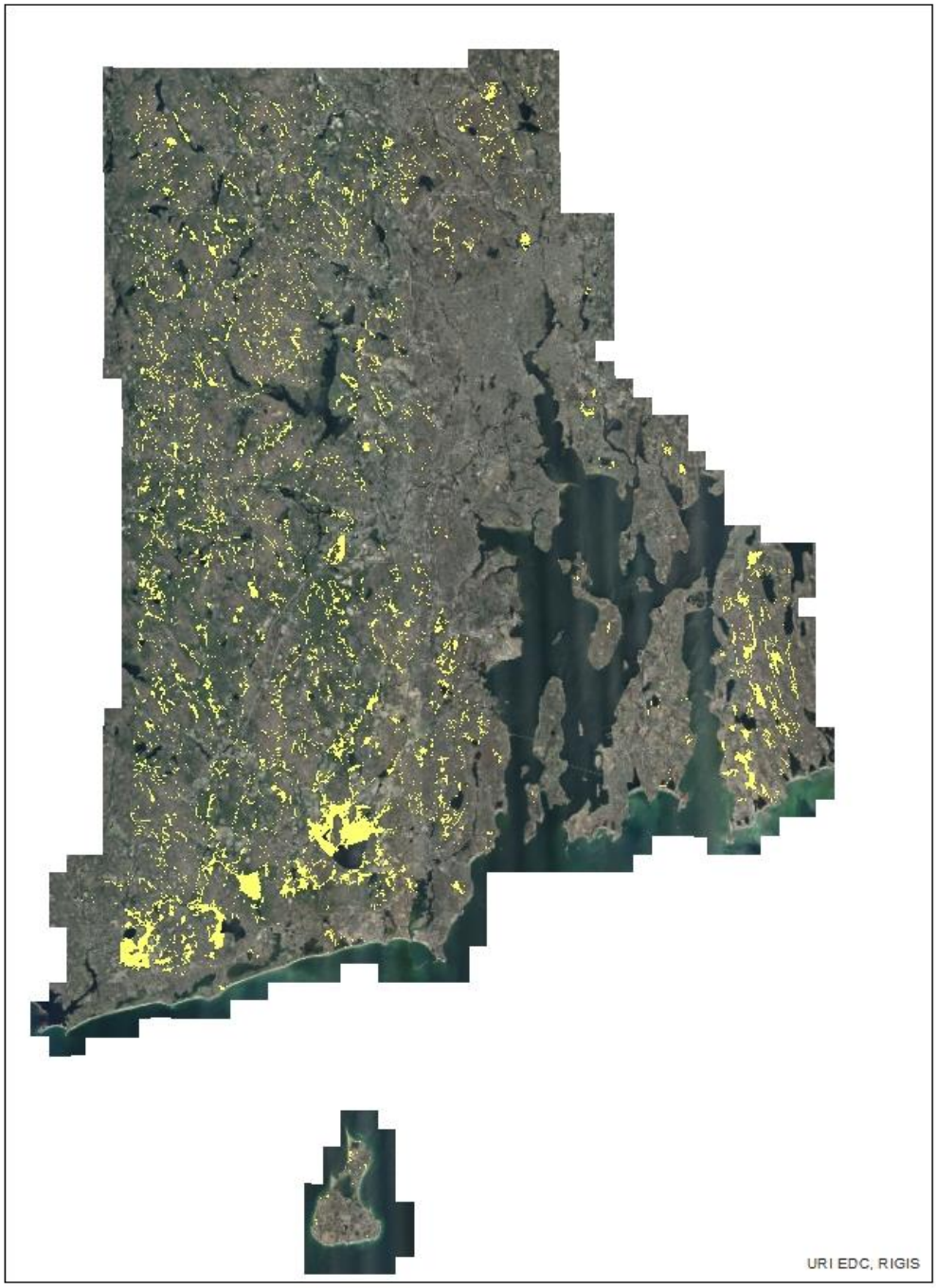
Unfragmented Freshwater Wetlands of Rhode Island

Technical report for the Rhode Island Department of Environmental Management
Office of Water Resources



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Introduction

Freshwater wetlands provide a number of benefits to humans, wildlife, and the environment. Freshwater wetlands promote water quality by filtering and sequestering toxins, sediments, and excessive nutrients from surface waters before they are discharged to streams, rivers, lakes, and groundwater systems; they are sources of lumber, firewood, and food; they directly act as breeding, foraging, and refuge habitats for numerous dependent wildlife species such as amphibians and reptiles, and for recreationally and commercially-important species such as waterfowl, beaver, American eels, and salmonids; they mitigate the velocity and peak volume of flood waters, particularly for watersheds that have been degraded by the addition of impervious surfaces; they increase groundwater recharge and promote stream flow during dry periods; and they serve as recreational platforms for swimming, small boating, fishing, and hunting. These ecosystem functions and services are at risk from wetland degradation associated with exploitation and other detrimental human activities. Human use and development of the landscape and associated stressors, such as impoundment, filling, pollution inputs, vegetation removal, soil disturbance, habitat fragmentation, and others, degrade wetlands and their values in numerous ways.

Habitat fragmentation is identified as a key habitat stressor in the Rhode Island Wildlife Action Plan (available at http://www.dem.ri.gov), and is a widespread and detrimental stressor of wetland function. Many wetland functions are dependent upon or directly augmented by surrounding vegetated uplands (Chase et al. 1997, Mitsch and Gosselink 2000); these include flood storage, pollution filtration, nutrient uptake, groundwater and stream recharge, habitat provision for amphibians, reptiles, mammals, birds and insects, and recreational platform function (Cahoon and Klemens 2002, Environmental Law Institute 2003, 2008). Therefore, fragmentation of both wetlands and their surrounding uplands will diminish wetland functions and ecosystem services. Specifically, habitat fragmentation of wetlands and surrounding uplands lowers species richness, dispersal, habitat suitability, and survival of various wildlife species including birds, reptiles, amphibians and mammals (Lehtinen et al. 1999, Baldwin et al. 2004, Cushman 2006, Rizkalla and Swihart 2006). Habitat fragmentation lowers the dispersal and genetic fitness of wetland flora (Lienert et al 2002, Hooftman et al. 2003). And, it may reduce the capacity of the lands to store floodwaters, recharge groundwater and surface waters, and filter and sequester nutrients and other pollutants from the water (Tiner 2005).

The Rhode Island Department of Environmental Management (DEM) is interested in managing freshwater wetlands to maximize the functions and ecosystem services they provide (NEIWPCC and DEM 2006). Knowing the status of statewide wetland ecosystem fragmentation will help to clarify the condition of freshwater wetlands, as unfragmented wetland systems may provide functions not effectively provided by fragmented systems, providing valuable information for management. This report describes the application of vetted methods and the latest community classification and infrastructure data to produce a geospatial dataset of unfragmented wetlands of Rhode Island.

Additionally, it presents summary statistics of unfragmented wetlands by municipality and by watershed, and discusses the implications of the findings.

Methods

Criteria for identifying unfragmented natural lands have been developed for earlier statewide projects in Rhode Island. The Rhode Island Resource Protection Project developed a geospatial dataset of "Unfragmented Lands of Rhode Island" using landscape and census data sourced from 1988 and 1990. More recently, Rhode Island Rising (2015, available at www.planning.ri.gov), a broadly-vetted statewide planning project administered by the Rhode Island Division of Planning, developed a geospatial dataset of unfragmented natural lands using land use data from 2003-2004 and road data from 2005. The method isolated natural communities from the land cover dataset and used roads, buffered according to road type, to bisect contiguous natural land blocks. Those blocks of natural land that remained 250 acres or greater after being bisected by buffered roads were identified as unfragmented lands.

This current project adapts the Rhode Island Rising method to identifying wetlands associated with large unfragmented parcels of natural land, i.e. unfragmented wetlands, using more recent data. Specifically, RIGIS "Ecological Communities Classification", a GIS dataset developed by DEM and partners (and available at RIGIS.org), was analyzed to isolate all freshwater (specifically Palustrine) wetlands and open waters (those open waters with an area of less than 20 acres) mapped in Rhode Island. The same "Ecological Communities Classification" dataset was also used to identify blocks of natural land, which included (under the attribute "Community") coniferous woodlands and forest, deciduous woodlands and forest, estuarine intertidal, forested wetlands, fresh water, mixed deciduous / coniferous forest, open mineral wetlands, open peatlands, open uplands, and ruderal forest. Blocks of contiguous natural land were conjoined into discrete, contiguous land blocks using the "Union" function (ESRI 2014). RIGIS "RIDOT Roads" polylines were buffered according to road type, where Class 1, 2, 3, and 4 roads were buffered by 100m, 75m, 50m, and 20m, respectively. Resulting road-buffer polygons were used to clip the natural-land blocks, effectively bisecting them into smaller units. Clipped natural-land blocks of less than 250 acres in area were removed from the dataset, leaving only large, unfragmented natural areas (≥250 acres each). The blocks were then intersected with the freshwater wetlands data to identify those freshwater wetlands that were fully or partly contained within the unfragmented natural-land blocks, and the data were clipped to the RIGIS "State Boundary"; these wetlands were identified as unfragmented freshwater wetlands of Rhode Island.

Unfragmented wetlands of Rhode Island data were subsequently laid over RIGIS "Municipal Boundaries", "Watershed Boundary", "State Conservation Lands", and "Local Conservation Lands" data for analysis. Microsoft Excel spreadsheets and pivot tables were used to summarize the data.

Results

According to the full, unmodified "Natural Communities of Rhode Island" dataset (RIGIS 2015), there are 83,898 acres of freshwater (Palustrine) wetlands in Rhode Island; these are dominated by forested

swamp (50,060 acres) and Palustrine open water (26,138 acres), followed by shrub swamp (5,149 acres), emergent marsh (2,110 acres), floodplain forest (221 acres), managed marsh (113 acres), and peatlands (107 acres). Our process produced a Geographic Information System (GIS) dataset "Unfrag_Wet_250_Statewide" documenting 9,730 unfragmented freshwater wetland features comprising 49,497 acres. This equates to 59% of the freshwater wetland area in Rhode Island remaining unfragmented according to our criteria (Table 1). Nearly 35% of unfragmented wetland area is protected through state or local conservation.

The municipalities in the southwestern portion of the state contain the most acreage of unfragmented wetlands, whereas the developed municipalities bordering upper Narragansett Bay contain the least, in general. Providence, Newport, and Bristol evidently do not contain any unfragmented wetlands, according to our criteria. This basic trend is further reflected in summarizing unfragmented wetlands by Hydrologic Unit Classification 10 (HUC 10) watershed; with western watersheds containing orders of magnitude more unfragmented wetland acreage than urban coastal watersheds (Table 2).

Discussion

This project generated a GIS dataset product that identifies unfragmented wetlands of Rhode Island. The dataset and accompanying datasets incorporating municipality, watershed, and conservation statistics are now available for use in freshwater wetland management and planning. Analyses beyond those presented in this report could shed further light on wetland conditions throughout the state and could potentially be applied for conservation. For example, locations and conservation statuses of vulnerable wetlands, such as peat-dominated wetlands or vernal pools, could be identified for conservation consideration. Notably, only 18% of unfragmented peat-dominated wetlands (Table 1), which are uncommon in the state and particularly sensitive to human disturbances, are conserved; this is a lower proportion than any other wetland type in our analysis. Our findings suggest that conservation of remaining unfragmented peat-dominated wetlands may warrant management consideration.

The state and municipalities could also use the dataset for general development planning by municipality, watershed, and statewide. For example, municipalities with a low proportion of unfragmented wetlands in conservation could be flagged. East Providence, West Warwick, and Foster all hold below 10% of their unfragmented wetlands in conservation. Such information may be useful for town planners in those municipalities.

We used wetlands and their contiguous surrounding natural lands to identify unfragmented wetlands. Nearly all wetland functions are augmented by surrounding natural uplands, and important functions, such as habitat provision, critically depend on surrounding uplands for functionality (Chase et al. 1997, Mitsch and Gosselink 2000, Cahoon and Klemens 2002). Therefore, focusing in on fragmentation of wetlands disregarding surrounding upland fragmentation would result in erroneous information on wetland functionality. The Rhode Island Rising methodology, applied here to the most recent and best available land cover and habitat data, considers continuity of both the wetlands and their surrounding

uplands, thus indicating a more comprehensive and accurate characterization of wetland functionality. Additionally, the methodology was the product of a planning process that was developed and rigorously vetted through a partnership of virtually every RI State agency including DEM, several RI municipalities, several non-profit organizations, and many commissions and councils. We are therefore confident that the methodology provides information considered most valuable to the State.

We used the RIGIS dataset "Ecological Communities Classification" because it is the most rigorously-developed community, land cover, and wetlands classification available in the State. The older RIGIS "Wetlands 93" GIS dataset has been found to be problematic in that it is spatially inaccurate and contains numerous errors associated with the quality of the base imagery data and the methods of interpretation. It is also over two decades old. "Ecological Communities Classification" was developed using recent (2011) aerial imagery, LiDAR data, and the latest National Wetlands Inventory dataset. We sought advice from GIS experts and analyzed all available wetlands and community classification data in-house at RINHS. We are confident that the "Ecological Communities Classification" dataset was the most reliable and accurate wetlands and uplands community classification GIS dataset available for this project.

Tables

Table 1. Acreage of unfragmented wetlands of Rhode Island identified by municipality, type, and conservation status, where PFO = forested swamp, FF = floodplain forest, PSS = shrub swamp, PEM = emergent marsh, MM = managed marsh, Peat = peatland, POW = Palustrine open water, and Cons = wetlands that are protected by state or local conservation mechanisms.

Municipality	PFO	FF	PSS	PEM	MM	Peat	POW	Total Acres	Cons Acres	% Cons
SOUTH KINGSTOWN	5562.7		371.9	51.2		3.2	199.0	6188.0	3175.3	51.3
CHARLESTOWN	3729.4	75.9	194.6	37.8		1.4	139.6	4178.7	1305.7	31.2
RICHMOND	2991.7		95.4	45.0		1.3	228.2	3361.6	1057.7	31.5
EXETER	2712.5		274.4	65.2		1.6	220.5	3274.3	1463.8	44.7
COVENTRY	2445.9		321.7	103.3		28.7	265.0	3164.6	823.3	26.0
WEST GREENWICH	2327.9		426.2	30.4		6.8	202.2	2993.5	1389.1	46.4
WESTERLY	2122.4	32.9	401.8	34.3	37.0	0.4	114.3	2743.1	1293.3	47.1
FOSTER	2019.1		189.4	122.6		3.0	245.3	2579.5	244.7	9.5
HOPKINTON	2117.3	93.2	108.8	28.2		4.2	181.7	2533.5	795.0	31.4
GLOCESTER	2030.5		173.7	51.7	31.0		232.4	2519.4	719.3	28.5
TIVERTON	2225.1		105.7	28.2			33.8	2392.8	582.0	24.3
SCITUATE	2116.8		64.0	44.0			118.3	2343.0	683.9	29.2
BURRILLVILLE	1754.3	44.4	150.8	48.1	42.9	31.0	167.0	2238.6	751.1	33.6
LITTLE COMPTON	1769.2		144.1	19.5			30.8	1963.7	792.6	40.4
NORTH KINGSTOWN	1167.8		179.0	80.9			87.5	1515.3	613.2	40.5
CUMBERLAND	850.1		32.8	66.3			52.1	1001.4	426.7	42.6
NORTH SMITHFIELD	623.6		84.7	45.8			86.9	840.9	88.9	10.6
SMITHFIELD	585.9		26.0	17.3			92.9	722.1	99.1	13.7
EAST GREENWICH	513.4		82.5	19.9			26.3	642.1	143.2	22.3
JOHNSTON	440.7		12.1	11.5			9.3	473.5	170.6	36.0
CRANSTON	378.4		6.8	16.5			28.3	430.1	83.1	19.3
LINCOLN	291.4		0.7	45.4			50.3	387.7	140.0	36.1
WARREN	132.7		7.3	25.1			17.2	182.2	71.5	39.2
EAST PROVIDENCE	150.5		1.1	15.1			3.5	170.2	6.3	3.7
PORTSMOUTH	106.2		19.1	10.2			8.2	143.8	118.1	82.1
NARRAGANSETT	124.9		9.9				1.3	136.1	41.0	30.1
NEW SHOREHAM	3.2		38.1	2.9			48.0	92.1	69.8	75.7
WOONSOCKET	58.7						4.0	62.8	9.7	15.4
MIDDLETOWN	6.9		11.2	33.9			2.7	54.7	46.8	85.5
CENTRAL FALLS	34.6			10.5				45.1	19.3	42.8
BARRINGTON	36.6		4.6				0.4	41.7	31.9	76.6
PAWTUCKET	23.0			5.3				28.3	19.2	67.7
WARWICK	13.6		0.2	2.8			4.4	21.1	3.9	18.3
JAMESTOWN	15.3		2.3				0.7	18.3	15.8	86.5
WEST WARWICK	9.3			0.2				9.6	0.0	0.0
NORTH PROVIDENCE	1.1		1.5	0.8			0.2	3.5	1.3	37.6
Total	41493.2	246.4	3542.5	1120.0	110.9	81.5	2902.2	49496.8	17296.2	34.9
Cons Acres	14351.1	126.7	1467.6	401.0	104.0	14.6	831.2			
% Cons	34.6	51.4	41.4	35.8	93.7	17.9	28.6			

Table 2. Acreage of unfragmented wetlands of Rhode Island categorized by HUC 10 watersheds, where PFO = forested swamp, FF = floodplain forest, PSS = shrub swamp, PEM = emergent marsh, MM = managed marsh, Peat = peatland, and POW = Palustrine open water.

Watershed	PFO	FF	PSS	PEM	MM	Peat	POW	Total Acres
Upper Pawcatuck River	12730.9	176.0	1232.5	157.4	37.0	10.9	540.2	14884.8
Pawtuxet River	6318.5		517.4	153.6		3.0	558.2	7550.7
Lower Blackstone River	3535.1	44.4	316.4	203.3	2.8	19.3	377.5	4498.9
Narragansett Bay	3390.3		329.1	185.4			141.9	4046.7
Wood River	2841.1		308.8	67.5		6.5	271.7	3495.6
Moosup River	1857.8		313.4	145.0		30.3	265.9	2612.4
Sakonnet Point-Rhode Island Sound	1628.5		104.5	18.6			39.4	1791.1
Frontal Block Island Sound	1123.4		80.9	48.1			241.1	1493.4
Woonasquatucket-Moshassuck River	1010.5		86.7	52.5			150.0	1299.7
Fivemile River	672.7		36.6	14.8	71.0		88.6	883.6
Lower Taunton River	347.2		24.8				0.6	372.5
Lower Pawcatuck River	230.1		7.6	0.5			15.2	253.3
Palmer River	29.1		3.4	4.5			2.9	39.9
Pachaug River	30.3						0.2	30.5
Ten Mile River	21.6			6.4				28.0
Total Acres	35767.1	220.5	3362.1	1057.6	110.8	69.8	2693.4	43281.3

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