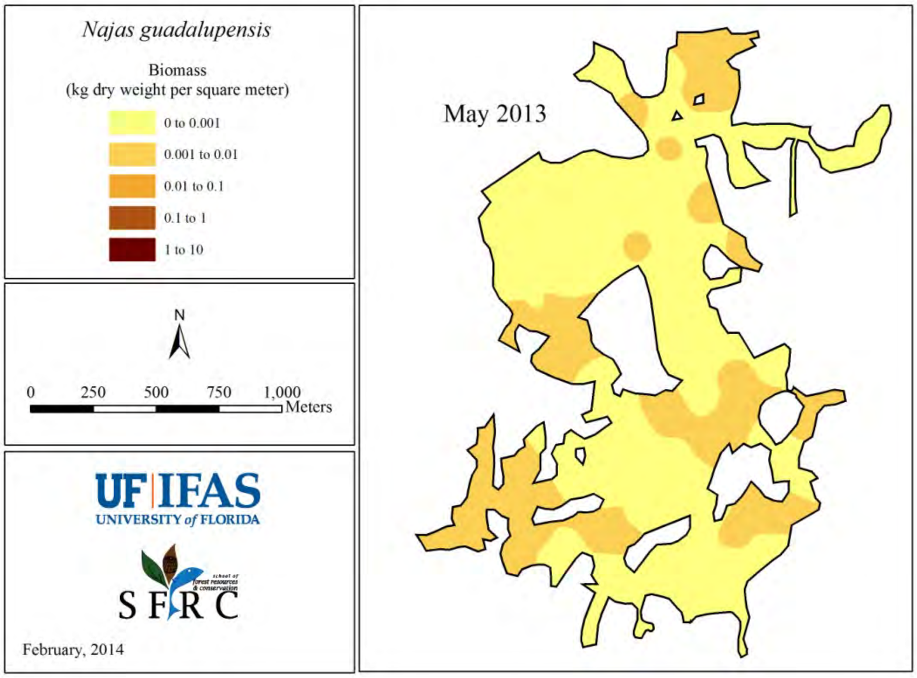
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UF IFAS
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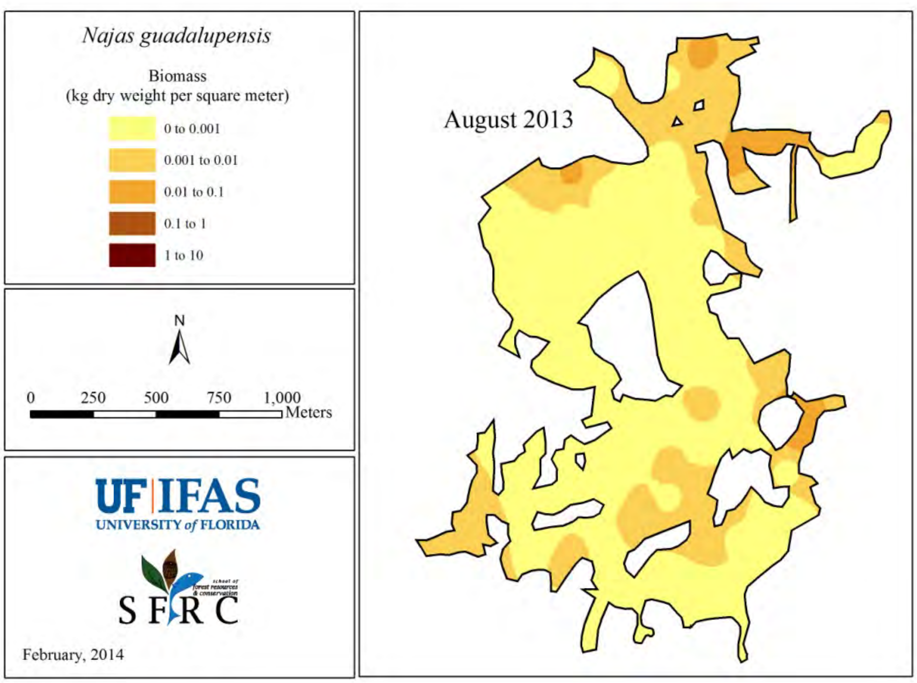
S F R C
February, 2014
May 2013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Biomass
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UF IFAS
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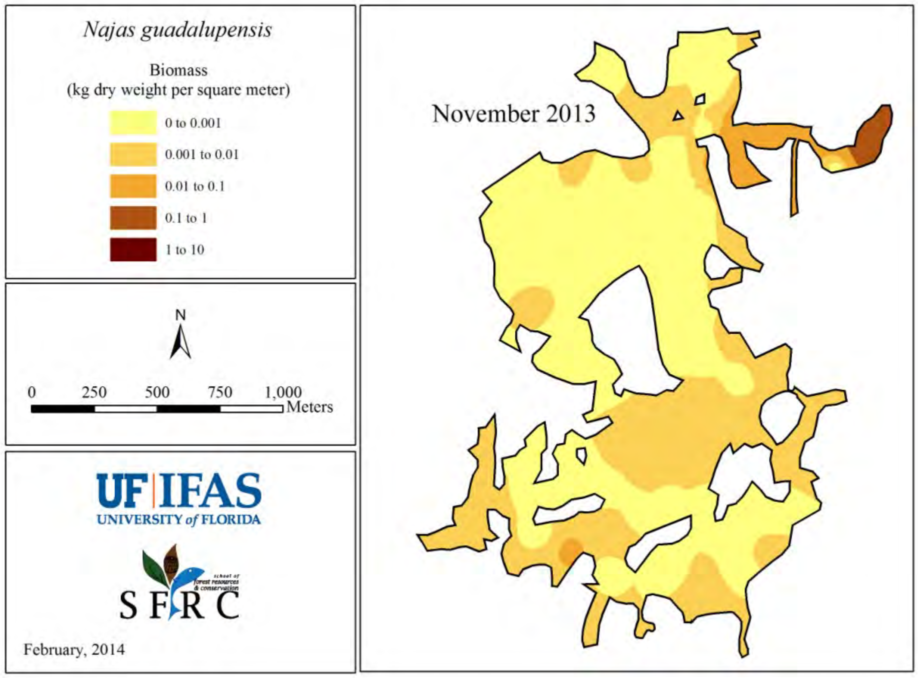
S F R C
February, 2014
August 2013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Biomass
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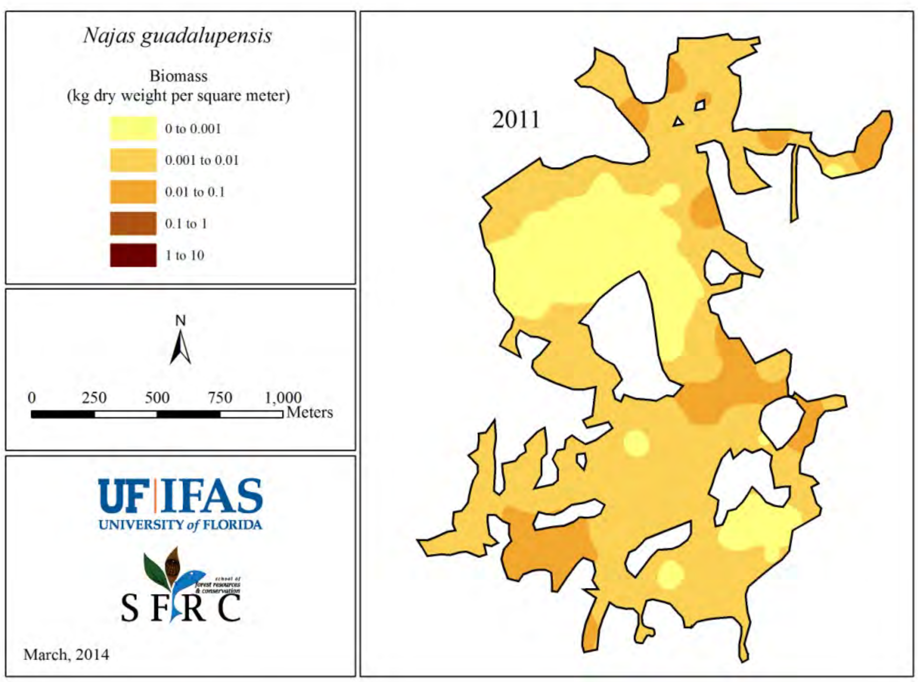
Meters
February, 2014
November 2013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March, 2014
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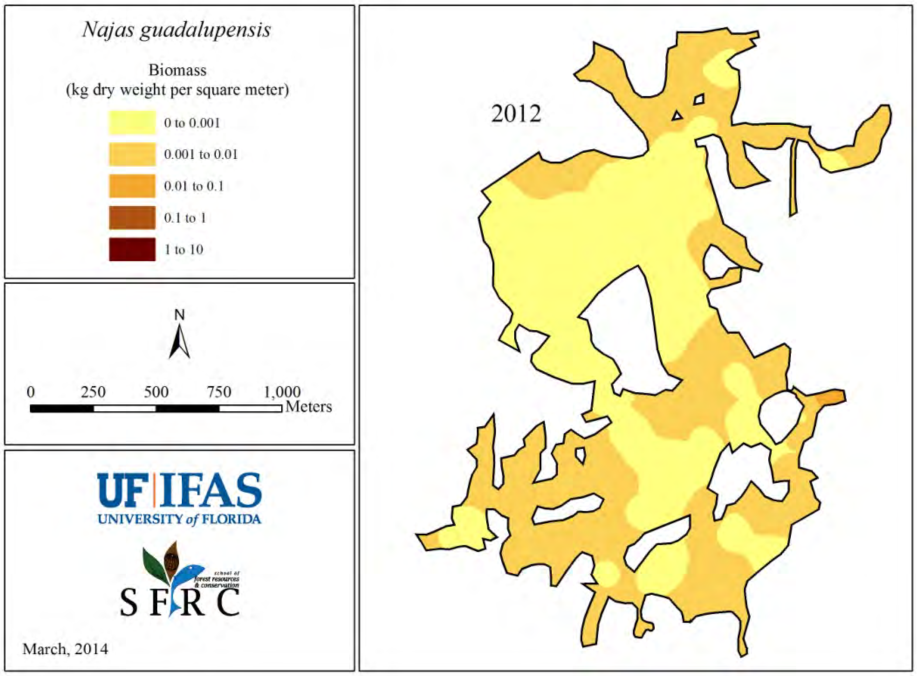
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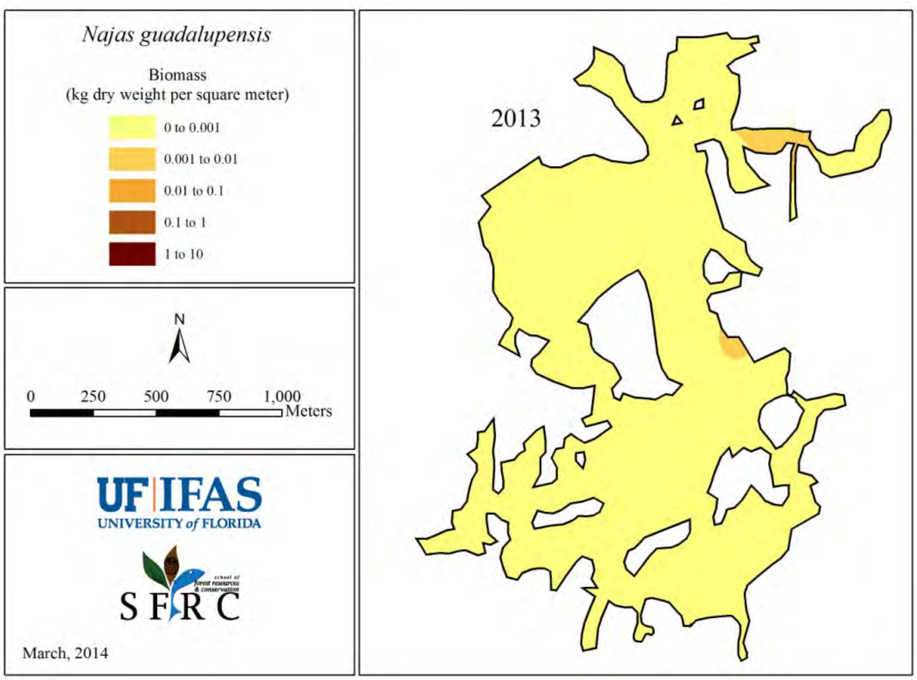
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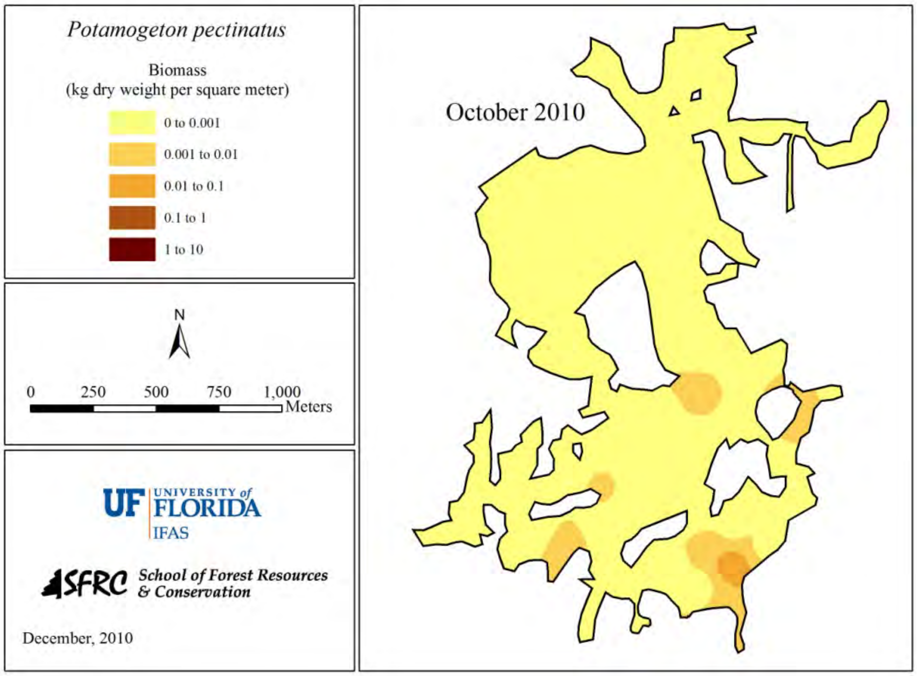
Potamogeton pectinatus
Biomass
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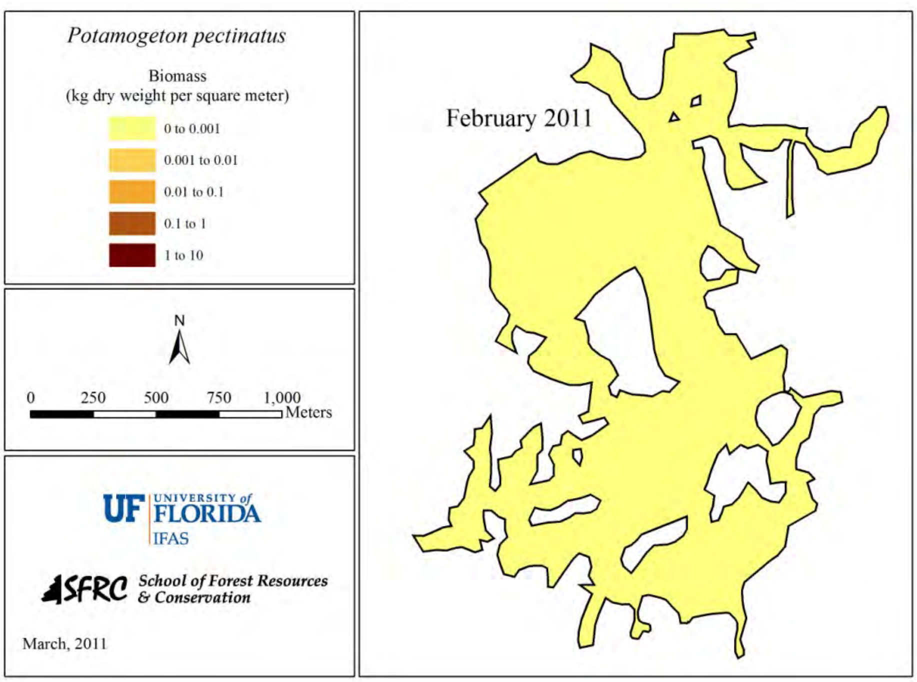
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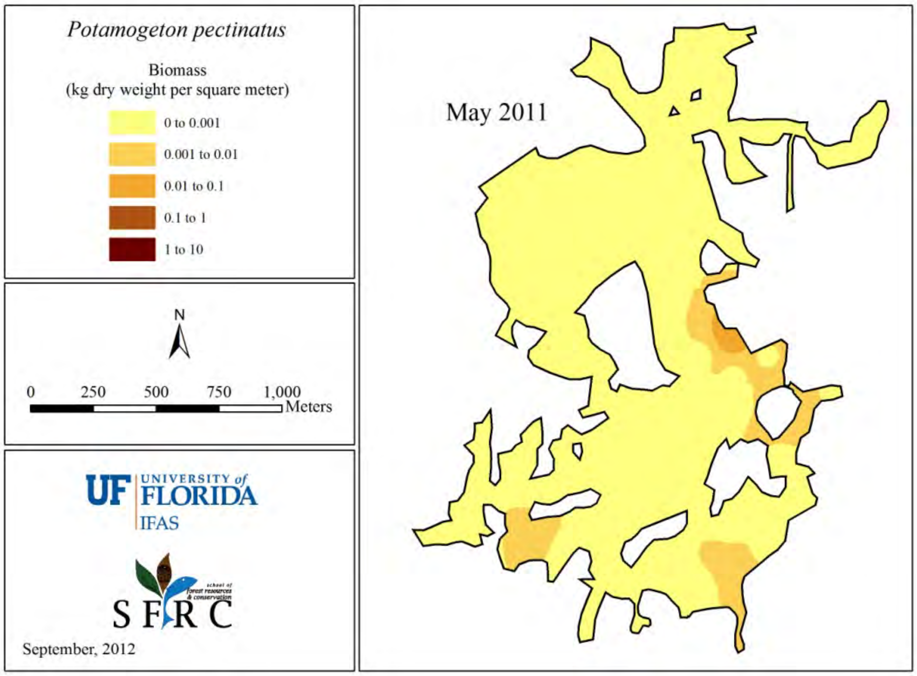
Potamogeton pectinatus
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S F R C
September, 2012
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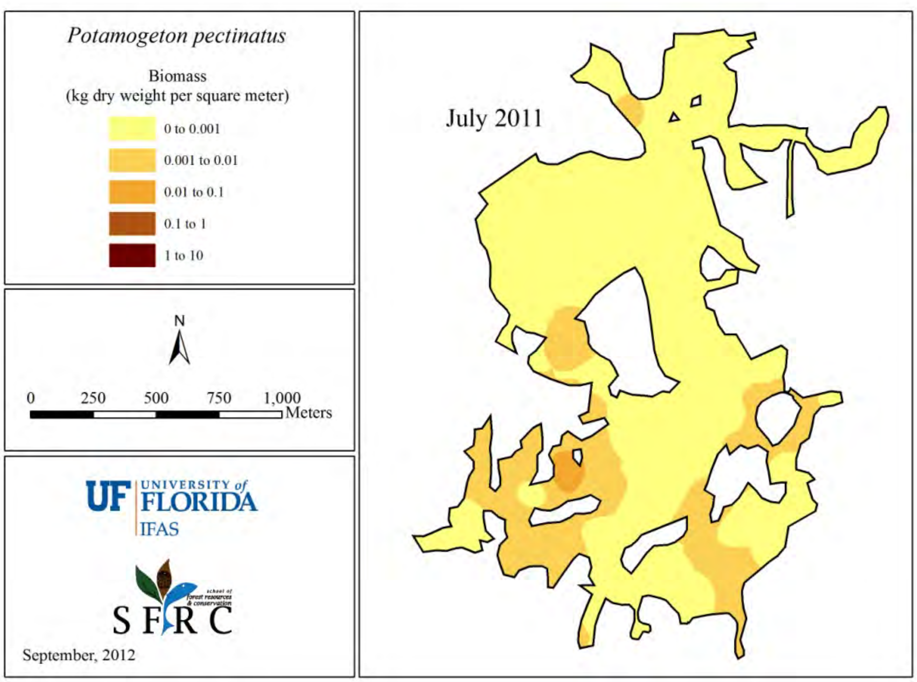
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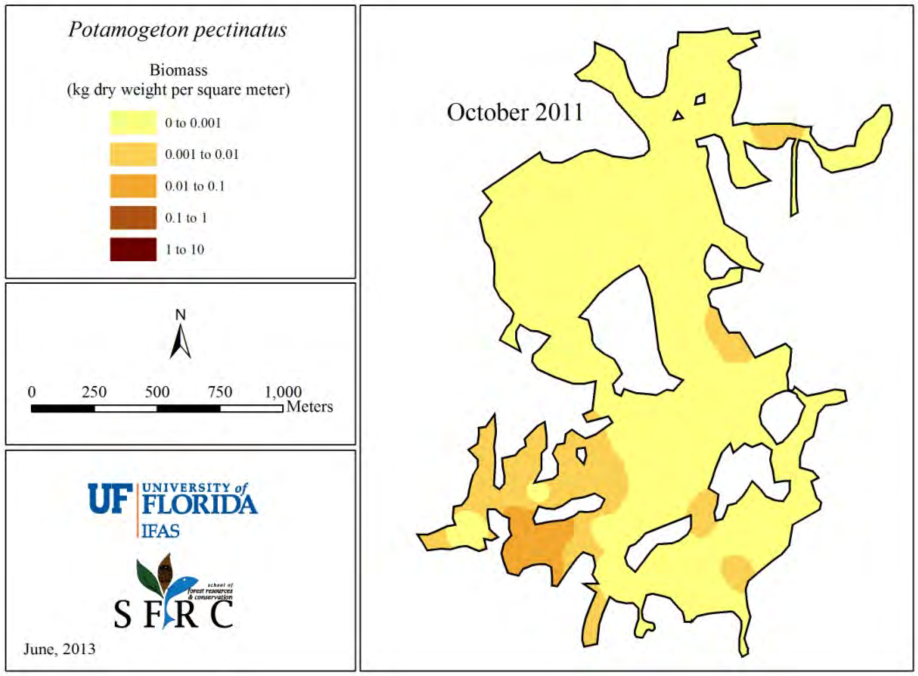
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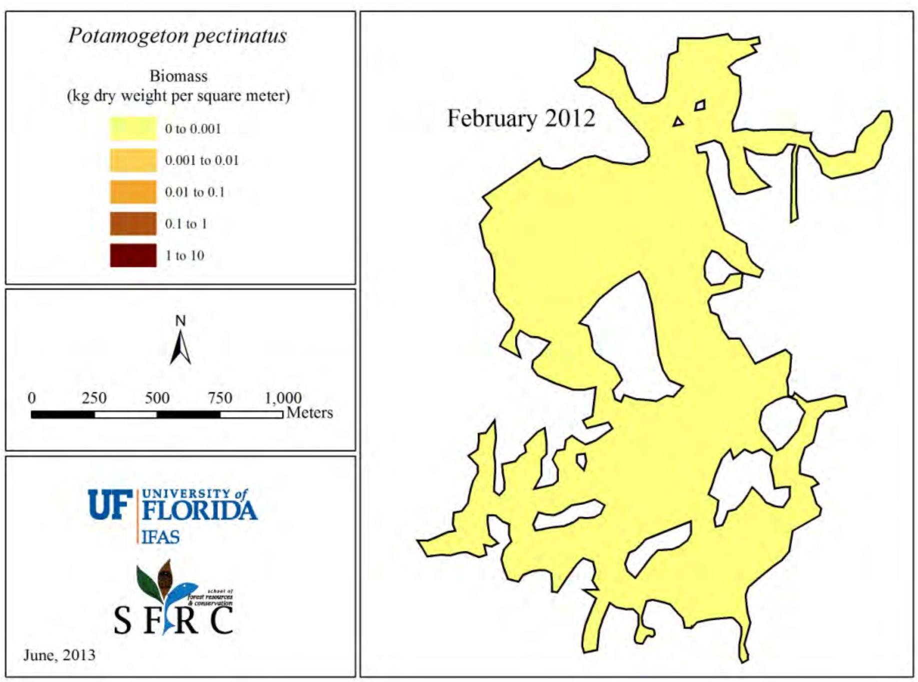
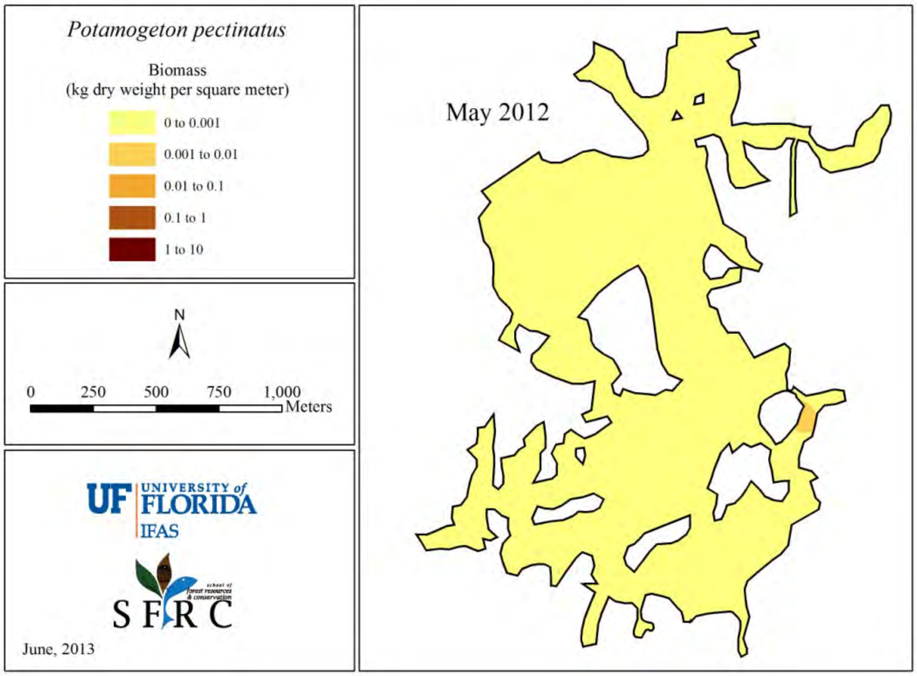

Potamogeton pectinatus
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
S F R C
June, 2013
February 2012


Potamogeton pectinatus
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
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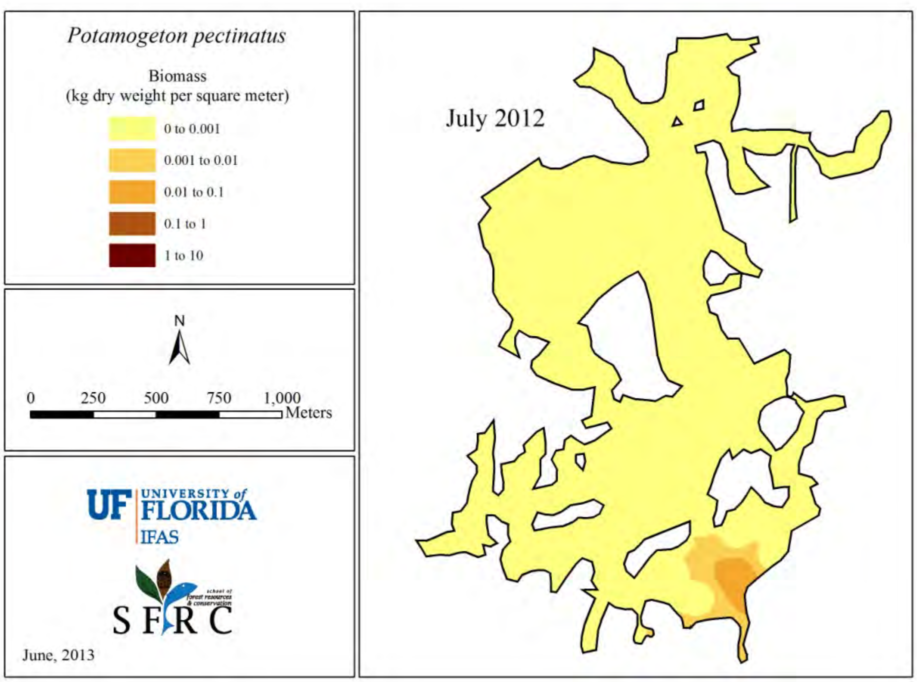
250
500
750
1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
S F R C
June, 2013
May 2012


Potamogeton pectinatus
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
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0.1 to 1
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750
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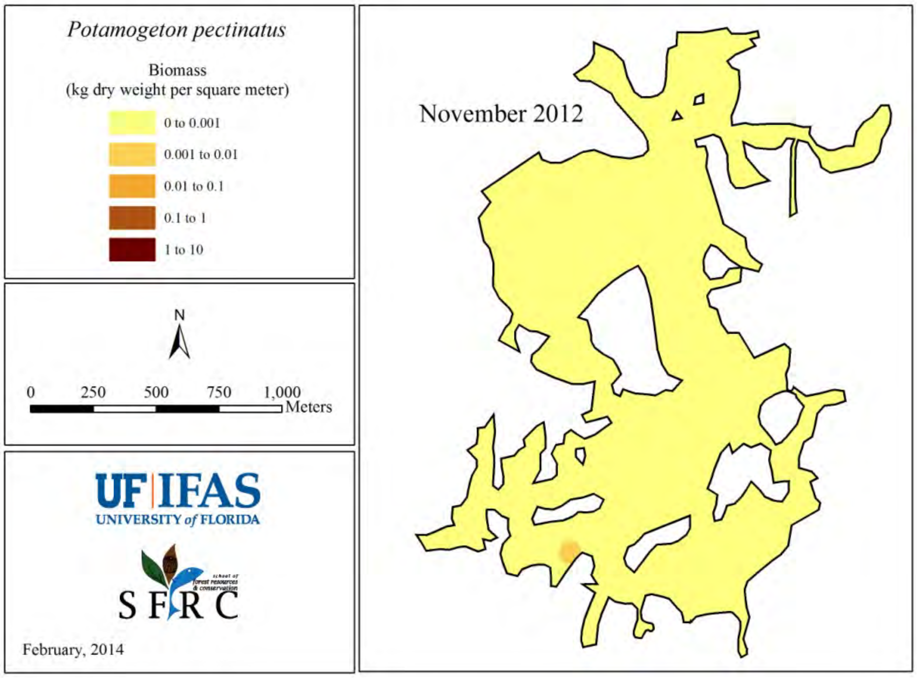
Meters
UF UNIVERSITY of FLORIDA
IFAS
S F R C
June, 2013
July 2012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Biomass
(kg dry weight per square meter)
0 to 0.001
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N
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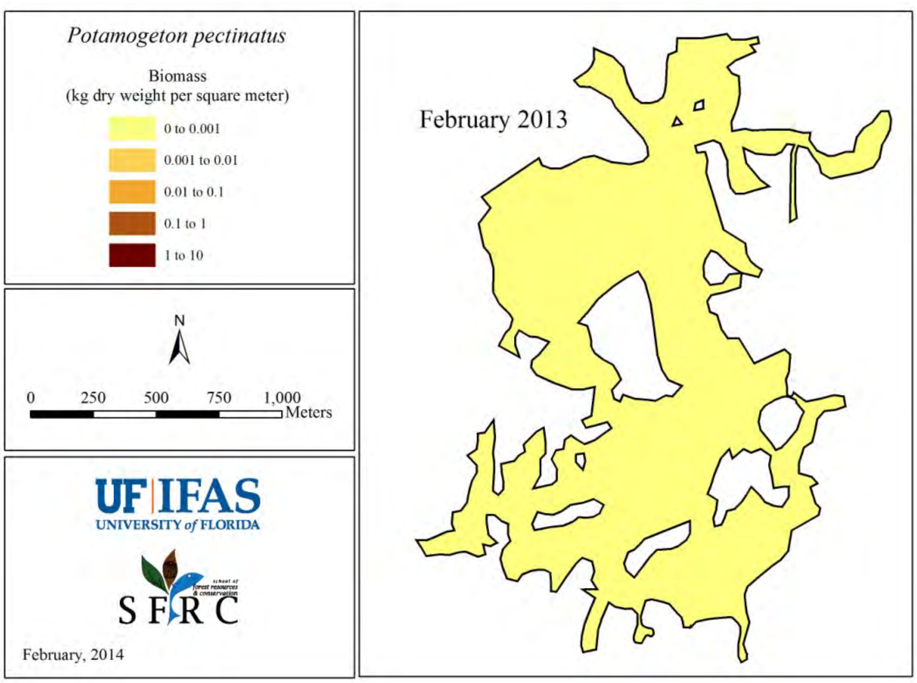
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
November 2012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Biomass
(kg dry weight per square meter)
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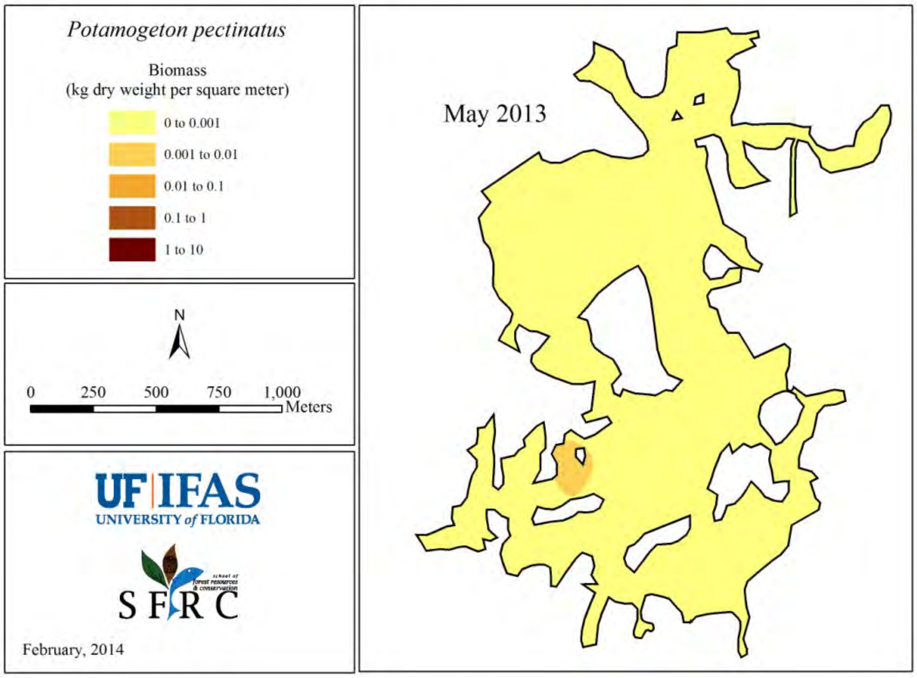
UNIVERSITY of FLORIDA
SFRC
February, 2014
February 2013


Potamogeton pectinatus
Biomass
(kg dry weight per square meter)
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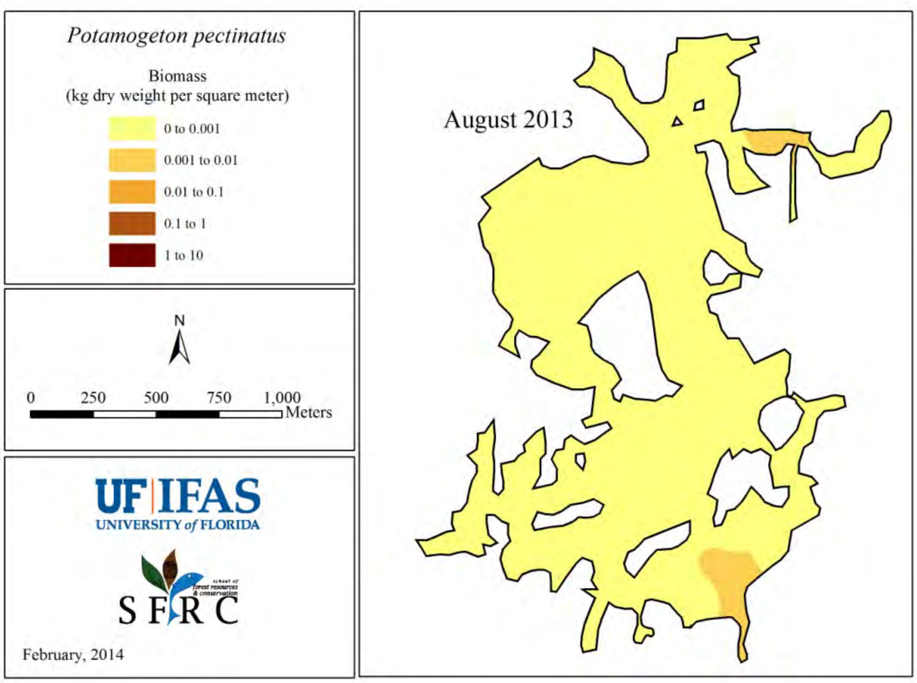
UNIVERSITY of FLORIDA
SFRC
February, 2014
May 2013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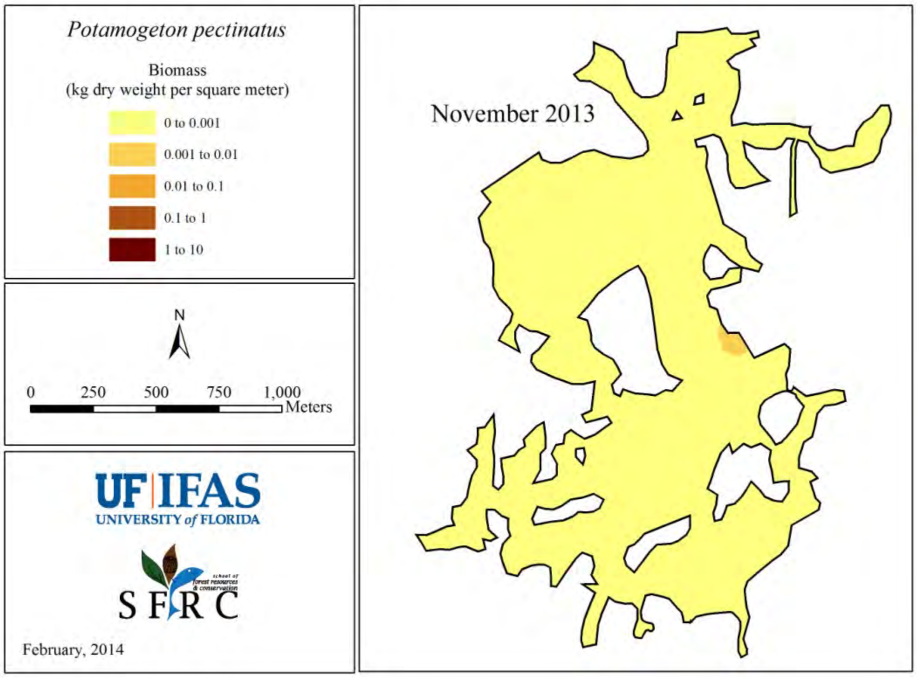
UNIVERSITY of FLORIDA
SFRC
February, 2014
August 2013


Potamogeton pectinatus
Biomass
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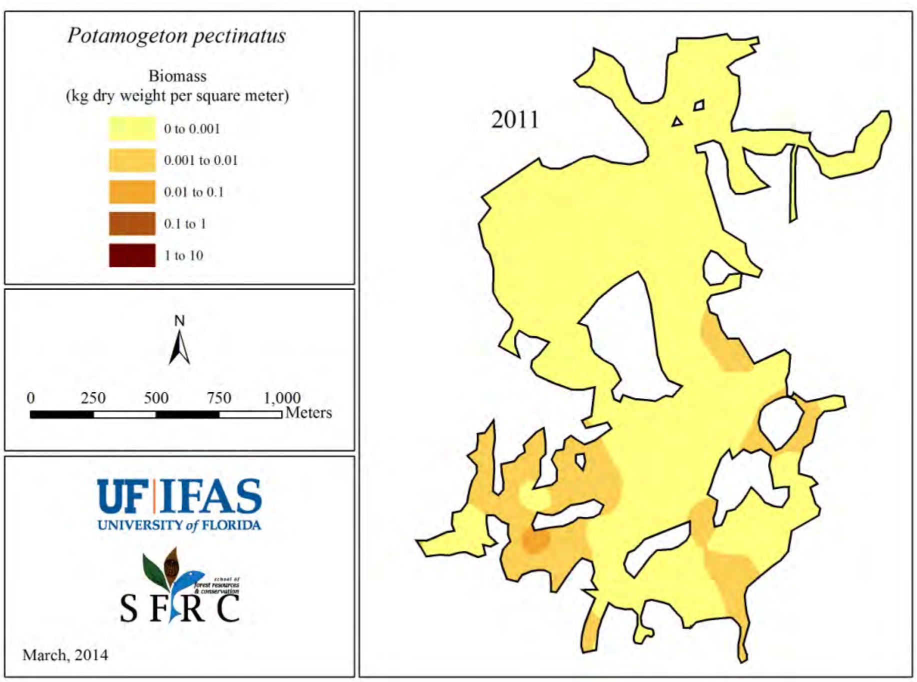
UNIVERSITY of FLORIDA
SFRC
February, 2014
November 2013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Biomass
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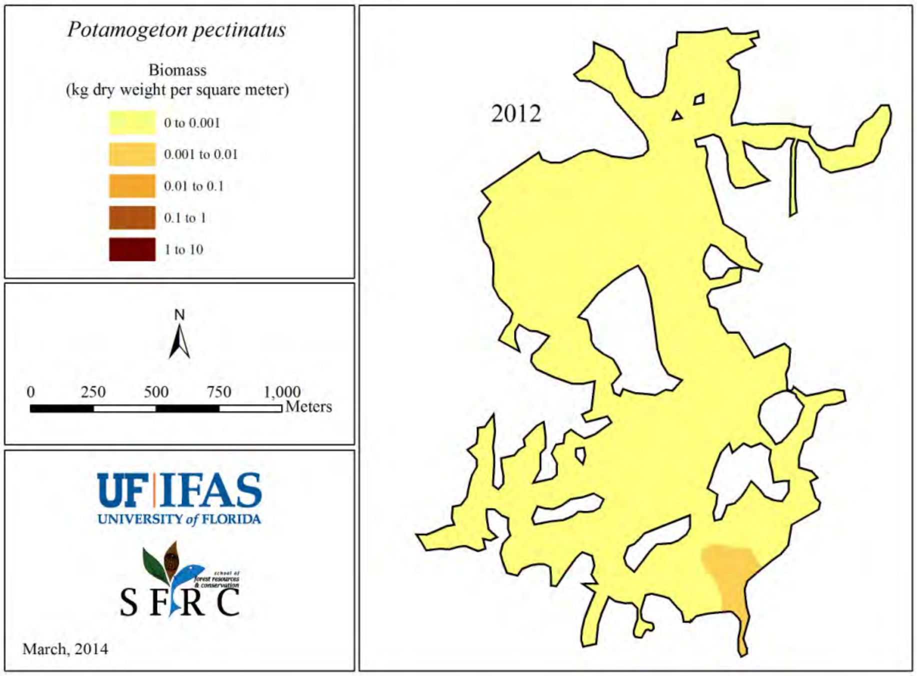
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2011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March, 2014
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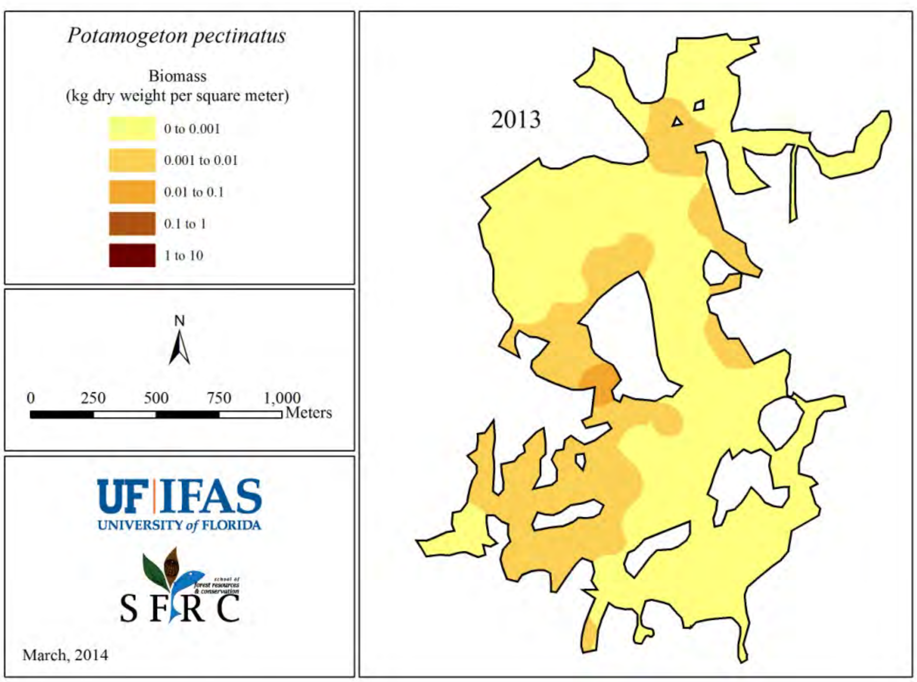
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UNIVERSITY of FLORIDA
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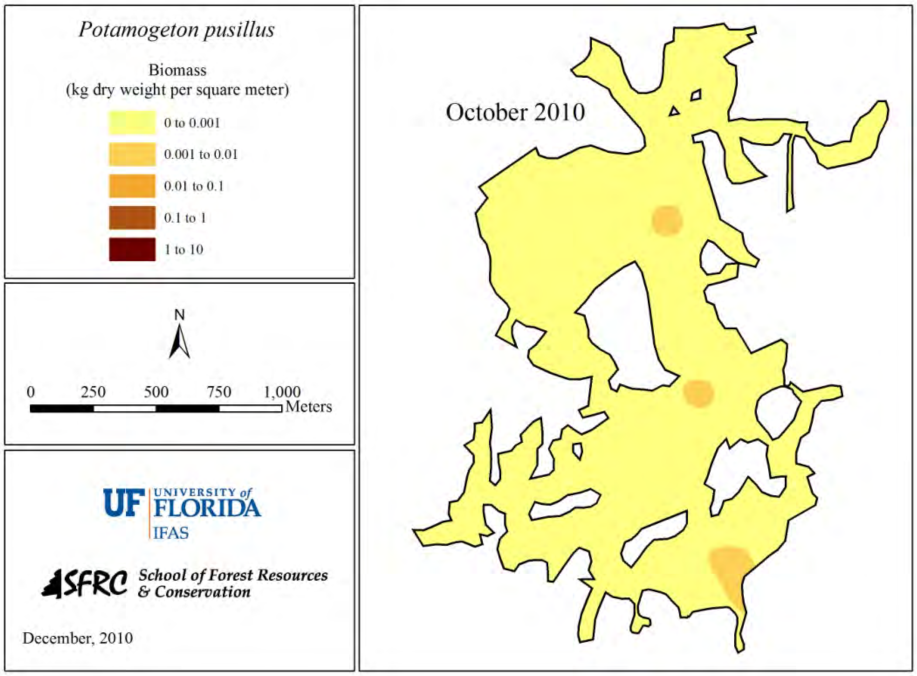
March, 2014
2013


Potamogeton pusillus
Biomass
(kg dry weight per square meter)
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0.1 to 1
1 to 10
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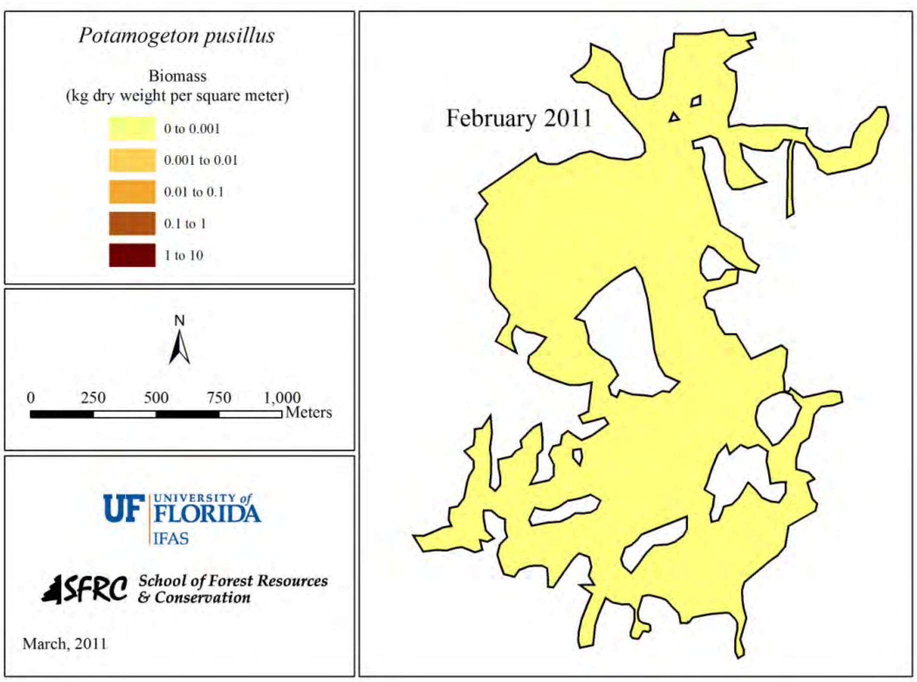
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC School of Forest Resources & Conservation
December, 2010
October 2010


Potamogeton pusillus
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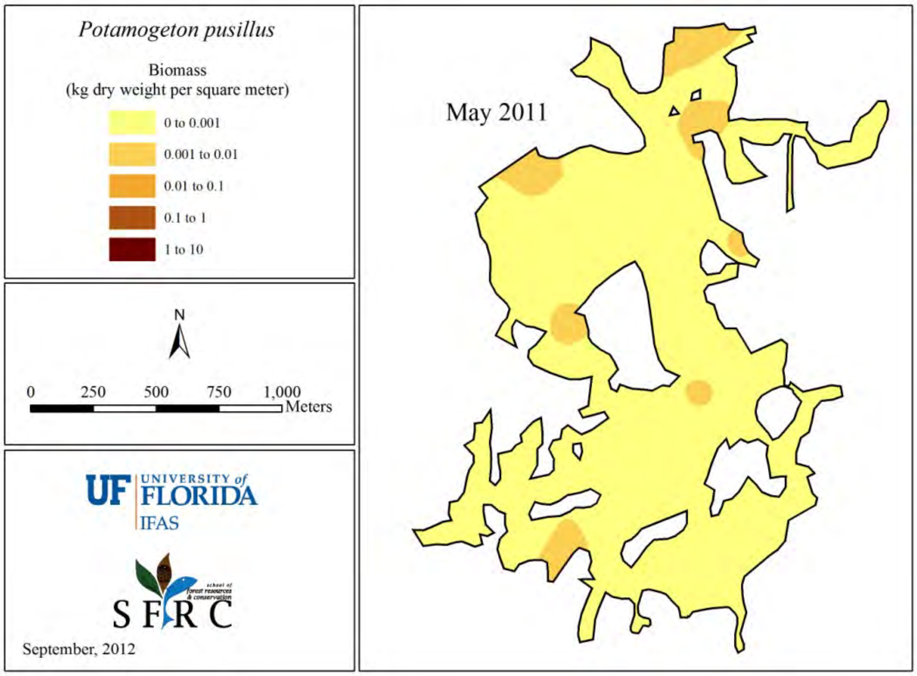
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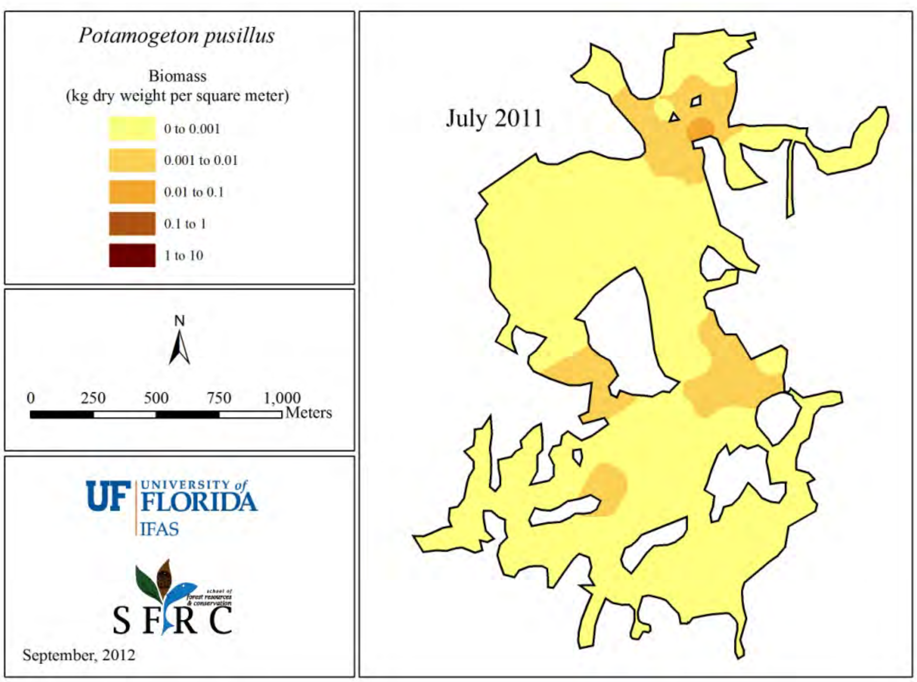
UF UNIVERSITY of FLORIDA
IFAS
SFRC
September, 2012
May 2011


Potamogeton pusillus
Biomass
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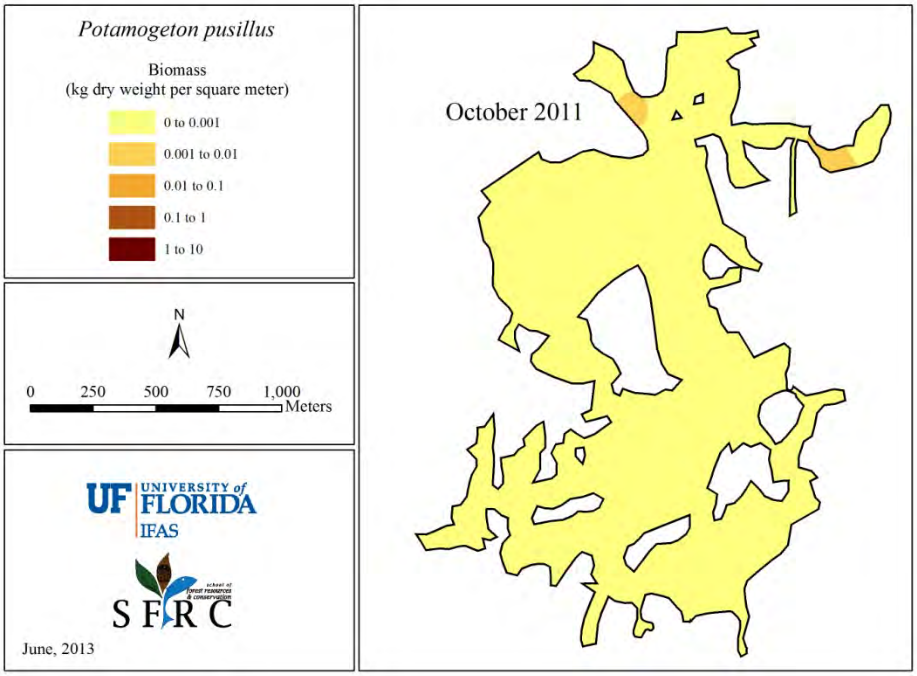
UF UNIVERSITY of FLORIDA
IFAS
SFRC
September, 2012
July 2011



Potamogeton pusillus
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(kg dry weight per square meter)
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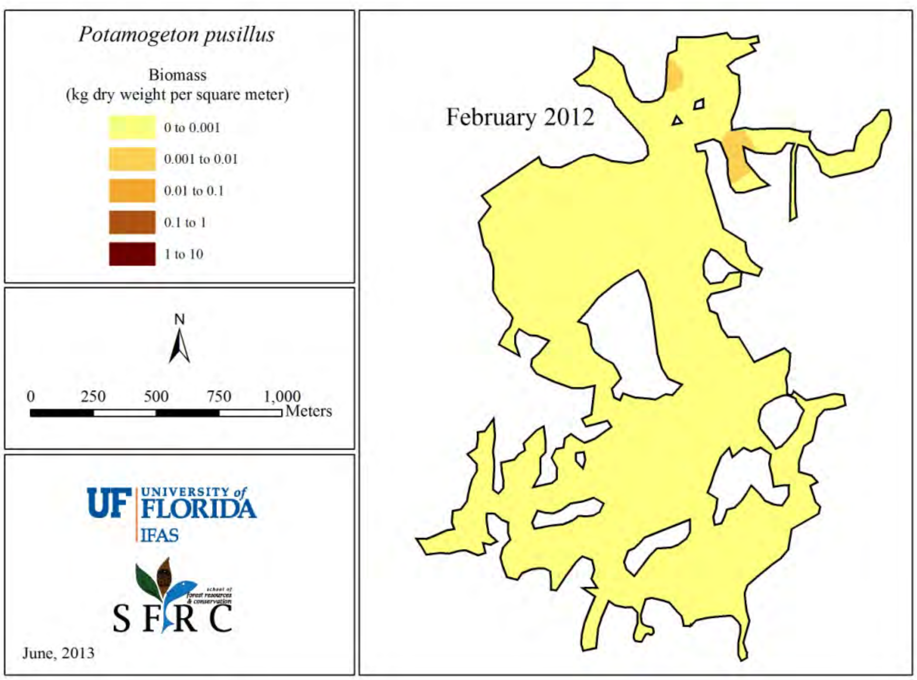
UF UNIVERSITY of FLORIDA
IFAS
SFRC
June, 2013
October 2011



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Biomass
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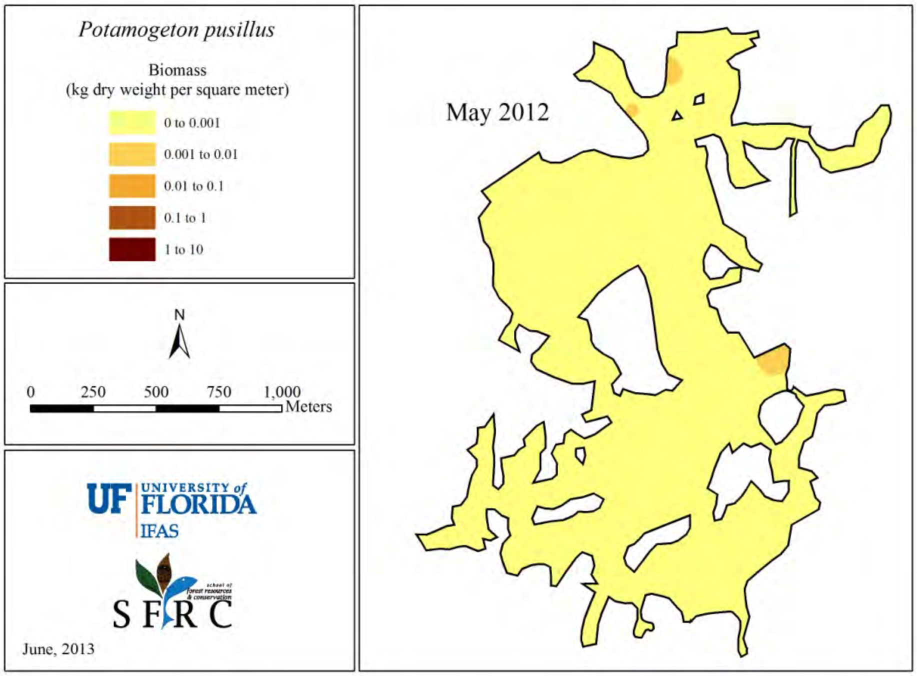
June, 2013
February 2012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Biomass
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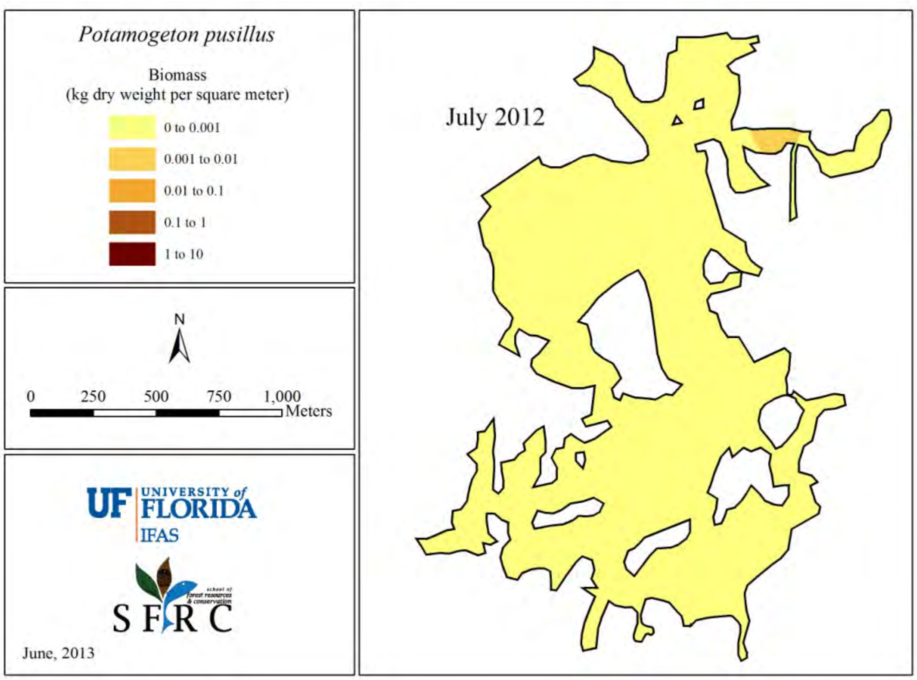
May 2012


Potamogeton pusillus
Biomass
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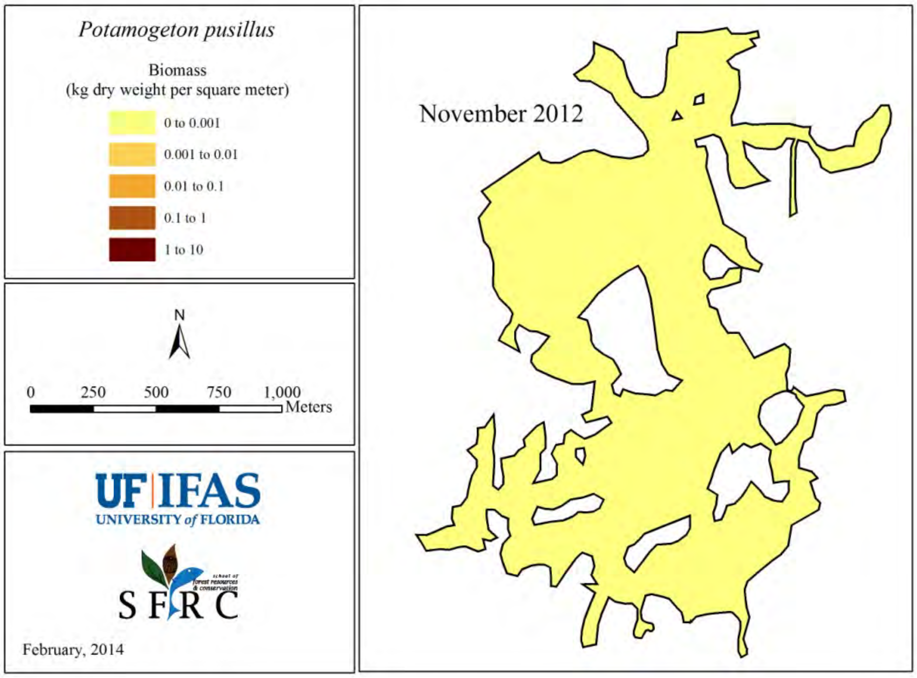
Meters
June, 2013
July 2012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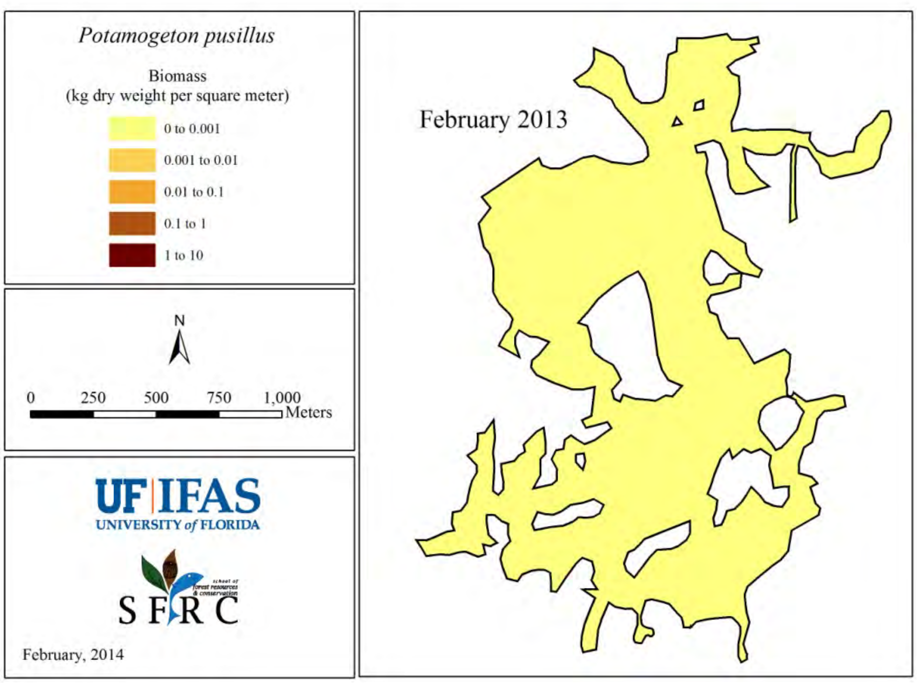
UNIVERSITY of FLORIDA
SFRC
February, 2014
November 2012


Potamogeton pusillus
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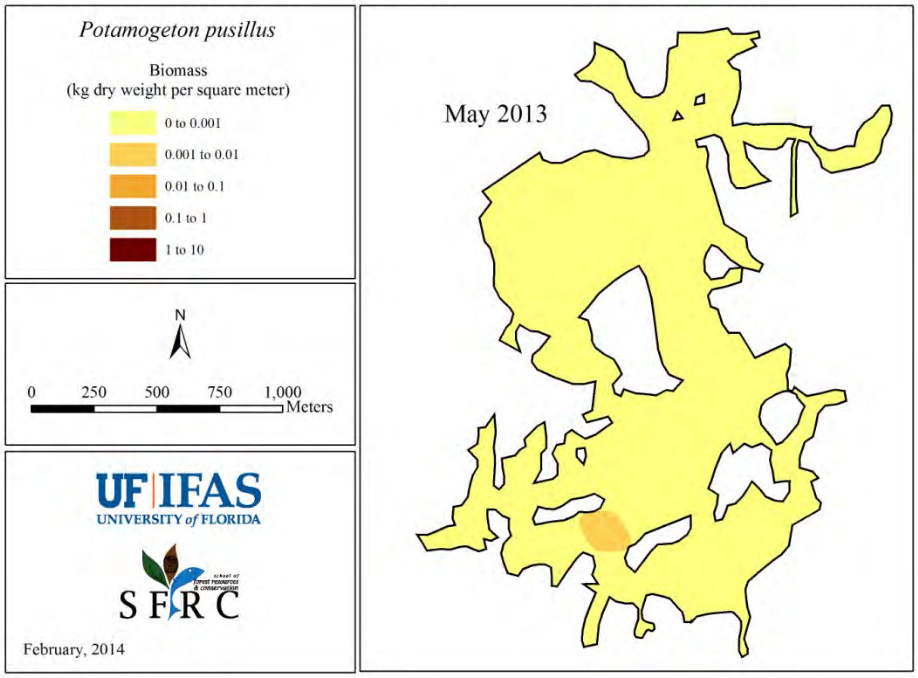
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
February 2013


Potamogeton pusillus
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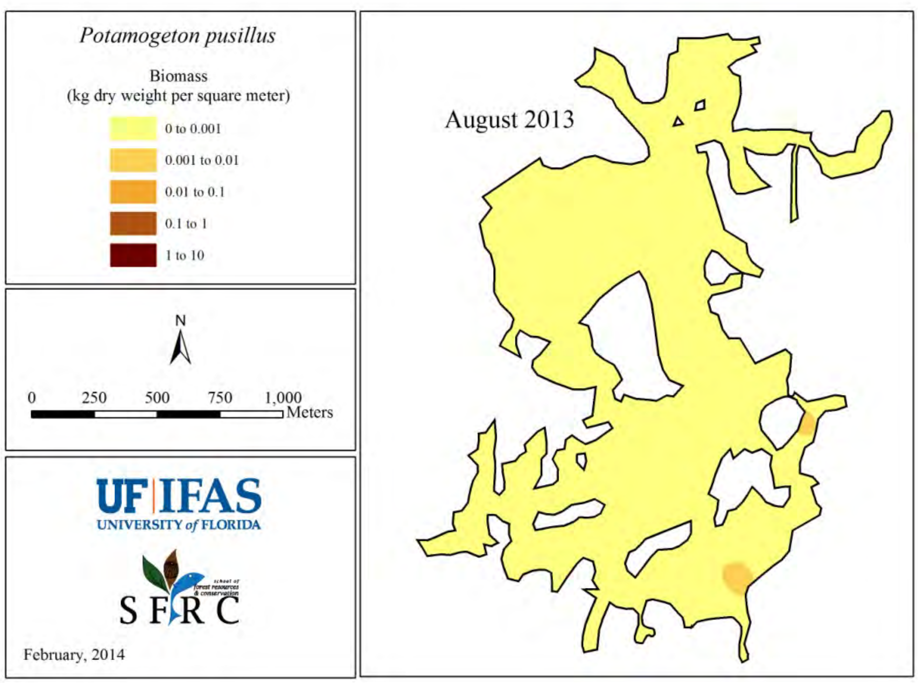
UNIVERSITY of FLORIDA
SFRC
February, 2014
May 2013


Potamogeton pusillus
Biomass
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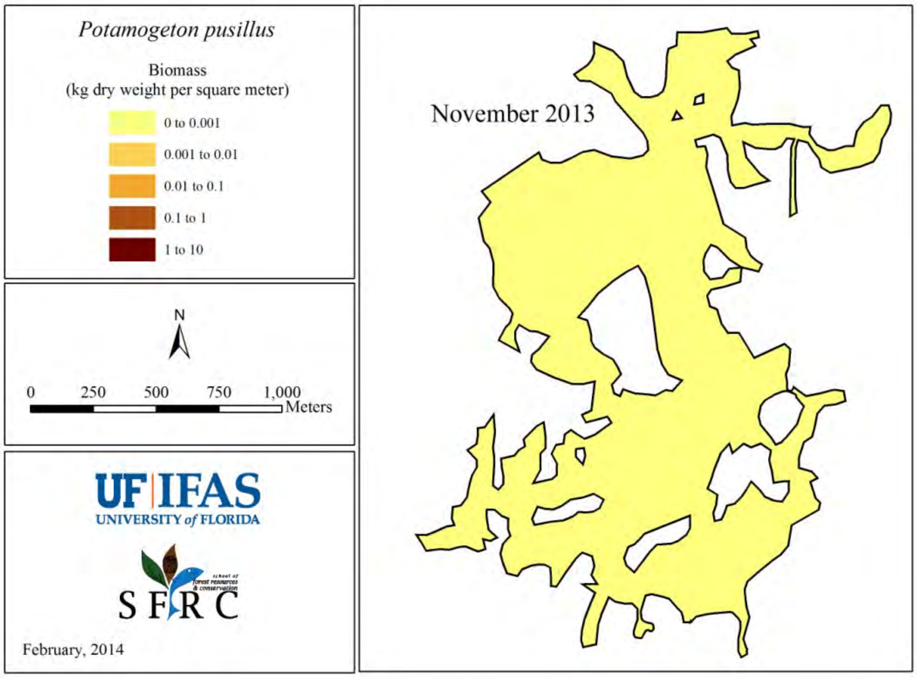
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
August 2013


Potamogeton pusillus
Biomass
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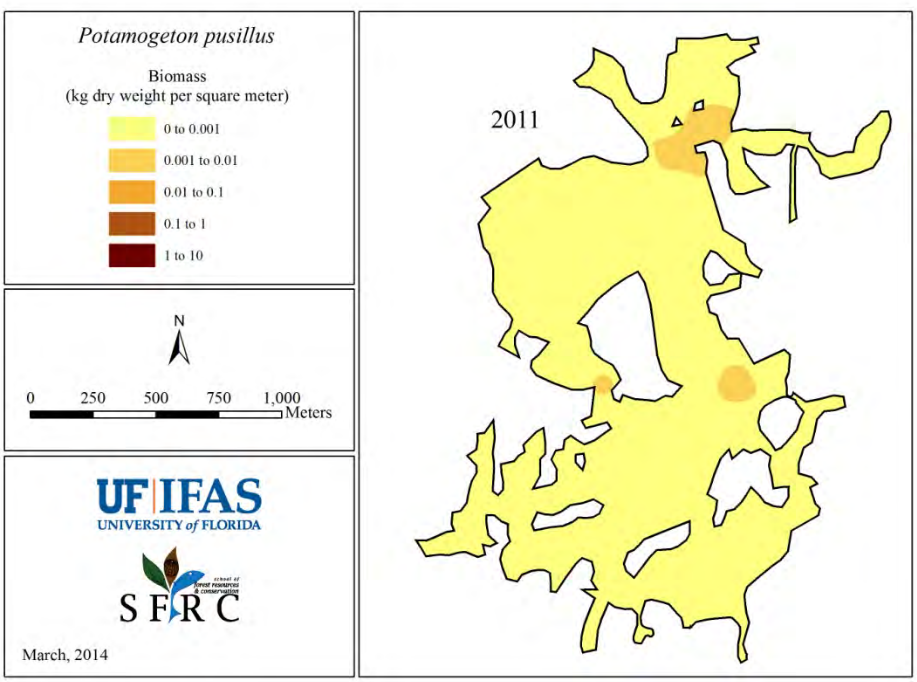
UNIVERSITY of FLORIDA
SFRC
February, 2014
November 2013


Potamogeton pusillus
Biomass
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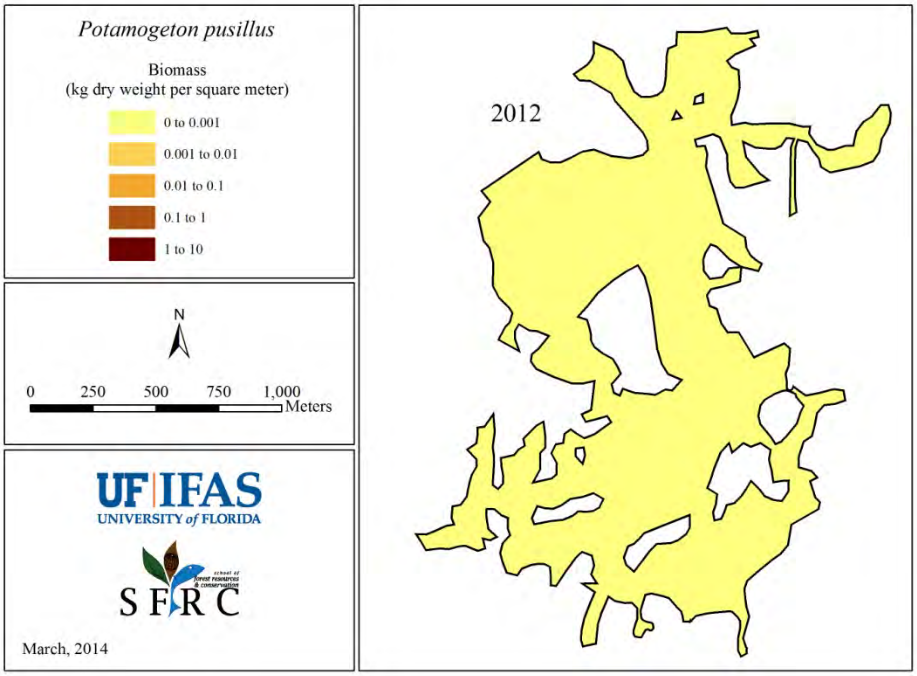
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2011


Potamogeton pusillus
Biomass
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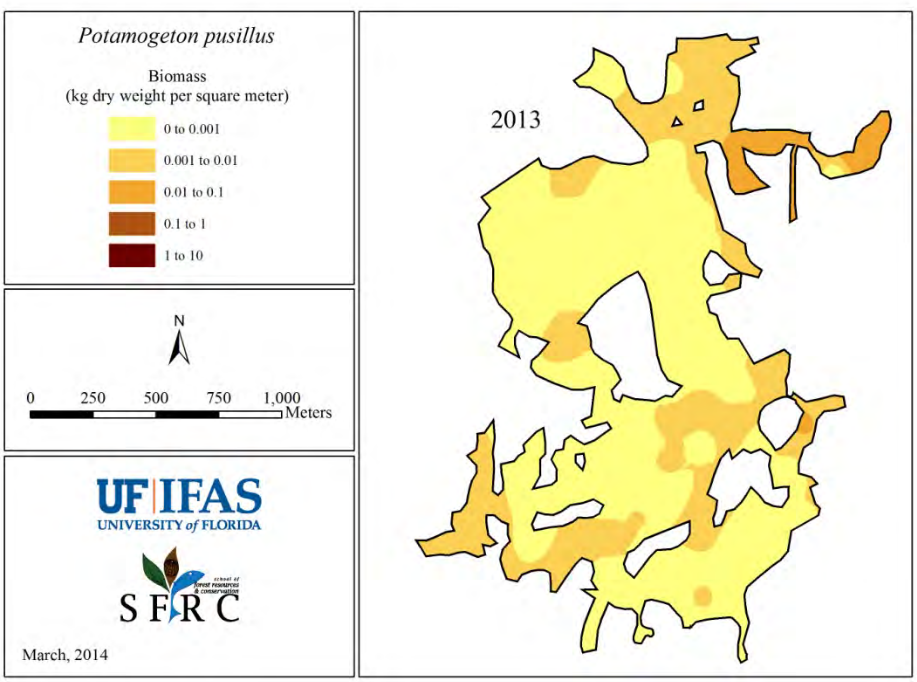
UF IFAS
UNIVERSITY of FLORIDA
S F R C
March, 2014
2012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Biomass
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1 to 10
N
0 250 500 750 1,000
Meters
UF IFAS
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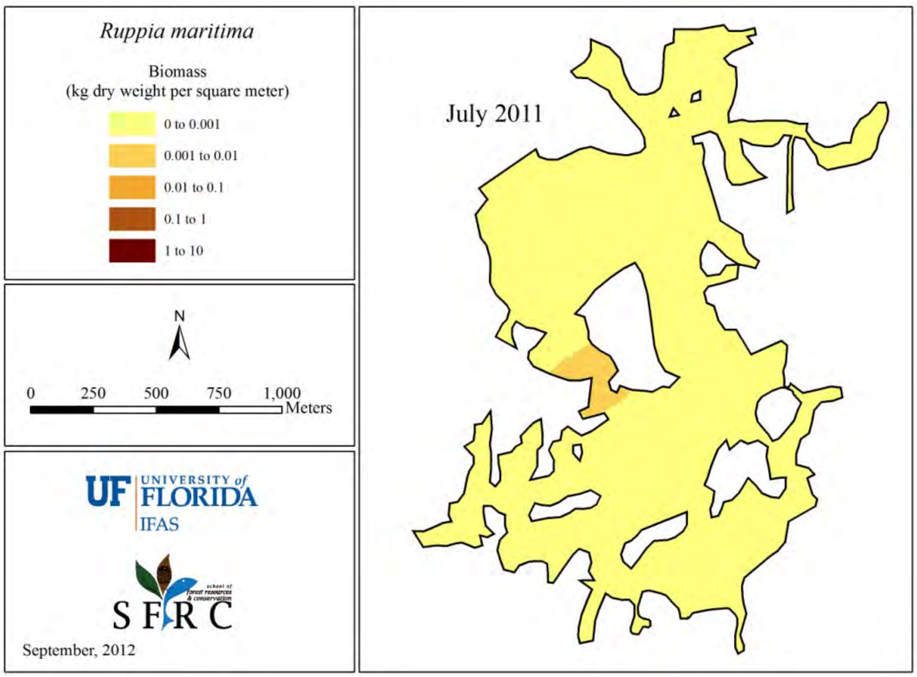
S F R C
March, 2014
2013

Ruppia maritima was not found in any quadrat in October 2010

Ruppia maritima was not found in any quadrat in February 2011

Ruppia maritima was not found in any quadrat in May 2011



Ruppia maritima was not found in any quadrat in October 2011

Ruppia maritima was not found in any quadrat in February 2012

Ruppia maritima was not found in any quadrat in May 2012

Ruppia maritima was not found in any quadrat in July 2012

Ruppia maritima was not found in any quadrat in November 2012

Ruppia maritima was not found in any quadrat in February 2013

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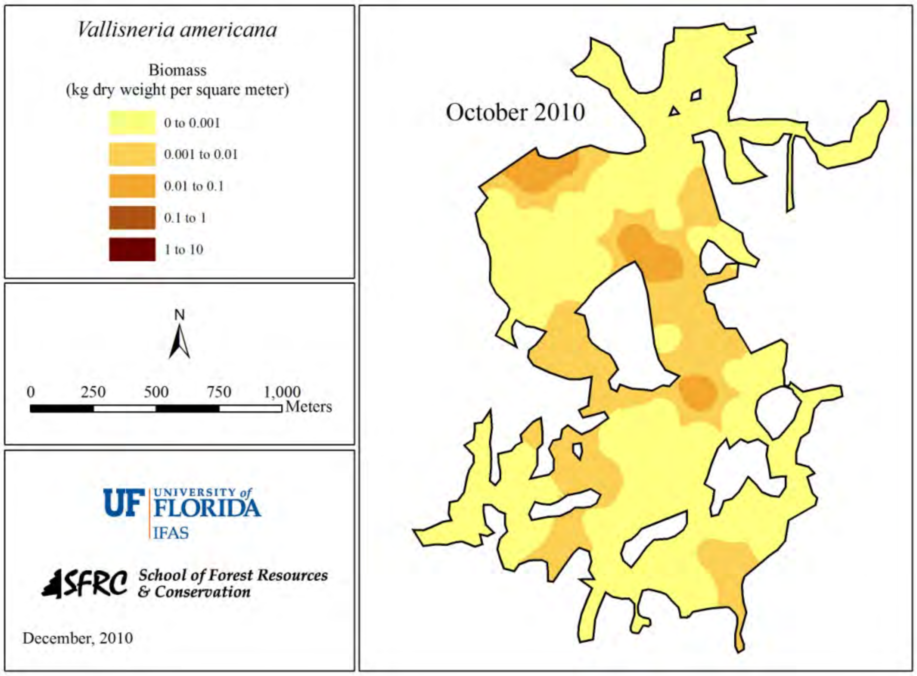
Ruppia maritima was not found in any quadrat in November 2013


Vallisneria americana
Biomass
(kg dry weight per square meter)
0 to 0.001
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0.1 to 1
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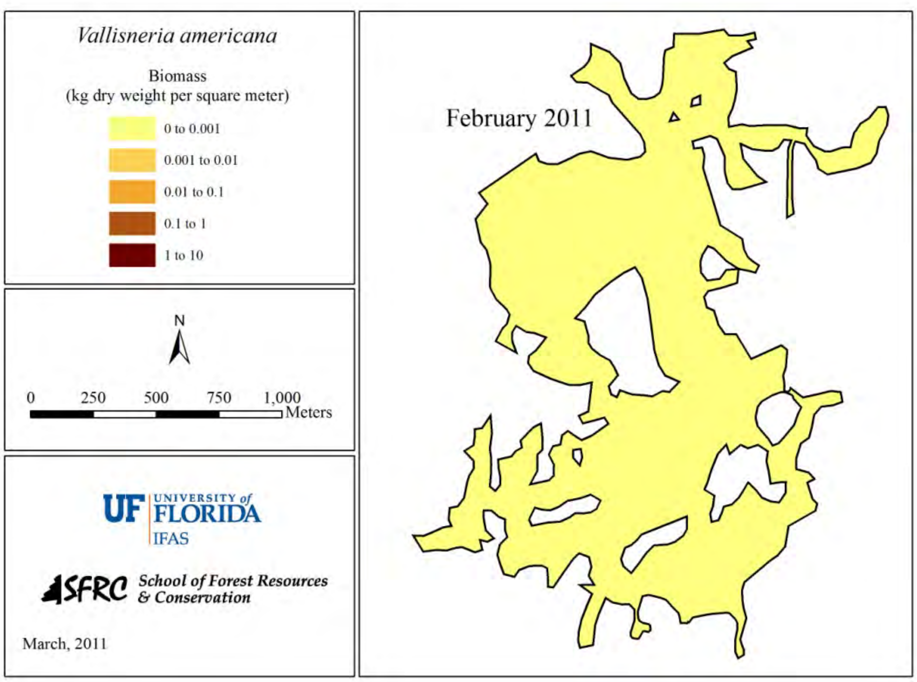
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC School of Forest Resources & Conservation
December, 2010
October 2010


Vallisneria americana
Biomass
(kg dry weight per square meter)
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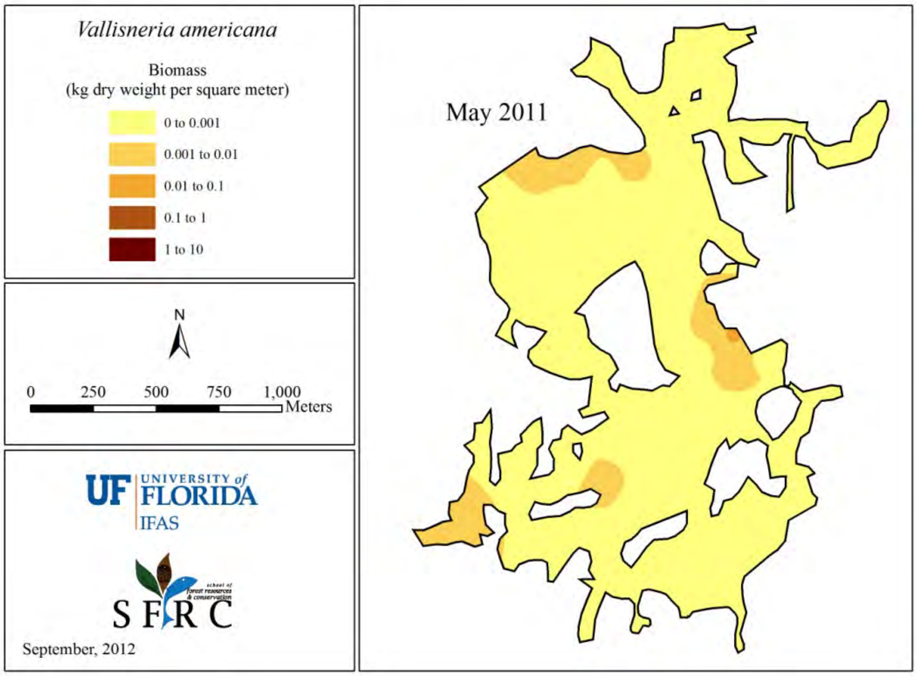
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Biomass
(kg dry weight per square meter)
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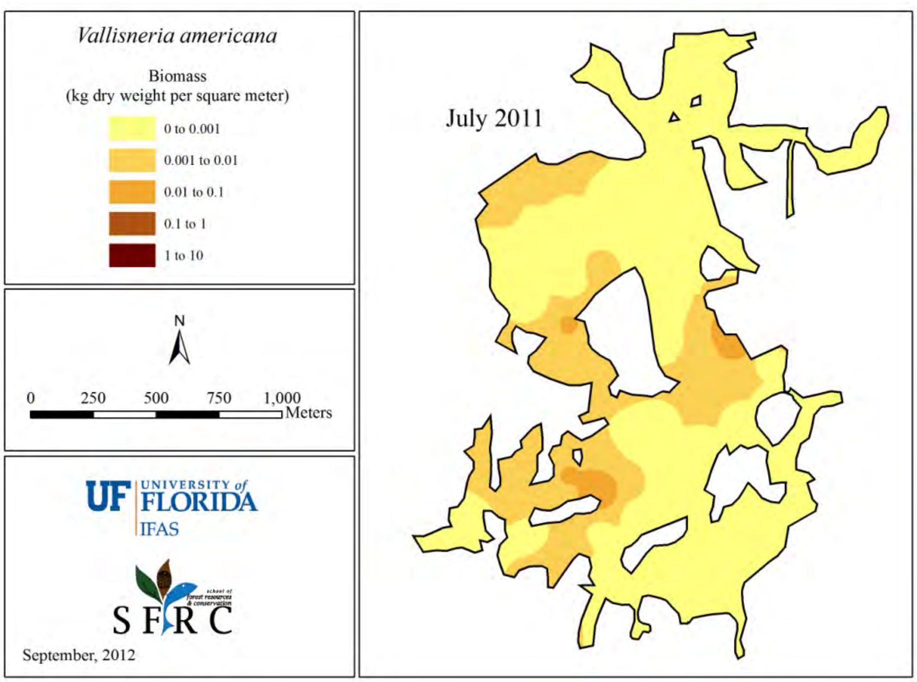
UF UNIVERSITY of FLORIDA
IFAS
S F R C
September, 2012
May 2011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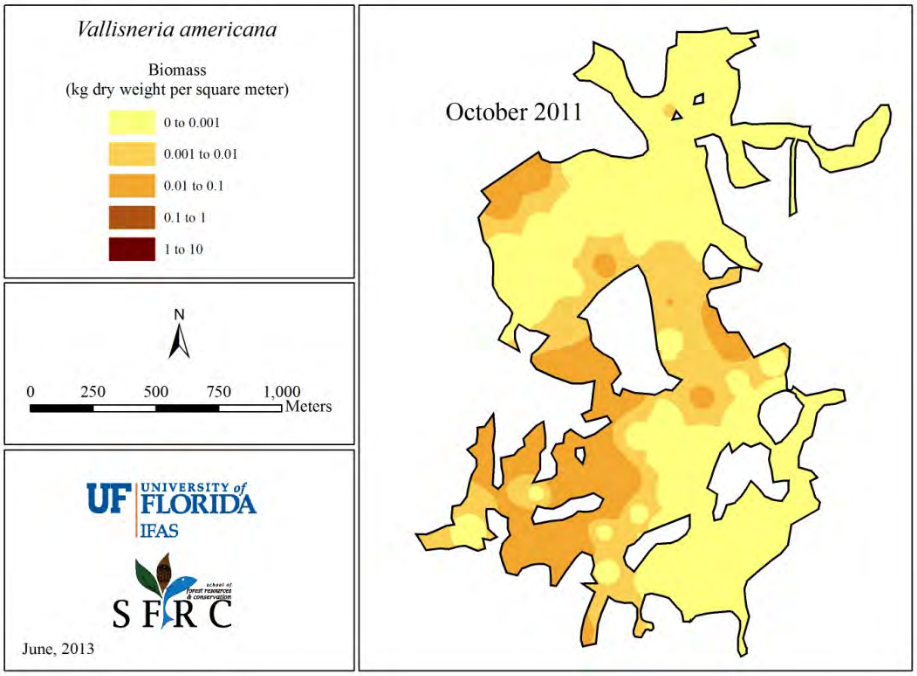
UF UNIVERSITY of FLORIDA
IFAS
S F R C
September, 2012
July 2011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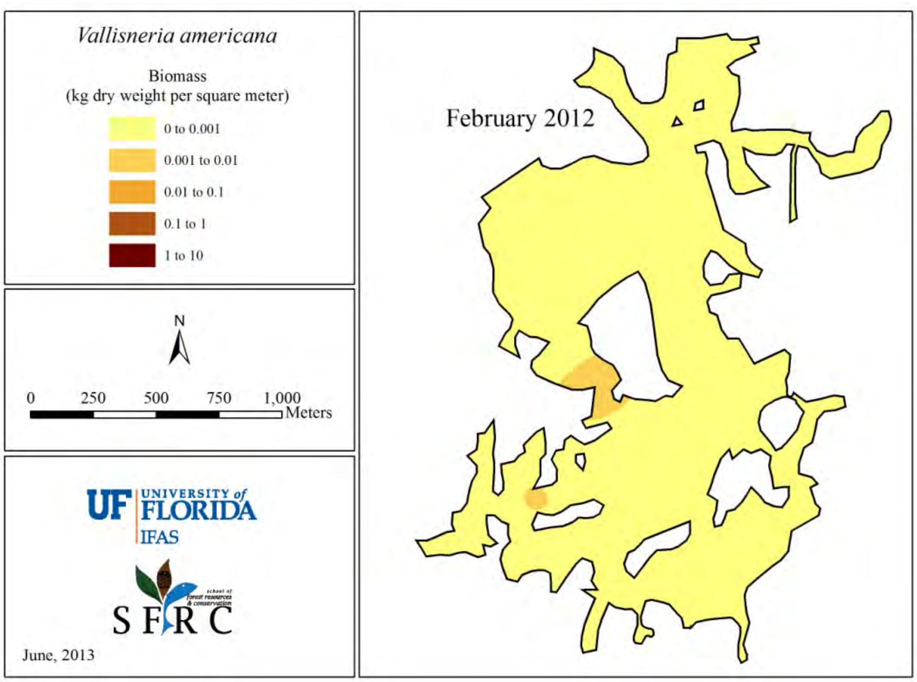
UF UNIVERSITY of FLORIDA
IFAS
S F R C
June, 2013
October 2011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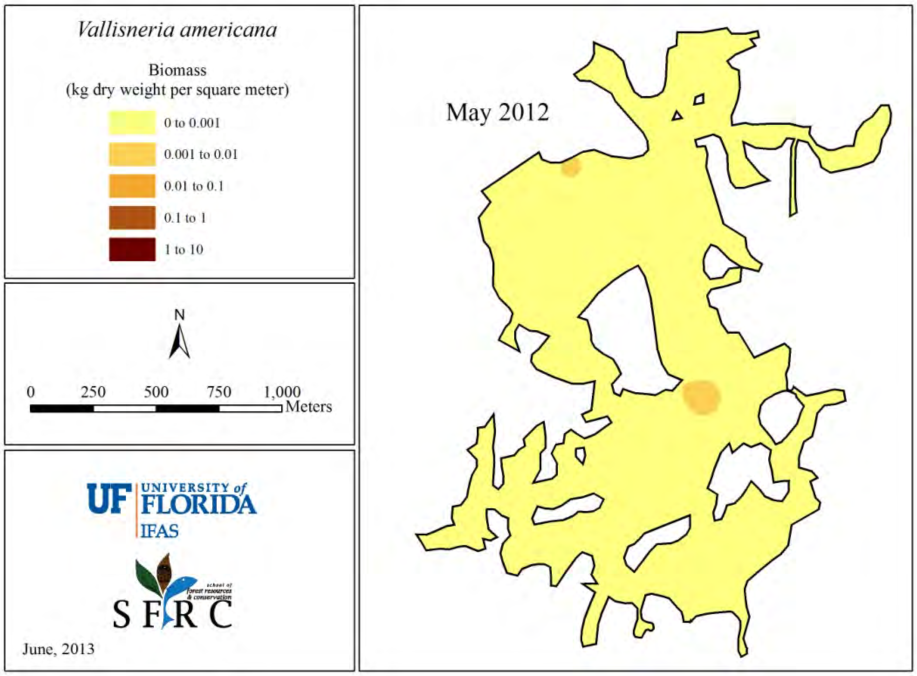
Vallisneria americana
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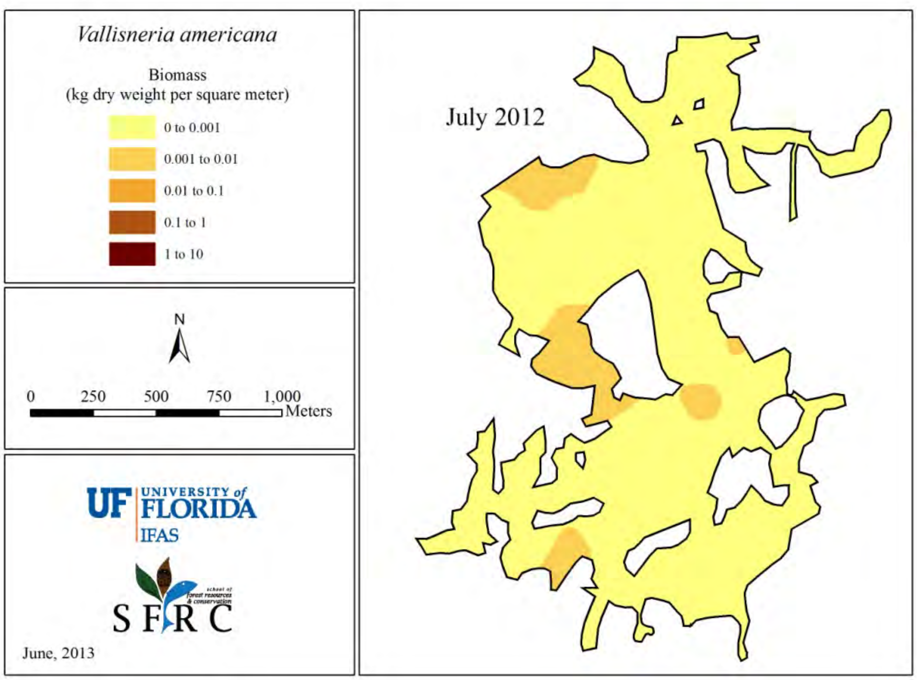
June, 2013
May 2012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June, 2013
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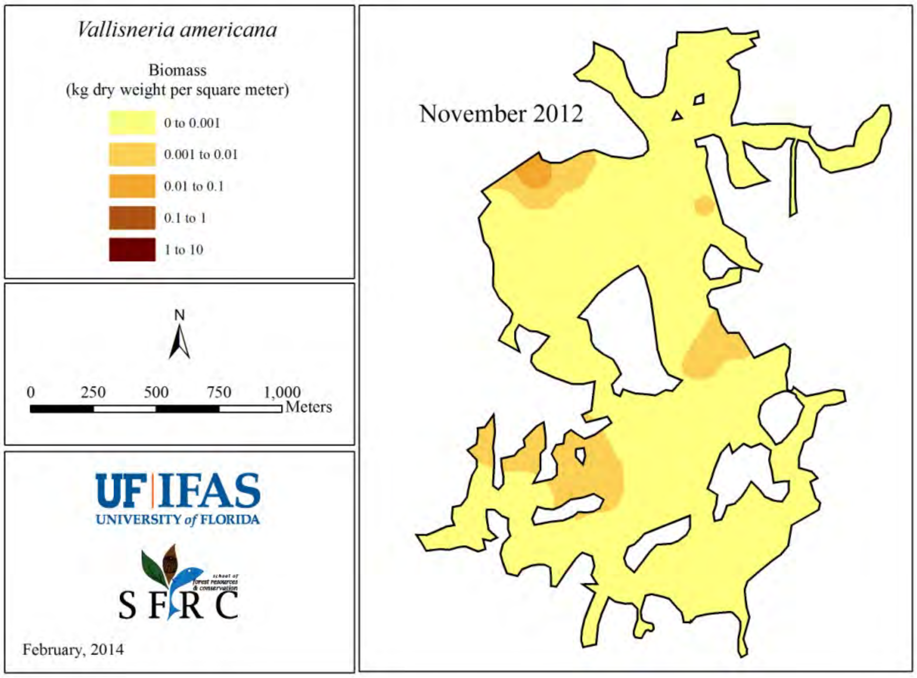
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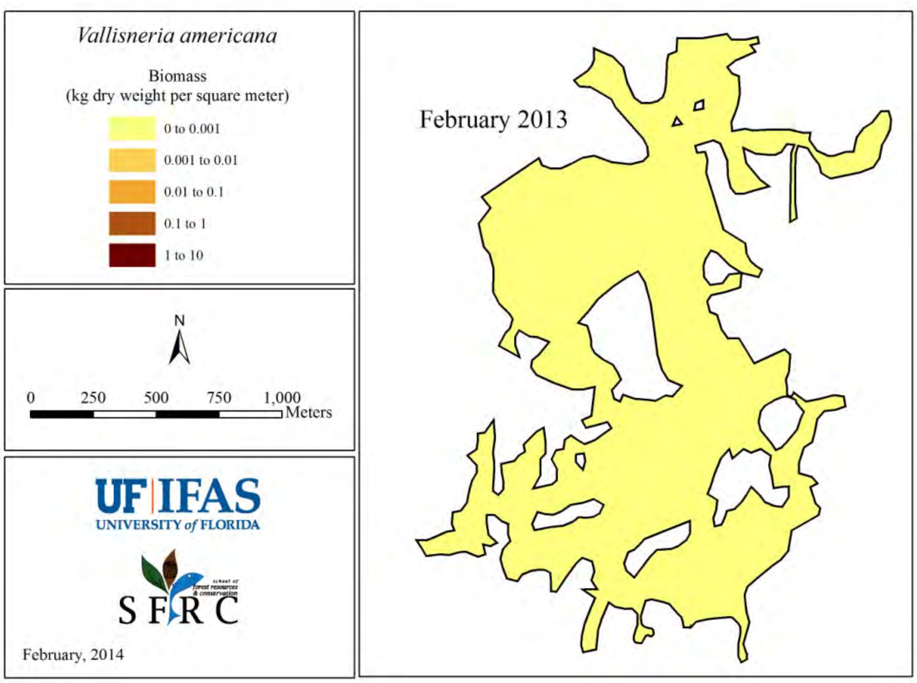
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SFRC
February, 2014
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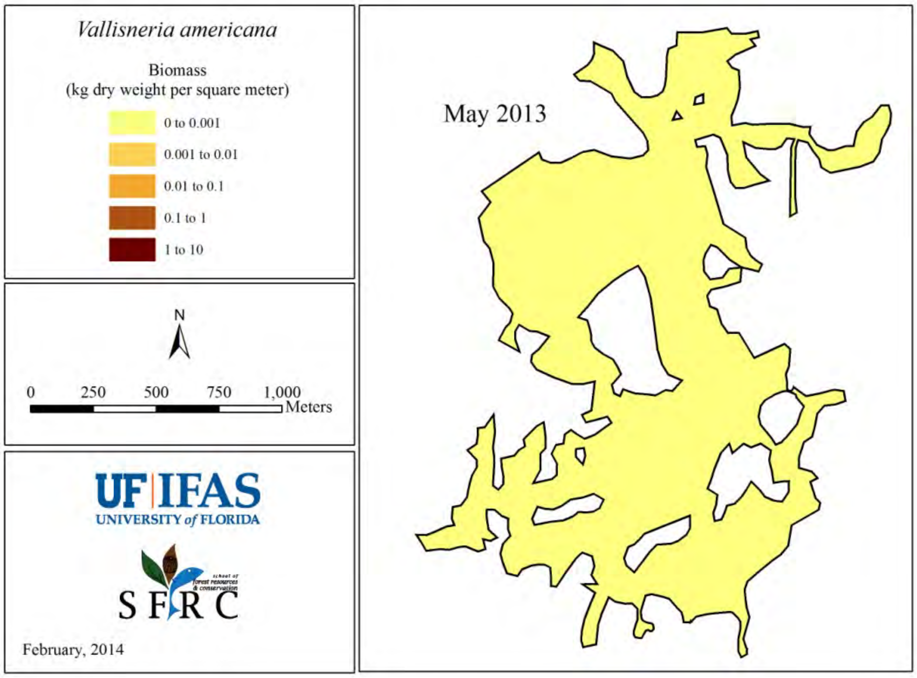
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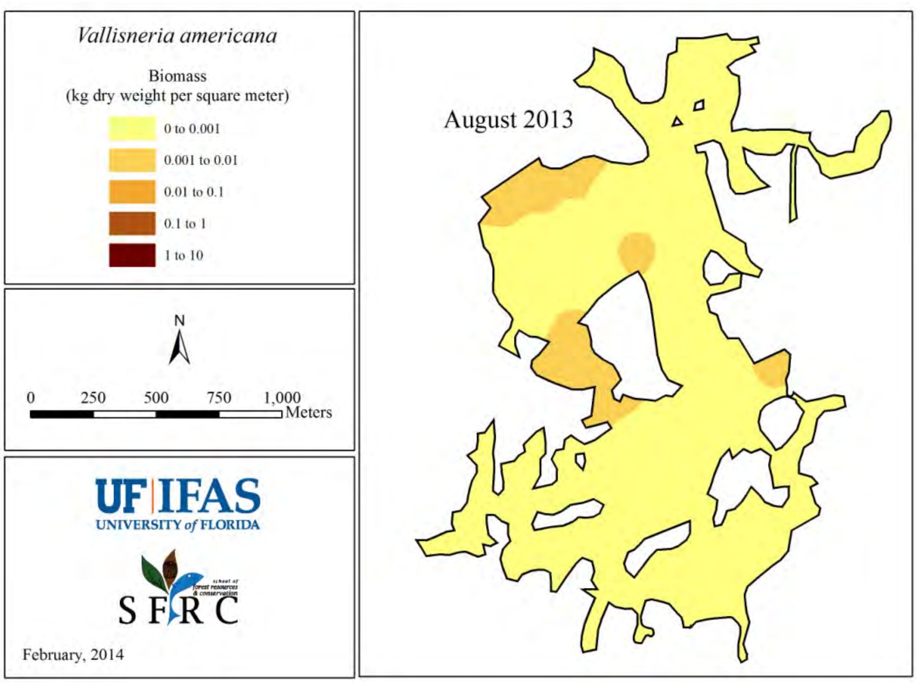
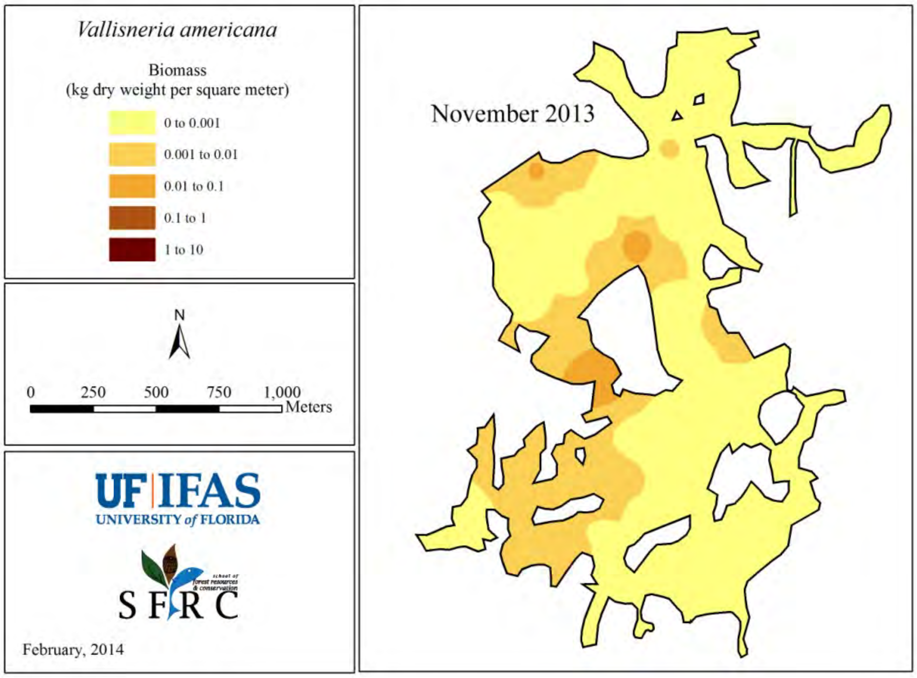
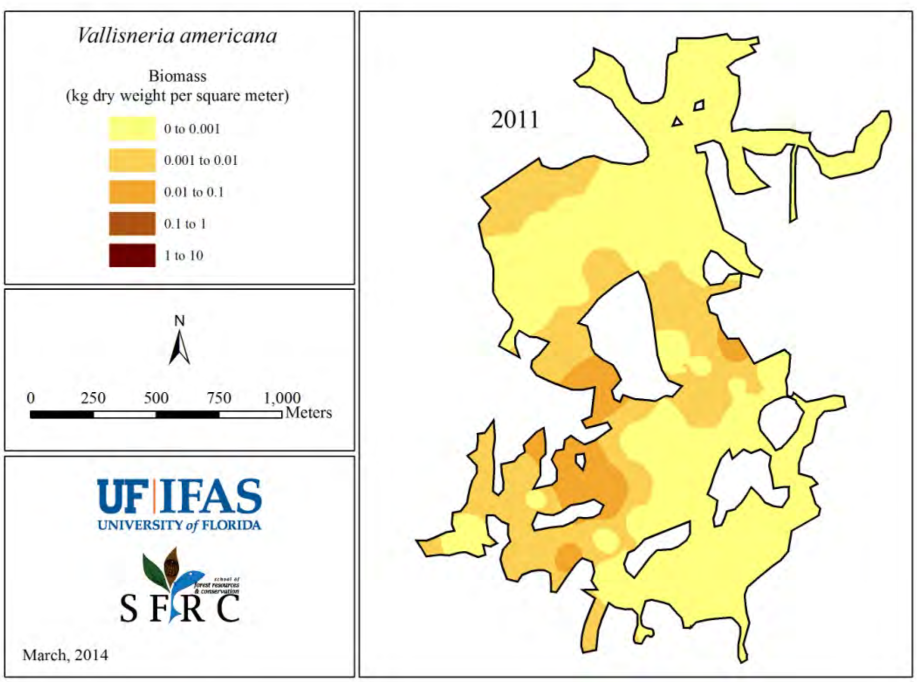
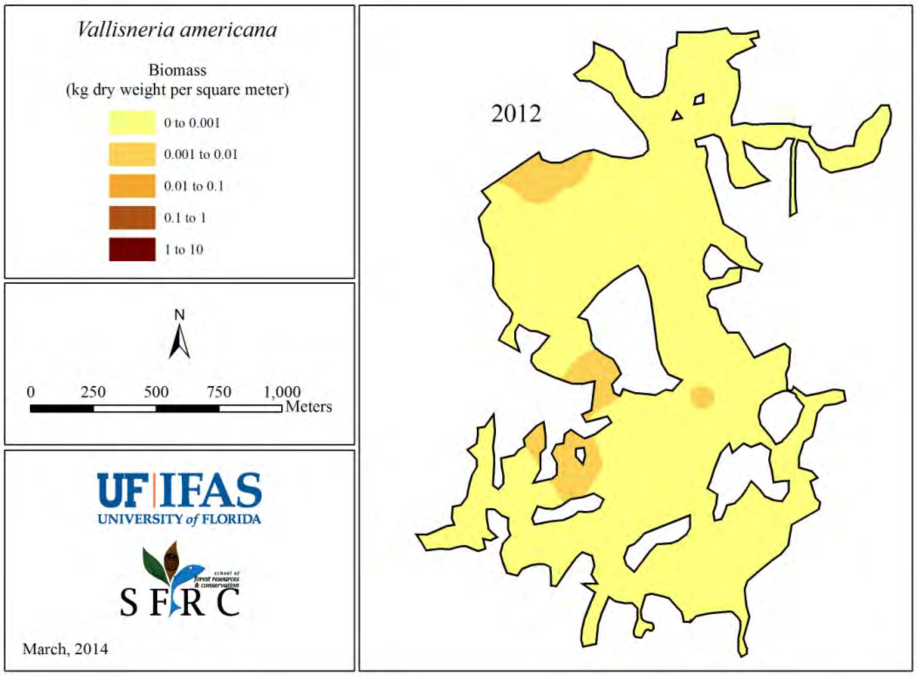
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
February, 2014
May 2013

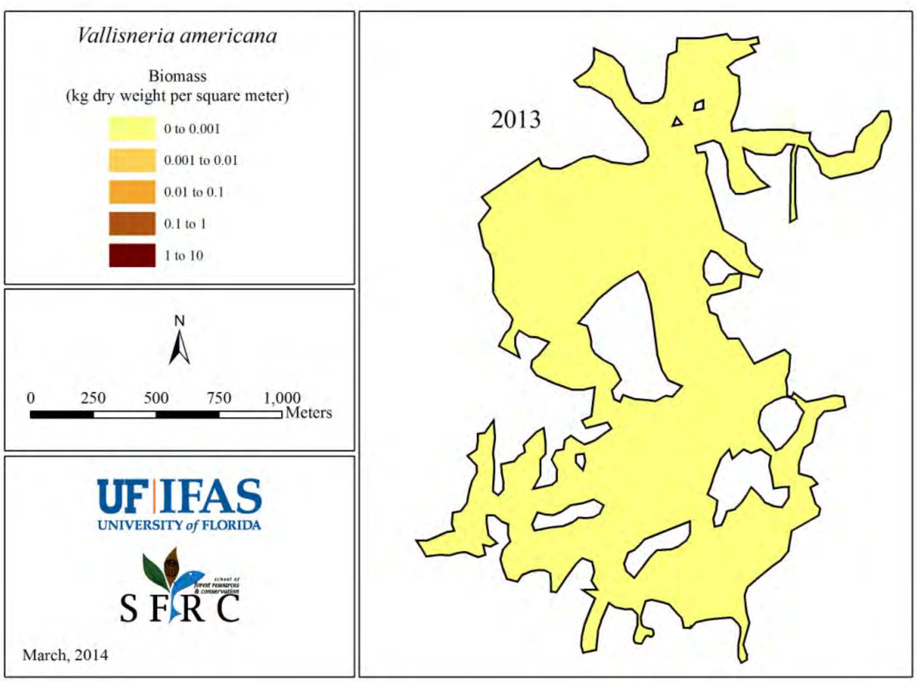

Vallisneria americana
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
February, 2014
August 2013


Vallisneria americana
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
February, 2014
November 2013

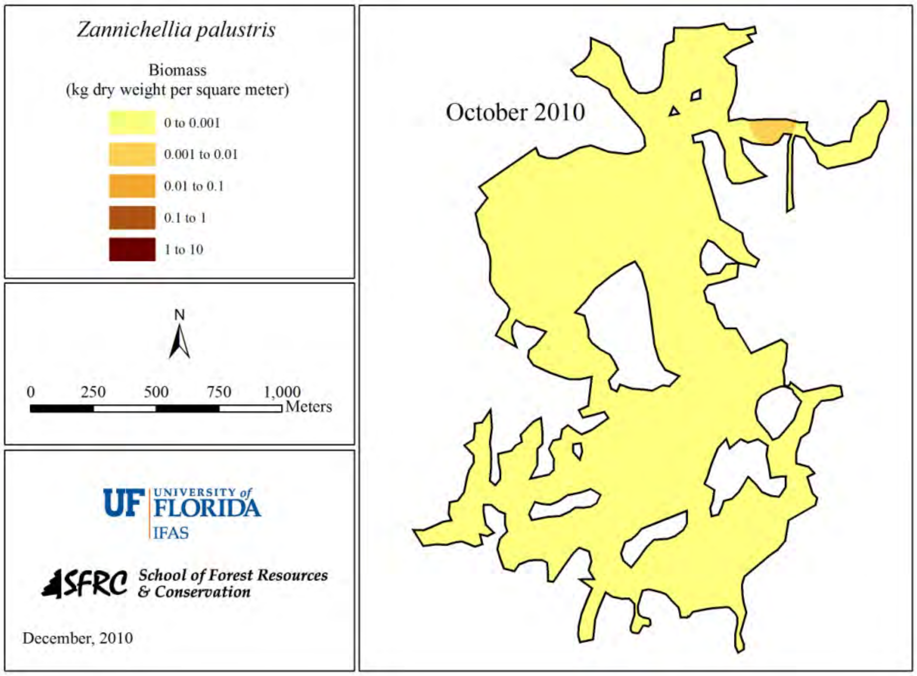

Vallisneria americana
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
March, 2014
2011

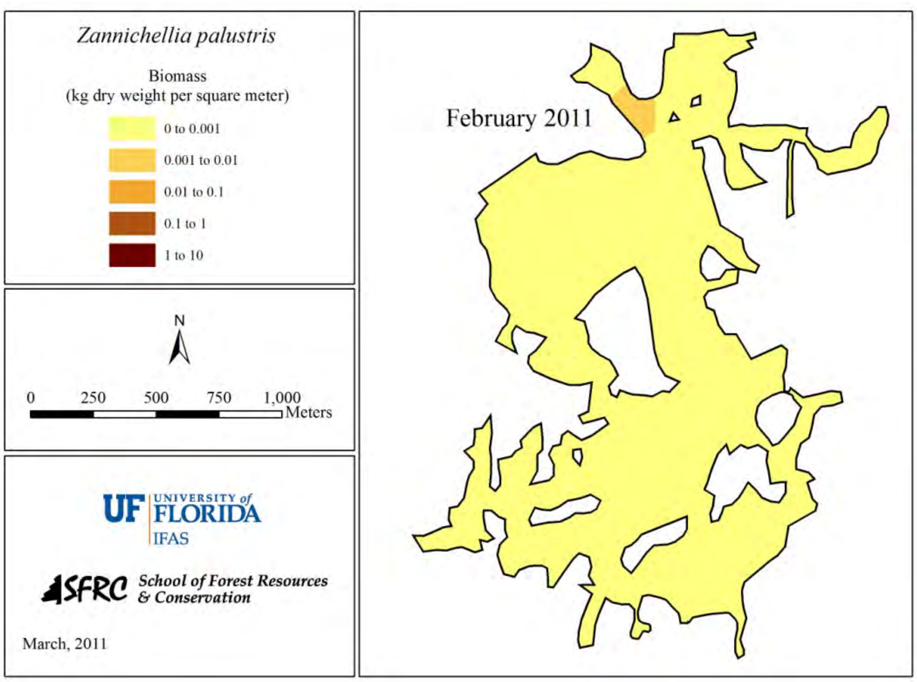


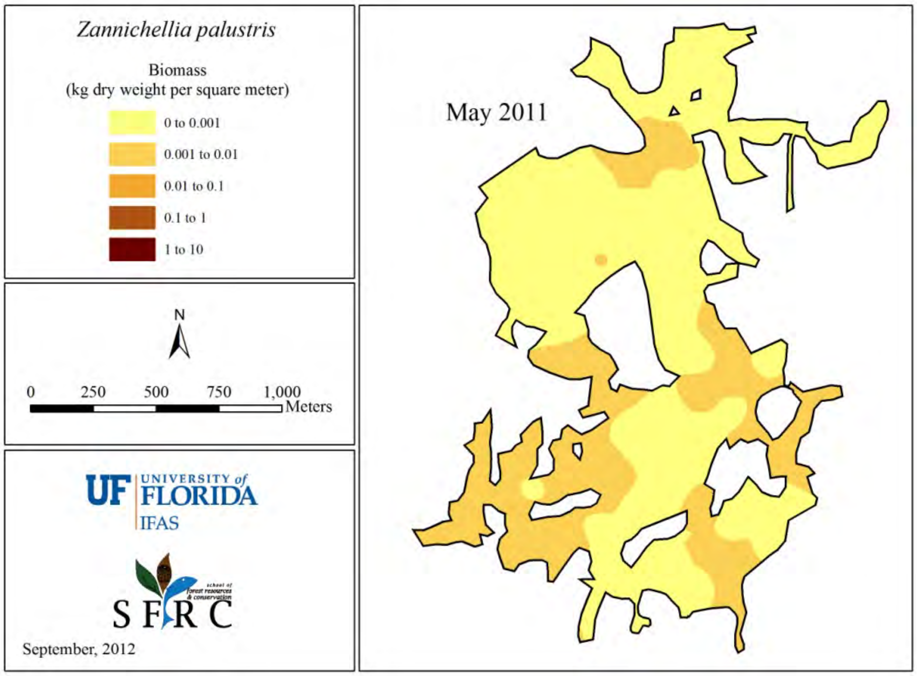
Vallisneria americana
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2012

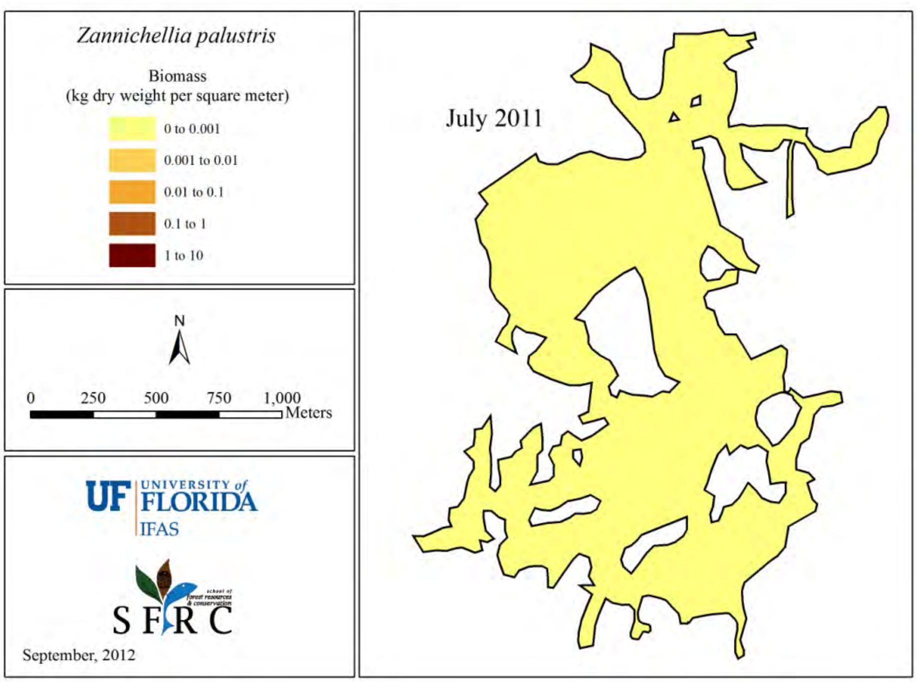


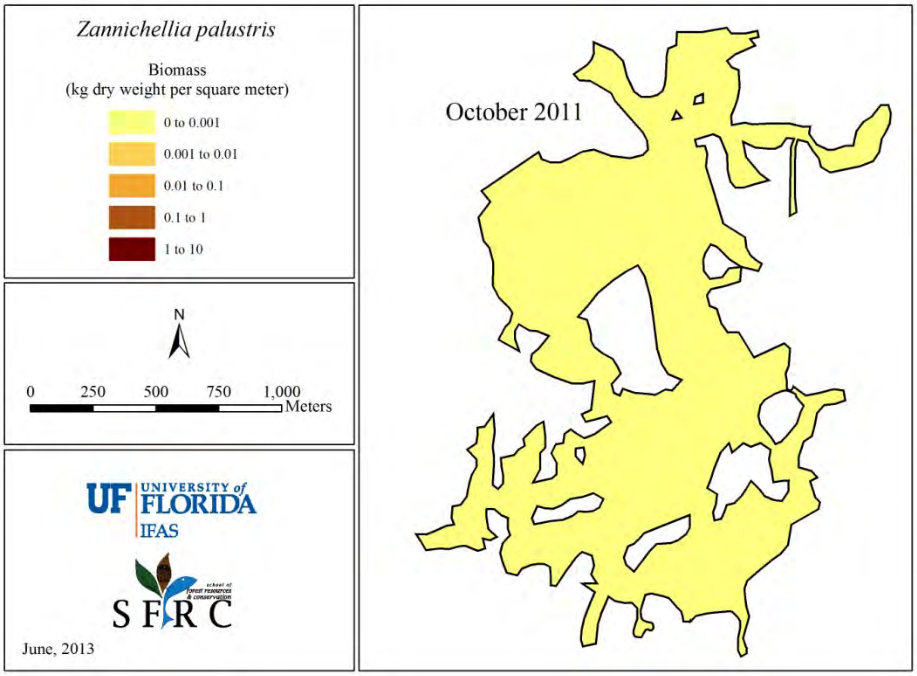
Vallisneria americana
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2013

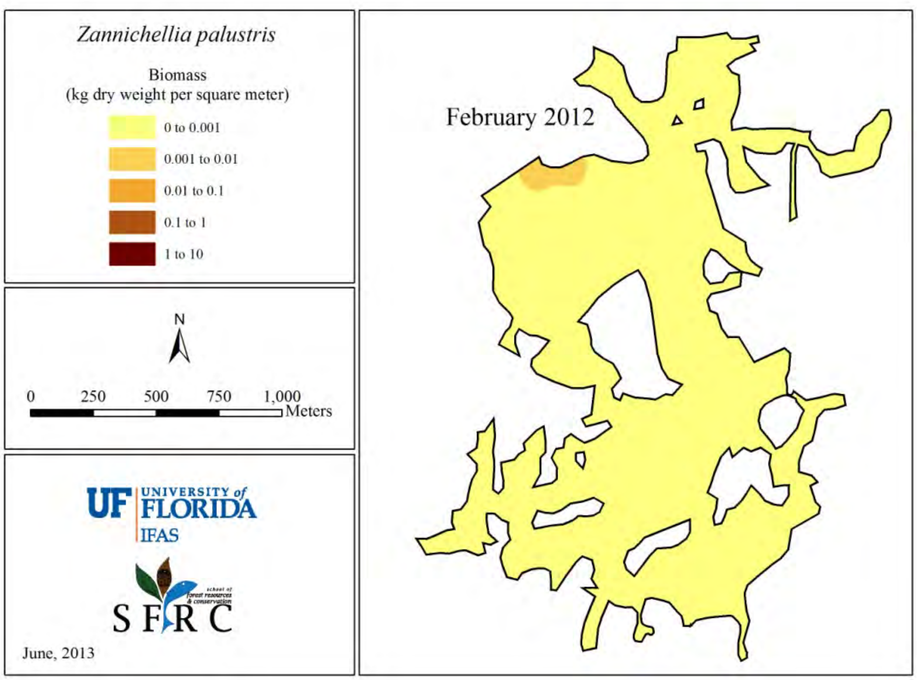

Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC School of Forest Resources & Conservation
December, 2010
October 2010

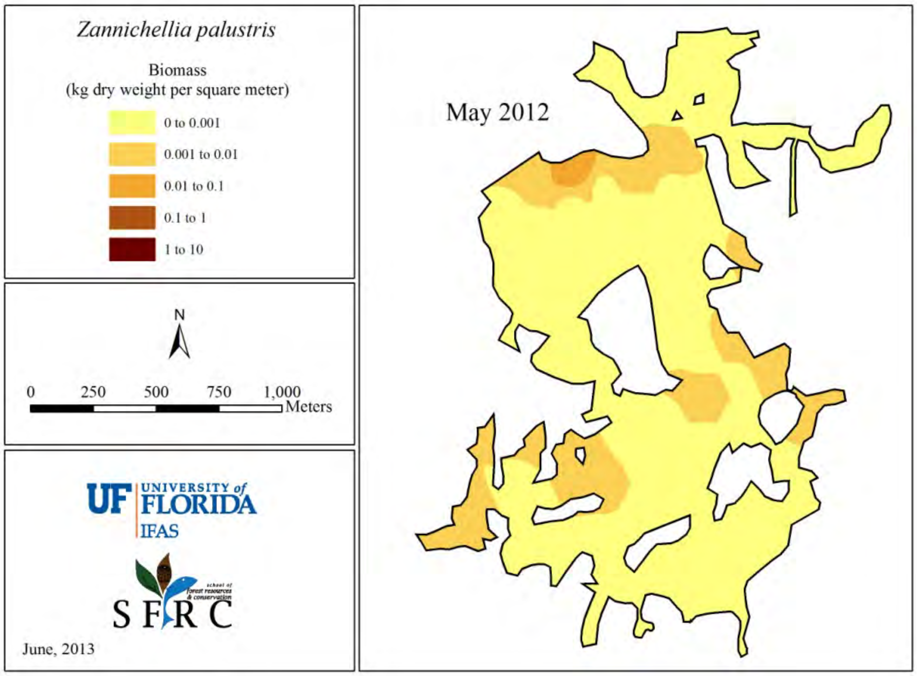

Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC School of Forest Resources & Conservation
March, 2011
February 2011

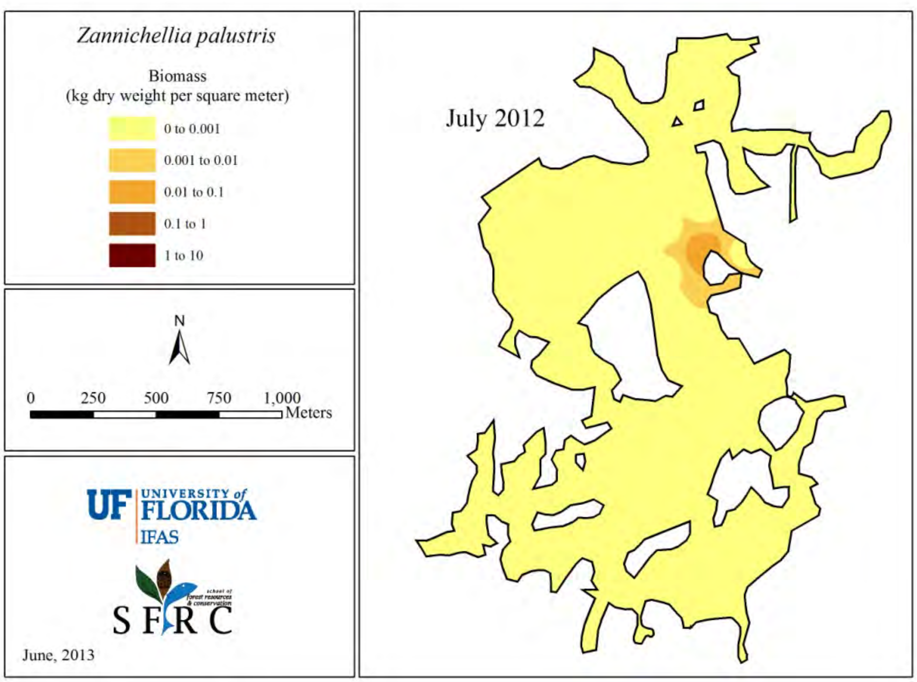

Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0
250
500
750
1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC
September, 2012
May 2011

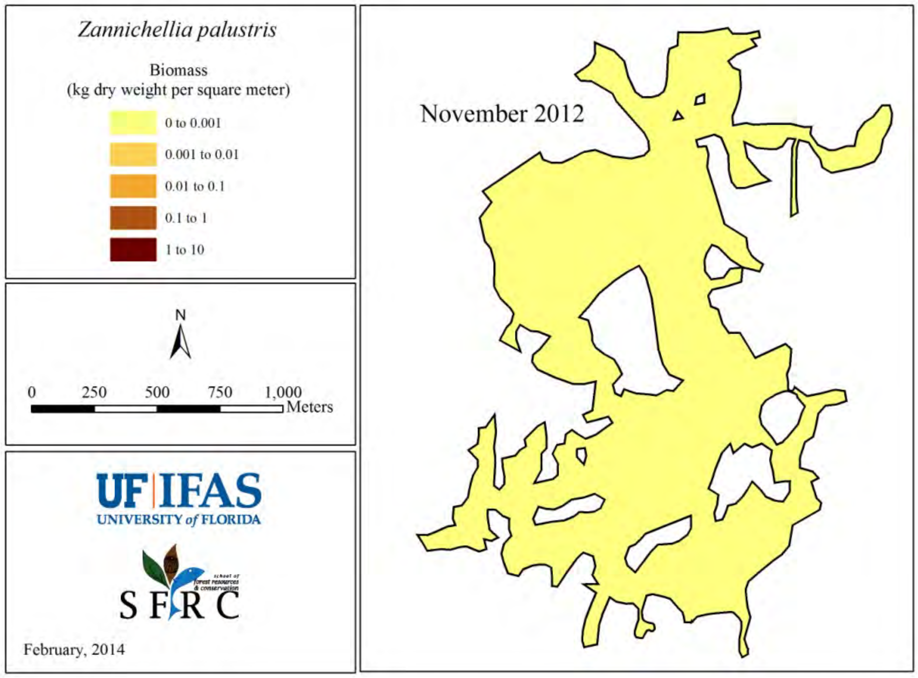

Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0
250
500
750
1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC
September, 2012
July 2011

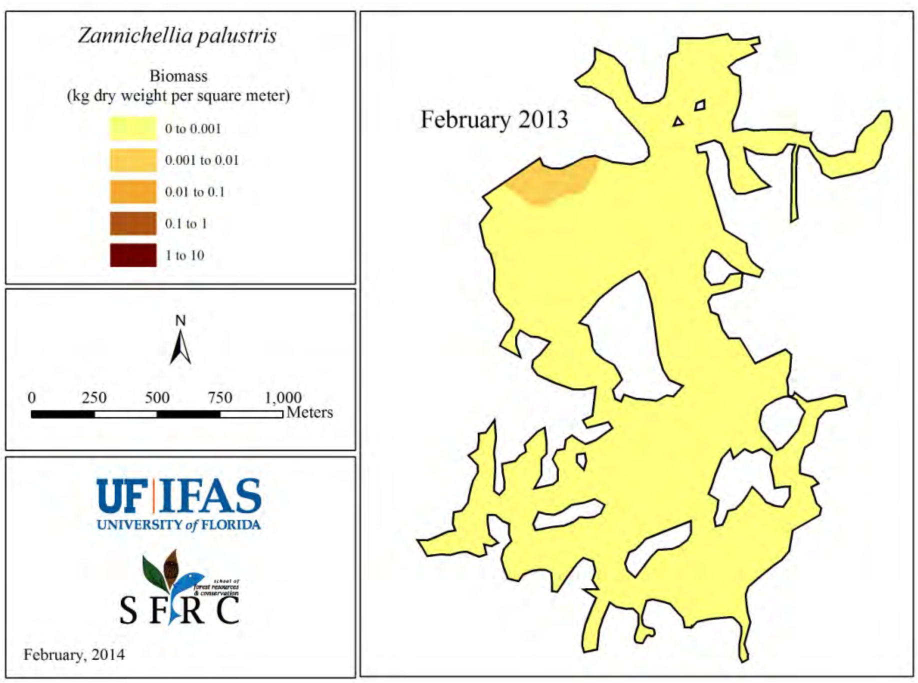

Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0
250
500
750
1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC
June, 2013
October 2011

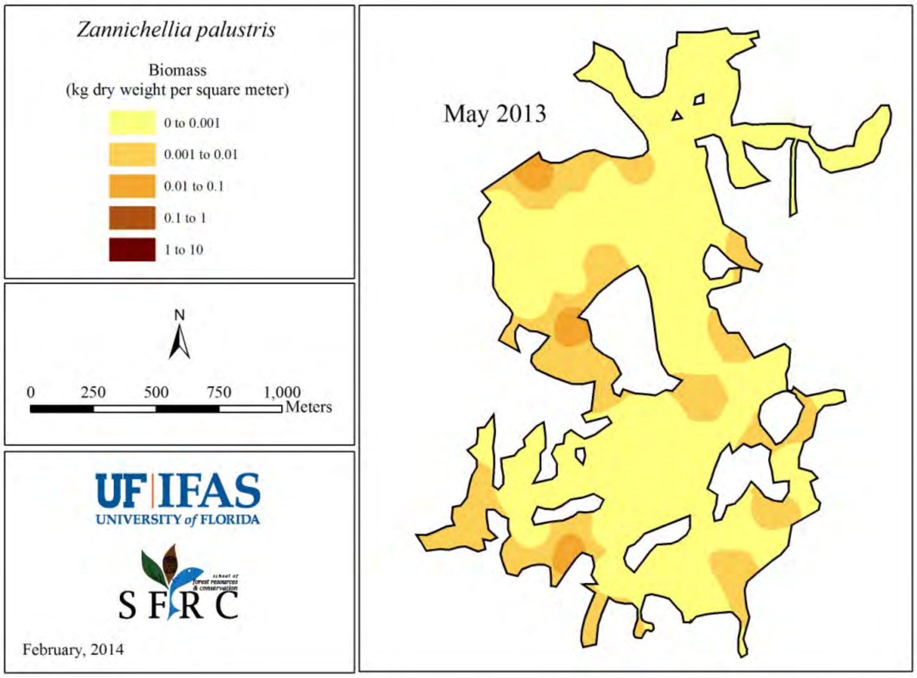

Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0
250
500
750
1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC
June, 2013
February 2012

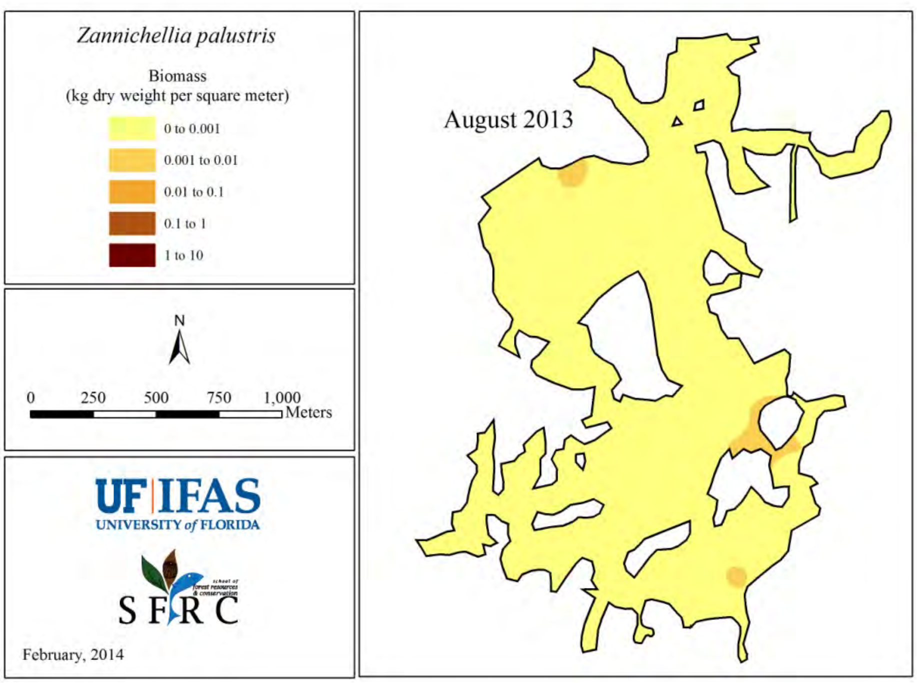

Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC
June, 2013
May 2012

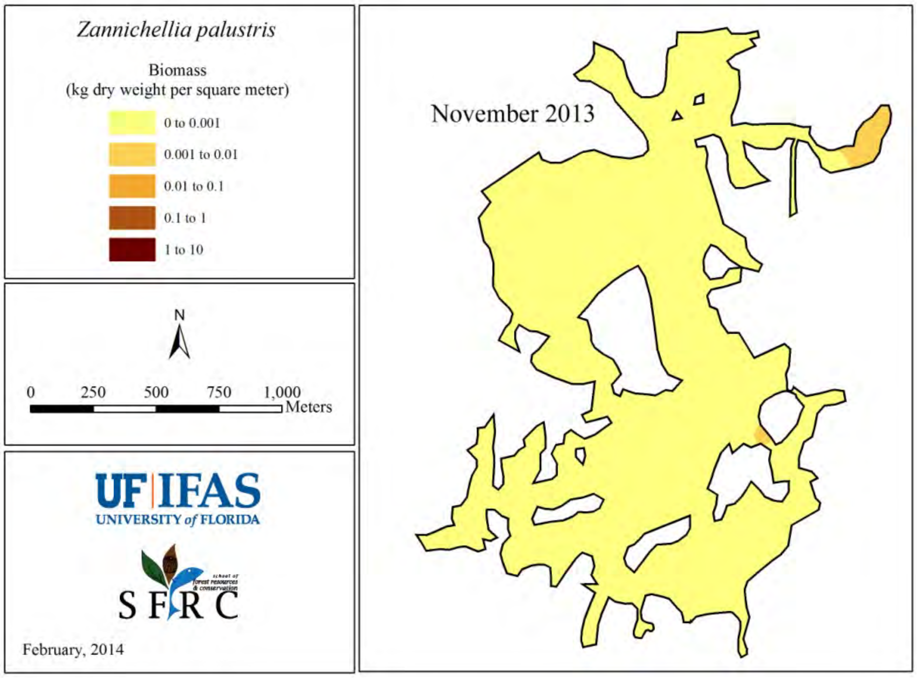

Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000
Meters
UF UNIVERSITY of FLORIDA
IFAS
SFRC
June, 2013
July 2012

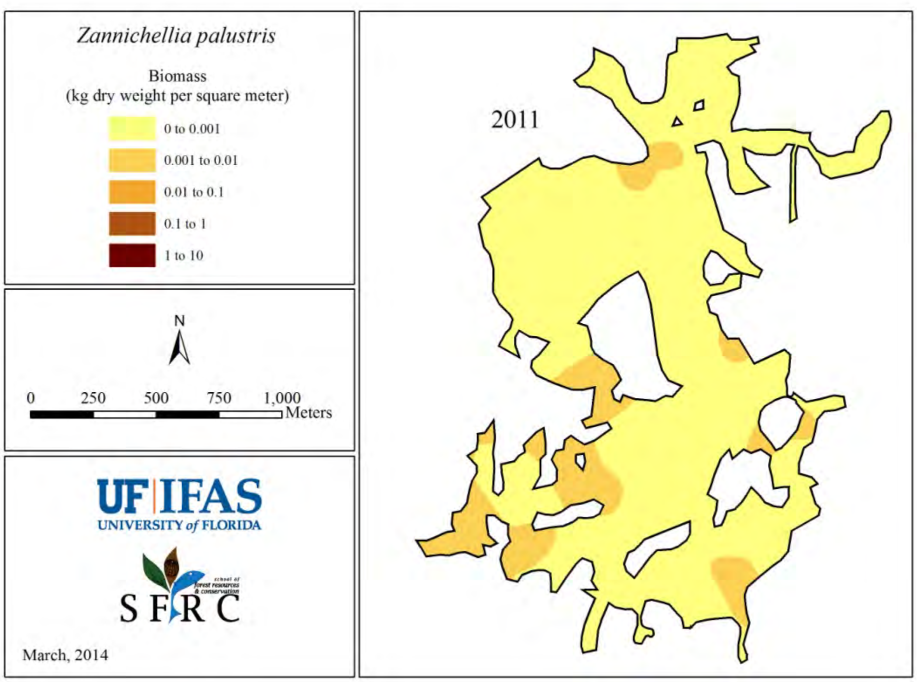

Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
November 2012

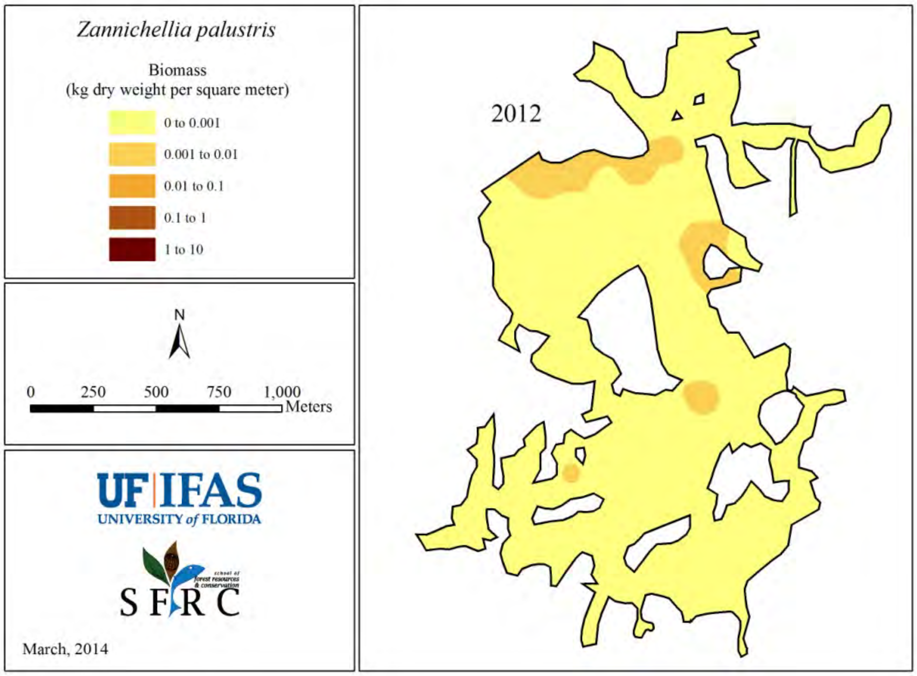

Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
February 2013


Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0
250
500
750
1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
May 2013

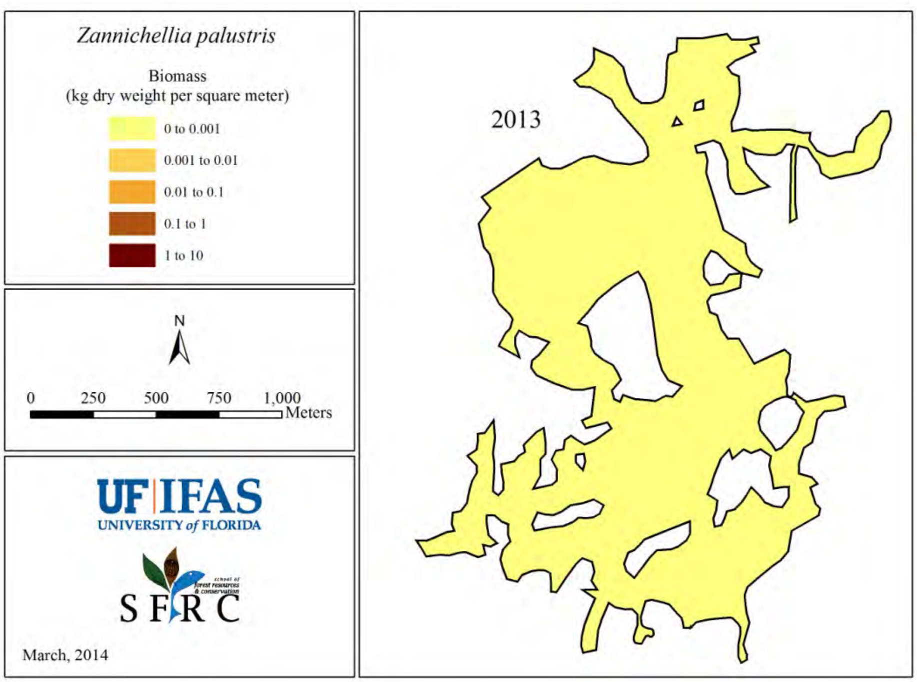

Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0
250
500
750
1,000
Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
February, 2014
August 2013


Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
February, 2014
November 2013


Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
March, 2014
2011



Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2012



Zannichellia palustris
Biomass
(kg dry weight per square meter)
0 to 0.001
0.001 to 0.01
0.01 to 0.1
0.1 to 1
1 to 10
N
0 250 500 750 1,000 Meters
UF IFAS
UNIVERSITY of FLORIDA
SFRC
March, 2014
2013

APPENDIX D: METADATA FOR MAPS OF INTERPOLATED PERCENT COVER AND BIOMASS DATA

METADATA FOR MAPS OF INTERPOLATED PERCENT COVER DATA

- Identification Information
- Data Quality Information
- Spatial Data Organization Information
- Spatial Reference Information
- Entity and Attribute Information
- Distribution Information
- Metadata Reference Information

Identification_Information:
Citation:
Citation_Information:
Originator:
Frazer, T.K., C.A. Jacoby and R.A. Swett; Program of Fisheries and Aquatic Sciences, Institute of Food and Agricultural Sciences, University of Florida
Publication_Date: March 2014
Title: Kings Bay Vegetation Evaluation 2010, 2011, 2012, and 2013: Percent Cover
Geospatial_Data_Presentation_Form: vector digital data
Online_Linkage: N/A
Description:
Abstract:

A series of polygon shapefiles (ESRI, Inc.) were created (in ArcGIS 10.1) that contain estimates (interpolations) of percent areal coverage for 12 SAV community components in Kings Bay, Citrus County, Florida for the years 2010, 2011, 2012, and 2013. The estimates of percent areal coverage at unsampled locations in the Bay are based on measurements made at 71 sample locations that were distributed throughout the bay. The twelve SAV components observed and measured were: (1) total SAV (the combination of all angiosperms and macroalgae), (2) *Ceratophyllum demersum*, (3) *Chara* spp., (4) filamentous algae (including *Lyngbya* spp.), (5) *Hydrilla verticillata*, (6) *Myriophyllum spicatum*, (7) *Najas guadalupensis*, (8) *Potamogeton pectinatus*, (9) *Potamogeton pusillus*, (10) *Ruppia maritima*, (11) *Vallisneria americana*, and (12) *Zannichellia palustris*. For each of the 12 SAV components, thirteen polygon shapefiles of interpolated areal coverage were created: one for each of the relevant sampling periods (February, May, July/August, and October/November) over four years (2010, 2011, 2012, and 2013).

The measurements of percent areal coverage made for each of the 12 SAV components at each of the 71 field stations were used to estimate percent coverage values at unsampled locations within Kings Bay. To be consistent with methods employed by Frazer and Hale in 2001 (i.e., An Atlas of Submersed Aquatic Vegetation of Kings Bay, Citrus County, FL), Inverse Distance Weighting (IDW) was used as the interpolation method. Estimated values were interpolated into a grid using the ESRI ArcMap v.10.x IDW algorithm (Geostatistical Wizard) using the following values for the method parameters: power = 3, neighborhood search, neighbors to include = 5 (include at least 5), searching ellipse angle = 0, major and minor semiaxis radius = 400, and sector mode = 0. The resulting grid was converted to a shapefile containing polygonal geometry, with each polygon representing one of the following classes of percent coverage: less than 5 percent coverage; 5 to 25 percent coverage; 25 to 50 percent coverage; 50 to 75 percent coverage; and greater than 75 percent coverage.

The naming convention for each of the shapefiles that represent percent cover is as follows:

1) SAV: SAV_Cover_Feb201x, SAV_Cover_May201x, SAV_Cover_July201x or SAV_Cover_Aug201x, SAV_Cover_Oct201x or SAV_Cover_Nov201x, SAV_Cover_201xAnnual
2) *Ceratophyllum demersum*: Cera_Cover_Feb201x, Cera_Cover_May201x, Cera_Cover_July201x or Cera_Cover_Aug201x, Cera_Cover_Oct201x or Cera_Cover_Nov201x, Cera_Cover_201xAnnual
3) *Chara* sp.: Chara_Cover_Feb201x, Chara_Cover_May201x, Chara_Cover_July201x or Chara_Cover_Aug201x, Chara_Cover_Oct201x or Chara_Cover_Nov201x, Chara_Cover_201xAnnual
4) Filamentous algae: Falg_Cover_Feb201x, Falg_Cover_May201x, Falg_Cover_July201x or Falg_Cover_Aug201x, Falg_Cover_Oct201x or Falg_Cover_Nov201x, Falg_Cover_201xAnnual
5) *Hydrilla verticillata*: Hydr_Cover_Feb201x, Hydr_Cover_May201x, Hydr_Cover_July201x or Hydr_Cover_Aug201x, Hydr_Cover_Oct201x or Hydr_Cover_Nov201x, Hydr_Cover_201xAnnual
6) *Myriophyllum spicatum*: Myrio_Cover_Feb201x, Myrio_Cover_May201x, Myrio_Cover_July201x or Myrio_Cover_Aug201x, Myrio_Cover_Oct201x or Myrio_Cover_Nov201x, Myrio_Cover_201xAnnual
7) *Najas guadalupensis*: Najas_Cover_Feb2010x, Najas_Cover_May201x, Najas_Cover_July201x or Najas_Cover_Aug201x, Najas_Cover_Oct201x or Najas_Cover_Nov201x, Najas_Cover_201xAnnual
8) *Potamogeton pectinatus*: Ppec_Cover_Feb201x, Ppec_Cover_May201x, Ppec_Cover_July201x or Ppec_Cover_Aug201x, Ppec_Cover_Oct201x or Ppec_Cover_Nov201x, Ppec_Cover_201xAnnual
9) *Potamogeton pusillus*: Ppus_Cover_Feb201x, Ppus_Cover_May201x, Ppus_Cover_July201x or Ppus_Cover_Aug201x, Ppus_Cover_Oct201x or Ppus_Cover_Nov201x, Ppus_Cover_201xAnnual
10) *Ruppia maritima*: Rup_Cover_Feb201x, Rup_Cover_May201x, Rup_Cover_July201x or Rup_Cover_Aug201x, Rup_Cover_Oct201x or Rup_Cover_Nov201x, Rup_Cover_201xAnnual
11) *Vallisneria americana*: Val_Cover_Feb201x, Val_Cover_May201x, Val_Cover_July201x or Val_Cover_Aug201x, Val_Cover_Oct201x or Val_Cover_Nov201x, Val_Cover_201xAnnual
12) *Zannichellia palustris*: Zan_Cover_Feb201x, Zan_Cover_May201x, Zan_Cover_July201x or Zan_Cover_Aug201x, Zan_Cover_Oct201x or Zan_Cover_Nov201x, Zan_Cover_201xAnnual

Purpose:

The polygon shapefiles were produced as part of a quantitative estimate of submersed aquatic vegetation within Kings Bay for the years 2010, 2011, 2012, and 2013. The project objective was to establish a vegetation evaluation and monitoring program to complement other activities and data acquisition efforts in Kings Bay.

Time_Period_of_Content:
Time_Period_Information:
Multiple_Dates/Times:
Single_Date/Time:
Calendar_Date: February, 2011, 2012, and 2013

Single_Date/Time:
Calendar_Date: May, 2011, 2012, and 2013
Single_Date/Time:
Calendar_Date: July, 2011 and 2012
Single_Date/Time:
Calendar_Date: August, 2013
Single_Date/Time:
Calendar_Date: October, 2010 and 2011
Currentness_Reference:
Calendar_Date: November, 2012 and 2013
Single_Date/Time:
Data were collected in 2010, 2011, 2012, and 2013 during winter (February), spring (May), summer (July or August) and fall (October or November)
Status:
Progress: Data collection complete for the 2010, 2011, 2012, and 2013 study
Maintenance_and_Update_Frequency: No updates are planned
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -82.609222
East_Bounding_Coordinate: -82.589508
North_Bounding_Coordinate: 28.899136
South_Bounding_Coordinate: 28.876374
Keywords:
Theme:
Theme_Keyword_Thesaurus: Other
Theme_Keyword: SAV
Theme_Keyword: Submersed Aquatic Vegetation
Theme_Keyword: Ceratophyllum demersum
Theme_Keyword: Chara sp.
Theme_Keyword: Filamentous algae
Theme_Keyword: Hydrilla verticillata
Theme_Keyword: Myriophyllum spicatum
Theme_Keyword: Najas guadalupensis
Theme_Keyword: Potamogeton pectinatus
Theme_Keyword: Potamogeton pusillus
Theme_Keyword: Ruppia maritima
Theme_Keyword: Vallisneria americana
Theme_Keyword: Zannichellia palustris
Place:
Place_Keyword_Thesaurus: Other
Place_Keyword: Kings Bay
Place_Keyword: Citrus County
Place_Keyword: Florida
Temporal:
Temporal_Keyword: winter 2011, 2012, and 2013
Temporal_Keyword: spring 2011, 2012, and 2013
Temporal_Keyword: summer 2011, 2012, and 2013
Temporal_Keyword: fall 2010, 2011, 2012, and 2013
Access_Constraints: None

Use_Constraints:
Abundance of benthic vegetation likely varies due to many physical and biological factors, including seasonal changes, grazing, and mechanical harvest.
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: T.K. Frazer
Contact_Organization:
School of Natural Resources and Environment, Institute of Food and Agricultural Sciences, University of Florida
Contact_Position: Professor and Director
Contact_Address:
Address_Type: mailing address
Address: Box 116455, 103 Black Hall
City: Gainesville
State_or_Province: Florida
Postal_Code: 32611
Country: USA
Contact_Voice_Telephone: 352-392-9230
Contact_Facsimile_Telephone: 352-392-9748
Contact_Electronic_Mail_Address: frazer@ufl.edu
Data_Set_Credit:
Jason Hale, Emily Hall, Stephen Larson, Chanda Littles, Kelly Robinson, Darlene Saindon, Kristen Dormsjo, Katherine Lazar, Vince Politano, Ray Valla, Savanna Barry, Zanethia Choice, Morgan Edwards and Jessica Frost of the UF/IFAS, Program of Fisheries and Aquatic Sciences for assistance in the field and lab. Joyce Kleen and James Kraus of the USFWS, Crystal River National Wildlife Refuge for facilitating the project and providing data. Citrus County Aquatic Management for providing data. Amy Remley, Veronica Craw, Gary Williams and Chris Anastasiou of the Southwest Florida Water Management District for guidance and assistance as project managers. Funding provided through the Southwest Florida Water Management District.
Security_Information:
Security_Classification_System: N/A
Security_Classification: Unclassified
Native_Data_Set_Environment:
Microsoft Windows 7 Enterprise Service Pack 1; ESRI ArcGIS Desktop 10.1.1.3143

Data_Quality_Information:
Completeness_Report:
Field sampling was conducted in 2010, 2011, 2012, and 2013 during winter (February), spring (May), summer (July or August) and fall (October or November) at 71 stations previously established by Frazer and Hale (2001, An Atlas of Submersed Aquatic Vegetation of Kings Bay, Citrus County, FL, University of Florida; the ESRI shapefile SamplePts contains the locations of the 71 stations). At each of the 71 sampling stations in each of the aforementioned sampling periods, divers visually estimated the percent cover of all SAV (broadly defined as angiosperms and macroalgae) present within three replicate 0.25 square meter quadrats. Separate areal coverage estimates were made for angiosperms (flowering, vascular plants) by species as well as attached macroalgae and filamentous forms. Following the *in situ* collection of all coverage data, the aboveground biomass within these same quadrats was removed by the divers, placed into uniquely labeled plastic bags and transported to the University of Florida for subsequent processing in the laboratory. In the laboratory, SAV from each quadrat sample were cleaned and hand separated by

species/type and dried at 70° C to a constant dry weight. Fresh weight measurements were made of 2,556 SAV samples that had been gently blotted with absorbent paper to remove adhering water. Vegetation weights typically were recorded to the nearest 0.001 g to quantify biomass for each of the sorted plant and algal groups. The 2010, 2011, 2012, and 2013 Kings Bay sampling effort resulted in 2,769 unique SAV quadrats. For subsequent analyses, data were averaged by station for each sampling period (February, May, July/August, and October/November). Interpolated maps of coverage and biomass were generated, using mean data from each of the aforementioned 71 sampling stations, for (1) each of the recognized taxonomic groupings (see abstract) and (2) each of the 13 sampling periods.

Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
No correction for SA of GPS signals yields horizontal accuracy between 5 and 30 m.
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: N/A
Lineage:
Process_Step:
Process_Description:

The measurements of percent areal coverage made for each of the 12 SAV components (see metadata abstract and metadata completeness report) at each of the 71 field stations were used to estimate percent coverage values at unsampled locations within Kings Bay. To be consistent with methods employed by Frazer and Hale in 2001 (i.e., An Atlas of Submersed Aquatic Vegetation of Kings Bay, Citrus County, FL), Inverse Distance Weighting (IDW) was used as the interpolation method. Estimated values were interpolated into a grid using the ESRI ArcMap v.10.x IDW algorithm (Geostatistical Wizard) using the following parameter values: power = 3, neighborhood search, neighbors to include = 5 (include at least 5), searching ellipse angle = 0, major and minor semiaxis radius = 400, and sector mode = 0. The resulting grid was converted to a shapefile containing polygonal geometry. Each polygon represented one of the following classes of percent coverage: less than 5 percent coverage; 5 to 25 percent coverage; 25 to 50 percent coverage; 50 to 75 percent coverage; and greater than 75 percent coverage.

Process_Date: December 2010, March 2011, September 2012, June 2013, and March 2014
Process_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Garin Davidson
Contact_Organization:
University of Florida, Institute of Food and Agricultural Sciences, Florida Sea Grant
Contact_Position: Senior GIS Analyst
Contact_Voice_Telephone: 352-392-5870
Contact_Electronic_Mail_Address: gdavids@ufl.edu

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: Varies

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Transverse Mercator
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000004
Ordinate_Resolution: 0.000004
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: D_North_American_1983_HARN
Ellipsoid_Name: Geodetic Reference System 80
Semimajor_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: See metadata abstract for shapefile names
Attribute:
Attribute_Label: FID
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain:
Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: Shape
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.
Attribute:
Attribute_Label: Classes
Attribute_Definition: Defines the range of percent cover that the polygon encompasses
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 0
Enumerated_Domain_Value_Definition: less than 5 percent cover
Enumerated_Domain:
Enumerated_Domain_Value: 1
Enumerated_Domain_Value_Definition: 5 to 25 percent cover

Enumerated_Domain:
Enumerated_Domain_Value: 2
Enumerated_Domain_Value_Definition: 25 to 50 percent cover
Enumerated_Domain:
Enumerated_Domain_Value: 3
Enumerated_Domain_Value_Definition: 50 to 75 percent cover
Enumerated_Domain:
Enumerated_Domain_Value: 4
Enumerated_Domain_Value_Definition: greater than 75 percent cover
Attribute_Value_Accuracy_Information:
Attribute_Value_Accuracy:
Based on IDW interpolation using 71 sample stations in Kings Bay
Attribute_Value_Accuracy_Explanation:
See metadata abstract and processing steps for method description
Attribute:
Attribute_Label: Value_Min
Attribute_Definition: Minimum percent cover within the class
Attribute:
Attribute_Label: Value_Max
Attribute_Definition: Maximum percent cover within the class

Distribution_Information:
Resource_Description: Downloadable Data
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Transfer_Size: varies

Metadata_Reference_Information:
Metadata_Date: 20140304
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: G.F. Davidson or T.K. Frazer
Contact_Organization:
School of Natural Resources and Environment, Institute of Food and Agricultural Sciences, University of Florida
Contact_Position: Senior GIS Analyst and Research Professor
Contact_Address:
Address_Type: mailing address
Address: Box 116455, 103 Black Hall
City: Gainesville
State_or_Province: FL
Postal_Code: 32611
Country: USA
Contact_Voice_Telephone: 352-392-5870 or 352-392-9230
Contact_Electronic_Mail_Address: gdavids@ufl.edu or frazer@ufl.edu
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Metadata_Time_Convention: local time
Metadata_Access_Constraints: None
Metadata_Use_Constraints: None
Metadata_Security_Information:
Metadata_Security_Classification_System: N/A
Metadata_Security_Classification: Unclassified
Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile

METADATA FOR MAPS OF INTERPOLATED BIOMASS DATA

- Identification Information
- Data Quality Information
- Spatial Data Organization Information
- Spatial Reference Information
- Entity and Attribute Information
- Distribution Information
- Metadata Reference Information

Identification_Information:
Citation:
Citation_Information:
Originator:
T.K. Frazer, T.K., C.A. Jacoby and R.A. Swett; Department of Fisheries and Aquatic Sciences, Institute of Food and Agricultural Sciences, University of Florida
Publication_Date: March 2014
Title: Kings Bay Vegetation Evaluation 2010, 2011, 2012, and 2013: Biomass
Geospatial_Data_Presentation_Form: vector digital data
Online_Linkage: N/A
Description:
Abstract:
A series of polygon shapefiles (ESRI, Inc.) were created (in ArcGIS 10.1) that contain estimates (interpolations) of biomass (kg dry weight per square meter) for 12 SAV community components in Kings Bay, Citrus County, Florida for the years 2010, 2011, 2012, and 2013. The estimates of biomass at unsampled locations in the Bay are based on measurements made at 71 sample locations that were distributed throughout the bay. The twelve SAV components observed and measured were: (1) total SAV (the combination of all angiosperms and macroalgae), (2) *Ceratophyllum demersum*, (3) *Chara* sp., (4) filamentous algae, (5) *Hydrilla verticillata*, (6) *Myriophyllum spicatum*, (7) *Najas guadalupensis*, (8) *Potamogeton pectinatus*, (9) *Potamogeton pusillus*, (10) *Ruppia maritima*, (11) *Vallisneria americana*, and (12) *Zannichellia palustris*. For each of the 12 SAV components, sixteen polygon shapefiles of interpolated biomass were created: one for each of the relevant sampling periods (February, May, July/August, and October/November) over four years (2010, 2011, 2012, and 2013).
The measurements of biomass made for each of the 12 SAV components at each of the 71 field stations were used to estimate biomass values at unsampled locations within Kings Bay. To be consistent with methods employed by Frazer and Hale in 2001 (i.e., An Atlas of Submersed Aquatic Vegetation of Kings Bay, Citrus County, FL), Inverse Distance Weighting (IDW) was

used as the interpolation method. Estimated values were interpolated into a grid using the ESRI ArcMap v.10.x IDW algorithm (Geostatistical Wizard) using the following values for the method parameters: power = 3, neighborhood search, neighbors to include = 5 (include at least 5), searching ellipse angle = 0, major and minor semiaxis radius = 400, and sector mode = 0. The resulting grid was converted to a shapefile containing polygonal geometry, with each polygon representing one of the following biomass classes (kg dry weight per square meter): 0 to 0.001; 0.001 to 0.01; 0.01 to 0.1; 0.1 to 1.0; and 1.0 to 10.0.

The naming convention for each of the shapefiles that present biomass estimates is as follows:

1) SAV: SAV_BM_Feb201x, SAV_BM_May201x, SAV_BM_July201x or SAV_BM_Aug201x, SAV_BM_Oct201x or SAV_BM_Nov201x, SAV_BM_201xAnnual
2) *Ceratophyllum demersum*: Cera_BM_Feb201x, Cera_BM_May201x, Cera_BM_July201x or Cera_BM_Aug201x, Cera_BM_Oct201x or Cera_BM_Nov201x, Cera_BM_201xAnnual
3) *Chara* sp.: Chara_BM_Feb201x, Chara_BM_May201x, Chara_BM_July201x or Chara_BM_Aug201x, Chara_BM_Oct201x or Chara_BM_Nov201x, Chara_BM_201xAnnual
4) Filamentous algae: Falg_BM_Feb201x, Falg_BM_May201x, Falg_BM_July201x or Falg_BM_Aug201x, Falg_BM_Oct201x or Falg_BM_Nov201x, Falg_BM_201xAnnual
5) *Hydrilla verticillata*: Hydr_BM_Feb201x, Hydr_BM_May201x, Hydr_BM_July201x or Hydr_BM_Aug201x, Hydr_BM_Oct201x or Hydr_BM_Nov201x, Hydr_BM_201xAnnual
6) *Myriophyllum spicatum*: Myrio_BM_Feb201x, Myrio_BM_May201x, Myrio_BM_July201x or Myrio_BM_Aug201x, Myrio_BM_Oct201x or Myrio_BM_Nov201x, Myrio_BM_201xAnnual
7) *Najas guadalupensis*: Najas_BM_Feb2010x, Najas_BM_May201x, Najas_BM_July201x or Najas_BM_Aug201x, Najas_BM_Oct201x or Najas_BM_Nov201x, Najas_BM_201xAnnual
8) *Potamogeton pectinatus*: Ppec_BM_Feb201x, Ppec_BM_May201x, Ppec_BM_July201x or Ppec_BM_Aug201x, Ppec_BM_Oct201x or Ppec_BM_Nov201x, Ppec_BM_201xAnnual
9) *Potamogeton pusillus*: Ppus_BM_Feb201x, Ppus_BM_May201x, Ppus_BM_July201x or Ppus_BM_Aug201x, Ppus_BM_Oct201x or Ppus_BM_Nov201x, Ppus_BM_201xAnnual
10) *Ruppia maritima*: Rup_BM_Feb201x, Rup_BM_May201x, Rup_BM_July201x or Rup_BM_Aug201x, Rup_BM_Oct201x or Rup_BM_Nov201x, Rup_BM_201xAnnual
11) *Vallisneria americana*: Val_BM_Feb201x, Val_BM_May201x, Val_BM_July201x or Val_BM_Aug201x, Val_BM_Oct201x or Val_BM_Nov201x, Val_BM_201xAnnual
12) *Zannichellia palustris*: Zan_BM_Feb201x, Zan_BM_May201x, Zan_BM_July201x or Zan_BM_Aug201x, Zan_BM_Oct201x or Zan_BM_Nov201x, Zan_BM_201xAnnual

Purpose:
The polygon shapefiles were produced as part of a quantitative estimate of submersed aquatic vegetation within Kings Bay for the years 2010, 2011, 2012, and 2013. The project objective was to establish a vegetation evaluation and monitoring program to complement other activities and data acquisition efforts in Kings Bay.
Time_Period_of_Content:
Time_Period_Information:
Multiple_Dates/Times:
Single_Date/Time:
Calendar_Date: February, 2011, 2012, and 2013
Single_Date/Time:
Calendar_Date: May, 2011, 2012, and 2013
Single_Date/Time:
Calendar_Date: July, 2011 and 2012
Single_Date/Time:
Calendar_Date: August, 2013
Single_Date/Time:
Calendar_Date: October, 2010 and 2011
Single_Date/Time:
Calendar_Date: November, 2012 and 2013
Currentness_Reference:
Data were collected in 2010, 2011, 2012, and 2013 during winter (February), spring (May), summer (July or August) and fall (October or November)
Status:
Progress: Data collection complete for the 2010, 2011, 2012, and 2013 study
Maintenance_and_Update_Frequency: No updates are planned
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -82.609222
East_Bounding_Coordinate: -82.589508
North_Bounding_Coordinate: 28.899136
South_Bounding_Coordinate: 28.876374
Keywords:
Theme:
Theme_Keyword_Thesaurus: Other
Theme_Keyword: Biomass
Theme_Keyword: SAV
Theme_Keyword: Submersed Aquatic Vegetation
Theme_Keyword: Ceratophyllum demersum
Theme_Keyword: Chara sp.
Theme_Keyword: Filamentous algae
Theme_Keyword: Hydrilla verticillata
Theme_Keyword: Myriophyllum spicatum
Theme_Keyword: Najas guadalupensis
Theme_Keyword: Potamogeton pectinatus
Theme_Keyword: Potamogeton pusillus
Theme_Keyword: Ruppia maritima
Theme_Keyword: Vallisneria americana
Theme_Keyword: Zannichellia palustris
Place:
Place_Keyword_Thesaurus: Other

Place_Keyword: Kings Bay
Place_Keyword: Citrus County
Place_Keyword: Florida
Temporal:
Temporal_Keyword: winter 2011, 2012, and 2013
Temporal_Keyword: spring 2011, 2012, and 2013
Temporal_Keyword: summer 2011, 2012, and 2013
Temporal_Keyword: fall 2010, 2011, 2012, and 2013
Access_Constraints: None
Use_Constraints:
Abundance of benthic vegetation likely varies due to many physical and biological factors, including seasonal changes, grazing, and mechanical harvest.
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: T.K. Frazer
Contact_Organization:
School of Natural Resources and Environment, Institute of Food and Agricultural Sciences, University of Florida
Contact_Position: Professor and Director
Contact_Address:
Address_Type: mailing address
Address: Box 116455, 103 Black Hall
City: Gainesville
State_or_Province: Florida
Postal_Code: 32611
Country: USA
Contact_Voice_Telephone: 352-392-9230
Contact_Facsimile_Telephone: 352-392-9748
Contact_Electronic_Mail_Address: frazer@ufl.edu
Data_Set_Credit:
Jason Hale, Emily Hall, Stephen Larson, Chanda Littles, Kelly Robinson, Darlene Saindon, Kristen Dormsjo, Katherine Lazar, Vince Politano, Ray Valla, Savanna Barry, Zanethia Choice, Morgan Edwards and Jessica Frost of the UF/IFAS, Program of Fisheries and Aquatic Sciences for assistance in the field and lab. Joyce Kleen and James Kraus of the USFWS, Crystal River National Wildlife Refuge for facilitating the project and providing data. Citrus County Aquatic Management for providing data. Amy Remley, Veronica Craw, Gary Williams and Chris Anastasiou of the Southwest Florida Water Management District for guidance and assistance as project managers. Funding provided through the Southwest Florida Water Management District.
Security_Information:
Security_Classification_System: N/A
Security_Classification: Unclassified
Native_Data_Set_Environment:
Microsoft Windows 7 Enterprise Service Pack 1; ESRI ArcGIS Desktop 10.1.1.3143

Data_Quality_Information:
Completeness_Report:
Field sampling was conducted in 2010, 2011, 2012, and 2013 during winter (February), spring (May), summer (July or August) and fall (October or November) at 71 stations previously established by Frazer and Hale (2001, An Atlas of Submersed Aquatic Vegetation of Kings Bay,

Citrus County, FL, University of Florida; the ESRI shapefile SamplePts contains the locations of the 71 stations). At each of the 71 sampling stations in each of the aforementioned sampling periods, divers visually estimated the percent cover of all SAV (broadly defined as angiosperms and macroalgae) present within three replicate 0.25 square meter quadrats. Separate areal coverage estimates were made for angiosperms (flowering, vascular plants) by species as well as attached macroalgae and filamentous forms. Following the in situ collection of all coverage data, the aboveground biomass within these same quadrats was removed by the divers, placed into uniquely labeled plastic bags and transported to the University of Florida for subsequent processing in the laboratory. In the laboratory, SAV from each quadrat sample were cleaned and hand separated by species/type and dried at 70° C to a constant dry weight. Fresh weight measurements were made of 2,556 SAV samples that had been gently blotted with absorbent paper to remove adhering water. Vegetation weights typically were recorded to the nearest 0.001 g to quantify biomass for each of the sorted plant and algal groups. The 2010, 2011, 2012, and 2013 Kings Bay sampling efforts resulted in 2,769 unique SAV quadrats. For subsequent analyses, data were typically averaged by station for each sampling period (February, May, July/August, and October/November). Interpolated maps of coverage and biomass were generated, using mean data from each of the aforementioned 71 sampling stations, for (1) each of the recognized taxonomic groupings (see abstract) and (2) each of the 13 sampling periods.

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:

No correction for SA of GPS signals yields horizontal accuracy between 5 and 30 m.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: N/A

Lineage:

Process_Step:

Process_Description:

The measurements of biomass made for each of the 12 SAV components (see metadata abstract and metadata completeness report) at each of the 71 field stations were used to estimate biomass at unsampled locations within Kings Bay. To be consistent with methods employed by Frazer and Hale in 2001 (i.e., An Atlas of Submersed Aquatic Vegetation of Kings Bay, Citrus County, FL), Inverse Distance Weighting (IDW) was used as the interpolation method. Estimated values were interpolated into a grid using the ESRI ArcMap v.10.x IDW algorithm (Geostatistical Wizard) using the following parameter values: power = 3, neighborhood search, neighbors to include = 5 (include at least 5), searching ellipse angle = 0, major and minor semiaxis radius = 400, and sector mode = 0. The resulting grid was converted to a shapefile containing polygonal geometry, with each polygon representing one of the following biomass classes (kg dry weight per square meter): 0 to 0.001; 0.001 to 0.01; 0.01 to 0.1; 0.1 to 1.0; and 1.0 to 10.0.

Process_Date: December 2010, March 2011, September 2012, June 2013, and February 2014

Process_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Garin Davidson

Contact_Organization:

University of Florida, Institute of Food and Agricultural Sciences, Florida Sea Grant

Contact_Position: Senior GIS Analyst

Contact_Voice_Telephone: 352-392-5870

Contact_Electronic_Mail_Address: gdavids@ufl.edu

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: Varies

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Transverse Mercator
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000004
Ordinate_Resolution: 0.000004
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: D_North_American_1983_HARN
Ellipsoid_Name: Geodetic Reference System 80
Semimajor_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: See metadata abstract for shapefile names
Attribute:
Attribute_Label: FID
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain:
Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: Shape
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.
Attribute:
Attribute_Label: Classes

Attribute_Definition: Defines the range of biomass that the polygon encompasses (kg dry weight per square meter)
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 0
Enumerated_Domain_Value_Definition: 0 to 0.001
Enumerated_Domain:
Enumerated_Domain_Value: 1
Enumerated_Domain_Value_Definition: 0.001 to 0.01
Enumerated_Domain:
Enumerated_Domain_Value: 2
Enumerated_Domain_Value_Definition: 0.01 to 0.1
Enumerated_Domain:
Enumerated_Domain_Value: 3
Enumerated_Domain_Value_Definition: 0.1 to 1.0
Enumerated_Domain:
Enumerated_Domain_Value: 4
Enumerated_Domain_Value_Definition: 1.0 to 10.0
Attribute_Value_Accuracy_Information:
Attribute_Value_Accuracy:
Based on IDW interpolation using 71 sample stations in Kings Bay
Attribute_Value_Accuracy_Explanation:
See metadata abstract and processing steps for method description
Attribute:
Attribute_Label: Value_Min
Attribute_Definition: Minimum biomass within the class
Attribute:
Attribute_Label: Value_Max
Attribute_Definition: Maximum biomass within the class

Distribution_Information:
Resource_Description: Downloadable Data
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Transfer_Size: varies

Metadata_Reference_Information:
Metadata_Date: 20140304
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: G.F. Davidson or T.K. Frazer
Contact_Organization:
School of Natural Resources and Environment, Institute of Food and Agricultural Sciences, University of Florida
Contact_Position: Senior GIS Analyst and Research Professor
Contact_Address:
Address_Type: mailing address

Address: Box 116455, 103 Black Hall
City: Gainesville
State_or_Province: FL
Postal_Code: 32611
Country: USA
Contact_Voice_Telephone: 352-392-5870 or 352-392-9617
Contact_Electronic_Mail_Address: gdavids@ufl.edu or frazer@ufl.edu
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Time_Convention: local time
Metadata_Access_Constraints: None
Metadata_Use_Constraints: None
Metadata_Security_Information:
Metadata_Security_Classification_System: N/A
Metadata_Security_Classification: Unclassified
Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile