Reclassification and Mapping of the Vassar Farm and Ecological Preserve

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Introduction

Ecological research and management is driven by accurate knowledge of habitat species composition, structure, and biogeochemical properties. Ecological communities are dynamic, changing in both species composition, size, and location over time. The map and associated information allow users to observe trends concerning how ecological communities change and make predictions about how these communities might change in the future. The global spread of invasives and the effects of climate change have intensified both the rate and nature of ecological change, often in unpredictable ways. The purpose of this project was to create a comprehensive map of the ecological communities on the VFEP based on standardized classification systems and compare it to a map of the Preserve made in 1996. This project also served as a pilot for future surveying at other preserves across the Hudson Valley, as the VFEP is a member of the Environmental Monitoring and Management Alliance (EMMA).

Methods

This project was done in two parts: forests in 2016, and shrublands, wetlands, and herbaceous areas in 2017. In 2017, 40 plots measuring 5x5 meters were distributed across the Preserve - a total of 66 plots across both years. Data were collected according to NBS/NPS vegetation mapping protocols. In order to address anomalous areas on the preliminary map, researchers also went to 56 observation points to record dominant species and environmental characteristics.

Species data were run through PC-ORD, generating a cluster dendrogram with plots clustered by species composition. TWINSPAN analysis showed the relative importance of species in different plots. This data was used to reclassify communities based on New York Natural Heritage and the United States National Vegetation Classification. Reclassified communities were organized into a dichotomous key for accuracy assessment. Observers visited 168 randomly distributed points to assess the accuracy of the map (Table 1).

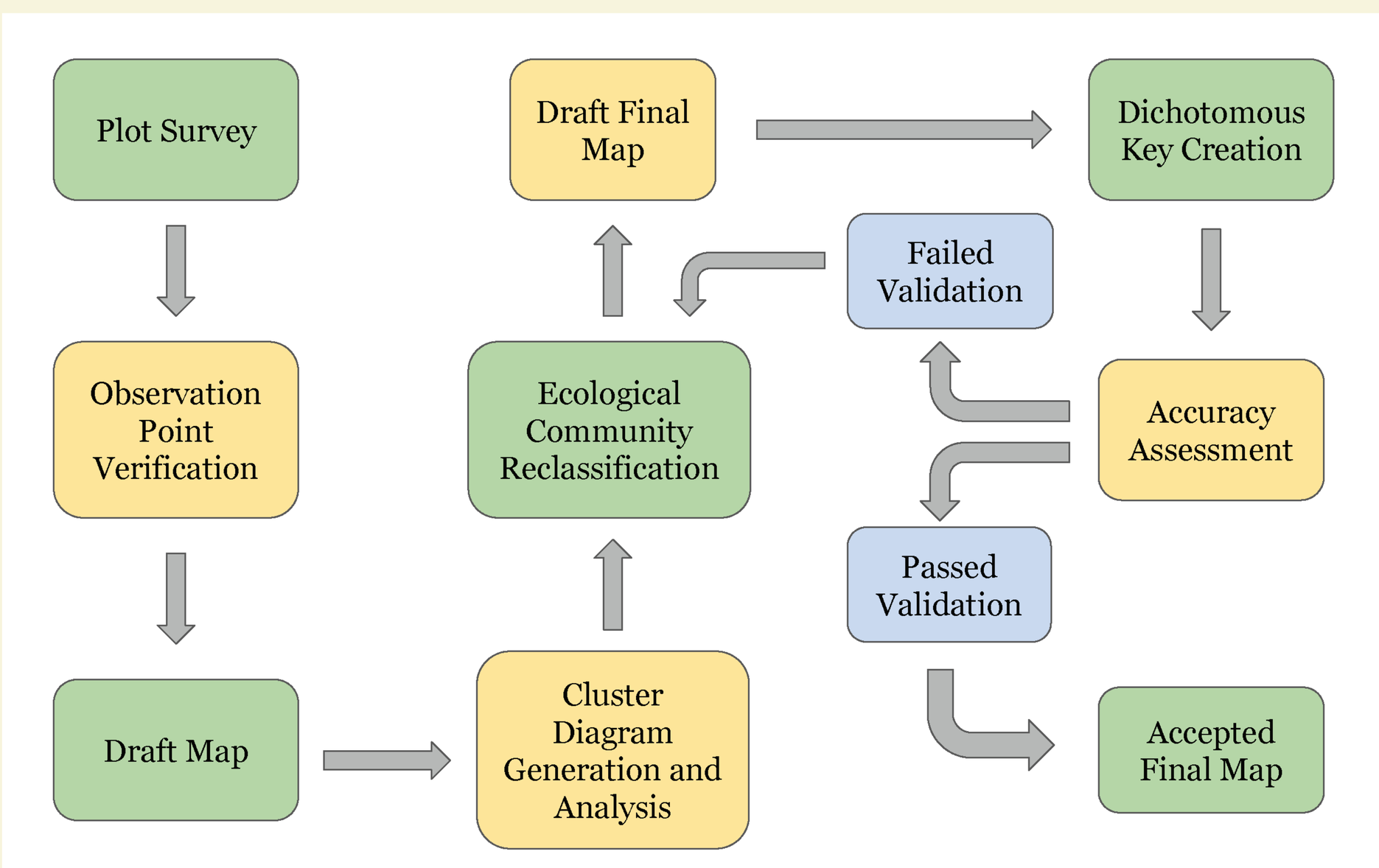

Figure 1. A layout of the project's methodology, modeled after the protocols of the NBS/NPS Vegetation Mapping Program (1994).

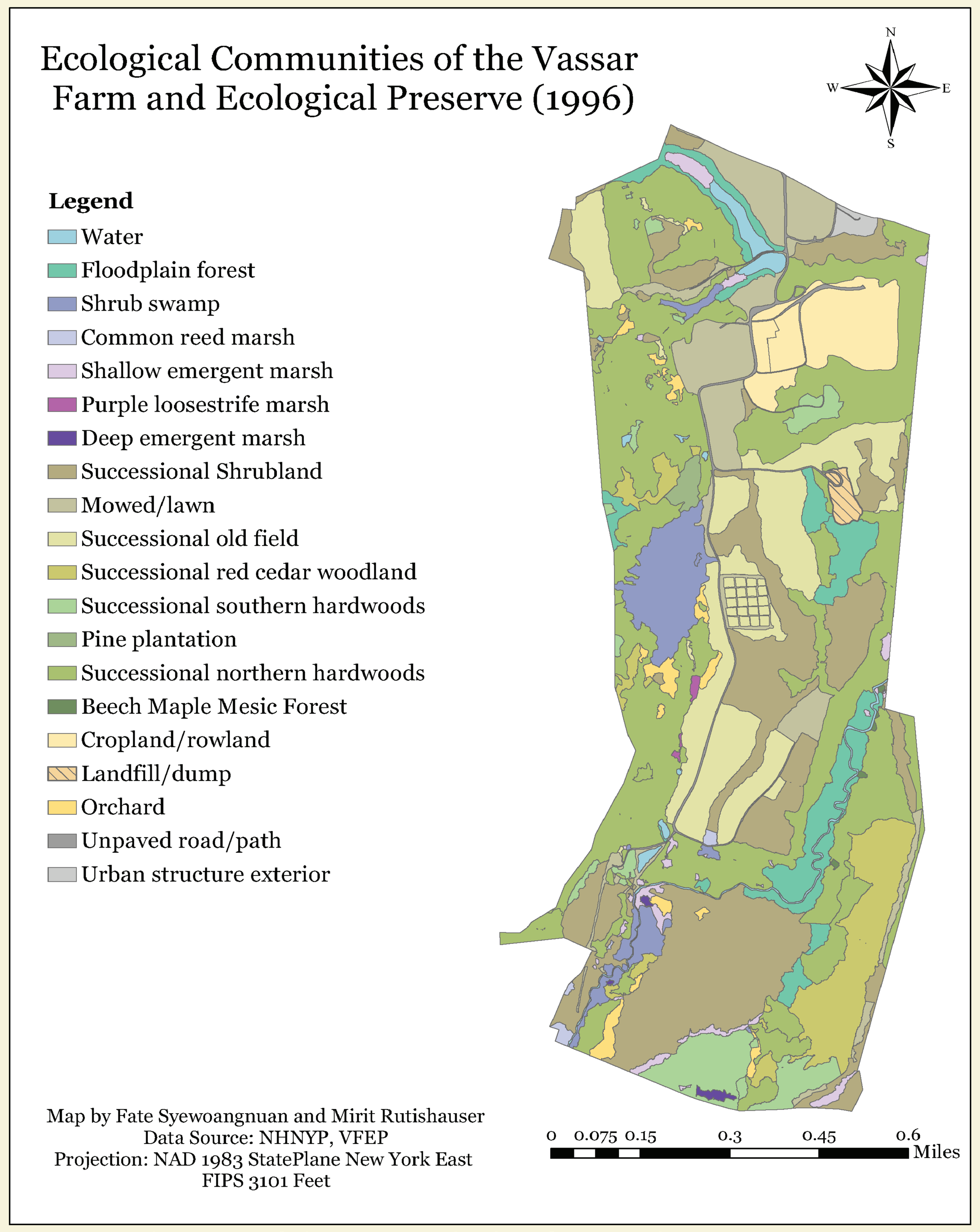

Figure 2. The map of the VFEP with classifications by visiting scientist Troy Weldy, with community names from NYNH.

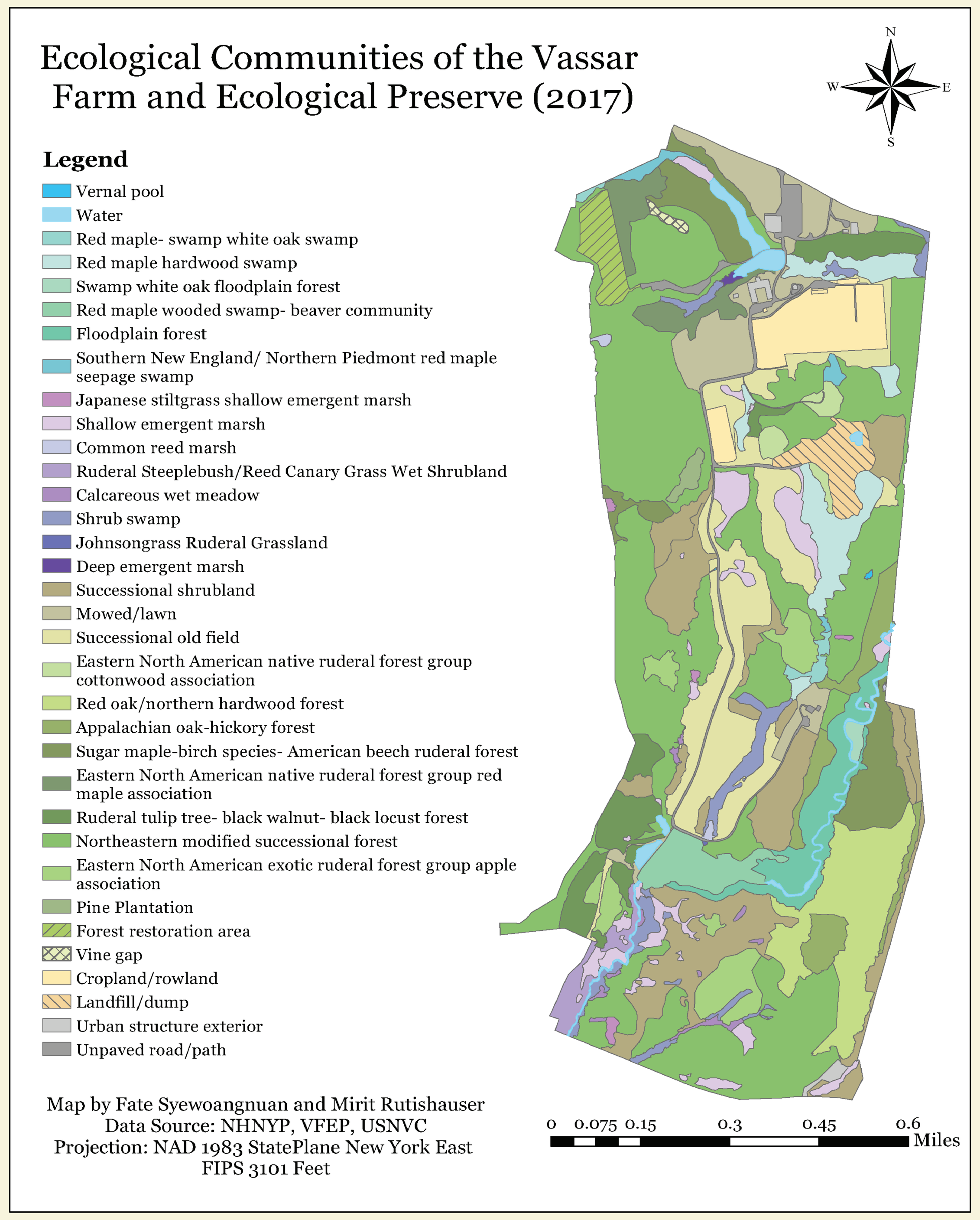

Figure 3. Includes community names from both NYNH and USNVC. Six communities were removed from the previous map and nineteen added, including six communities created specifically for the VFEP: the Apple, Cottonwood, and Red Maple groups, as well as the Red Maple Wooded Swamp, Vine Gap, and Japanese Stiltgrass Shallow Emergent Marsh.

Acknowledgements

Lindsay Charlop, Neil Curri, Kathryn Davison, Dylan Finley, Shawn Ganz, Takunda Maisva, Elise Matera, Jeremy Middleman, Ellie Opdahl, Jessie Prutisto-Chang, Meg Ronsheim, Addison Tate, and Jeff Walker

Results

After surveying, nineteen new communities were added to the updated map, while six were removed. Six of the new communities were novel communities modified from USNVC or NYNH classifications to better fit the VFEP. Surveying revealed increased heterogeneity within reclassified communities compared to the 1996 classifications. For example, areas classified as Successional Shrubland in 1996 were occupied by twenty-eight different communities in 2017, primarily by remaining Successional shrubland, Northeastern modified successional forest, and Apple forest. The invasion of 1.13 hectares of Successional shrubland by the invasive species Phragmites australisled to the new community Ruderal Steeplegrass/Reed Canary Grass Wet Shrubland. Several areas classified as Shallow Emergent Marsh or Successional Shrubland were reclassified as Calcareous Wet Meadow when calcareous indicator species were found. Five of the new communities were characterized by invasive species, though other communities are prone to invasion as well (Figure 4).

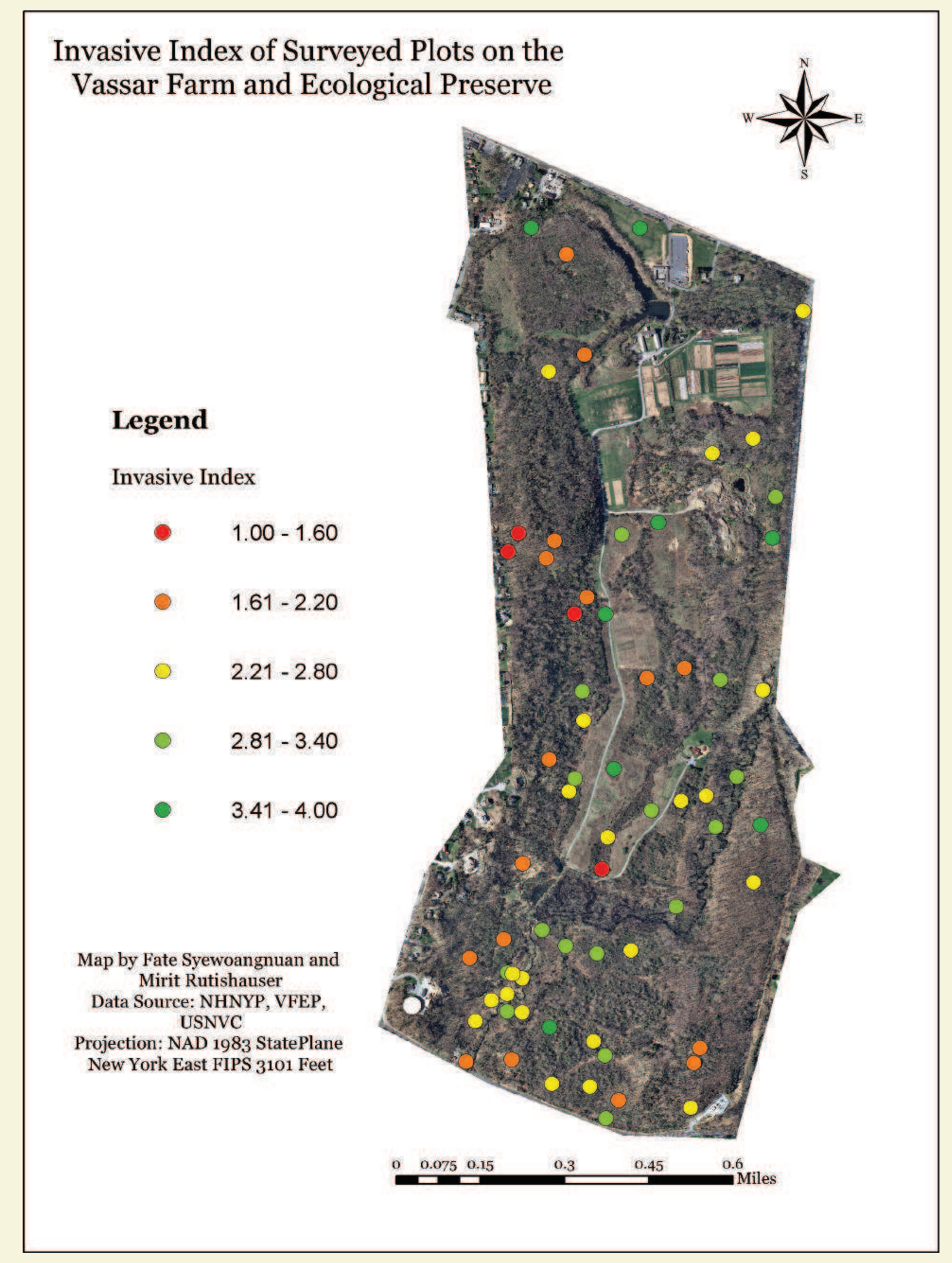

Figure 4. Invasive index is on a scale of 1-4, with 1 being the most invaded. Values are averages of the shrub, herb, and vine strata at surveyed plots.

Conclusion

The VFEP has undergone noticeable changes in ecological composition over the past twenty-one years. The Preserve has a highly heterogeneous landscape which is now dominated by invasive species in numerous locations. The finalized map and its accompanying ecological data can be used to better understand the process of succession and the effects of invasives. Future work will include another round of accuracy assessment, exploring the expanding role of invasives in plant communities and classification systems, and using the data gathered in this project to explore more ecological questions. In particular, researchers should explore if communities that become co-dominant with invasives have different structural and funtional properties. These methods can also be used at other EMMA sites for convenient comparison of ecological data across different habitats and preserves.

Table 1. The values in the popluation contingency table show the proportion of all surveyed lands that are mapped as class x and ground-truthed as class y. Values in the shaded diagonal represent where the community was mapped accurately. Overall accuracy is calculated from the values in the shaded diagonals. Grey areas are communities that were not assessed for accuracy, but were present at accuracy assessment points.

Overall Accuracy (with 90% confidence interval) = **73.5%** (65.11% - 81.89%)	AOHF	CWM	CRM	DEM	ERFGA	NRFGRM	ESBWM	NMSF	JSSEM	JGRG	PP	MSOS	RMHS	RMWS	RWS	RTWLF	SEM	SS	RMSS	SOF	SSL	MBBRF	SWOFF	VP	Area (hectares)	Area (proportion of total)	User's Accuracy
Appalachian Oak-Hickory Forest	0.054	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.18	0.0539	100.0%
Calcareous Wet Meadow	0	0.002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.237	0.0025	100.0%
Common Reed Marsh	0	0	0.001	0	0	0	0	0	0	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.258	0.0027	50.0%
Deep Emergent Marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0.005	0	0	0.005	0	0	0	0	0	0	0	0.916	0.0095	0.0%
Eastern North American Exotic Ruderal Forest Group Apple Association	0	0	0	0	0.056	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.35	0.0556	100.0%
Eastern North American Native Ruderal Forest Group Red Maple Association	0	0	0	0	0	0.038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.62	0.0376	100.0%
Eastern Sedge/ Bluejoint Wet Meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.006	0	0	0	0	0	0	0	0.621	0.0065	0.0%
Northeastern Modified Successional Forest																											
Japanese Stiltgrass Shallow Emergent Marsh	0	0.001	0	0	0	0	0	0	0.003	0	0	0	0	0	0	0	0.001	0	0	0	0	0	0	0	0.523	0.0054	50.0%
Johnson Grass Ruderal Grassland																											
Pine Plantation	0	0	0	0	0	0	0	0	0	0	0.006	0	0	0	0	0	0	0	0	0	0	0	0	0	0.615	0.0064	100.0%
Red Maple-Swamp White Oak Swamp	0	0	0	0	0	0	0	0	0	0	0	0	0.002	0	0	0	0	0	0.002	0	0	0	0	0	0.471	0.0049	0.0%
Red Maple Hardwood Swamp	0	0	0	0	0	0	0	0	0	0	0	0	0.05	0	0	0	0	0.017	0	0	0	0	0	0	6.37	0.0662	75.0%
Red Maple Wooded Swamp - Beaver Community																											
Ruderal Steeplebush/ Reed Canary Grass Wet Shrubland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0	0	0	0	0	1.86	0.0193	50.0%
Ruderal Tulip Tree - Black Walnut - Black Locust Forest	0	0	0	0	0.018	0	0	0.018	0	0	0	0	0	0	0	0.037	0	0	0	0	0.018	0	0	0	8.85	0.092	40.0%
Shallow Emergent Marsh	0	0.009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.043	0	0	0	0	0	0	0	5	0.052	83.3%
Shrub Swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.008	0.025	0	0.008	0	0	0.008	0	4.79	0.0498	50.0%
Southern New England/ Northern Piedmont red maple seepage swamp																											
Successional Old Field	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.017	0	0	0.173	0.017	0	0	0	20	0.208	83.3%
Successional Shrubland	0	0	0	0	0.022	0	0	0.022	0	0	0	0	0	0	0	0	0.022	0	0	0	0.157	0	0	0	21.5	0.2236	70.0%
Sugar Maple - Birch species - American Beech Ruderal Forest	0	0	0	0	0	0.019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.076	0	0	9.12	0.0948	80.0%
Swamp White Oak Floodplain Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.004	0	0.004	0	0.842	0.0088	50.0%
Vernal Pool	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4E-04	0.0004	0.0004	100.0%
Column Total	0.0539	0.0125	0.0013	0	0.0964	0.0566	0	0.0408	0.0027	0.0013	0.0064	0	0.0521	0.0048	0.0097	0.0465	0.1039	0.0415	0.0024	0.1816	0.1966	0.0759	0.0127	0.0004			
Estimated True Map Class Area (hectares)	5.1779	1.2006	0.1289	0	9.2662	5.4418	0	3.9184	0.2614	0.1289	0.6147	0	5.0109	0.4578	0.9296	4.4682	9.9873	3.9859	0.2354	17.458	18.9	7.293	1.2188	0.04			
Producer's accuracy	100.0%	19.7%	100.0%	0.0%	57.7%	66.5%	0.0%		100.0%		100.0%	0.0%	95.3%		100.0%	35.4%	41.7%	60.1%		95.4%	79.6%	100.0%	34.5%	100.0%			

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