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Wetlands Regulatory Assistance Program (WRAP)

Review of Landscape Data Available to Evaluate the Accuracy of Wetland Indicator Status Ratings

Betsy L. Harbert, Robert W. Lichvar, and Jennifer J. Goulet

October 2019

Cold Regions Research and Engineering Laboratory

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Vicksburg, MS 39180-6133

Under Work Item GLK386, “Evaluate Ratings with Landscape-Level Frequency Data”

Abstract

Plant species on the National Wetland Plant List (NWPL) are assigned wetland indicator status ratings—intended to reflect frequency of occurrence in wetlands as opposed to nonwetlands—for each of the 10 U.S. Army Corps of Engineers Wetland Regions. NWPL ratings are updated periodically. They may be challenged or reevaluated as new information describing the habitats and ranges of plant species is acquired. The majority of ratings rely on literature and herbaria records rather than on a random sampling of an individual species' population. Thus, it is difficult to know the accuracy of current ratings without large-scale, potentially costly studies. Using available data sources that capture occurrence information from across the United States to inform species wetland frequencies could improve current wetland ratings. The National Park Service and the U.S. Forest Service collect data throughout the United States for long-term vegetation monitoring efforts and forest inventory, respectively. This report discusses error introduced by processing and adapting these data for use in wetland frequency calculations and makes recommendations for data use based on potential limitations. Once properly vetted, these data could provide much information regarding species occurrences in wetlands and nonwetlands for use in NWPL challenges or rating reevaluations.

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Preface

Support and funding for this project were provided by the U.S. Army Corps of Engineers (USACE) Headquarters through the Wetlands Regulatory Assistance Program (WRAP) under Work Item GLK386, "Evaluate Ratings with Landscape-Level Frequency Data." The authors acknowledge and appreciate the interest and support of Ms. Margaret Gaffney-Smith, Ms. Jennifer Moyer, Ms. Karen Mulligan, and Ms. Stacey Jensen of the USACE Headquarters Regulatory Program. Ms. Sally Stroupe of the USACE Engineer Research and Development Center (ERDC), Environmental Laboratory, was the technical monitor.

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Acronyms and Abbreviations

AW	Arid West
CRREL	Cold Regions Research and Engineering Laboratory
ERDC	U.S. Army Engineer Research and Development Center
ESRI	Environmental Systems Research Institute
FAC	Facultative
FACU	Facultative Upland
FACW	Facultative Wetland
FIA	Forest Inventory and Analysis
NC	Nature Conservancy
NCNE	Northcentral and Northeast
NPS	National Park Service
NTCWV	National Technical Committee for Wetland Vegetation
NWPL	National Wetland Plant List
OBL	Obligate
UPL	Upland
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WMVC	Western Mountains, Valleys, and Coast
WRAP	Wetlands Regulatory Assistance Program

1 Introduction

1.1 Background

The outcomes of wetland delineations can have significant financial and conservation impacts on property owners, private companies, and communities. The U.S. Army Corp of Engineers (USACE), tasked with implementing wetland regulations under Section 404 of the Clean Water Act, has striven to maximize consistency and accuracy by producing wetland delineation protocols based on the best available science. Three-factor wetlands are delineated based on the presence of hydrophytic vegetation, hydric soils, and wetland hydrology, according to procedures described in the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987). Determining the dominance of hydrophytes relies in part on the ratings of individual plant species. Thus, accurate wetland ratings for plant species directly affect the accuracy of wetland delineations.

For plant species, there are five wetland ratings categories with associated qualitative and quantitative descriptions. These descriptions are based on a plant species' estimated frequency of occurrence in three-factor wetlands as compared to nonwetland areas across a species' habitat distribution within a Corps region (Figure 1). The wetland indicator status ratings are Obligate (OBL), Facultative Wetland (FACW), Facultative (FAC), Facultative Upland (FACU), and Upland (UPL) (Table 1). Historically, wetland indicator status ratings have been assigned based on the best professional judgment of wetland scientists from a number of government agencies, universities, private sector businesses, and the public (Lichvar and Gillrich 2011; Trott 2011). The qualitative definitions are the standard definitions for these ratings categories while the quantitative definitions offer a numerical standard when current ratings are challenged (Table 1).

Efforts to assess and reevaluate wetland ratings have been ongoing since administrative responsibility for the National Wetland Plant List (NWPL) was transferred from the U.S. Fish and Wildlife Service (USFWS) to the USACE in 2006 (Lichvar and Gillrich 2011). Today, NWPL ratings may be challenged (USACE 2011) or reexamined as new information documenting the habitats and ranges of plant species is acquired (USACE 2016). In

support of these ongoing efforts, this project examines frequency data collected during large-scale vegetation surveys to determine whether it is suitable for calculating wetland frequency.

Figure 1. Map of USACE NWPL regions. Wetland ratings for plants used in wetland delineation processes are specific to each region.

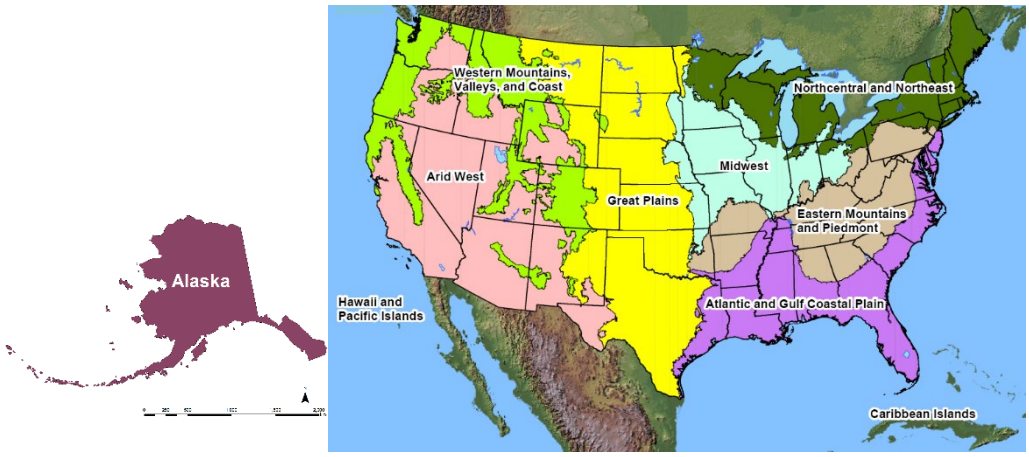

Table 1. Qualitative and quantitative descriptions of indicator status ratings.

Indicator Status	Abbreviation	Qualitative Description (Lichvar et al. 2012)	Frequency of Occurrence in Wetlands (%)
Obligate	OBL	Almost always occurs in wetlands	99
Facultative Wetland	FACW	Usually occurs in wetlands, but may occur in nonwetlands	67–99
Facultative	FAC	Occurs in wetlands and nonwetlands	34–66
Facultative Upland	FACU	Usually occurs in nonwetlands, but may occur in wetlands	1–33
Upland	UPL	Almost never occurs in wetlands	1

The quantitative descriptions of wetland ratings, expressed as the percentage that individuals of a certain species occur within a wetland across the landscape within a given USACE Wetland Region, is scientifically testable. Collecting the necessary frequency data for all plant species on the NWPL is a formidable and cost-prohibitive task. However, landscape-scale vegetation data are available from Federal agencies—including the National Park Service (NPS), Inventory and Monitoring Network; the U.S. Geological Survey (USGS); and the U.S. Department of Agriculture, Forest Service (USFS)—because of their efforts to describe or monitor vegetation in national parks and USFS lands. These data are a source of broad-scale occurrence data that could potentially inform indicator status ratings for a wide range of species. However, because these studies were designed to

meet inventorying and monitoring objectives, these data may not be suitable to answer questions about species wetland frequency.

1.2 Objectives

A previous study, designed with the guidance of the National Technical Committee for Wetland Vegetation (NTCWV) and funded by the USACE Wetlands Regulatory Assistance Program (WRAP) (Buff and Leopold 2013), calculated frequency values from occurrence data obtained by NPS, USGS, and USFS studies and compared them to current NWPL indicator status ratings across USACE wetland regions. Given this earlier work, the goal of this project was to determine whether frequency data developed by Buff and Leopold (2013) are suitable for determining wetland frequency. Specific objectives included

1. reviewing the methods NPS, USGS, and USFS used to collect vegetation data;
2. discussing potential sources of error and bias; and
3. providing recommendations for appropriate use of these data for wetland frequency determinations.

1.3 Approach

In 2012 and 2013, the NTCWV worked with an ecologist/database developer to create a methodology for a meta-analysis of regional-scale wetland frequency by using existing data obtained from large databases. They considered various sampling designs, scale, missing data, wetland identifications and designations, etc. (Buff 2012, 2013). The notes from these meetings (Buff 2012, 2013) and the subsequent report (Buff and Leopold 2013) discuss in detail the methods used for collecting and arranging available data for the purposes of the landscape frequency study. Buff and Leopold (2013) obtained the national park data from the USGS-NPS Vegetation Mapping and Inventory Program database (https://irma.nps.gov) and the USFS data from the Forest Inventory and Analysis (FIA) Program (https://www.fia.fs.fed.us/). Park Service Staff collected vegetation data from plots within national parks for vegetation mapping and plant community identification purposes using nonrandom sampling methods (NC and ESRI 1994). The FIA Program collected vegetation data as a forest census to project the future state of forests in the United States.

Buff and Leopold (2013) created a database of species occurrence records in wetlands and nonwetlands from the FIA and the NPS data. They used the geographic coordinates of plots to separate plots by USACE wetland region. Buff and Leopold (2013) classified plots as either wetland or nonwetland, using Cowardin codes developed by the USFWS (Cowardin et al. 1979). If a species was present in a plot, this was counted as one occurrence. Unassigned plots that could not be confidently classified as wetland or nonwetland were not used in Buff and Leopold's (2013) wetland ratings calculations.

Buff and Leopold's (2013) wetland frequency calculations used occurrence records within plots, sorted by region and by occurrence within wetlands or uplands. Two frequencies were determined. The first is an unadjusted frequency using Equation (1) (Buff and Leopold 2013):

$$Unadjusted\ Wetland\ Frequency\ = {}^{n_{pw}}\Big/_{(n_{pw}\ +\ n_{pn})} \tag{1}$$

where

n_{pw} = the number of occurrences of a particular species in a wetland and
n_{pn} = the number of occurrences of that same species in a nonwetland.

The second is an adjusted frequency using Equation (2) (Buff and Leopold 2013), which takes into account the relative sampling effort within wetlands and nonwetlands (i.e., an adjustment for the comparatively small area wetlands occupy across the landscape in both the Arid West [AW] and Western Mountains, Valleys, and Coast [WMVC] wetland regions):

$$Adjusted\ Wetland\ Frequency = {}^{1}\Big/_{(1\ +\ \frac{n_{pn}*A_w}{n_{pw}*A_n})} \tag{2}$$

where

A_w = the total area of wetland plots, and
A_n = the total area of nonwetland plots.

See Buff and Leopold (2013) for further explanations of the unadjusted and adjusted equations.

Building on these previous efforts, this report discusses error introduced by processing and adapting this data for use in wetland frequency calculations and makes recommendations for data use based on potential limitations. It also examines whether wetland frequency calculated from Buff and Leopold's (2013) database is similar to that of observational field studies that collected data specifically for the purpose of determining wetland frequency. Once properly vetted, these data could provide much information regarding species occurrences in wetlands and nonwetlands for use in NWPL challenges or rating reevaluations.

2 Discussion

Buff and Leopold (2013) developed methods for adapting vegetation data collected during vegetation mapping and inventory projects throughout the U.S. for use in wetland frequency calculations. The error introduced from Buff and Leopold's approach is unquantifiable, thus making the use of these frequency data without supporting evidence questionable.

2.1 The wetland/upland determination

Using the Cowardin classification system to assign sample plots to either wetland or upland categories introduces error in several ways:

1. It is unknown how accurately the Cowardin classification system predicts the presence of a three-factor wetland.
2. The plots themselves may have spanned a wetland boundary. In these cases, a plant may have occurred inside or outside of a three-factor-wetland boundary.
3. It is unknown how accurately field surveyors applied the Cowardin classification system to sample plots.

Error from field surveyors is inherent in any study; so while (3) may be an acceptable source of error, (1) and (2) may have serious impacts on the frequency calculations and resultant indicator status determinations.

Error from (1) is unquantifiable; and as a result, the extent to which "wetland" plots in this study truly represent three-factor wetlands is unknown. Currently, USACE and academic partners are investigating relationships between the USFWS National Wetland Inventory maps, which use the Cowardin classification system, and wetlands delineated using USACE's three-factor method. Results may provide some insight into the efficacy of using Cowardin classifications to represent three-factor wetlands.

NPS staff placed plots within homogenous stands of vegetation following standard protocols for vegetation classification (NC and ESRI 1994). This may help control for error introduced by (2) because vegetation within wetlands can be restricted to a certain suite of species that can tolerate long periods of saturation. However, hydrologic conditions are not the only factor driving the presence of a homogenous stand of vegetation, especially where FAC species are prevalent. Thus, it cannot always be assumed that these

plots are fully within a wetland. Therefore, a species' occurrence within a given plot does not definitively mean it occurred in a wetland, even if a portion of the plot was truly within a three-parameter wetland. Additionally, FIA plots are randomly assigned across the landscape and may span different vegetation types. Thus, it is unknown what portions of a given FIA plot actually occurred in a wetland and if the particular species of interest actually occurred within that wetland portion. Therefore, it is impossible to quantify or control for error introduced by (2).

2.2 Frequency calculation bias and sampling effort

If there was less of a sampling effort in wetlands as opposed to uplands, unadjusted frequency calculations would produce relatively low wetland frequencies; this would likely occur for nonspecialist species in the FAC and FACU rating categories. Alternatively, the adjusted wetland frequency in attempting to correct for different sampling efforts between wetlands and nonwetlands might assign ratings with higher wetland frequency than the unadjusted calculation.

Because the actual frequency of a given plant species across the landscape is unknown, and in the case of the NPS data, a random selection of that population has not been conducted, there is no way of knowing which frequency calculation is more accurate. There are currently two baseline, landscape-scale frequency studies conducted for Blue spruce in the WMVC region (Gage et al. 2016) and one was for Eastern Hemlock in the North-central and Northeast (NCNE) region (Lichvar and Gillrich 2017). These two studies show that calculations of unadjusted and adjusted frequency using data collected at small watershed scales (approximately 100 km^2) disagreed with the frequency determined by the landscape-scale data collection. In addition, unadjusted frequency may (Lichvar and Gillrich 2017) or may not (Gage et al. 2016) agree with current wetland ratings. However, unadjusted frequencies for Blue spruce and Eastern Hemlock that Buff and Leopold (2013) calculated agreed with the landscape-level data collected by the authors of the two studies. Additional landscape-scale, randomized studies of different plant species would allow a baseline of comparison to determine the frequency calculation that would most accurately model the results of randomized studies.

2.3 Landscape Scale or Local Frequency

Data from the NPS and FIA projects were limited in their representation of the landscape. This may be an impediment to determining accurate wetland ratings from the data. FIA data were gathered only within forests, so its use would be most appropriate for determining woody species distribution. NPS data was not restricted to forested land but occurred only within national parks, which may contain environmental conditions not typical of lands outside of national parks. In addition, because of differing land uses of public and private lands, these public parklands may not fully capture the habitats plant species occupy across the broader landscape.

3 Recommendations

Without controlling for or quantifying the error introduced by assigning plots a wetland or upland status, landscape-scale data from NPS and FIA studies should be used with caution, if at all, for determining plant species' wetland indicator status ratings. If accuracy can be verified in some way by comparing the data to frequency studies in the region, it may be appropriate to conduct analysis using these data. While it is tempting to use any available landscape-scale data to help inform wetland ratings' accuracies, there is too much inherent error introduced by using NPS and FIA data for this purpose. As a result, it is unknown whether calculated frequencies from these studies are better than best professional judgment, literature, and herbaria records that are already used to inform current wetland ratings for plant species on the NWPL.

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14. ABSTRACT

Plant species on the National Wetland Plant List (NWPL) are assigned wetland indicator status ratings—intended to reflect frequency of occurrence in wetlands as opposed to nonwetlands—for each of the 10 U.S. Army Corps of Engineers Wetland Regions. NWPL ratings are updated periodically. They may be challenged or reevaluated as new information describing the habitats and ranges of plant species is acquired. The majority of ratings rely on literature and herbaria records rather than on a random sampling of an individual species' population. Thus, it is difficult to know the accuracy of current ratings without large-scale, potentially costly studies. Using available data sources that capture occurrence information from across the United States to inform species wetland frequencies could improve current wetland ratings. The National Park Service and the U.S. Forest Service collect data throughout the United States for long-term vegetation monitoring efforts and forest inventory, respectively. This report discusses error introduced by processing and adapting these data for use in wetland frequency calculations and makes recommendations for data use based on potential limitations. Once properly vetted, these data could provide much information regarding species occurrences in wetlands and nonwetlands for use in NWPL challenges or rating reevaluations.

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