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Evaluation of EMAP-Wetlands Sampling Design Using National Wetlands Inventory Data

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EVALUATION OF EMAP-WETLANDS SAMPLING DESIGN USING NATIONAL WETLANDS INVENTORY DATA

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ABSTRACT

The U.S. Environmental Protection Agency initiated the Environmental Monitoring and Assessment Program (EMAP)-Wetlands (Leibowitz et al. 1991) to monitor the current status and long-term trends in the condition of the nation's wetlands. To support this effort, an EMAP classification system was devised by aggregating subclasses of the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) classification system (Cowardin et al. 1979) to: 1) provide fewer classes per region allowing for adequate sample sizes per class and, 2) establish distinct boundaries between other EMAP resource groups. Aggregation of the NWI classification to the EMAP classification system was based on dominant vegetation cover, flooding regimes, dominant water source, adjacency to rivers and lakes, and other relevant information. This study evaluates the EMAP classification system and sampling design using NWI digital wetlands data for portions of Illinois, Washington, North Dakota and South Dakota. A comparison of the EMAP classification to the NWI classification and evaluation of the EMAP sampling design were conducted relative to numbers of wetlands, total areas, average areas, and common versus rare classes. As expected, the EMAP aggregation of NWI data resulted in fewer wetland polygons, each with larger areas, but did not alter the number of wetlands or the total wetland area in each region. Summary statistics based on comparisons of the sampling estimates to true population parameters demonstrated the effectiveness of the EMAP sampling design with the exception of rare wetland classes. Rare EMAP classes (e.g., saturated palustrine emergents, saturated emergents along rivers, and saturated forested/scrub-shrub wetlands along rivers), estuarine emergents (e.g., coastal salt mashes) and large wetlands (>50 ha) were usually poorly estimated, but the EMAP design is readily adapted to provide better estimates for these categories.

INTRODUCTION

The United States Environmental Protection Agency (EPA) initiated the Environmental Monitoring and Assessment Program (EMAP)-Wetlands program (Leibowitz et al. 1991) to provide quantitative assessments of status and trends in the condition of the nation's wetlands on both regional and national scales. Program objectives include the following:

- Estimate the current status, trends and changes in selected indicators of the condition of the Nation's ecological resources on a regional basis with known confidence.

- Estimate the geographic coverage and extent of the Nation's ecological resources with known confidence.

- Seek associations between selected indicators of natural and anthropogenic stresses and indicators of the condition of ecological resources.

- Provide annual statistical summaries and periodic assessments of the Nation's ecological resources.

EMAP-Wetlands will meet these objectives by developing and evaluating the following elements:

- A sampling strategy which provides unbiased probability estimates of wetland condition with known precision and accuracy for national and regional scales of resolution:

- Indicators that describe and quantify wetland condition:

- Techniques and a conceptual framework to analyze the data collected so that results accurately represent a regional wetland population's condition relative to regional reference sites, models, available literature, and expert judgement.

This evaluation of the EMAP classification system and statistical design is part of the overall planning to meet long range program objectives. The program objectives depend on the development of a statistical design and sampling frame for selecting and monitoring wetlands. The EMAP sampling design has been developed to provide unbiased probability estimates of both current resource condition and long-term trends with known precision for national and regional scales of resolution. The design is based on a systematic triangular point grid randomly located over the conterminous United States (Overton et al. 1991). A wetlands sampling frame, built upon the EMAP design, provides a list of functionally distinct wetlands which could be selected for field visits. Development of a wetlands sampling frame depends on several criteria: 1) the availability of spatial data including the distribution and extent of wetlands, 2) provide coverage for the entire region, 3) an accurate representation of the wetlands resource, and 4) the wetland classification system used should allow transformation to the EMAP classification scheme. The most appropriate data source for developing the EMAP-Wetlands sampling frame is the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) wetland maps, which cover 73% of the nation's wetland resources, of which 14% have been digitized (Wilen, 1990).

The goal of this study is to quantitatively assess the EMAP classification system and the statistical sampling design using regionally representative NWI digital data sets. The specific objectives of the project are to:

- Compare the EMAP classification to the NWI classification relative to
  - numbers of identified wetland polygons
  - total surface areas of wetlands
  - average surface areas of wetlands
  - common versus rare classes, and
  - minimum mapping unit

- Evaluate the EMAP design at the base EMAP grid density of 27 km between sampling points and compare the hexagon samples to the population values for the parameters listed above.
- Compare the design and classification across three regions: Upper Mississippi drainage area represented by Illinois; the Pacific Northwest represented by Washington; and the Upper Midwest Prairie Pothole region represented by North and South Dakota.
- Discuss the feasibility of using NWI digital map data for generating an EMAP-Wetlands sampling frame.

This study provides EMAP personnel and other regional scientists and managers engaged in sampling and assessment efforts using digital data sets with evaluations of the EMAP classification and statistical design for both regional and inter-regional scales. The EMAP approach for completing a comprehensive regional program is discussed in terms of how accurately the classification system represents the NWI population of wetlands, how closely the sample data represent the population data for each region, and how problems encountered in the sampling design and classification system can be corrected so that data are comparable across regions. The resulting database will require only field verification before use as the basis for wetland classification and sample selection in region-wide monitoring efforts in Illinois, Washington, and parts of North and South Dakota.

METHODS

This study evaluates an inter-regional comparison of wetland characteristics and landscape attributes related to the overall EMAP design. The design 1) considers three areas of the country, 2) achieves a representative sample for comparative purposes, and 3) distributes samples geographically across several ecoregions (Omernik 1987).

The status of digital wetlands information was assessed during an informal workshop in October 1990 in Warrenton, Virginia with participants from EPA, EPA contractors, and NWI personnel (see Appendix H for a list of participants). The available data sets were discussed and ranked in relation to the following criteria: 1) age of photography used to create digital wetland coverages, 2) detail of wetland classification (Cowardin et al. 1979) mapped, and 3) regional representation and unique features of wetlands in selected areas. The consensus was to use the regional digital data sets which postdated 1979.

Wetlands data for this study were mapped and digitized by the NWI Program (Wilen, 1990). Dates of aerial photography used for the three regions included 1980 to 1987 for Illinois, 1980 to 1984 for Washington state, and 1979 for North and South Dakota. Each digital 7.5' NWI quadrangle map included the coverages of all linear and polygon wetlands coded using the Cowardin system (Cowardin et al. 1979). The mapping was executed using primarily color infrared photography at a scale of 1:58,000-1:65,000 for the states of Illinois, North Dakota, and South Dakota and 4% black and white photography (1:80,000) and 96% color infra-red (CIR) at a scale of 1:58,000 for the state of Washington. Wetlands attribute data collected for the statistical analysis include surface area and number of wetlands for both the regional wetland populations and samples for each NWI and EMAP class. All wetlands, including dot, linear, and polygons, had been assigned surface area values according to NWI photointerpretation and cartographic standards (U.S Fish and Wildlife Service 1990a and 1990b). Linear wetlands were considered the domain of other EMAP resource groups. Linear wetlands were used in this study to assign qualifiers indicating the wetland was associated with a riverine system. For this study, existing NWI digital wetlands data were used to define the mapped wetland populations to be sampled. In the future, EMAP will attempt to confirm the accuracy of the mapped wetland classification on a subset of the NWI wetlands data during field reconnaissance and sampling operations.

The digital data include portions of Illinois, Washington, North Dakota and South Dakota. The Illinois data represents inland wetlands with a broad range of flooded water regimes, primarily situated in floodplains with a smaller population of wetlands associated with isolated basins. The Washington data represents the West Coast environment with extreme diversity in water regimes and habitats, ranging from desert, wet and dry floodplains, isolated wetland basins, to estuarine resources. All EMAP classes are represented. The North and South Dakota data represents the Prairie Pothole region containing a dense population of very small (<1.0 ha) wetlands set in an agricultural landscape.

Evaluation of both the EMAP classification system and sampling design necessitates bounding of the regional populations, and extracting a representative sample within each region. The initial step in the EMAP sampling design is to place a large hexagon containing a triangular grid of sampling points approximately 27 km apart over North America (See Figure 1). The wetland population domain is defined by overlaying adjacent, 640 km^2 hexagons, centered on the sampling points, on the available digital information. Sample data are extracted from 40 km^2 hexagons also centered on the same sampling points of each 640 km^2 hexagon in the selected regions. The sample data therefore, represent one sixteenth of the area of the population (Overton et al. 1991) (See Figure 2).

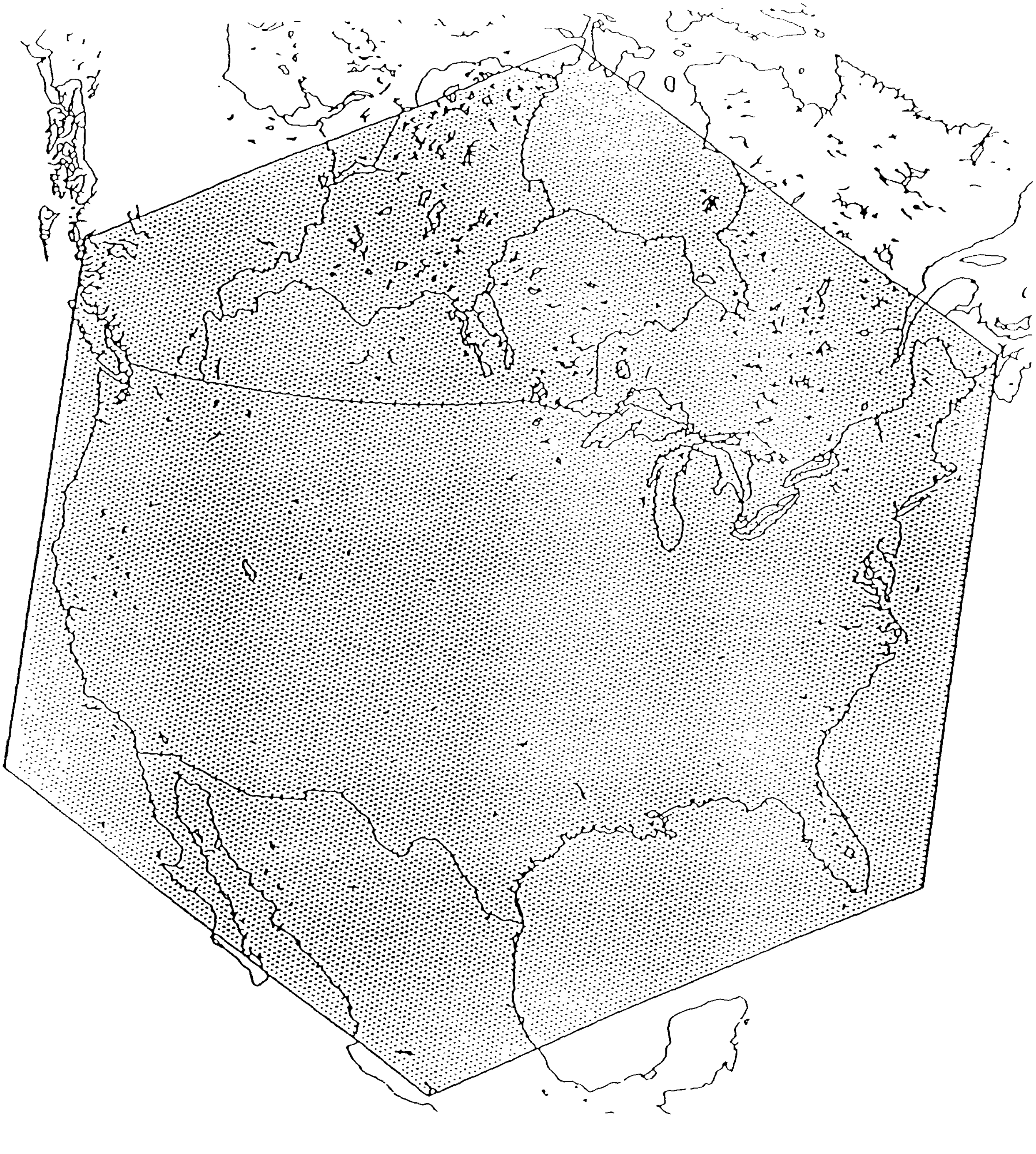

Figure 1. EMAP grid (not randomized) for North America. Spacing between points is approximately 27 km (Overton et al. 1991).

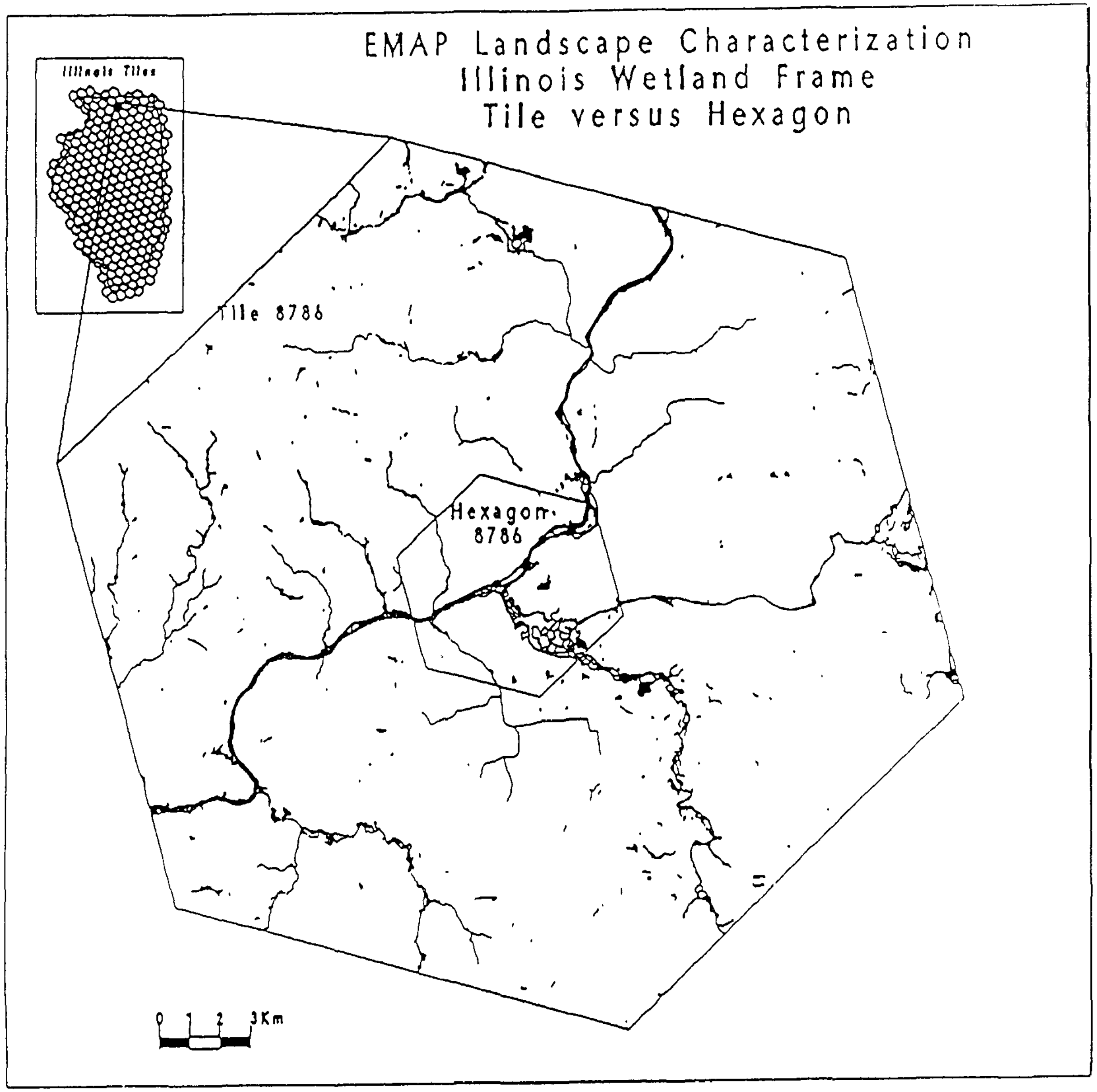

Figure 2. Example demonstrating placement of the 640 km^2 hexagons over a region (in this case Illinois) and the relationship between the 40 km^2 hexagons (hexagon number 8786) and the 640 km^2 hexagon (tile number 8786).

The distribution of each region's population of 640 km^2 hexagons (referred to here also as tiles) was selected to intersect with as many ecoregions (Omernik 1987) or subregions (Mann 1974) as possible.

Analysis of the Illinois data included 99 tiles distributed across five ecoregions (Figure 3). The Washington data included 97 tiles distributed across five ecoregions (Figure 4). The Prairie Pothole wetlands data included 36 tiles spread across three subregions (Figure 5).

Aggregating the NWI classification system into an EMAP classification system was proposed by Leibowitz et al. (1991) for the purpose of: 1) limiting the number of wetlands classes to less than 20 classes per region to allow for adequate sample sizes per class and, 2) establish distinct and logical boundaries between EMAP wetlands classes and other EMAP resource groups. NWI classifies wetlands into ecologically distinct wetland classes using aerial photographs, vegetation cover types, geomorphic settings and, flooding regimes (Cowardin et al. 1979). The EMAP classification system aggregates NWI classes into wetland classes characterized by dominant vegetation cover, dominant water sources, e.g., lake, river, basin, estuary or marine and flooding regime (See Table 1).

Specialized geographic information systems (GIS) programs were developed by the Environmental Photographic Interpretation Center (EPIC in Warrenton, Virginia) to automate the conversion of NWI wetland polygons into EMAP wetland polygons and to generate the sample and population data (see Appendices A and B for further discussion). GIS algorithms were developed to automate the recoding of the Cowardin (NWI) wetland classes into the EMAP classification (Roose and Stout, 1992). The recoding portion of the program performs the following four functions:

1) Splits the full Cowardin code into its hierarchical components and recognizes the components germane to the EMAP classes,

2) Aggregates functionally similar NWI codes into EMAP codes,

3) Identifies wetlands adjacent to riverine and lacustrine systems which approximate the dominant water source and assigns special hydrologic location codes (see Appendix B for a discussion of the technical challenges associated with the EMAP coding),

4) Combines the coded results of the two previous steps into an EMAP code. (Descriptions of the EMAP codes for the 16 EMAP wetlands classes are listed in Table 2).

Once the EMAP coding is established, the associated wetland characteristics for the EMAP and NWI polygons, including both number and size characteristics, are generated for both the 640 km^2 hexagons and 40 km^2 hexagons. Surface areas of individual wetlands are automatically generated by ARC/Info version 5.0.1 software (Environmental Systems Research Institute, Redlands, California). To prevent double counting, wetland polygons cut by the tile boundaries are tagged to exclude them from any individual wetland size analyses (e.g., average size), but not from total area calculations. See Roose and Stout, 1992, for details on how the associated wetland characteristics were generated.

The data manipulations described yield wetland data with the appropriate wetland polygon numbers and surface areas for each EMAP class. Wetlands attributes are extracted from a single GIS layer of wetlands data so that both NWI and EMAP codes are present and identified. This occasionally resulted in identical contiguous EMAP coded wetland polygons. Therefore, a new GIS layer is created to merge all contiguous polygons with identical EMAP codes, and the attributes were recalculated. As expected this new coverage included fewer, but larger, functionally distinct EMAP wetlands polygons.

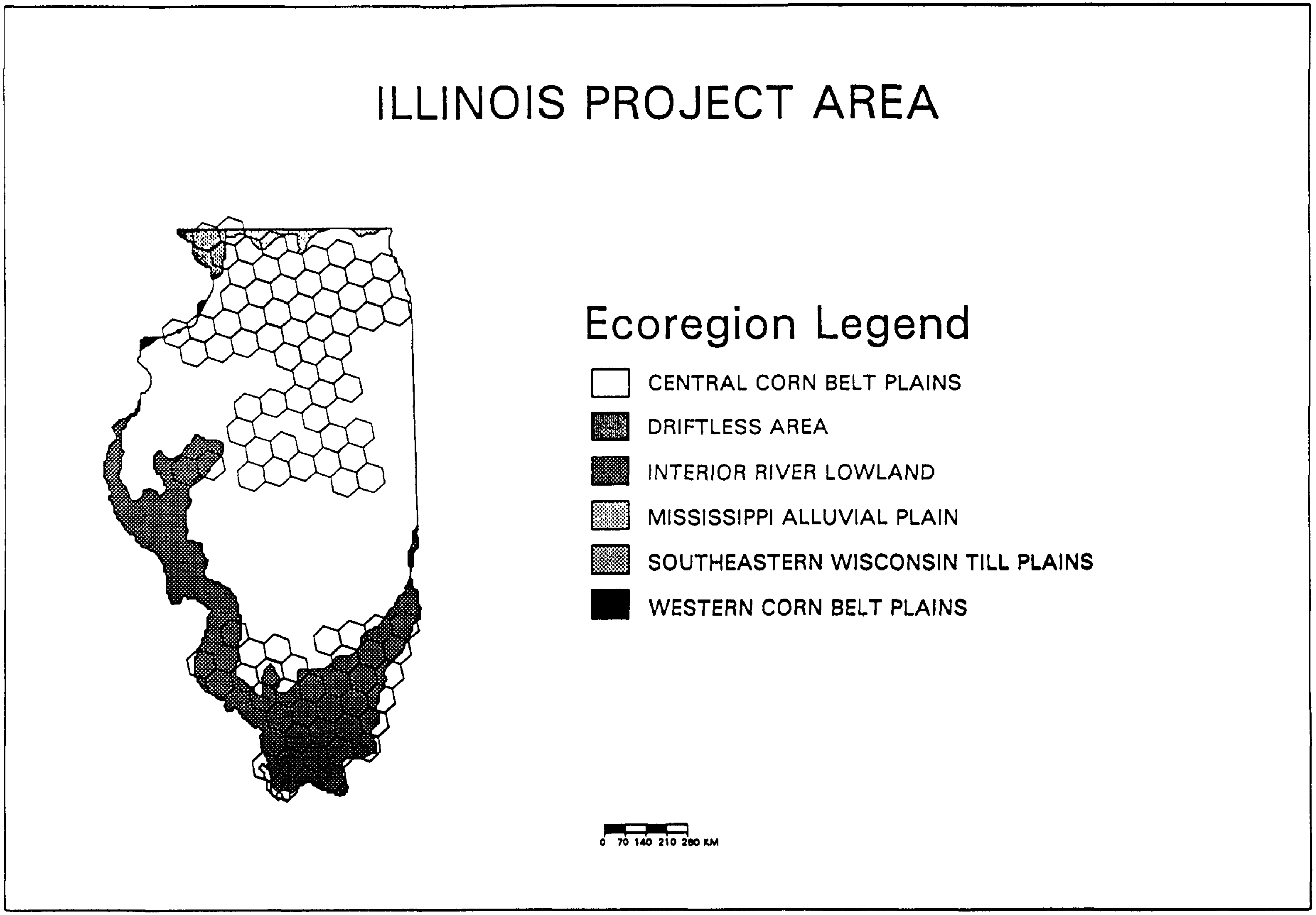

Figure 3. Illinois project area showing the location of the hexagons and ecoregions (Omernik, 1987).

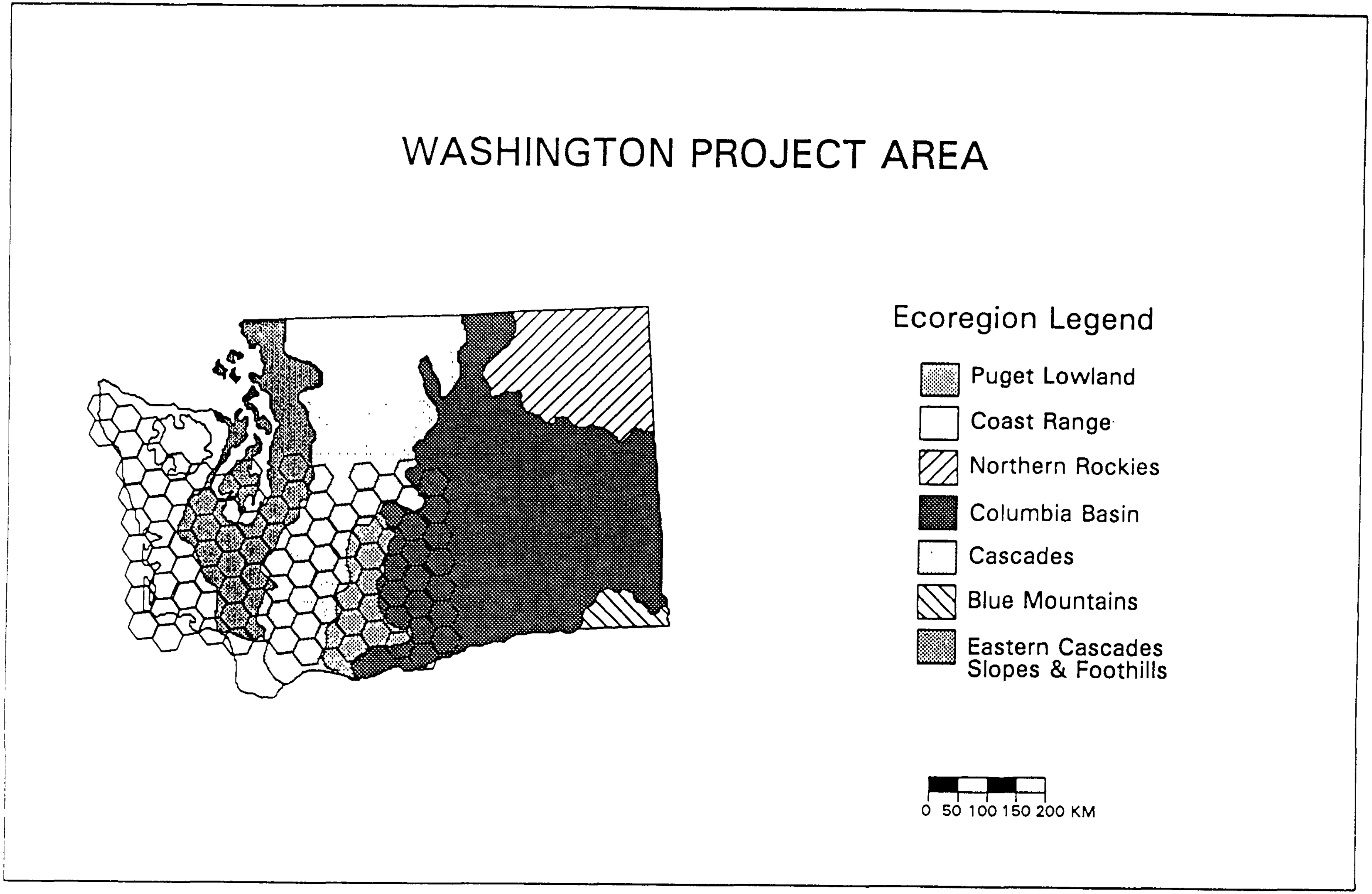

Figure 4. Washington project area showing the location of the hexagons and ecoregions (Omernik, 1987).

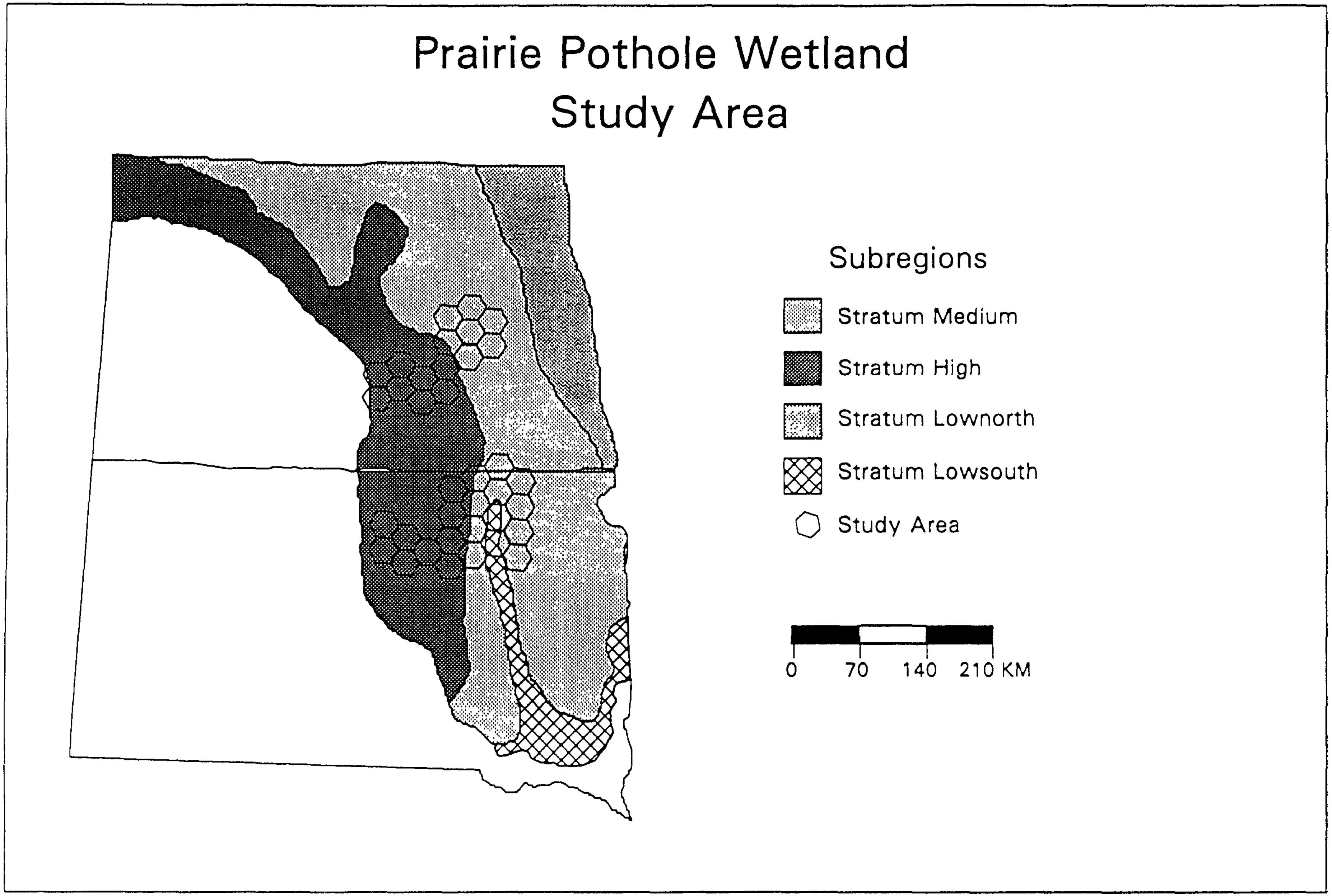

Figure 5. Prairie Pothole region project area showing the location of the hexagons and ecoregions (Mann, 1974).

Table 1. Proposed EMAP classification system for reporting wetland condition for the continental United States and corresponding classes in The Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979)

EMAP Class*		Cowardin Class
Palustrine Lake Edge	Vegetation	Palustrine emergent, forested or scrub-shrub wetland adjacent to lacustrine system (limnetic or littoral subsystem)
Palustrine Basin	Shallows	Palustrine unconsolidated bottom, aquatic bed, unconsolidated shore
	Emergent	Palustrine emergent wetlands
	Forested/Scrub-Shrub	Palustrine forest and scrub-shrub wetlands
Palustrine River Edge	Emergent	Palustrine emergent wetlands adjacent to all riverine subsystems (except intermittent)
	Forested/Scrub-Shrub	Palustrine forest and scrub-shrub wetlands adjacent to all riverine subsystems (except intermittent)
Estuarine	Emergent	Estuarine emergent wetlands
	Forested/ Scrub-Shrub	Estuarine forested and scrub-shrub wetlands

* Most classes will be monitored for temporary flooded, saturated, and seasonal-permanent flooded water regimes as defined in the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979).

Table 2. EMAP Wetland Code Description

EMAP CODE	DESCRIPTION
E2EM	Estuarine Emergent
E2FO/SS	Estuarine Forest and Scrub-Shrub
PEMAR	Palustrine Emergent - Temporarily flooded adjacent to a perennial riverine system
PEMA	Palustrine Emergent - Temporarily flooded
PEMBR	Palustrine Emergent - Saturated adjacent to a perennial riverine system
PEMB	Palustrine Emergent - Saturated
PEMCR	Palustrine Emergent - Seasonally flooded adjacent to a perennial riverine system
PEMC	Palustrine Emergent - Seasonally flooded
PFO/SSAR	Palustrine Forested and Scrub-Shrub - Temporarily flooded adjacent to a perennial riverine system
PFO/SSA	Palustrine Forested and Scrub-Shrub - Temporarily flooded
PFO/SSBR	Palustrine Forested and Scrub-Shrub - Saturated adjacent to a perennial riverine system
PFO/SSB	Palustrine Forested and Scrub-Shrub - Saturated
PFO/SSCR	Palustrine Forested and Scrub-Shrub - Seasonally flooded adjacent to a perennial riverine system
PFO/SSC	Palustrine Forested and Scrub-Shrub - Seasonally flooded
PL	Palustrine vegetation adjacent to lacustrine system
PS	Palustrine Shallows

An "expansion factor" is applied to the 640 km^2 hexagons and 40 km^2 hexagons to compensate for hexagons that are only partially represented (Appendix F provides tables for each of the regions showing the percentage of each hexagon included in the study). Partial hexagons result from boundary lines (extent of NWI digital data) cutting through the interior of a hexagon rather than following the perimeter. The expansion factor is determined by calculating the inverse of the proportion of the hexagon:

$$\text{EXPANSION FACTOR} = \frac{1}{\text{PROPORTION OF HEXAGON}}$$

The wetland attribute is multiplied by the expansion factor to estimate the attribute value as if the entire hexagon had been included in the study. The 640 km^2 hexagons and 40 km^2 hexagons are treated separately. For example: Suppose only 60% of a 640 km^2 hexagon and 10% of a 40 km^2 hexagon were included in the study. Then the number and area of the wetlands in the entire 640 km^2 hexagon would be multiplied by 1.67=(1/0.60) but by 10=(1/0.10) for wetlands in the 40 km^2 hexagon. Appendix G contains tables with entries based on the raw data values before application of the expansion factor correction.

Precision and Accuracy

For the purpose of this report we use the distinction between precision and accuracy presented in Cochran (1977). ***Accuracy*** refers to the magnitude of deviations from a population mean. ***Precision*** is reserved for describing the magnitude of deviations from a sampling mean. For example, the relative difference is a measure of accuracy. Relative difference measures the proportional difference between the known population value and an estimate of that value obtained by sampling. The coefficient of variation (CV) on the other hand, is the ratio between the standard error of an estimate and the estimate and therefore considered a measure of precision.

Quality Assurance

The NWI program was designed to estimate total acreage and change in total acreage for each wetland type within 10% of the true values with 90% probability (Frayer et al. 1983). The NWI staff performed both manual and automated quality control checks at various stages of their map efforts (Wilen 1990; U.S. Fish and Wildlife 1990a and 1990b). Wilen (1990) states that seven steps are necessary to produce final NWI maps: 1) preliminary field investigations, 2) interpretation of high altitude photographs, 3) review of existing wetlands information, 4) regional and national consistency quality control of interpreted photos, 5) draft map production, 6) interagency review of draft maps, and 7) final map production. Two studies (Swartwout, 1982; Crowley et al, 1988) show that the maps are greater than 90% accurate. Wilen attributes this level of accuracy to the combination of field studies, photointerpretation, use of existing information and interagency review of draft maps. The digitized map data for this study was derived from the NWI maps by NWI personnel. Cross-comparisons were made to ensure that the digitized information was consistent with the NWI map information.

Quality assurance issues related to the generation of EMAP-coded wetlands from the NWI-coded wetlands can be found in Appendices A and B. Issues such as double-counting wetlands cut by tile boundaries and assignment of riverine and lacustrine locators to wetlands influenced by riverine and lacustrine system external to a particular hexagon are discussed.

Data analysis was performed on two data sets for each region (see Appendix I for a description): 1) the COD data set contained coverages that retained the integrity of NWI polygons and relabeled polygons with the EMAP codes, and 2) the ECO data set which contained coverages that aggregated contiguous polygons with identical EMAP class codes (i.e., dissolved coincident boundaries between like classes). After generating the

EMAP codes from the NWI codes the results were checked to be sure that the NWI classes were successfully aggregated into the correct EMAP class. If not then the reason was ascertained and adjustments to the EMAP coding algorithms were made.

The data quality was verified and validated prior to analysis to check for errors associated with data generation or data transfer. A check was made to ensure that the hexagons for the NWI-coded data and the EMAP-coded data was consistent. Hexagons not contained in both data sets were not included in the analysis. The procedures used to aggregate the NWI data into the EMAP classes should not affect the total surface area in a hexagon. The data sets were compared to confirm this. A SAS (SAS Institute, Cary, North Carolina) program was written which checked the number and summed surface areas of each wetland class within each tile by region. The statistician reviewed this information to identify outliers, or problematic tiles and resulting information. This review identified several irregularities which were resolved before proceeding with the analyses. Outliers without any determinable errors were kept in the data sets.

RESULTS AND DISCUSSION

Data analysis for this study consists of two major components. The first component describes and compares population characteristics in the 99 Illinois tiles, 97 Washington tiles and 36 Prairie Pothole tiles. The data represent complete populations and thus permit assessing differences among the regional data sets without considering sampling variability. Complete population data are rarely available in practice. Comparison of the EMAP and NWI population attributes are based on surface area and number for each wetland class, and surface area and number of wetland polygons for several size classes for each region.

The second component compares estimates of surface area and number of wetland polygons obtained from the EMAP 40 km^2 hexagon sample data to the known population parameters. The hexagon sample data represent a single application of the EMAP design. While the statistical properties of the design, which are based on repeated applications of the sampling strategy, cannot be evaluated from this single sample, a comparison of the sample estimates to the population parameters provides a quantitative demonstration of the performance of an EMAP sample for wetlands. Additionally, the data provide information about the numbers and surface areas of wetlands likely to be obtained from the EMAP design. Results from this analysis will help when assessing whether there are sufficient numbers of wetlands, sampled by the EMAP grid density of one sampling point per 27 km, to satisfy the precision standards of the design.

Estimates of surface area and number within each wetland class or size class are theoretically unbiased. Deviations of the sample estimates from the known population parameters reflect the inherent sampling error of any sampling design. We can determine deviations, both absolute and relative to the true surface area or number, for the EMAP sample. Estimated precision is reported as the CV for the estimate (standard error of the estimate divided by the estimate). When considering the EMAP design performance we recognized that estimates of number and areas of rare wetland classes (defined as comprising less than one percent of the total wetlands area or less than one percent of the total number of wetlands) would be poor. This is typical of any sampling program -- characteristics of rare classes are usually estimated with poor precision unless special design provisions are invoked specifically for improving estimates of rare classes.

Population estimates of both surface area and number of wetlands in any wetland or size class are attainable from the EMAP sample data. The procedure for estimating any quantity is to multiply the total number or total surface area of wetlands in the 40 km^2 sample within any classification (wetland, size, or combination of wetland and size class) by 16 (the EMAP 40 km^2 hexagon sample represents 1/16 of the total surface area of the 640 km^2 hexagon). From standard sampling theory, these estimates of numbers and surface areas are unbiased (Cochran 1977).

Because the EMAP sample is a systematic sample, unbiased estimates of precision are not available from a single systematic sample (Snedecor and Cochran 1980), so variances are approximated. The approximation assumes the EMAP sample performs as if the 40 km^2 hexagons were selected completely at random, rather than by the systematic spatial pattern used. Thus, this approximation performs well when wetlands are randomly distributed throughout the region. The more likely scenario though, is a clustered spatial distribution of wetlands. The variance approximation is inaccurate to the degree that the random distribution assumption is violated. While certain spatial distribution patterns (e.g., wetlands clustered in the landscape) create problems with variance estimation, such patterns often favor the true precision of the EMAP systematic design (Overton et al. 1991). The estimated variance overestimates the true variance if wetlands display a clustered spatial distribution. Thus, a tradeoff characteristic of systematic sampling is likely present - the actual precision of the design is better than a completely random design, but the estimates of precision do not reflect the gain in precision actually achieved.

Comparison of EMAP and NWI population data

The EMAP classification system aggregates adjacent NWI polygons with either functionally similar NWI codes (i.e., all vegetated classes next to lakes) or similar water regimes. Thus, the comparison of the EMAP and NWI population data for the Illinois, Washington, and the Prairie Pothole regions assesses the effect of this aggregated classification on total number of wetland polygons, total and average areas of wetlands, and rare and common wetland classes. The EMAP and NWI populations are compared and summarized by number and average size of wetlands in Figure 6. Aggregations resulted in a decrease of only 4.0% of the wetland polygon numbers for all the regions combined. Aggregations in Illinois showed a 6.2% decrease in total number of wetland polygons, the Washington wetland polygon number decreases by 11%, whereas the Prairie Pothole aggregation decreases the total number of wetland polygons by only 1.9%. The lower decrease in total wetland polygons reflects the existence of the Prairie Pothole wetlands as single units with fewer being subdivided in the way of the Illinois and Washington wetlands. Decreases in the number of wetland polygons following aggregation measures how often adjacent wetland polygons labelled with different NWI codes, were relabeled with identical EMAP codes. For example, if following aggregation two adjacent polygons had identical EMAP codes the boundary between them would be dissolved, the areas combined, and the polygon counted as a single wetland. Therefore, the actual number of wetland polygons based in the NWI classification would decrease by one but the total wetland surface area would remain unchanged. See Appendices A and B for greater detail.

Aggregating the NWI classes does not alter the total area of wetlands, since dissolving lines between functionally similar adjacent NWI polygons does not affect total wetland area. Figure 6 displays relative differences between the NWI and EMAP classifications for number and mean area of wetland polygons. Changes in relative differences in Figure 6 reflect changes in wetland numbers. In Illinois, the largest relative difference (approximately 50%) in wetland numbers resulted from aggregation of adjacent emergents, forests, and scrub-shrub around lakes (PL). This decrease in NWI wetland polygons (resulting from aggregating PL wetlands) is accompanied by a doubling in the mean area of the resultant PL wetlands. Relative differences for total number of wetland polygons for PFO/SSAR and PFO/SSCR coded wetlands in Illinois are approximately 27% and 16%, respectively. Relative differences from EMAP aggregations of NWI polygons for the remaining Illinois wetland classes are comparatively small with changes in polygon numbers of less than 12%. Relative differences resulting from aggregations of adjacent polygons in the Prairie Pothole region are smaller because the individual, functionally distinct, wetland classes are isolated in the landscape.

Comparison of the NWI coded population with the EMAP coded population functions as an internal check on the mechanical procedures of the aggregating algorithm. Exact correspondence in numbers might indicate: 1) every wetland polygon was a single separate entity with respect to the NWI classification -- a situation we knew not to be true or, 2) the ARC/Info program for resolving the NWI codes into the EMAP codes was not dissolving shared boundaries between adjacent identical EMAP coded polygons correctly. Following aggregation, if the total wetland surface areas of the EMAP coded polygons was not equivalent to the total surface area of the NWI coded polygons then the aggregating algorithm would again be suspect. Dissolving shared boundaries between adjacent identical EMAP classes will not alter the total wetlands surface area. Differences in total wetland surface areas, following aggregation, indicates errors when dissolving the shared boundaries between adjacent identical EMAP coded polygons or the existence of classes in the NWI classification lacking a corresponding EMAP class.

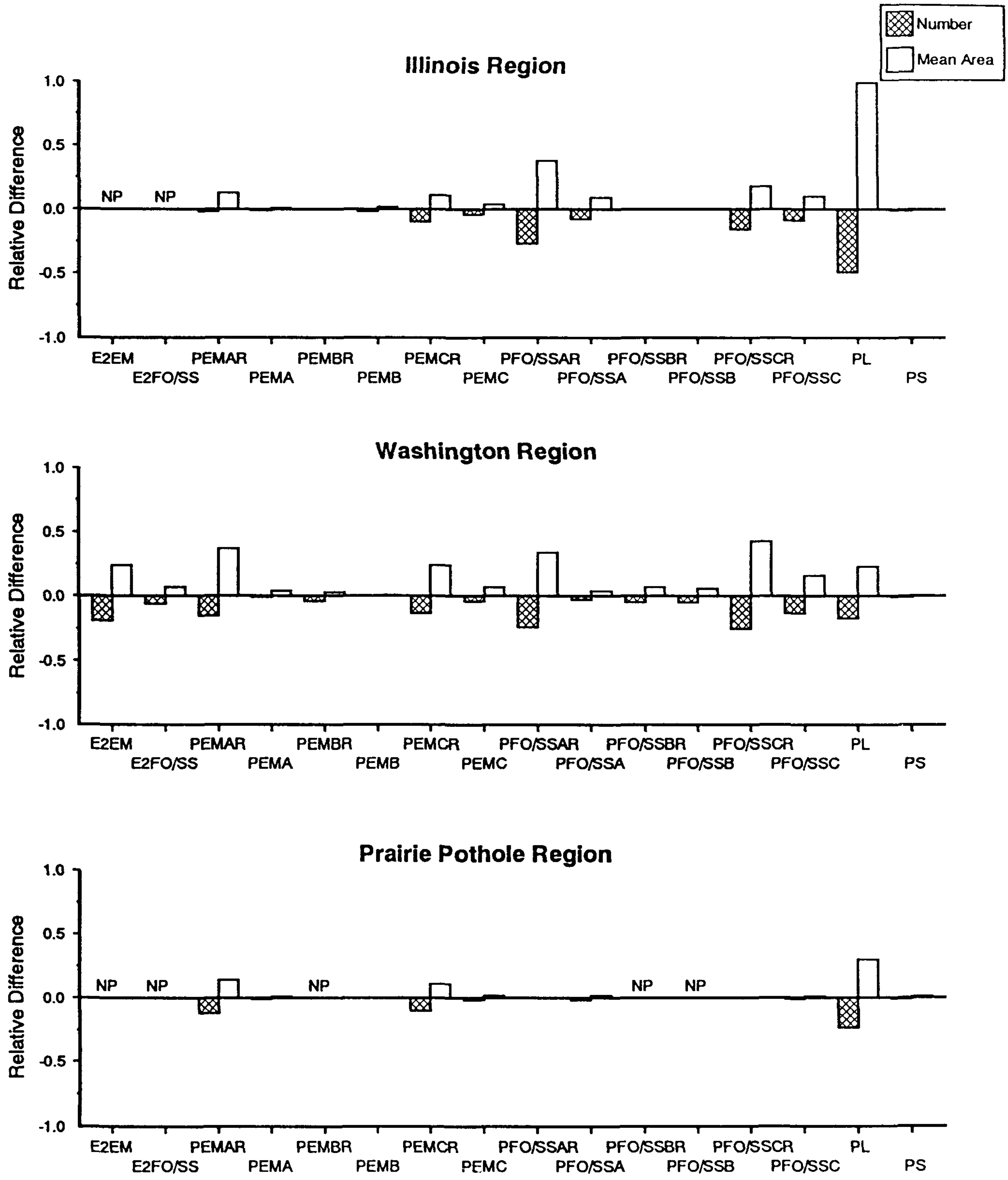

Figure 6. Comparison of the relative differences in wetland polygon numbers and mean areas of wetland polygons between the NWI level classification and the EMAP level classification. NP=Not present: No wetland polygons were found in the EMAP level classification.

Characterization of the area, size, and wetland classes of the three regions

Wetland populations of the three regions, employing the EMAP classification, are described and compared in terms of percent composition by numbers and area of wetland polygons and common and rare classes (Table 3). The three regions are distinct in terms of composition of wetlands (this was expected because the regions were selected to obtain characteristic geographic representation). Illinois wetlands are dominated by palustrine shallows (PS; 51.4% of total wetland polygons), and seasonally flooded emergents (PEMC; 13.8% of total wetland polygons). While the PS class in Illinois comprises 51.4% of the wetland population in terms of numbers, only 10.5% of the total wetland area is PS. This illustrates the importance of representing of wetlands by both number and area. Washington wetlands are more diverse and biologically variable, with common classes including seasonally flooded emergents (PEMC), seasonally flooded forest/scrub-shrub along rivers (PFO/SSCR), seasonally flooded forest/scrub-shrub (PFO/SSC), and palustrine shallows (PS). The Prairie Pothole region was dominated by emergents, primarily temporally flooded emergents (PEMA) and seasonally flooded emergents (PEMC). The following EMAP classes are relatively rare throughout the three regions; saturated emergents (PEMB), saturated emergents along rivers (PEMBR), saturated forest/scrub-shrub along rivers (PFO/SSBR), and saturated forest/scrub-shrub (PFO/SSB).

Table 3. Percentages of the number and areas of wetlands for each EMAP class for each of the three regions. NP denotes that the class was not present in the region.

	Illinois		Washington		Prairie Pothole	
EMAP Class	%No.	%Area	%No.	%Area	%No.	%Area
E2EM	NP	NP	1.8	6.6	NP	NP
E2FO/SS	NP	NP	0.0	0.0	NP	NP
PEMAR	0.8	1.1	1.1	3.0	0.0	0.3
PEMA	9.6	4.0	5.3	5.5	45.1	34.0
PEMBR	0.0	0.0	0.1	0.0	NP	NP
PEMB	0.1	0.2	0.6	0.3	0.0	0.0
PEMCR	1.0	1.9	4.8	8.1	0.1	1.2
PEMC	13.8	8.4	26.6	17.3	46.6	53.0
PFO/SSAR	6.3	32.3	4.6	7.9	0.0	0.1
PFO/SSA	7.9	15.0	4.7	5.2	0.5	0.2
PFO/SSBR	0.0	0.0	0.0	0.0	NP	NP
PFO/SSB	0.0	0.0	0.4	0.1	NP	NP
PFO/SSCR	2.2	9.9	9.9	16.1	0.0	0.1
PFO/SSC	5.5	8.7	20.4	22.4	0.2	0.1
PL	1.6	8.0	1.6	2.4	1.2	8.2
PS	51.4	10.5	18.1	5.0	6.2	2.9

Numbers and surface areas of the dominant NWI classes for each EMAP class in the respective regions are listed in Appendices C, D, and E.

Analysis of size classes of the three regions

The size class distributions of wetland polygons in each region are described and compared in Figures 7 and 8. Small wetland polygons dominate across all three regions; 73% of Illinois, 62% of Washington and 82% of the Prairie Pothole region are less than 1.0 ha in size (see Figure 7). But it is important to note

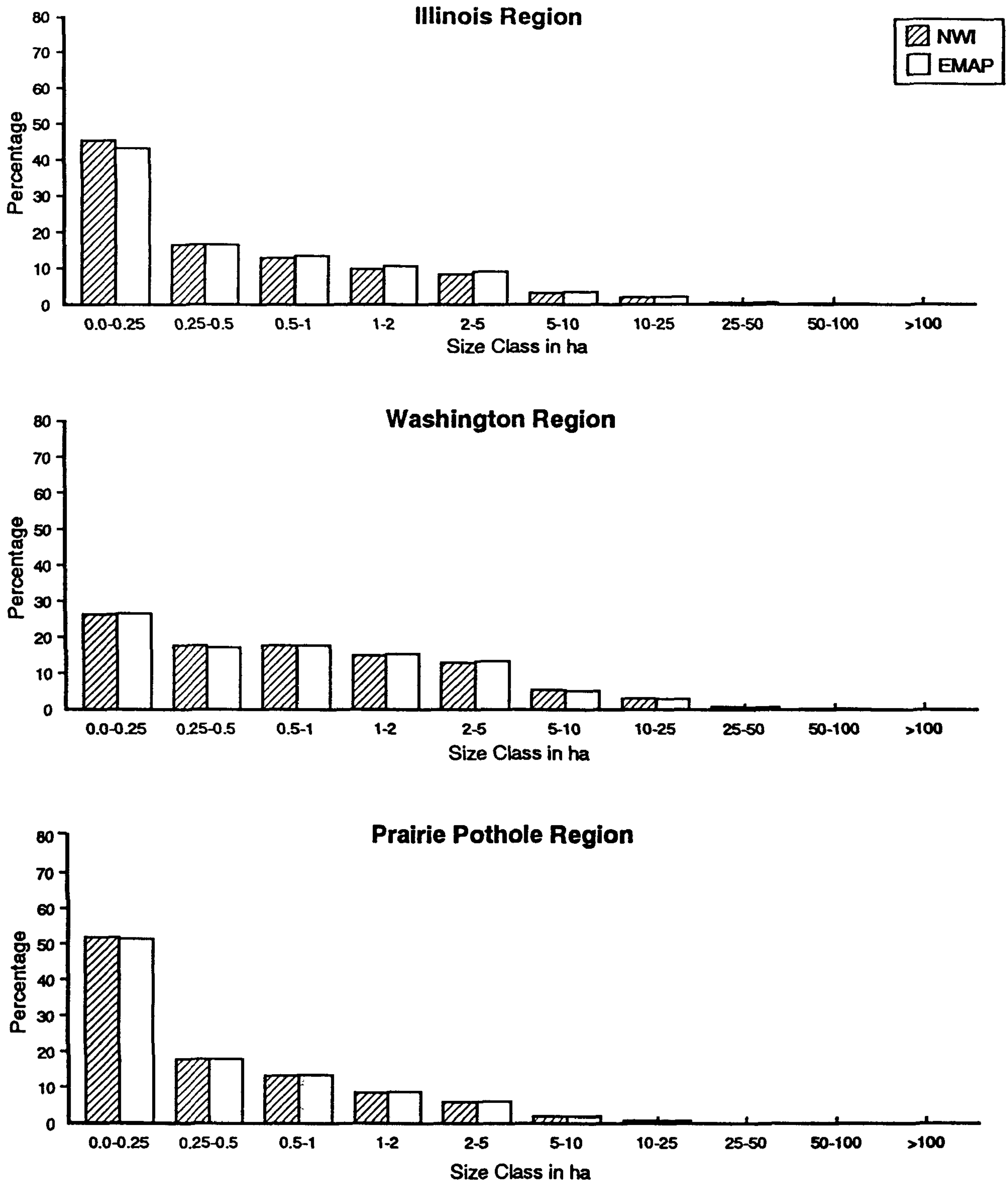

Figure 7. Population summary based on percentage of the number of wetlands in each region.

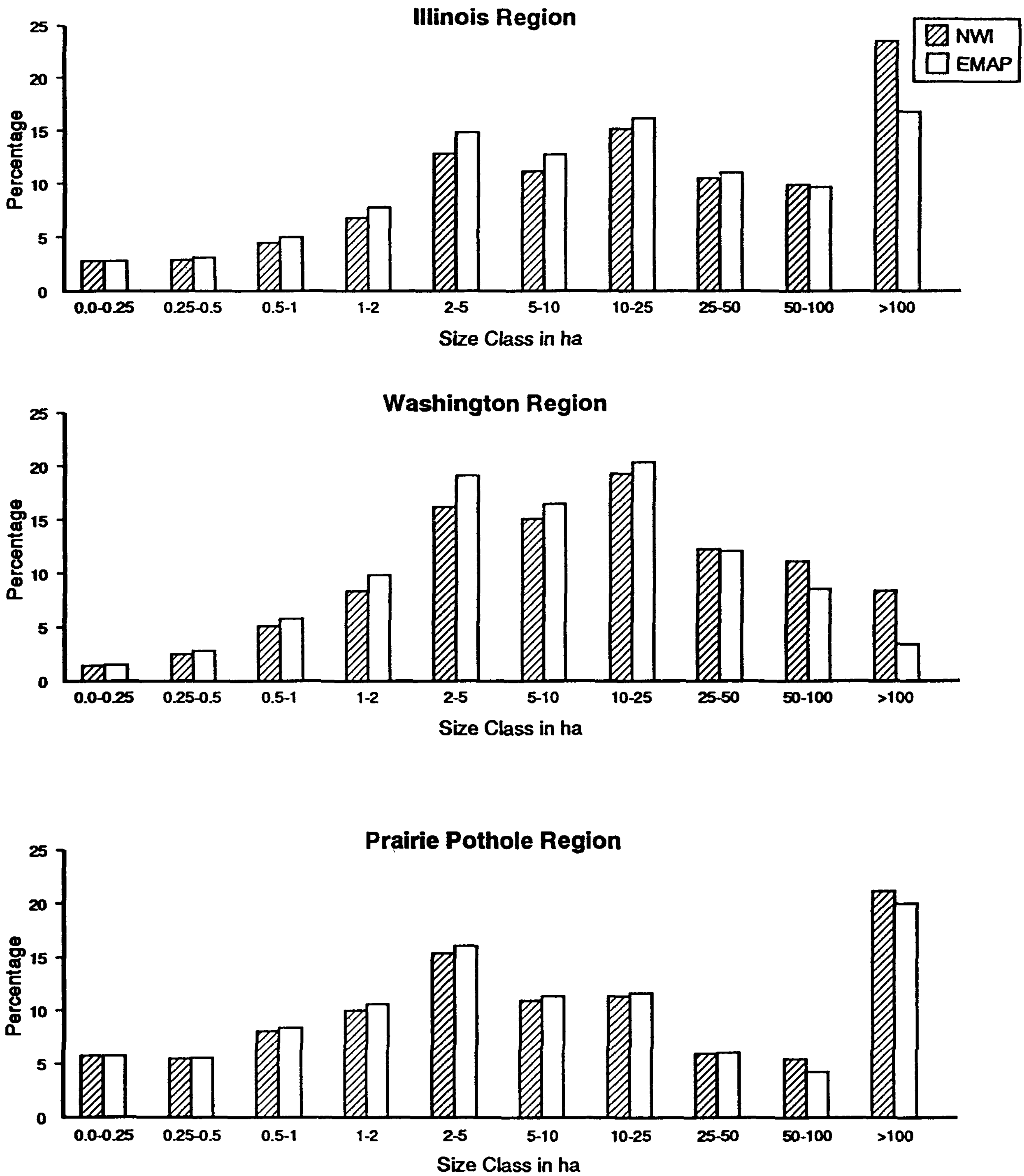

Figure 8. Population summary based on percentage of wetlands surface area in each region.

that these small polygons comprise only 10-20% of the wetland area in a region. In Illinois, 60% of the wetland polygons are less than 0.5 ha in size (see Figure 7), and these comprise 6% of the total wetland area (see Figure 8). Similarly, in Washington, 44% of the EMAP wetland polygons are less than 0.5 ha in size, comprising 4% of the wetland area. Prairie Pothole wetland polygons are also predominantly small, 69% are less than 0.5 ha in size, but comprise only 11% of the total wetland area in the region. Another interesting result is that approximately 21 - 24% of the wetland area in both Illinois and the Prairie Pothole region occur in the size class greater than 100 ha, while only 8% of Washington's wetlands occur in this size class. As expected, the EMAP aggregations of the NWI data result in a slight shift of the distribution of wetland areas to the larger size classes.

Figures 7 and 8 also provide information for assessing the effects of establishing minimum mapping unit standards for the detection of wetlands from aerial photography, satellite imagery or other types of remote sensing technology. Caution is recommended when evaluating map resolutions (e.g., minimum mapping units). Most wetlands in these regions are less than 1.0 ha and samples based on minimum mapping units of greater than 1.0 ha may result in erroneous conclusions by failing to detect the majority of wetlands in a region.

The population analyses reinforce the importance of describing the wetland classification in terms of both numbers and areas. For example, it is assumed that small wetlands surrounded by intense land uses (i.e., agricultural development) will not function or display similar physical and biological attributes as do large wetlands. In addition, we expect that dryer wetlands are subjected to more intense developmental pressures than their wetter counterparts. These commonly held assumptions may not be universally true and additional research is required for substantiation. Thus, when specifying a wetlands sampling design for monitoring purposes, consideration of both size and numeric attributes is important for representing the important biological attributes of a wetland.

Assessment of EMAP Design

The EMAP sampling design is evaluated by comparing the number and area of wetland polygons in the 40 km^2 hexagon sample data to the population parameters (number and area in the 640 km^2 hexagon). Relative differences (the ratio of the difference between the estimated value and the population value divided by the population value), standard errors (SE) and coefficients of variation (CV; ratio of the standard error and the estimated value) are employed to assess the performance of the statistical design in each region.

The assessment of the EMAP design using a fixed sample is subject to the following limitations:

1) Estimates of wetland classes with small numbers or areas would exhibit low precision.
   We expect rare wetland classes to exhibit high variability estimates with larger relative differences between the true population parameters and the estimated values.

2) The presence of a few wetlands with very large areas may adversely affect precision.
   If a rare large wetland was selected in the sample, the resulting estimated total area and the variability estimate of that class would be high. In other words, the estimated variance for wetland area will be high if a few, very large wetlands are present.

3) <u>The resulting estimates of population numbers and areas are not independent</u>.

When one parameter is not estimated well neither is the other. Estuarine emergents are not well estimated using the current design structure. This was expected because of the spatially restricted distribution of estuarine emergents along the Washington coast; the EMAP sampling plan supports intensification to allow better estimation of features of this EMAP class.

The EMAP design provides accurate and precise estimates of wetland numbers and areas with the exception of rare classes (e.g., saturated emergents, PEMB; saturated emergents along rivers, PEMBR; saturated forest/scrub-shrub along rivers, PFO/SSBR; and saturated forest/scrub-shrub, PFO/SSB (see Tables 4-6 and Figures 9-11). Relative differences were comparatively low for most EMAP classes (excluding rare classes). Recall that relative difference is a measure of accuracy. In Figures 9-11, relative difference is displayed along the abscissa. EMAP classes closest to a vertical line through zero on the abscissa are estimated with the greatest accuracy. Generally the rare EMAP classes are estimated with less accuracy than common classes. For example, in Illinois, the relative difference for numbers of PEMA (<0.01), PEMC (-0.01), PL (-0.03), and PS (-0.01), were quite good (see Table 4 and Figure 9). In the Prairie Pothole region the results are based on a very small number of hexagons and therefore, less satisfactory estimates are expected. The existence of a few large wetland areas among the smaller sized wetlands would result in larger variances and thus less accurate estimates (see Table 6 and Figure 11).

The CV is a function of the standard error relative to the mean and is a measure of precision. Recall that the estimated CVs are probably high because of the variance approximation used. The estimated variance overestimates the true variance if wetlands display a clustered spatial distribution. Figures 9-11 display the CV along the ordinate axis. The higher a value is along the ordinate axis indicates that the estimate was measured less precisely than those lower on the axis.

Therefore, EMAP classes clustered closest to the point 0,0 are the most accurate and precise estimates. Generally, EMAP classes with fewer that 500 wetland polygons were estimated with less precision (CV range: 0.50 to 0.97) and accuracy (relative difference range: 0.38 to 2.20). In only one class, seasonally flooded palustrine forested/scrub-shrub (PFO/SSC) wetlands of the Prairie Pothole region, was this not the case. There were 366 PFO/SSC wetland polygons with a relative difference of -0.04 and CV of 0.25 (see Tables 4-6).

The EMAP sampling design provides accurate and precise estimates of wetland numbers and surface areas with the true population value usually contained within the 90% confidence bounds. Exceptions to this trend were usually, but not always, rare classes. In the Washington region, PEMA, PEMC and PS wetlands were underestimated with respect to wetland surface area. A likely explanation is the existence of several large wetlands of these types in the region. In the Prairie Pothole region, PL was underestimated with respect to both numbers of wetland polygons and surface area and PEMA, PEMC and PL with respect to surface area. Sample size in addition to the existence of a few large wetlands contributed to the relatively poorer estimations. The EMAP sampling design provides for intensification of the sampling grid density to increase the sampling intensity when rare classes are of interest.

Aggregation into the selected size classes creates no rare classes, therefore, numbers of wetland polygons are estimated more accurately than the EMAP classes (see Tables 7-9 and Figure 12). Aggregation into size classes reduces variation of surface area resulting in increased accuracy. In addition, the EMAP design provided precise estimates for most size classes, with CVs less than 15% for most size classes below 10 ha in size. The relative difference increases slightly as the size classes increase from 10 to 100 ha, this is considered a function of fewer wetland polygons in these size classes, and results in higher estimates of variability and relative difference between the estimated population characteristics. In most size classes the 90% confidence intervals for the estimates of wetland polygon number and surface areas contained the true population value.

Table 4. Sample estimates for number and areas of wetlands by EMAP class for the Illinois region. "*" indicates that the true population value is contained within the estimate's confidence interval. NP identifies EMAP classes not present in the region. "--" denotes that estimates were not obtainable for that EMAP class in the region.

A. --------------- Number of Wetlands ---------------

EMAP Class	Number	Est. Number	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
E2EM	NP	--	--	--	--	--	--
E2FO/SS	NP	--	--	--	--	--	--
PEMAR	968	1079	0.11	208	0.19	737	1422*
PEMA	11518	11531	<0.01	1398	0.12	9231	13831*
PEMBR	5	0	-1.00	--	--	--	--
PEMB	104	64	-0.38	44	0.68	-8	136*
PEMCR	1169	1287	0.10	215	0.17	934	1640*
PEMC	16483	16331	-0.01	2509	0.15	12203	20459*
PFO/SSAR	7515	8276	0.10	1196	0.14	6310	10243*
PFO/SSA	9438	10267	0.09	1193	0.12	8303	12230*
PFO/SSBR	1	0	-1.00	--	--	--	--
PFO/SSB	9	0	-1.00	--	--	--	--
PFO/SSCR	2587	3116	0.20	941	0.30	1567	4664*
PFO/SSC	6568	7882	0.20	1239	0.16	5845	9920*
PL	1861	1776	-0.03	533	0.30	900	2652*
PS	61519	60600	-0.01	7302	0.12	48588	72611*
TOTAL	119745	122209	-0.02				

B. ------ Area of Wetlands in Hectares ------

EMAP Class	Area (ha)	Est. Area	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
E2EM	NP	--	--	--	--	--	--
E2FO/SS	NP	--	--	--	--	--	--
PEMAR	2742	4089	0.49	1288	0.32	1969	6208*
PEMA	9929	9855	-0.01	1528	0.16	7341	12369*
PEMBR	90	0	-1.00	--	--	--	--
PEMB	401	93.26	-0.77	84	0.90	-45	232
PEMCR	4690	4395	-0.06	1661	0.38	1663	7128*
PEMC	20806	18279	-0.12	4398	0.24	11044	25513*
PFO/SSAR	79920	81169	0.02	25290	0.31	39566	122771*
PFO/SSA	37012	42018	0.14	9661	0.23	26125	57910*
PFO/SSBR	0	0	1.00	--	--	--	--
PFO/SSB	27	0	-1.00	--	--	--	--
PFO/SSCR	24427	22457	-0.09	7110	0.32	10762	34153*
PFO/SSC	21584	20028	-0.07	4050	0.20	13365	26691*
PL	19751	14816	-0.25	6497	0.44	4129	25503*
PS	26042	26169	<0.01	2936	0.11	21339	30999*
TOTAL	247421	243368	0.02				

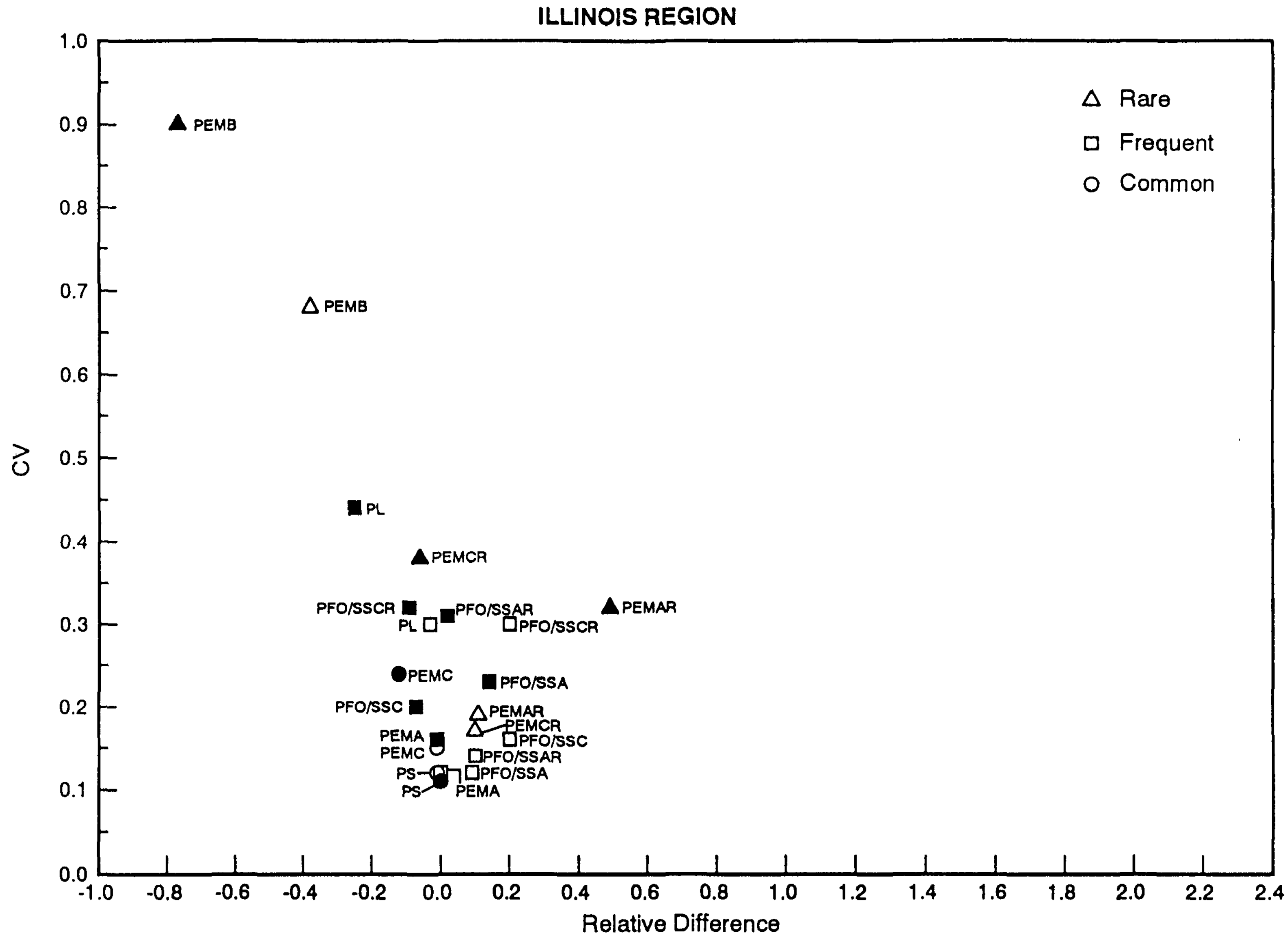

Figure 9. Scatter plot for the Illinois region relating relative differences, a measure of accuracy, and CVs, a measure of precision. Open symbols represent numbers of wetland polygons while closed symbols represent surface area of wetlands. Categories of rare (<1%), frequent (1%-10%), and common (>10%) are relative to the total number of wetland polygons or total wetland surface area. Estimates were not obtained for the PEMBR, PFO/SSBR and PFO/SSB classes due to low numbers in the population. Two EMAP-Wetlands classes were not found in the region; E2EM and E2FO/SS.

Table 5. Sample estimates for number and areas of wetlands by EMAP class for the Washington region. "*" indicates that the true population value is contained within the estimate's confidence interval. "--" denotes that estimates were not obtainable for that EMAP class in the region.

A. -------------- Number of Wetlands --------------

EMAP Class	Number	Est. Number	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
E2EM	839	800	-0.05	260	0.33	372	1228*
E2FO/SS	15	48	2.20	34	0.72	-9	105*
PEMAR	507	433	-0.15	156	0.36	176	690*
PEMA	2443	1905	-0.22	544	0.29	1010	2800*
PEMBR	43	16	-0.63	15	0.97	-9	41
PEMB	278	160	-0.42	113	0.71	-26	346*
PEMCR	2219	1582	-0.29	351	0.22	1004	2160*
PEMC	12318	9664	-0.22	1885	0.20	6564	12765*
PFO/SSAR	2129	2305	0.08	449	0.19	1567	3044*
PFO/SSA	2188	2032	-0.07	395	0.19	1383	2681*
PFO/SSBR	19	0	-1.00	--	--	--	--
PFO/SSB	173	176	0.02	88	0.50	32	320*
PFO/SSCR	4585	4558	-0.01	912	0.20	3058	6058*
PFO/SSC	9454	8753	-0.07	1398	0.16	6452	11053*
PL	746	656	-0.37	238	0.36	264	1048*
PS	8390	6680	-0.22	1145	0.17	4797	8563*
TOTAL	46346	39768	-0.14				

B. ------ Area of Wetlands in Hectares ------

EMAP Class	Area (ha)	Est. Area	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
E2EM	7512	11785	0.57	5244	0.44	3159	20411*
E2FO/SS	37	92	1.50	63	0.69	-12	196*
PEMAR	3422	4428	0.29	3544	0.80	-1403	10259*
PEMA	6267	2968	-0.53	1271	0.43	878	5059
PEMBR	36	1	-0.96	1	0.97	-1	4
PEMB	303	111	-0.64	96	0.87	-48	269
PEMCR	9265	6306	-0.32	2249	0.36	2606	10006*
PEMC	19661	12970	-0.34	3594	0.28	7058	18881
PFO/SSAR	8979	7161	-0.20	1884	0.26	4062	10259*
PFO/SSA	5947	5642	-0.05	1624	0.29	2971	8312*
PFO/SSBR	16	0	-1.00	--	--	--	--
PFO/SSB	158	99	-0.37	78	0.78	-28	227*
PFO/SSCR	18336	21396	0.17	8385	0.39	7603	35189*
PFO/SSC	25477	31952	0.25	9055	0.28	17058	46848*
PL	2759	1851	-0.33	857	0.46	441	3261*
PS	5676	3469	-0.39	608	0.18	2469	4468
TOTAL	113851	110231	0.03				

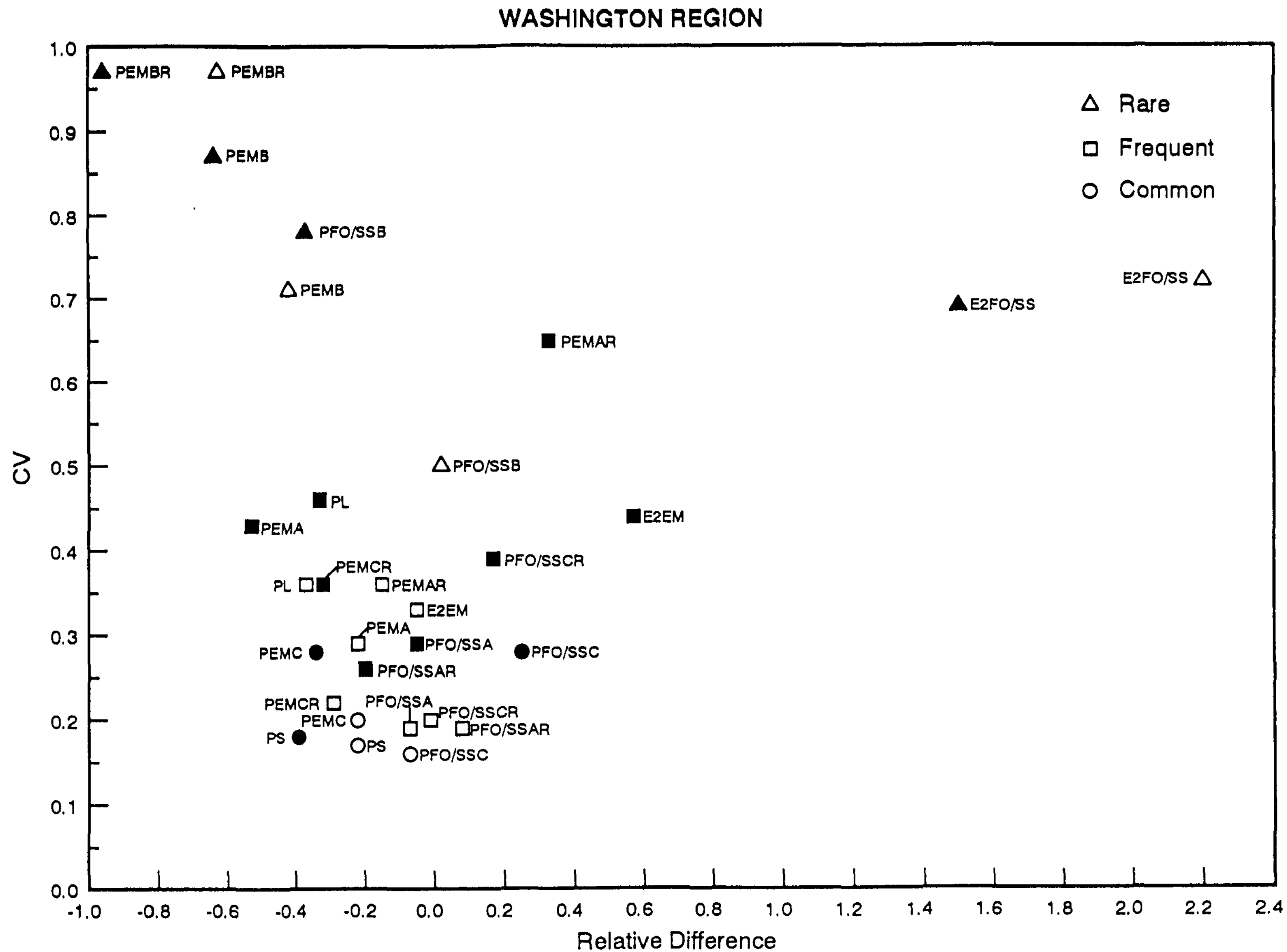

Figure 10. *Scatter plot for the Washington region relating relative differences*, a measure of accuracy, and CVs, a measure of precision. Open symbols represent numbers of wetland polygons while closed symbols represent surface area of wetlands. Categories of rare (<1%), frequent (1%-10%), and common (>10%) are relative to the total number of wetland polygons or total wetland surface area. Estimates were not obtained for the PFO/SSBR class due to low numbers in the population. All EMAP-Wetlands classes were found in the region.

Table 6. Sample estimates for number and areas of wetlands by EMAP class for the Prairie Pothole region. "*" indicates that the true population value is contained within the estimate's confidence interval. NP identifies EMAP not present in the region. "--" denotes that estimates were not obtainable for that EMAP class in the region.

A. -------------- Number of Wetlands --------------

EMAP Class	Number	Est. Number	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
E2EM	NP	--	--	--	--	--	--
E2FO/SS	NP	--	--	--	--	--	--
PEMAR	103	16	-0.84	15	0.97	-9	41
PEMA	99067	102704	0.04	13144	0.13	81082	124326*
PEMBR	NP	--	--	--	--	--	--
PEMB	2	0	-1.00	--	--	--	--
PEMCR	112	0	-1.00	--	--	--	--
PEMC	102252	84640	-0.17	10836	0.13	66815	102465*
PFO/SSAR	93	0	-1.00	--	--	--	--
PFO/SSA	1163	1232	0.06	261	0.21	802	1662*
PFO/SSBR	NP	--	--	--	--	--	--
PFO/SSB	NP	--	--	--	--	--	--
PFO/SSCR	88	0	-1.00	--	--	--	--
PFO/SSC	366	352	-0.04	87	0.25	209	495*
PL	2739	944	-0.66	469	0.50	173	1715
PS	13554	12032	-0.11	1360	0.11	9794	14270*
TOTAL	219539	210920	0.08				

B. ------ Area of Wetlands in Hectares ------

EMAP Class	Area (ha)	Est. Area	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
E2EM	NP	--	--	--	--	--	--
E2FO/SS	NP	--	--	--	--	--	--
PEMAR	859	46	-0.95	44	0.97	-27	118
PEMA	85644	65046	-0.24	6826	0.10	53817	76275
PEMBR	NP	--	--	--	--	--	--
PEMB	48	0	-1.00	--	--	--	--
PEMCR	2999	0	-1.00	--	--	--	--
PEMC	133691	104001	-0.22	10933	0.11	86015	121986
PFO/SSAR	186	0	-1.00	--	--	--	--
PFO/SSA	488	539	0.10	159	0.30	277	801*
PFO/SSBR	NP	--	--	--	--	--	--
PFO/SSB	NP	--	--	--	--	--	--
PFO/SSCR	231	0	-1.00	--	--	--	--
PFO/SSC	304	278	-0.09	106	0.38	104	452*
PL	20586	6206	-0.70	3670	0.59	168	1244
PS	7228	6960	-0.04	1625	0.23	4287	9632*
TOTAL	252264	183076	0.27				

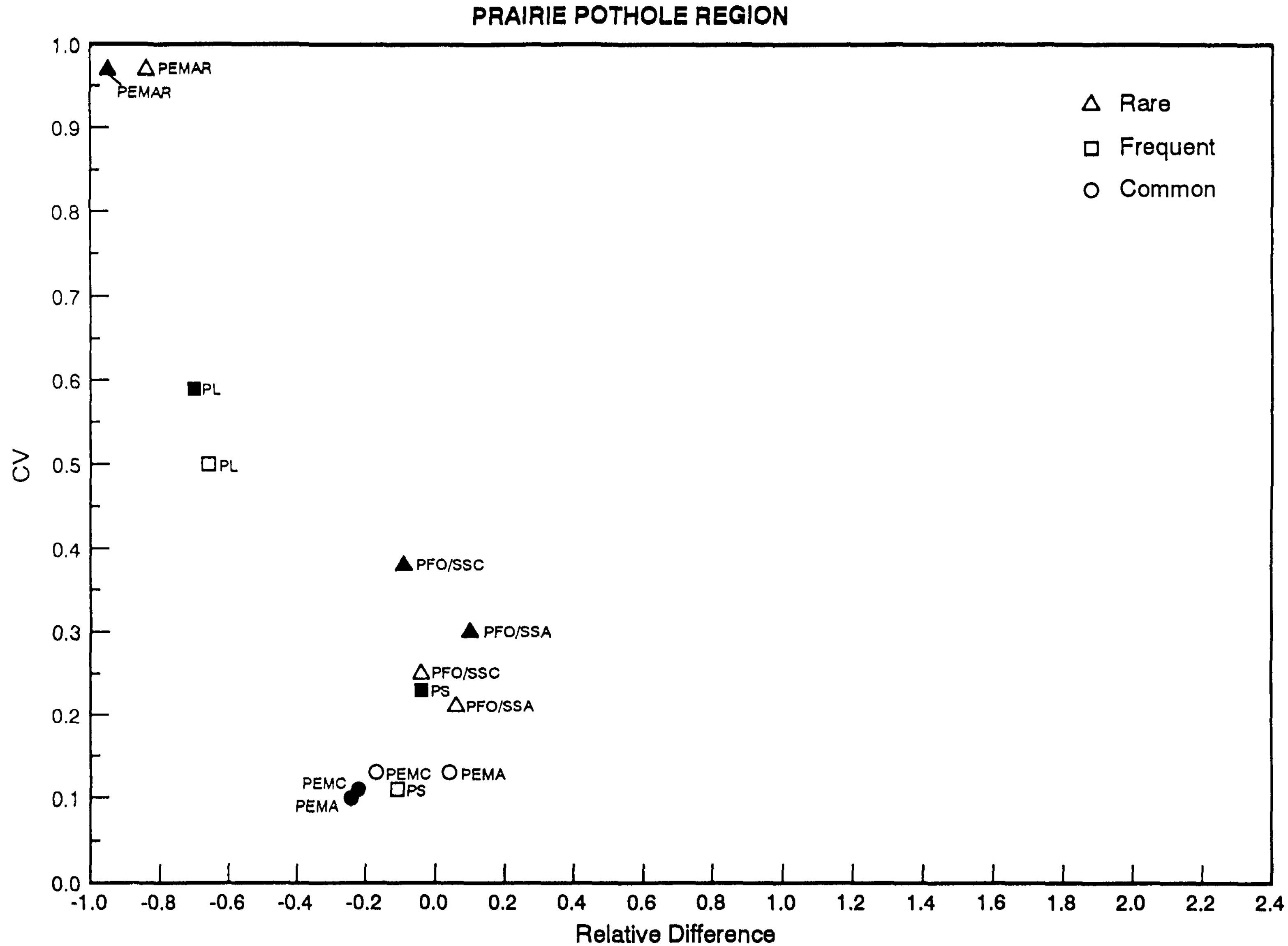

Figure 11. Scatter plot for the Prairie Pothole region relating relative differences, a measure of accuracy, and CVs, a measure of precision. Open symbols represent numbers of wetland polygons while closed symbols represent surface area of wetlands. Categories of rare (<1%), frequent (1%-10%), and common (>10%) are relative to the total number of wetland polygons or total wetland surface area. Estimates were not obtained for the PEMB, PEMCR, PFO/SSAR and PFO/SSCR classes due to low numbers in the population. Five EMAP-Wetlands classes were not found in the region; E2EM, E2FO/SS, PEMBR, PFO/SSBR and PFO/SSB.

Table 7. Sample estimates by size class for the Illinois region. "*" indicates that the true population value is contained within the estimate's confidence interval.

A. --------------- Number of Wetlands ---------------

						90% Conf. Int.	
Size Class	Number	Est. Number	Rel. Diff.	SE	CV	Lower Bound	Upper Bound
0 - 0.25	54299	54529	<0.01	6375	0.12	44042	65016*
0.25 - 0.50	20009	20304	0.01	1835	0.09	17285	23322*
0.50 - 1.0	15519	15963	0.03	1384	0.09	13686	18241*
1 - 2	11902	12671	0.06	1165	0.09	10754	14587*
2 - 5	10198	10797	0.06	1039	0.10	9089	12504*
5 - 10	4007	4064	0.01	474	0.12	3284	4845*
10 - 25	2454	2504	0.02	392	0.16	1859	3149*
25 - 50	755	843	0.12	151	0.18	596	1091*
50 - 100	351	389	0.11	94	0.24	234	544*
>100	250	144	-0.42	63	0.43	41	247

B. ---------- Area of Wetlands in Hectares ----------

						90% Conf. Int.	
Size Class	Area (ha)	Est. Area	Rel. Diff.	SE	CV	Lower Bound	Upper Bound
0 - 0.25	6847	6901	0.01	768	0.11	5637	8165*
0.25 - 0.50	7120	7291	0.02	658	0.09	6209	8373*
0.50 - 1.0	11021	11264	0.02	983	0.09	9647	12880*
1 - 2	16833	17892	0.06	1654	0.09	15172	20613*
2 - 5	31896	34225	0.07	3416	0.10	28605	39845*
5 - 10	27633	27786	0.01	3322	0.12	22321	33251*
10 - 25	37642	38525	0.02	6114	0.16	28467	48583*
25 - 50	25919	29177	0.13	5494	0.19	20139	38215*
50 - 100	24465	25619	0.05	6098	0.24	15589	35650*
>100	58044	44688	-0.23	25404	0.57	2899	86477*

Table 8. Sample estimates by size class for the Washington region. "*" indicates that the true population value is contained within the estimate's confidence interval.

A. -------------- Number of Wetlands --------------

						90% Conf. Int.	
Size Class (ha)	Number	Est. Number	Rel. Diff.	SE	CV	Lower Bound	Upper Bound
0 - 0.25	12279	10793	-0.12	1747	0.16	7919	13666*
0.25 - 0.50	8280	7727	-0.07	910	0.12	6231	9224*
0.50 - 1.0	8247	6928	-0.16	879	0.13	5481	8375*
1 - 2	6938	5169	-0.25	791	0.15	3868	6471
2 - 5	6028	5071	-0.16	844	0.17	3683	6459*
5 - 10	2497	2096	-0.16	463	0.22	1334	2858*
10 - 25	1439	1296	-0.10	375	0.29	680	1912*
25 - 50	406	400	-0.01	194	0.48	81	719*
50 - 100	178	208	0.17	109	0.53	28	388*
>100	55	80	0.45	40	0.51	13	147*

B. --------- Area of Wetlands in Hectares ---------

						90% Conf. Int.	
Size Class (ha)	Area (ha)	Est. Area	Rel. Diff.	SE	CV	Lower Bound	Upper Bound
0 - 0.25	1691	1499	-0.11	233	0.16	1116	1882*
0.25 - 0.50	2972	2813	-0.06	330	0.12	2270	3355*
0.50 - 1.0	5961	4982	-0.16	639	0.13	3931	6033*
1 - 2	9845	7365	-0.25	1143	0.16	5484	9246
2 - 5	18851	15753	-0.16	2658	0.17	11381	20125*
5 - 10	17297	14916	-0.14	3347	0.22	9412	20422*
10 - 25	22308	20843	-0.07	5969	0.29	11024	30661*
25 - 50	13941	13739	-0.01	6863	0.50	2450	25028*
50 - 100	11865	15060	0.27	8005	0.53	1891	28228*
>100	9113	13261	0.45	7128	0.54	1536	24986*

Table 9. Sample estimates by size class for the Prairie Pothole region. "*" indicates that the true population value is contained within the estimate's confidence interval.

A. --------------- Number of Wetlands ---------------

						90% Conf. Int.	
Size Class (ha)	Number	Est. Number	Rel. Diff.	SE	CV	Lower Bound	Upper Bound
0 - 0.25	113549	115531	0.02	12055	0.10	95700	135361*
0.25 - 0.50	39212	39415	0.01	3799	0.10	33167	45664*
0.50 - 1.0	29046	30076	0.04	2508	0.08	25950	34202*
1 - 2	18308	17575	-0.04	1736	0.10	14719	20432*
2 - 5	12733	12372	-0.03	1068	0.09	10615	14128*
5 - 10	4013	3449	-0.14	464	0.13	2686	4213*
10 - 25	1923	1633	-0.15	239	0.15	1240	2027*
25 - 50	437	321	-0.27	82	0.26	186	455*
50 - 100	198	96	-0.52	47	0.49	18	174
>100	121	55	-0.55	37	0.68	-6	116

B. ---------- Area of Wetlands in Hectares ----------

						90% Conf. Int.	
Size Class (ha)	Area (ha)	Est. Area	Rel. Diff.	SE	CV	Lower Bound	Upper Bound
0 - 0.25	14557	14862	0.02	1486	0.10	12418	17306*
0.25 - 0.50	13951	14004	<0.01	1337	0.10	11085	16204*
0.50 - 1.0	20535	21211	0.03	1784	0.08	18277	24145*
1 - 2	25574	24450	-0.04	2434	0.10	20446	28454*
2 - 5	38810	37399	-0.04	3332	0.09	31919	42880*
5 - 10	27673	23454	-0.15	3298	0.14	18029	28879*
10 - 25	28717	23087	-0.20	3426	0.15	17451	28723*
25 - 50	15123	10894	-0.28	2907	0.27	6112	15676*
50 - 100	13839	7312	-0.47	3623	0.50	1352	13273
>100	53485	6400	-0.88	4362	0.68	-776	13576

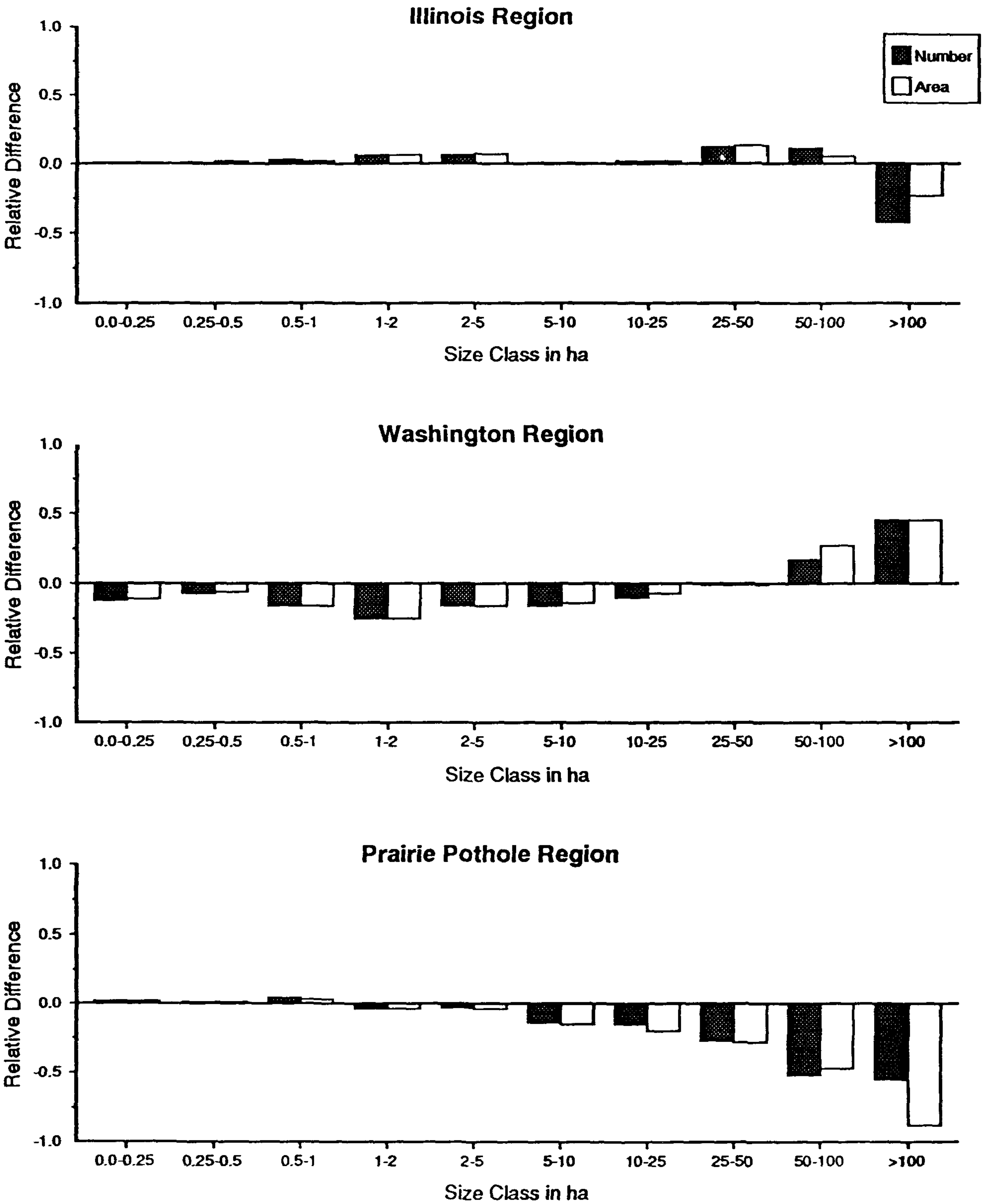

Figure 12. Comparison of the relative differences between the true population value and the estimated value for wetland numbers and surface area for several size classes in the 3 regions.

CONCLUSIONS

The goal of this study was to quantitatively assess the EMAP-Wetland's classification and statistical sampling design with the following objectives in mind: 1) compare wetland polygon numbers, surface areas, common versus rare wetland classes and the effect imposing a minimum mapping unit, 2) evaluate the EMAP base grid density of 27 km between sampling points and compare sample values to known population values, 3) compare the sampling design and EMAP classification across the three regions, 4) discuss procedures for generating a sampling frame using the NWI digital data.

The large majority of wetlands in the three regions were less than 1 ha in size. The types of wetlands in each of the regions were distinct. In the Illinois region the most common wetlands were seasonally flooded palustrine emergents (PEMC) and palustrine shallows (PS). All wetlands classes were present in the Washington region which was dominated by seasonally flooded palustrine emergents (PEMC) seasonally flooded forest/shrub-scrub wetlands (PFO/SSC) and palustrine shallows (PS). Palustrine emergents, both temporarily (PEMA) and seasonally flooded (PEMC), dominated the Prairie Pothole region. Information presented in this study regarding the size distribution of wetlands provides resource managers and others interested in wetland monitoring and assessment programs with the means to evaluate the magnitude of the effect of imposing minimum mapping units. For example, if a minimum mapping unit of 0.5 ha was chosen as the resolution level for identifying wetlands using remote sensing technology, approximately 70% of the wetlands in the Prairie Pothole region would be excluded. This would severely bias the results and underestimate the wetlands.

Evaluation of the sample data by comparison to the known population values provided accurate and precise estimates of wetland polygon numbers and surface areas with the exception of rare EMAP classes. It is unusual and informative to have the population data available to evaluate the performance of a sampling design. The availability of the population permitted identification of rare EMAP classes however, precision estimates for rare classes were lower than the more common classes. This is characteristic of any design not specifically tailored for the objective of estimating rare classes well. Population information pertaining to rare classes will prove valuable when intensifying the base grid density to sample a rare class.

The EMAP sampling design with a base grid density of 27 km performs well with the possible exception of rare classes and classes with restricted spatial distributions (e.g., estuarine emergent wetlands). Relative differences and CVs were comparatively low. The 90% confidence intervals for the estimates usually contained the population values for both the EMAP classes and size classes. The base grid density may require intensification to ensure adequate sample sizes for rare and spatially restricted wetland types when those classes are of interest. Results from our study suggest that intensification of the base sampling grid may be necessary when fewer than 500 wetlands occur in an EMAP class over a given region. Also, wetlands with surface areas above 50 ha, may also require intensification of the base grid density for adequate sampling. Rare wetland classes in the region sampled include saturated palustrine emergents (PEMB), saturated emergents along rivers (PEMBR) and saturated forest/scrub-shrub wetlands along rivers (PFO/SSBR).

Across all three regions the majority of wetlands were relatively small (less than 1 ha). The most common EMAP class across the regions were the seasonally flooded emergents (PEMC). Relatively rare EMAP classes across the three regions were saturated emergents (PEMB), saturated emergents along rivers (PEMBR), saturated forest/scrub-shrub along rivers (PFO/SSBR) and saturated forest/scrub-shrub (PFO/SSB).

As expected, the aggregation of wetlands from the NWI classification to the EMAP classification results in fewer wetlands with larger areas. Total wetland surface area in a region, however, is not affected. The presence of extremely large wetlands also creates a problem for area estimates. A possible solution would be sampling these wetlands employing a separate sampling design. Large wetlands are easy to locate and therefore development of a list frame should not pose a problem. Augmentation of the EMAP base grid density will be necessary for rare wetlands and those that are spatially restricted (e.g., estuarine emergent wetlands) to ensure adequate sample sizes. The EMAP sampling design allows for intensification across regions.

The NWI classification and digitized maps can be used for the EMAP sample frame development in the regions investigated. Expansion of this procedure for implementation across the entire U.S. requires further study. The NWI maps effectively match the criteria for EMAP sample frame development presented in the introduction. The NWI maps contain spatial data, include information about the distribution and extent of wetlands, when completed will cover the entire U.S. and, include all wetlands of interest to EMAP-Wetlands. The NWI program was designed to estimate total acreage and change in total acreage for each wetland type within 10% of the true values with a 90% probability (Frayer, et al. 1983). Our study demonstrates that the NWI classification based on Cowardin et al. (1979) can successfully be aggregated into the EMAP classification. This successful aggregation demonstrates that EMAP-Wetlands can develop sampling frames from the available NWI digital data sets.

It is expected that the EMAP sampling design and EMAP classification system will be useful for wetlands resource managers implementing regional monitoring and research programs. The NWI maps are currently the most appropriate maps available for EMAP-Wetlands sampling frame development. The NWI maps provide national coverage, include the distribution and extent of wetlands, and are the most complete in terms of covering the nations wetlands. The EMAP classification and sampling design based on NWI digital data will require only field verification (i.e., ground truthing) before implementation.

LITERATURE CITED

Cochran, W.G. 1977. Sampling Techniques. John Wiley and Sons, New York, New York. 428pp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-79/31. 131 pp.

Crowley, S., C. O'Brien, and S. Shea. 1988. Results of the wetland study and the 1988 draft wetland rules. Report by the Agency of Natural Resources Divisions of Water Quality, Waterbury, VT. 33 pp.

Frayer, W.E., T.J. Monahan, D.C. Bowden, and F.A. Graybill. 1983. Status and Trends of Wetlands and Deepwater Habitats of the Conterminous United States, 190's to 1970's. Colorado State University, Fort Collins, colorado. 32pp.

Leibowitz, N., L. Squires, and J. Baker. 1991. Research Plan for Monitoring Wetland Ecosystems. EPA/600/3-91/010. U.S. Environmental Protection Agency, Environmental Research Laboratory, Corvallis, OR. 157 pp plus appendices.

Mann, G.E. 1974. The Prairie Pothole Region: A Zone of Environmental Opportunity. [Map.] Naturalist 25(4):2.

Omernik, J.M. 1987. Ecoregions of the United States. Map at a scale of 1:7,500,000. Supplement to the Annals of the Association of American Geographers, Volume 77, Number 1.

Overton, W.S., D. White, and D.L. Stevens, Jr. 1991. Design Report for EMAP, Environmental Monitoring and Assessment Program. EPA 600/3-91/053. US Environmental Protection Agency, Environmental Research Laboratory, Corvallis, OR.

Roose, D.V. and K.K. Stout. 1992. GIS Methods for Reclassifying Wetland Maps for EMAP Sampling and Monitoring. Proceedings of the Twelfth Annual ESRI User Conference, Palm springs, CA. 19pp.

Snedecor, G.W. and W.G. Cochran. 1980. Statistical Methods. The Iowa State University Press, Ames, Iowa. 507pp.

Swartwout, D.J. 1982. An evaluation of National Wetlands Inventory in Massachusetts. MS Thesis, University of Massachusetts, Amherst. 123 pp.

U.S. Fish and Wildlife Service, National Wetlands Inventory. 1990a. Photointerpretation Conventions of the National Wetlands Inventory. Internal document. U.S. Fish and Wildlife Service, St. Petersburg, Florida. 45pp plus appendices.

U.S. Fish and Wildlife Service, National Wetlands Inventory. 1990b. Cartographic Conventions for the National Wetlands Inventory. Internal document. U.S. Fish and Wildlife Service. St. Petersburg, Florida. 43pp plus appendices.

Wilen, B.O. 1990. The U.S. Fish and Wildlife Service's National Wetlands Inventory. pp. 9-20 In: S.J. Kiraly, R.A. Cross, and J.D. Buffington (eds.) Federal Coastal Wetlands Mapping Programs. FWS Biological Report 90(18). US Department of the Interior Fish and Wildlife Service, Washington, DC.

Appendix A

Database Design and Procedures Necessary to
Correct Errors Associated with
Use of Multiple GIS Coverages

Database

The original NWI digital data existed in individual coverages equivalent in extent to U.S.G.S. 7 1/2' quadrangles. Software storage limitations (ARC/Info allows only 10,000 arcs per polygon) prevented the creation of one large GIS coverage for each region. A database design was therefore needed to partition the digital data into several artificially divided coverages, or tiles, with minimal effect on the desired wetland attributes. The optimum tile structure was defined as one that:

1) Would cover the largest geographic area (require the fewest coverage boundaries) as possible without exceeding ARC/Info storage limitations during any stage of processing,
2) Would not perturb the size and number of wetlands in the sample population (40 km^2 hexagons),
3) Would facilitate the correct coding of EMAP wetlands located at the borders of the separate coverages,
4) Would promote calculation of error rates associated with the impact of the coverage boundaries on wetland attributes.

The optimal tile size, location, and configuration was determined to be a 640 km^2 hexagon, positioned on the centroid of the 40 km^2 hexagon. Thus adjacent tiles represent continuous coverage of a study area, in which the center hexagon (1/16th of area) experiences a minimal chance of being cut by a tile boundary.

ARC/Info's Librarian module was used to reformat the data from the NWI quadrangle digital cover into the 640 km^2 tile structure. Librarian was selected for its extraction capability, the capability to automatically create a coverage of any defined geographical extent from a collection of source coverages. Because the data is geographically referenced within Librarian, the software can easily acquire the data, copy it, and reconstruct topologically correct coverages. This capability was used in the wetland recoding and enumeration steps described below. The Librarian software also provided a passive quality control on the data by accepting only source coverages that included identically defined items or data fields in the data base.

Technical Challenges with Polygon Enumerations

The multiple spatial coverages within a region caused some technical challenges which had to be overcome before accurate enumeration of the population was possible. Tile boundaries cut polygons on the border into two or more pieces/polygons, depending on the wetlands's shape, position within the tile, or position within a group of wetlands. (See Figure A1). The resulting total number of wetlands in the study area would be overestimated by summing the total number of wetlands in each tile.

A window coverage, a tile coverage and a 5 km buffer around the tile (refer to Figure 7), was used for both recoding and enumeration purposes. When the tile's boundary arc is inserted into a copy of the window containing wetlands with unique identifiers, wetlands at the tile border are split in pieces. These pieces (polygons) retain their original wetland identification. An INFO program that relates the original window to the 'split' wetland coverage, can count how many times each original wetland identification occurs in the split window. An uncut wetland will be counted as one, while a wetland cut three times receives a value of three.

The corrected number of wetlands in the study area is calculated by summing the number of wetlands that are not cut by the tile structure outline plus half the number of wetlands cut in two pieces plus a third of the number of wetlands cut in three pieces plus ... and so forth.

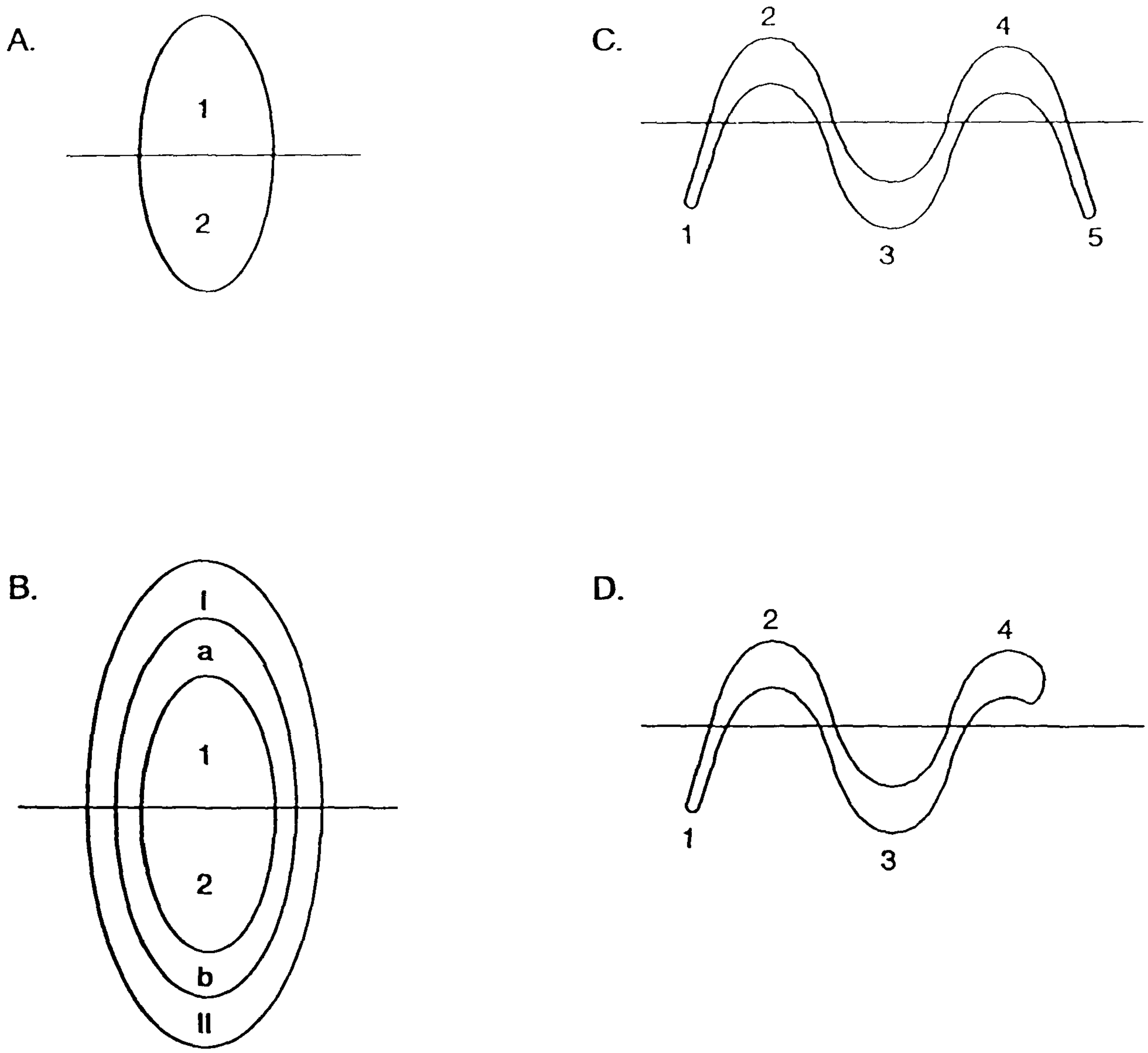

Figure A. **Wetlands can be cut by the tile structure** in various ways, creating an **unpredictable** number of **polygons.**

Appendix B

Technical Challenges Associated with EMAP Coding

Assigning EMAP Hydrologic Locators

An EMAP code depends on both its NWI code and its locational relationship to a perennial riverine or a lacustrine system. Riverine wetlands may be under-represented. Portions of some rivers or streams are mapped as Palustrine and not assigned the riverine hydrologic locator. This is because by NWI mapping conventions, if a river and its adjacent wetland vegetation do not exceed the minimum mapping unit width for polygons then only the wetland vegetation is mapped and represented as a Palustrine linear feature (Roose and Stout, 1992. Rivers or lakes located outside a tile could therefore influence the EMAP class assigned to a wetland within and along the tile's border. Since topological continuity between tiles does not exist in ARC/Info version 5.0.1, one must extract and recode a coverage wider than the tile to make sure that all external river or lake influences on the wetlands inside the tile are taken into account (see Figure B1). This coverage, referred to as 'window' in the text below, includes wetlands inside the tile and from a 5 km buffer area around the tile.

NWI digitizes rivers and lakes as either linear or polygons, depending on their size. In the original data for Illinois, linear and polygon features existed in separate ARC/Info coverages. They were combined in the same coverage for this study to determine adjacency of wetlands to riverine or lacustrine features. Once combined, the impact of surrounding features on each wetland polygon was searched and identified using the powerful relational capabilities of INFO, the database portion of the software. Using INFO for this search greatly increased processing efficiency and reduced processing time.

However, there were situations where INFO topology alone could not accurately code all river edge wetlands (i.e. in the case of island polygons.) According to the EMAP Wetland classification, if a group of contiguous polygon wetlands is surrounded by a riverine wetland, all the individual wetlands are influenced by the river and should receive the appropriate riverine hydrologic locator code. This is true even when there are upland polygons in the group.

Fortunately, ARC manipulations and analyses were well suited to respond to these situations. In the above example, the polygon group is correctly characterized in terms of its relationship to the riverine system by creating a second coverage containing only the riverine polygons, without island groups. By doing so, riverine attributes now extend over the former island area. Overlaying the two coverages creates an INFO table that can be used to code the wetlands from the original coverage that are within the riverine polygons of the second coverage. A similar procedure is used to exclude island wetlands that are completely surrounded by upland.

Coding Limitations

Hydrologic locators were introduced in the EMAP classification to differentiate the source of hydrology among wetlands (e.g., basin, riverine, lacustrine). The riverine locator was intended to represent the influence of all perennial rivers. It was assumed that all rivers were mapped by NWI as riverine systems. However, according to NWI mapping conventions, if a river and its adjacent wetland vegetation do not exceed the minimum mapping unit width for polygons, only the wetland vegetation is mapped and represented as a linear feature. Therefore, portions of some rivers or streams are mapped as palustrine systems, and were not used in this model to assign the riverine hydrologic locator. In some instances, rivers (polygons or linear) were not mapped as they flowed through a chain of wetlands. In those cases the program only assigns the riverine hydrologic locator to the wetland at the ends of the chain. Using non-network GIS topology it is not possible to distinguish between interior wetlands in the chain, and a wetland separated from a river by another wetland. (see Figure B2). Therefore, river edge wetlands will be under represented in both the sample and the wetland population.

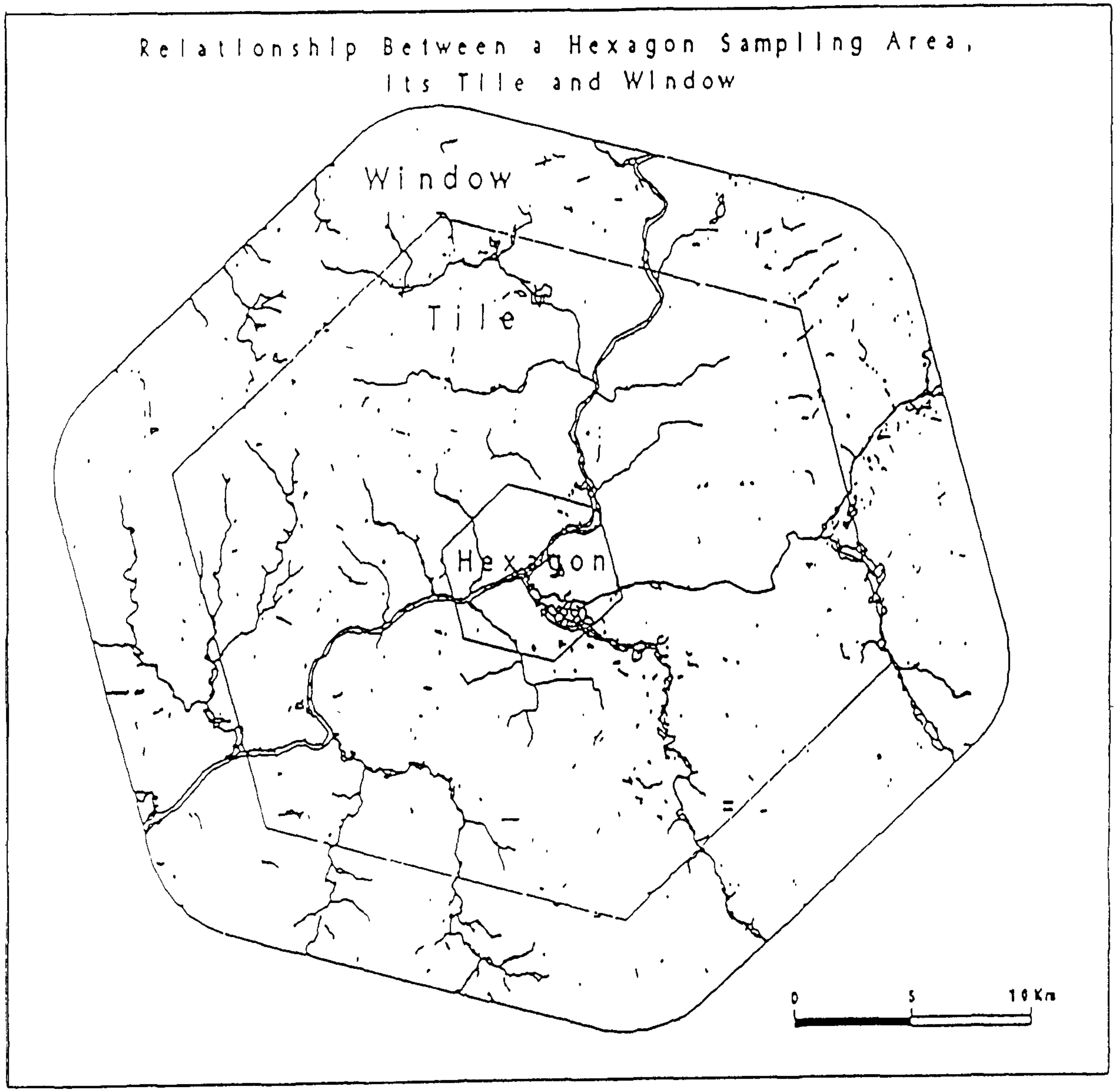

Figure B1. Relationship between a hexagon sampling area, its tile and window.

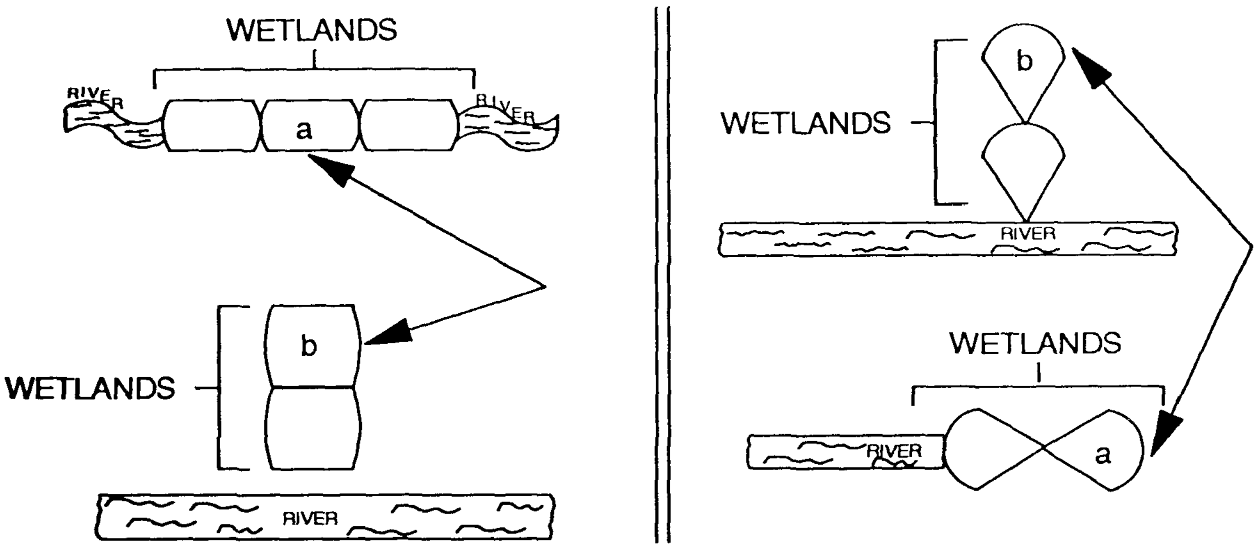

Figure B2. Non-network topology can not distinguish among the situations above.

Old NWI Water Regimes

Some of the quadrangles in the Washington study area were mapped using older NWI water regime modifiers (X,Y,Z). The modifier Y lumps saturated, semipermanent, and seasonal water regimes. These are separate under the EMAP wetland classification (i.e., B = saturated, C = seasonally-permanently flooded). All NWI classes with the Y water regime modifier were placed in a class with a "C" EMAP water regime, the wetter regime.

NWI Mixed Wetland Classes

The NWI-to-EMAP code translation was complicated by the occurrence of NWI mixed classes. If two vegetative classes co-exist in the same wetland and each of them covers at least 30% of the area, NWI codes the wetland with both classes. For example, 'PEM/SS1C' is a palustrine wetland where both emergent and scrub-shrub extend over at least 30% of the area and where 'EM' has the largest extent. In the NWI code, the dominant class precedes the other and is separated from it by a slash (/). This latter may only appear in the fourth, fifth or sixth position in the code, limiting the situations to a manageable and programmable number.

The dominant wetland class is used exclusively when assigning the EMAP wetland code. 'PEM/SS1C' is thus simplified to a Palustrine ('P') Emergent ('EM') for EMAP recoding purpose.

Other Notes

In the recoding program two general classes were created which included EMAP-Surface Water, rivers and lakes, and EMAP-Near Coastal resources, marine and intertidal resources other than wetlands. These classes were not included in the study analysis. In addition, an orphan class was added in order to identify NWI codes not assigned to an EMAP resource class. Wetlands falling into this orphan class were reviewed regularly. Older, obsolete NWI codes in the data were identified this way, and where possible, were assigned to the appropriate EMAP class.

Appendix C

Table summarizing the EMAP classes after aggregating the NWI classes for the Illinois region

Table C. Summary of NWI classes mapped to each EMAP class for the Illinois Region.

		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PEMAR	PEM/FO1A	34	3.3	112.2	4.3	3.30
	PEM/FOA	2	0.2	1.6	0.1	0.82
	PEM/SS1A	70	6.7	201.7	7.7	2.88
	PEM/USA	1	0.1	0.4	0.0	0.45
	PEM1A	4	0.4	5.5	0.2	1.37
	PEMA	824	78.9	1804.6	69.3	2.19
	PEMAD	32	3.1	238.6	9.2	7.46
	PEMADF	8	0.8	56.0	2.2	7.00
	PEMAF	55	5.3	144.8	5.6	2.63
	PEMAH	11	1.1	16.1	0.6	1.46
	PEMAX	4	0.4	23.6	0.9	5.91
PEMA	PEM/FO1A	37	0.3	79.2	0.9	2.14
	PEM/SS1A	97	0.9	346.0	3.7	3.57
	PEM1A	13	0.1	42.9	0.5	3.30
	PEM1AD	1	0.0	1.0	0.0	0.96
	PEM1AF	1	0.0	1.0	0.0	0.96
	PEMA	3900	35.4	3758.7	40.7	0.96
	PEMAC	1	0.0	0.2	0.0	0.20
	PEMAD	385	3.5	818.2	8.9	2.13
	PEMADF	635	5.8	945.9	10.2	1.49
	PEMADH	3	0.0	15.3	0.2	5.10
	PEMAF	5670	51.5	3060.8	33.1	0.54
	PEMAFD	7	0.1	5.8	0.1	0.83
	PEMAFH	4	0.0	2.8	0.0	0.69
	PEMAFX	1	0.0	0.3	0.0	0.25
	PEMAH	168	1.5	102.7	1.1	0.61
	PEMAX	82	0.7	56.4	0.6	0.69
PEMBR	PEM/SS1B	1	20.0	58.5	65.0	58.53
	PEMB	4	80.0	31.5	35.0	7.87
PEMB	PEM/FO1B	4	3.8	36.9	9.2	9.23
	PEM/SS1B	5	4.8	52.4	13.1	10.49
	PEMB	86	81.9	157.1	39.2	1.83
	PEMBD	10	9.5	154.0	38.4	15.40
PEMCR	PEM/FO1C	14	1.1	51.4	1.2	3.67
	PEM/FO1F	6	0.5	13.4	0.3	2.24
	PEM/FOC	1	0.1	0.3	0.0	0.34
	PEM/OWF	1	0.1	4.3	0.1	4.26
	PEM/SS1C	36	2.9	196.3	4.5	5.45
	PEM/SS1F	3	0.2	4.7	0.1	1.55
	PEM/UBF	1	0.1	14.7	0.3	14.72
	PEM1C	4	0.3	4.5	0.1	1.12
	PEM1F	2	0.2	0.5	0.0	0.25
	PEM2G	4	0.3	4.1	0.1	1.02

Illinois Region

		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	**NWI**					
PEMCR	**PEMC**	782	63.9	2250.0	52.0	2.88
	PEMCD	79	6.5	766.0	17.7	9.70
	PEMCDF	10	0.8	373.0	8.6	37.30
	PEMCDH	1	0.1	1.6	0.0	1.58
	PEMCF	8	0.7	5.7	0.1	0.71
	PEMCH	34	2.8	58.2	1.3	1.71
	PEMCX	16	1.3	23.6	0.5	1.47
	PEMF	199	16.3	518.3	12.0	2.60
	PEMFD	5	0.4	5.4	0.1	1.09
	PEMFH	10	0.8	26.4	0.6	2.64
	PEMFX	6	0.5	3.1	0.1	0.52
	PEMG	1	0.1	0.2	0.0	0.15
PEMC	**PEM/AB3F**	6	0.0	106.2	0.5	17.70
	PEM/AB4F	9	0.1	9.2	0.0	1.02
	PEM/ABF	17	0.1	62.8	0.3	3.69
	PEM/ABG	1	0.0	22.7	0.1	22.72
	PEM/FO1C	83	0.5	182.1	0.9	2.19
	PEM/FO1F	9	0.1	13.6	0.1	1.51
	PEM/FO1G	1	0.0	4.0	0.0	4.00
	PEM/FO6F	2	0.0	6.6	0.0	3.32
	PEM/OWF	29	0.2	22.3	0.1	0.77
	PEM/OWFH	2	0.0	8.5	0.0	4.27
	PEM/OWFX	1	0.0	1.4	0.0	1.41
	PEM/OWG	2	0.0	3.0	0.0	1.51
	PEM/SS1C	229	1.4	781.8	4.0	3.41
	PEM/SS1F	12	0.1	19.5	0.1	1.62
	PEM/UBF	5	0.0	48.6	0.2	9.72
	PEM/UBFH	2	0.0	0.3	0.0	0.13
	PEM/UBFX	1	0.0	0.5	0.0	0.47
	PEM/UBGX	1	0.0	2.1	0.0	2.14
	PEM1/2FH	1	0.0	3.5	0.0	3.46
	PEM1C	20	0.1	22.3	0.1	1.11
	PEM1CD	2	0.0	0.2	0.0	0.08
	PEM1CH	5	0.0	1.1	0.0	0.22
	PEM1F	2	0.0	2.5	0.0	1.27
	PEM1FH	1	0.0	0.1	0.0	0.15
	PEM2/AB3	1	0.0	10.0	0.1	10.02
	PEM2CD	2	0.0	1.7	0.0	0.87
	PEM2F	18	0.1	36.9	0.2	2.05
	PEM2FH	2	0.0	0.8	0.0	0.41
	PEM2G	19	0.1	15.6	0.1	0.82

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		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PEMC	PEM2GH	15	0.1	19.7	0.1	1.31
	PEMC	9987	60.8	10529.0	53.3	1.05
	PEMCD	924	5.6	2986.9	15.1	3.23
	PEMCDF	108	0.7	300.6	1.5	2.78
	PEMCDH	5	0.0	37.2	0.2	7.44
	PEMCF	427	2.6	442.6	2.2	1.04
	PEMCFD	1	0.0	2.0	0.0	1.96
	PEMCFX	1	0.0	0.3	0.0	0.32
	PEMCH	714	4.3	494.6	2.5	0.69
	PEMCHX	4	0.0	2.9	0.0	0.73
	PEMCX	371	2.3	178.5	0.9	0.48
	PEMF	2141	13.0	2496.9	12.6	1.17
	PEMFB	1	0.0	4.9	0.0	4.87
	PEMFD	86	0.5	227.8	1.2	2.65
	PEMFH	578	3.5	281.9	1.4	0.49
	PEMFHX	1	0.0	0.1	0.0	0.12
	PEMFX	548	3.3	342.1	1.7	0.62
	PEMG	6	0.0	4.9	0.0	0.81
	PEMGH	17	0.1	9.8	0.0	0.58
	PEMGX	6	0.0	7.8	0.0	1.29
PFO/SSAR	PFO/SS1A	25	0.3	240.3	0.3	9.61
	PFO1/4A	1	0.0	1.1	0.0	1.11
	PFO1/EMA	54	0.5	224.2	0.3	4.15
	PFO1A	9064	90.9	72156.9	94.4	7.96
	PFO1AD	15	0.2	299.8	0.4	19.99
	PFO1AH	90	0.9	1401.4	1.8	15.57
	PFO1AX	1	0.0	26.5	0.0	26.48
	PFOA	1	0.0	0.2	0.0	0.22
	PSS/EM1A	1	0.0	6.3	0.0	6.32
	PSS/FO1A	11	0.1	90.6	0.1	8.24
	PSS1/EMA	60	0.6	218.0	0.3	3.63
	PSS1/USA	1	0.0	1.2	0.0	1.25
	PSS1A	636	6.4	1743.5	2.3	2.74
	PSS1AD	3	0.0	6.6	0.0	2.20
	PSS1AH	7	0.1	9.9	0.0	1.42
	PSSA	1	0.0	1.3	0.0	1.29
PFO/SSA	PFO/EM1A	1	0.0	6.6	0.0	6.64
	PFO/EMA	1	0.0	1.4	0.0	1.41
	PFO/SS1A	50	0.5	230.9	0.7	4.62
	PFO1/EMA	59	0.6	211.2	0.6	3.58
	PFO1A	7875	80.8	30844.6	88.2	3.92

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EMAP	NWI	Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
PFO/SSA	PFO1AD	110	1.1	443.4	1.3	4.03
	PFO1AF	2	0.0	2.3	0.0	1.14
	PFO1AH	191	2.0	385.2	1.1	2.02
	PFO1AX	7	0.1	3.9	0.0	0.56
	PFOA	1	0.0	0.4	0.0	0.45
	PFOAH	1	0.0	0.1	0.0	0.07
	PSS/EM1A	6	0.1	17.9	0.1	2.98
	PSS/FO1A	16	0.2	105.5	0.3	6.60
	PSS1/EMA	99	1.0	334.5	1.0	3.38
	PSS1A	1248	12.8	2271.0	6.5	1.82
	PSS1AD	28	0.3	34.2	0.1	1.22
	PSS1AH	44	0.5	88.4	0.3	2.01
	PSS1AX	7	0.1	3.0	0.0	0.43
	PSSA	6	0.1	3.9	0.0	0.66
PFO/SSBR	PFO1B	1	100.0	0.4	100.0	0.42
PFO/SSB	PFO1B	5	55.6	15.8	58.8	3.16
	PSS1/EMB	1	11.1	7.6	28.4	7.65
	PSS1B	1	11.1	1.7	6.2	1.67
	PSS1BD	2	22.2	1.8	6.6	0.88
PFO/SSCR	PFO/EMC	1	0.0	0.7	0.0	0.67
	PFO/SS1C	20	0.7	135.2	0.6	6.76
	PFO/SS1F	2	0.1	16.6	0.1	8.28
	PFO1/EMC	30	1.1	124.4	0.6	4.15
	PFO1/EMF	4	0.1	10.4	0.0	2.61
	PFO1C	2251	79.9	18408.7	86.4	8.18
	PFO1CD	10	0.4	33.0	0.2	3.30
	PFO1CH	62	2.2	726.2	3.4	11.71
	PFO1CX	5	0.2	7.0	0.0	1.39
	PFO1F	75	2.7	220.5	1.0	2.94
	PFO1FH	2	0.1	0.7	0.0	0.35
	PFO1FX	1	0.0	3.6	0.0	3.55
	PFO5G	2	0.1	4.7	0.0	2.34
	PFO6/SS1	1	0.0	26.8	0.1	26.76
	PFO6/UBF	1	0.0	3.8	0.0	3.79
	PFO6C	5	0.2	37.3	0.2	7.47
	PFO6F	12	0.4	241.1	1.1	20.09
	PSS/FO1C	3	0.1	27.0	0.1	9.00
	PSS1/ABF	1	0.0	2.3	0.0	2.31
	PSS1/EMC	23	0.8	70.9	0.3	3.08
	PSS1/EMF	5	0.2	25.1	0.1	5.01
	PSS1/UBF	4	0.1	43.0	0.2	10.74

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EMAP	NWI	Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
PFO/SSCR	PSS1C	251	8.9	828.5	3.9	3.30
	PSS1CD	2	0.1	17.9	0.1	8.93
	PSS1CH	3	0.1	18.9	0.1	6.29
	PSS1F	25	0.9	225.1	1.1	9.00
	PSS1FD	1	0.0	1.1	0.0	1.06
	PSS1FH	15	0.5	33.9	0.2	2.26
	PSS1FX	1	0.0	2.7	0.0	2.73
PFO/SSC	PFO/EMC	1	0.0	0.6	0.0	0.60
	PFO/SS1C	66	1.0	322.2	1.6	4.88
	PFO/SS1F	2	0.0	19.5	0.1	9.75
	PFO/UBGH	1	0.0	0.7	0.0	0.67
	PFO1/5F	2	0.0	10.7	0.1	5.37
	PFO1/EMC	104	1.6	220.0	1.1	2.12
	PFO1/EMF	43	0.6	95.3	0.5	2.22
	PFO1/OWF	2	0.0	3.6	0.0	1.79
	PFO1/UBF	7	0.1	62.8	0.3	8.97
	PFO1C	4045	60.4	12753.0	65.3	3.15
	PFO1CD	91	1.4	192.1	1.0	2.11
	PFO1CDH	5	0.1	10.5	0.1	2.09
	PFO1CH	196	2.9	375.2	1.9	1.91
	PFO1CX	39	0.6	55.3	0.3	1.42
	PFO1F	376	5.6	988.9	5.1	2.63
	PFO1FD	3	0.0	1.2	0.0	0.39
	PFO1FH	43	0.6	106.4	0.5	2.47
	PFO1FX	9	0.1	20.4	0.1	2.27
	PFO1GH	1	0.0	3.4	0.0	3.40
	PFO2/SS1	1	0.0	0.8	0.0	0.80
	PFO2C	1	0.0	0.6	0.0	0.60
	PFO2F	2	0.0	34.3	0.2	17.13
	PFO2FH	2	0.0	5.8	0.0	2.90
	PFO5/6G	1	0.0	31.0	0.2	30.96
	PFO5/AB4	1	0.0	0.4	0.0	0.45
	PFO5/OWF	2	0.0	1.1	0.0	0.53
	PFO5/SS1	1	0.0	20.4	0.1	20.44
	PFO5F	7	0.1	19.5	0.1	2.79
	PFO5FH	3	0.0	1.8	0.0	0.62
	PFO5G	4	0.1	16.6	0.1	4.14
	PFO5GH	3	0.0	4.3	0.0	1.43
	PFO6/AB4	1	0.0	26.9	0.1	26.92
	PFO6C	1	0.0	1.8	0.0	1.76
	PFO6F	76	1.1	1303.0	6.7	17.14

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		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PFO/SSC	PFO6FD	1	0.0	2.1	0.0	2.10
	PFO6FH	4	0.1	41.7	0.2	10.43
	PFO6G	2	0.0	73.0	0.4	36.51
	PFOC	1	0.0	0.2	0.0	0.16
	PSS/EM1F	4	0.1	17.1	0.1	4.29
	PSS/EMC	4	0.1	4.7	0.0	1.17
	PSS/EMF	1	0.0	4.6	0.0	4.60
	PSS/FO1C	31	0.5	91.5	0.5	2.95
	PSS/FO1F	1	0.0	61.1	0.3	61.14
	PSS1/AB4	2	0.0	2.1	0.0	1.07
	PSS1/ABF	5	0.1	4.3	0.0	0.87
	PSS1/EM2	1	0.0	2.7	0.0	2.65
	PSS1/EMC	149	2.2	503.9	2.6	3.38
	PSS1/EMF	19	0.3	97.7	0.5	5.14
	PSS1/FO5	6	0.1	8.5	0.0	1.42
	PSS1C	968	14.4	1236.5	6.3	1.28
	PSS1CD	42	0.6	83.5	0.4	1.99
	PSS1CDH	2	0.0	2.3	0.0	1.13
	PSS1CH	45	0.7	49.5	0.3	1.10
	PSS1CX	12	0.2	11.5	0.1	0.96
	PSS1F	205	3.1	462.1	2.4	2.25
	PSS1FD	6	0.1	3.5	0.0	0.58
	PSS1FH	31	0.5	42.8	0.2	1.38
	PSS1FX	14	0.2	9.4	0.0	0.67
	PSS5F	1	0.0	1.6	0.0	1.58
	PSSCD	1	0.0	0.7	0.0	0.70
	PSSF	1	0.0	0.6	0.0	0.61
PL	L2EM/UBG	2	0.1	58.2	0.3	29.09
	L2EM2G	3	0.1	183.9	1.0	61.32
	L2EM2GH	7	0.2	20.8	0.1	2.98
	L2EMGH	5	0.1	47.2	0.3	9.43
	PAB3F	1	0.0	0.3	0.0	0.34
	PAB3FH	2	0.1	10.6	0.1	5.30
	PAB4/SS1	1	0.0	4.0	0.0	4.03
	PAB4F	5	0.1	6.1	0.0	1.23
	PAB4FH	2	0.1	0.3	0.0	0.17
	PAB4GH	1	0.0	0.8	0.0	0.85
	PABF	2	0.1	2.9	0.0	1.45
	PABFH	4	0.1	6.4	0.0	1.59
	PABGH	13	0.4	30.8	0.2	2.37
	PABHH	1	0.0	2.3	0.0	2.26

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EMAP	NWI	Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
PL	PEM/AB3F	1	0.0	46.8	0.3	46.77
	PEM/AB4F	2	0.1	0.9	0.0	0.44
	PEM/ABGH	1	0.0	5.5	0.0	5.46
	PEM/FO1A	2	0.1	6.8	0.0	3.41
	PEM/FO1C	12	0.3	44.4	0.2	3.70
	PEM/FO1F	4	0.1	8.2	0.0	2.06
	PEM/OWF	1	0.0	0.3	0.0	0.29
	PEM/SS1A	9	0.3	17.8	0.1	1.98
	PEM/SS1C	29	0.8	77.5	0.4	2.67
	PEM/SS1F	27	0.8	154.2	0.8	5.71
	PEM/UBFX	1	0.0	5.9	0.0	5.93
	PEM1A	2	0.1	15.9	0.1	7.95
	PEM1AH	1	0.0	0.3	0.0	0.25
	PEM1CH	2	0.1	2.5	0.0	1.25
	PEM1FH	4	0.1	8.2	0.0	2.05
	PEM2G	1	0.0	0.3	0.0	0.30
	PEM2GH	2	0.1	1.5	0.0	0.73
	PEMA	28	0.8	44.8	0.2	1.60
	PEMAD	3	0.1	5.1	0.0	1.69
	PEMAF	5	0.1	15.1	0.1	3.02
	PEMAFH	5	0.1	27.7	0.1	5.53
	PEMAH	89	2.6	132.7	0.7	1.49
	PEMAHF	2	0.1	8.6	0.0	4.30
	PEMAX	4	0.1	3.9	0.0	0.98
	PEMBD	1	0.0	60.4	0.3	60.40
	PEMC	92	2.6	307.6	1.7	3.34
	PEMCD	4	0.1	43.4	0.2	10.85
	PEMCF	1	0.0	2.0	0.0	1.95
	PEMCH	305	8.7	643.8	3.5	2.11
	PEMCHX	1	0.0	0.4	0.0	0.38
	PEMCX	28	0.8	23.3	0.1	0.83
	PEMF	47	1.3	268.2	1.5	5.71
	PEMFD	1	0.0	6.3	0.0	6.29
	PEMFH	247	7.1	580.6	3.1	2.35
	PEMFX	20	0.6	32.9	0.2	1.65
	PEMGH	2	0.1	11.1	0.1	5.53
	PFO/EM1C	1	0.0	0.1	0.0	0.14
	PFO/SS1A	3	0.1	19.8	0.1	6.59
	PFO/SS1C	9	0.3	45.4	0.2	5.04
	PFO/SS1F	8	0.2	91.8	0.5	11.47
	PFO1/EMA	5	0.1	13.6	0.1	2.73

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		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PL	PFO1/EMC	28	0.8	51.5	0.3	1.84
	PFO1/EMF	38	1.1	115.6	0.6	3.04
	PFO1/UBF	10	0.3	44.5	0.2	4.45
	PFO1A	232	6.6	2142.9	11.6	9.24
	PFO1AH	565	16.2	4156.6	22.5	7.36
	PFO1C	134	3.8	1019.2	5.5	7.61
	PFO1CH	685	19.6	4302.6	23.3	6.28
	PFO1CHX	1	0.0	0.2	0.0	0.23
	PFO1CX	2	0.1	0.6	0.0	0.30
	PFO1F	22	0.6	76.5	0.4	3.48
	PFO1FH	74	2.1	705.2	3.8	9.53
	PFO1FX	1	0.0	2.4	0.0	2.42
	PFO2/UBG	2	0.1	0.7	0.0	0.36
	PFO5F	1	0.0	12.2	0.1	12.20
	PFO5FH	4	0.1	21.0	0.1	5.26
	PFO5GH	2	0.1	10.5	0.1	5.26
	PFO5GX	1	0.0	51.2	0.3	51.24
	PFO5HH	12	0.3	115.8	0.6	9.65
	PFO6/UBG	2	0.1	13.0	0.1	6.52
	PFO6C	2	0.1	42.7	0.2	21.36
	PFO6F	10	0.3	65.7	0.4	6.57
	PFO6G	6	0.2	342.8	1.9	57.13
	PFOAH	1	0.0	0.2	0.0	0.24
	POW/EMF	1	0.0	0.9	0.0	0.91
	POW/FO5F	1	0.0	1.1	0.0	1.09
	POWF	2	0.1	0.5	0.0	0.27
	POWGX	2	0.1	0.3	0.0	0.17
	POWH	1	0.0	0.4	0.0	0.40
	POWHX	3	0.1	0.6	0.0	0.19
	PSS/FO1A	1	0.0	1.8	0.0	1.79
	PSS/FO1C	4	0.1	3.4	0.0	0.84
	PSS/FO1F	22	0.6	142.7	0.8	6.49
	PSS1/EMA	1	0.0	4.8	0.0	4.85
	PSS1/EMC	23	0.7	140.0	0.8	6.09
	PSS1/EMF	35	1.0	356.0	1.9	10.17
	PSS1A	25	0.7	68.1	0.4	2.72
	PSS1AH	35	1.0	74.8	0.4	2.14
	PSS1AX	3	0.1	3.2	0.0	1.05
	PSS1C	33	0.9	213.5	1.2	6.47
	PSS1CH	106	3.0	256.7	1.4	2.42
	PSS1CX	3	0.1	4.9	0.0	1.65

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		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PL	PSS1F	9	0.3	75.3	0.4	8.37
	PSS1FH	132	3.8	435.1	2.4	3.30
	PSS1FX	3	0.1	3.5	0.0	1.16
	PSSCH	1	0.0	0.4	0.0	0.45
	PUB/ABG	3	0.1	15.8	0.1	5.28
	PUBF	8	0.2	5.6	0.0	0.71
	PUBFH	26	0.7	29.8	0.2	1.15
	PUBG	11	0.3	20.5	0.1	1.86
	PUBGH	68	1.9	108.7	0.6	1.60
	PUBGHX	6	0.2	5.6	0.0	0.94
	PUBGX	23	0.7	30.9	0.2	1.34
	PUSCH	1	0.0	1.6	0.0	1.59
	PUSCX	1	0.0	3.1	0.0	3.14
PS	PAB/EMF	5	0.0	8.2	0.0	1.64
	PAB/FO5F	3	0.0	3.5	0.0	1.17
	PAB/OWF	9	0.0	11.9	0.0	1.32
	PAB/OWFH	1	0.0	0.9	0.0	0.90
	PAB/OWG	1	0.0	0.4	0.0	0.38
	PAB/OWGH	1	0.0	4.4	0.0	4.38
	PAB/OWH	1	0.0	0.3	0.0	0.31
	PAB/OWHH	1	0.0	0.2	0.0	0.23
	PAB/OWHX	1	0.0	1.0	0.0	1.01
	PAB/UBFX	1	0.0	6.4	0.0	6.36
	PAB/UBGH	3	0.0	0.5	0.0	0.16
	PAB/UBGX	1	0.0	0.3	0.0	0.33
	PAB1F	1	0.0	0.2	0.0	0.21
	PAB2C	1	0.0	0.8	0.0	0.80
	PAB2GX	1	0.0	0.5	0.0	0.51
	PAB3F	86	0.1	80.0	0.3	0.93
	PAB3FH	20	0.0	4.4	0.0	0.22
	PAB3FX	2	0.0	0.6	0.0	0.28
	PAB3G	45	0.1	50.4	0.2	1.12
	PAB3GH	215	0.4	78.5	0.3	0.37
	PAB3GX	35	0.1	15.0	0.1	0.43
	PAB4/3G	2	0.0	4.7	0.0	2.36
	PAB4/EMF	7	0.0	3.9	0.0	0.56
	PAB4/FO1	1	0.0	1.6	0.0	1.65
	PAB4/FO5	1	0.0	0.4	0.0	0.41
	PAB4/FO6	1	0.0	21.9	0.1	21.91
	PAB4/OWF	10	0.0	7.7	0.0	0.77
	PAB4/OWG	1	0.0	0.9	0.0	0.88

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EMAP	NWI	Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
PS	PAB4/OWH	3	0.0	1.8	0.0	0.59
	PAB4/SS5	2	0.0	6.5	0.0	3.27
	PAB4/UBG	1	0.0	0.4	0.0	0.38
	PAB4F	201	0.3	88.5	0.4	0.44
	PAB4FH	25	0.0	3.4	0.0	0.13
	PAB4FX	9	0.0	3.5	0.0	0.38
	PAB4G	32	0.1	31.4	0.1	0.98
	PAB4GH	140	0.2	37.9	0.2	0.27
	PAB4GX	64	0.1	19.9	0.1	0.31
	PAB4H	6	0.0	10.7	0.0	1.78
	PAB4HH	1	0.0	0.3	0.0	0.32
	PAB4HX	4	0.0	1.0	0.0	0.25
	PAB6GH	1	0.0	1.0	0.0	1.00
	PABF	382	0.6	195.3	0.8	0.51
	PABFD	10	0.0	14.7	0.1	1.47
	PABFH	158	0.3	19.2	0.1	0.12
	PABFX	61	0.1	14.3	0.1	0.23
	PABG	189	0.3	210.7	0.8	1.11
	PABGD	4	0.0	2.0	0.0	0.51
	PABGDH	1	0.0	4.4	0.0	4.35
	PABGH	694	1.2	208.8	0.8	0.30
	PABGX	178	0.3	77.5	0.3	0.44
	PABH	6	0.0	7.0	0.0	1.17
	PABHH	4	0.0	1.6	0.0	0.40
	PABHX	2	0.0	0.1	0.0	0.07
	POW/AB4F	15	0.0	15.2	0.1	1.01
	POW/AB4G	8	0.0	4.7	0.0	0.59
	POW/AB4H	3	0.0	0.9	0.0	0.31
	POW/ABF	48	0.1	22.6	0.1	0.47
	POW/ABFD	1	0.0	0.5	0.0	0.54
	POW/ABFH	1	0.0	1.9	0.0	1.87
	POW/ABFX	2	0.0	0.6	0.0	0.29
	POW/ABG	8	0.0	9.0	0.0	1.12
	POW/ABGX	6	0.0	5.6	0.0	0.93
	POW/ABH	2	0.0	3.5	0.0	1.74
	POW/ABHH	1	0.0	0.4	0.0	0.44
	POW/ABHX	5	0.0	1.9	0.0	0.38
	POW/EMF	31	0.1	28.9	0.1	0.93
	POW/EMFH	3	0.0	1.7	0.0	0.56
	POW/EMFX	4	0.0	1.0	0.0	0.26
	POW/EMG	1	0.0	1.9	0.0	1.90

Illinois Region

EMAP	NWI	Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
PS	POW/EMGH	3	0.0	4.5	0.0	1.51
	POW/FO5F	3	0.0	2.3	0.0	0.77
	POWF	532	0.9	131.3	0.5	0.25
	POWFD	2	0.0	1.3	0.0	0.64
	POWFH	9	0.0	2.1	0.0	0.23
	POWFX	66	0.1	16.6	0.1	0.25
	POWG	114	0.2	70.2	0.3	0.62
	POWGH	102	0.2	37.9	0.2	0.37
	POWGX	1134	1.9	461.5	1.8	0.41
	POWH	227	0.4	187.4	0.7	0.83
	POWHH	332	0.6	251.3	1.0	0.76
	POWHX	1951	3.3	1278.5	5.1	0.66
	POWHXD	1	0.0	0.0	0.0	0.01
	PUB/AB3G	1	0.0	0.8	0.0	0.85
	PUB/AB4G	4	0.0	2.3	0.0	0.58
	PUB/ABF	2	0.0	0.7	0.0	0.34
	PUB/ABGH	12	0.0	11.6	0.0	0.97
	PUB/ABGX	2	0.0	13.3	0.1	6.63
	PUB/EM2F	1	0.0	0.9	0.0	0.91
	PUB/EM2G	1	0.0	1.9	0.0	1.90
	PUB/EMF	2	0.0	41.8	0.2	20.92
	PUB/FO1F	1	0.0	13.6	0.1	13.63
	PUB/FO5G	3	0.0	9.2	0.0	3.08
	PUB/SS1F	1	0.0	0.3	0.0	0.34
	PUBA	1	0.0	11.9	0.0	11.92
	PUBAH	1	0.0	0.6	0.0	0.60
	PUBCH	1	0.0	0.9	0.0	0.87
	PUBCX	1	0.0	0.5	0.0	0.49
	PUBF	1297	2.2	606.1	2.4	0.47
	PUBFD	22	0.0	33.5	0.1	1.52
	PUBFH	2530	4.2	273.8	1.1	0.11
	PUBFHX	2	0.0	4.7	0.0	2.37
	PUBFX	1590	2.7	339.8	1.4	0.21
	PUBG	2351	3.9	1379.7	5.5	0.59
	PUBGB	1	0.0	0.1	0.0	0.11
	PUBGD	4	0.0	2.1	0.0	0.51
	PUBGDH	2	0.0	4.0	0.0	1.98
	PUBGF	3	0.0	0.3	0.0	0.11
	PUBGH	33256	55.8	10906.3	43.5	0.33
	PUBGHR	1	0.0	0.8	0.0	0.78
	PUBGHX	10	0.0	4.2	0.0	0.42

Illinois Region

EMAP	NWI	Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
PS	PUBGX	10812	18.1	6795.7	27.1	0.63
	PUBH	29	0.0	49.5	0.2	1.71
	PUBHH	93	0.2	173.5	0.7	1.87
	PUBHX	214	0.4	506.2	2.0	2.37
	PUBKH	5	0.0	2.6	0.0	0.51
	PUS/EMAH	1	0.0	1.6	0.0	1.59
	PUS2/EMC	2	0.0	0.3	0.0	0.16
	PUS2/EMF	2	0.0	0.9	0.0	0.43
	PUSA	10	0.0	3.9	0.0	0.39
	PUSAH	3	0.0	0.9	0.0	0.30
	PUSAX	8	0.0	7.9	0.0	0.99
	PUSC	10	0.0	10.0	0.0	1.00
	PUSCH	18	0.0	9.8	0.0	0.54
	PUSCX	63	0.1	39.5	0.2	0.63
	PUSFX	1	0.0	0.7	0.0	0.74
	PUSGH	1	0.0	0.3	0.0	0.30

Appendix D

Table summarizing the EMAP classes after aggregating the NWI classes for the Washington region

Table D. Summary of NWI classes mapped to each EMAP class for the Washington Region.

		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
E2EM	E2EM/ABN	1	0.5	2.3	0.4	2.35
	E2EM/USN	21	11.5	83.7	13.7	3.98
	E2EM1N	14	7.7	45.3	7.4	3.24
	E2EM1P	3	1.6	3.6	0.6	1.19
	E2EMN	119	65.4	434.7	71.4	3.65
	E2EMP	24	13.2	39.1	6.4	1.63
PEMAR	PEM/SS1A	1	0.4	13.1	1.3	13.10
	PEM/SSA	1	0.4	0.7	0.1	0.71
	PEM1A	6	2.3	47.0	4.6	7.84
	PEM1W	31	11.5	64.2	6.3	2.07
	PEMA	217	80.2	809.8	79.0	3.99
	PEMAD	11	4.1	84.0	8.2	9.34
	PEMAH	1	0.4	0.8	0.1	0.76
	PEMS	2	0.8	5.0	0.5	4.98
PEMA	PEM/FO1A	2	0.1	5.9	0.1	2.94
	PEM/FO1W	1	0.1	1.0	0.0	1.00
	PEM/FOA	1	0.1	0.5	0.0	0.54
	PEM/SS1A	2	0.1	7.6	0.2	3.78
	PEM/SSA	7	0.4	25.8	0.7	6.46
	PEM/SSAD	2	0.1	3.1	0.1	3.11
	PEM1A	67	4.4	657.8	16.7	12.65
	PEM1W	269	17.6	292.4	7.4	1.09
	PEM1WD	6	0.4	13.7	0.3	2.28
	PEM1WX	1	0.1	0.9	0.0	0.93
	PEMA	1071	70.2	2031.0	51.4	2.03
	PEMAD	78	5.1	706.9	17.9	10.40
	PEMAH	16	1.0	140.8	3.6	11.73
	PEMAX	1	0.1	0.4	0.0	0.38
	PEMJ	2	0.1	63.1	1.6	63.09
PEMBR	PEM1/FO4	3	6.8	3.0	23.6	1.51
	PEM1B	9	23.8	6.7	52.5	0.96
	PEMB	26	69.4	3.1	23.9	0.15
PEMB	PEM/SSB	2	1.0	5.3	2.7	5.33
	PEM1B	121	57.1	171.1	85.4	2.48
	PEMB	89	41.9	23.8	11.9	0.42
PEMCR	PEM/ABF	2	0.1	32.6	0.6	32.59
	PEM/ABH	3	0.2	60.5	1.2	30.23
	PEM/OWF	4	0.2	4.7	0.1	4.69
	PEM/SS1Y	3	0.2	112.8	2.2	37.59
	PEM/SSC	13	0.7	188.4	3.6	18.84
	PEM/SSCB	6	0.3	11.4	0.2	1.90
	PEM/SSF	6	0.3	10.2	0.2	2.05

		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PEMCR	PEM/SSFB	4	0.2	6.0	0.1	6.00
	PEM/SSFH	1	0.1	1.0	0.0	1.04
	PEM/SSR	7	0.4	30.2	0.6	10.07
	PEM1/OWZ	1	0.1	2.9	0.1	2.94
	PEM1C	28	1.5	65.1	1.2	2.60
	PEM1CD	2	0.1	3.8	0.1	3.76
	PEM1CH	1	0.1	0.3	0.0	0.32
	PEM1F	1	0.1	1.2	0.0	1.20
	PEM1FH	11	0.6	30.4	0.6	30.37
	PEM1R	2	0.1	1.9	0.0	0.97
	PEM1RD	1	0.1	3.9	0.1	3.91
	PEM1Y	45	2.4	60.3	1.2	1.34
	PEM1YD	1	0.1	4.5	0.1	4.54
	PEM1YH	1	0.1	1.3	0.0	1.25
	PEM1Z	1	0.1	0.2	0.0	0.22
	PEMC	1338	72.2	3881.5	74.3	3.29
	PEMCB	24	1.3	13.4	0.3	0.56
	PEMCD	7	0.4	56.3	1.1	8.04
	PEMCH	28	1.5	247.9	4.7	8.85
	PEMCX	7	0.4	5.2	0.1	0.74
	PEMF	158	8.5	127.7	2.4	0.93
	PEMFB	31	1.7	12.6	0.2	0.45
	PEMFH	13	0.7	6.2	0.1	0.48
	PEMFX	8	0.4	3.3	0.1	0.42
	PEMH	6	0.3	4.3	0.1	0.71
	PEMHB	3	0.2	2.8	0.1	0.94
	PEMR	81	4.4	224.2	4.3	5.34
	PEMRS	2	0.1	0.8	0.0	0.82
	PEMT	2	0.1	1.1	0.0	1.06
	PEMY	1	0.1	1.5	0.0	1.45
PEMC	PEM/ABF	9	0.1	22.4	0.2	2.80
	PEM/ABH	13	0.1	76.6	0.6	6.38
	PEM/FO1C	1	0.0	2.6	0.0	2.64
	PEM/FO1Y	2	0.0	5.3	0.0	2.65
	PEM/FOC	3	0.0	25.9	0.2	12.97
	PEM/OWF	7	0.1	15.4	0.1	2.20
	PEM/OWFH	1	0.0	0.2	0.0	0.17
	PEM/OWH	18	0.2	45.8	0.4	3.06
	PEM/OWZ	1	0.0	1.4	0.0	1.38
	PEM/SS1C	12	0.1	16.6	0.1	8.29

EMAP	NWI	Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
PEMC	PEM/SSC	72	0.8	218.4	1.7	3.58
	PEM/SSCB	10	0.1	19.7	0.2	1.97
	PEM/SSCH	1	0.0	2.4	0.0	2.45
	PEM/SSCX	2	0.0	13.4	0.1	13.42
	PEM/SSF	34	0.4	114.5	0.9	3.82
	PEM/SSFB	4	0.0	1.5	0.0	1.53
	PEM/SSFH	3	0.0	4.5	0.0	1.48
	PEM1/AB4	6	0.1	22.6	0.2	3.76
	PEM1/OWY	56	0.6	60.6	0.5	1.08
	PEM1/OWZ	10	0.1	16.6	0.1	1.66
	PEM1C	165	1.8	373.6	2.9	3.63
	PEM1F	22	0.3	7.2	0.1	0.38
	PEM1FH	2	0.0	0.3	0.0	0.16
	PEM1Y	484	5.4	560.8	4.4	1.19
	PEM1YD	4	0.0	20.7	0.2	5.17
	PEM1YH	17	0.2	10.7	0.1	0.63
	PEM1Z	18	0.2	23.3	0.2	1.30
	PEMC	6510	72.6	9690.5	76.1	1.63
	PEMCB	69	0.8	35.2	0.3	0.58
	PEMCD	57	0.6	231.0	1.8	4.62
	PEMCH	71	0.8	173.7	1.4	2.52
	PEMCHS	2	0.0	3.9	0.0	3.88
	PEMCS	2	0.0	6.9	0.1	6.89
	PEMCX	48	0.5	21.3	0.2	0.45
	PEMF	917	10.2	695.5	5.5	0.80
	PEMFB	131	1.5	36.9	0.3	0.38
	PEMFH	56	0.6	53.0	0.4	1.08
	PEMFX	44	0.5	33.5	0.3	0.76
	PEMG	14	0.2	12.8	0.1	0.91
	PEMGB	2	0.0	3.1	0.0	1.57
	PEMGH	2	0.0	4.5	0.0	2.24
	PEMH	51	0.6	25.3	0.2	0.55
	PEMHB	14	0.2	15.8	0.1	1.13
	PEMHH	1	0.0	1.4	0.0	1.38
	PEMYD	1	0.0	1.4	0.0	1.39
PFO/SSAR	PFO/EM1A	1	0.1	5.5	0.1	5.52
	PFO/EMA	1	0.1	1.3	0.0	1.35
	PFO/SS1A	4	0.2	60.5	1.1	20.18
	PFO/SS1W	5	0.3	43.7	0.8	8.74
	PFO/SSA	11	0.6	176.4	3.3	25.19

EMAP	NWI	Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
PFO/SSAR	PFO1A	34	1.9	329.2	6.1	9.97
	PFO1W	113	6.3	464.3	8.6	4.22
	PFO4A	1	0.1	5.8	0.1	5.81
	PFO4W	1	0.1	0.0	0.0	0.00
	PFOA	1002	56.3	3063.7	56.8	3.33
	PFOAH	12	0.7	84.1	1.6	7.64
	PFOAS	1	0.1	3.4	0.1	3.36
	PFOJ	11	0.6	361.1	6.7	72.22
	PFOS	8	0.5	8.4	0.2	1.20
	PSS/FOA	4	0.2	14.2	0.3	3.54
	PSS1/FLW	3	0.2	7.2	0.1	2.40
	PSS1A	11	0.6	13.8	0.3	1.53
	PSS1W	26	1.5	49.2	0.9	1.89
	PSS4/1W	1	0.1	0.9	0.0	0.91
	PSSA	530	29.8	701.5	13.0	1.47
PFO/SSA	PFO/EM1A	3	0.2	5.2	0.1	1.72
	PFO/EM1W	3	0.2	27.2	0.8	9.08
	PFO/EMA	3	0.2	14.8	0.4	7.38
	PFO/SS1A	10	0.7	57.3	1.6	5.73
	PFO/SS1W	4	0.3	8.1	0.2	2.02
	PFO/SSA	5	0.3	32.1	0.9	6.41
	PFO1/4A	1	0.1	0.5	0.0	0.50
	PFO1/4W	6	0.4	33.2	0.9	5.53
	PFO1/4WD	1	0.1	11.3	0.3	11.32
	PFO1A	51	3.5	83.1	2.3	1.81
	PFO1W	101	6.9	308.0	8.6	3.05
	PFO4/1W	4	0.3	20.3	0.6	5.07
	PFO4A	3	0.2	71.1	2.0	35.56
	PFO4W	9	0.6	21.7	0.6	2.42
	PFOA	800	55.0	2346.0	65.6	3.56
	PFOAD	1	0.1	2.4	0.1	2.42
	PFOAH	2	0.1	6.0	0.2	2.98
	PFOAX	2	0.1	2.6	0.1	1.32
	PFOJS	2	0.1	24.0	0.7	23.96
	PSS/EM1A	2	0.1	9.0	0.3	4.48
	PSS/EM1W	2	0.1	3.3	0.1	1.64
	PSS/EMA	2	0.1	1.9	0.1	0.93
	PSS/FO1A	1	0.1	0.7	0.0	0.66
	PSS/FOA	1	0.1	6.8	0.2	6.77
	PSS1/4W	1	0.1	1.5	0.0	1.46

		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PFO/SSA	PSS1A	11	0.8	9.3	0.3	0.93
	PSS1W	85	5.8	86.6	2.4	1.02
	PSS4/1W	2	0.1	4.4	0.1	2.22
	PSS4W	6	0.4	10.5	0.3	1.75
	PSSA	325	22.3	357.1	10.0	1.17
	PSSAD	3	0.2	6.0	0.2	1.99
	PSSAX	3	0.2	2.7	0.1	0.89
PFO/SSBR	PFO1B	1	8.8	0.2	3.8	0.24
	PFOB	3	20.9	1.5	23.8	0.49
	PSS1B	1	8.8	2.3	37.2	2.30
	PSSB	9	61.5	2.2	35.2	0.31
PFO/SSB	PFO1/4B	3	2.0	1.0	0.8	0.52
	PFO1B	4	2.9	3.7	2.9	1.24
	PFO4/1B	5	3.5	43.0	33.0	10.75
	PFO4/EM1	1	1.0	5.0	3.8	4.98
	PFO4B	21	15.9	43.1	33.1	4.79
	PFOB	33	25.9	10.5	8.1	0.81
	PSS/EM1B	1	0.8	0.7	0.6	0.73
	PSS/EMB	1	0.8	0.8	0.6	0.80
	PSS1B	12	9.2	2.8	2.1	0.28
	PSS4/EM1	7	5.5	8.5	6.5	1.41
	PSS4B	1	1.0	0.2	0.1	0.17
	PSSB	41	31.6	10.8	8.3	0.28
PFO/SSCR	PFO/EM1C	3	0.1	1.2	0.0	0.60
	PFO/EM1Y	1	0.0	4.5	0.0	4.45
	PFO/EMC	4	0.1	17.0	0.2	5.67
	PFO/SS1Y	10	0.2	48.5	0.5	4.85
	PFO/SSC	26	0.6	186.2	2.0	7.16
	PFO/SSCH	1	0.0	28.0	0.3	28.00
	PFO/SSF	4	0.1	6.8	0.1	6.75
	PFO/SSR	2	0.0	10.2	0.1	10.18
	PFO/USC	2	0.0	2.0	0.0	1.01
	PFO1/4Y	2	0.0	24.9	0.3	12.47
	PFO1/FLY	1	0.0	4.4	0.0	4.41
	PFO1/OWY	1	0.0	7.7	0.1	7.69
	PFO1C	15	0.3	15.4	0.2	1.19
	PFO1R	3	0.1	9.9	0.1	3.30
	PFO1Y	80	1.8	360.7	3.8	4.51
	PFO4/1C	11	0.2	18.2	0.2	18.22
	PFO4/5C	3	0.1	1.7	0.0	0.86

		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PFO/SSCR	PFO4C	13	0.3	10.6	0.1	3.55
	PFO4Y	1	0.0	1.4	0.0	1.44
	PFOC	739	16.4	2571.6	27.3	3.91
	PFOCB	1	0.0	0.6	0.0	0.57
	PFOCD	3	0.1	14.6	0.2	4.85
	PFOCH	1	0.0	1.1	0.0	1.05
	PFOCS	4	0.1	2.0	0.0	1.02
	PFOR	29	0.6	90.2	1.0	5.31
	PSS/EM1C	1	0.0	4.3	0.0	4.32
	PSS/EMC	15	0.3	135.5	1.4	12.31
	PSS/EMCB	3	0.1	3.1	0.0	1.03
	PSS/EMR	2	0.0	1.1	0.0	1.12
	PSS/FO1C	1	0.0	2.8	0.0	2.81
	PSS/FOC	15	0.3	58.1	0.6	4.15
	PSS/USC	10	0.2	29.2	0.3	2.92
	PSS1/4C	1	0.0	0.5	0.0	0.49
	PSS1/4Y	2	0.0	3.6	0.0	1.79
	PSS1/FLY	2	0.0	5.0	0.1	2.51
	PSS1C	5	0.1	3.4	0.0	0.68
	PSS1Y	76	1.7	184.4	2.0	2.43
	PSS4/1Y	3	0.1	13.3	0.1	4.43
	PSS5Z	5	0.1	5.5	0.1	1.10
	PSS5ZH	1	0.0	0.2	0.0	0.21
	PSSC	3258	72.5	5095.7	54.0	1.75
	PSSCB	21	0.5	37.5	0.4	1.78
	PSSCD	2	0.0	35.0	0.4	17.51
	PSSCH	27	0.6	90.6	1.0	3.62
	PSSCX	2	0.0	5.8	0.1	2.88
	PSSF	9	0.2	12.6	0.1	1.41
	PSSFB	9	0.2	4.3	0.0	0.48
	PSSFH	2	0.0	11.4	0.1	5.68
	PSSR	63	1.4	251.7	2.7	5.99
	PSSY	1	0.0	1.6	0.0	1.65
PFO/SSC	PFO/ABHH	2	0.0	6.2	0.0	6.24
	PFO/EM1C	2	0.0	5.1	0.0	2.55
	PFO/EM1Y	10	0.1	32.2	0.2	3.22
	PFO/EMC	10	0.1	51.3	0.3	6.41
	PFO/SS1Y	12	0.1	58.0	0.4	4.83
	PFO/SSC	33	0.4	169.3	1.1	7.70
	PFO/SSCB	1	0.0	1.9	0.0	1.87

		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PFO/SSC	PFO/SSF	1	0.0	1.9	0.0	1.94
	PFO1/4C	17	0.2	59.9	0.4	4.28
	PFO1/4Y	10	0.1	118.3	0.7	11.83
	PFO1C	79	1.0	79.0	0.5	1.58
	PFO1Y	128	1.6	214.4	1.4	1.67
	PFO4/1C	6	0.1	38.6	0.2	7.73
	PFO4/1Y	26	0.3	124.0	0.8	4.77
	PFO4/5C	7	0.1	6.4	0.0	1.07
	PFO4/EM1	1	0.0	3.3	0.0	3.34
	PFO4/SS1	1	0.0	4.4	0.0	4.40
	PFO4C	26	0.3	71.0	0.4	5.46
	PFO4Y	43	0.5	91.6	0.6	2.13
	PFO5/1Y	1	0.0	3.7	0.0	3.71
	PFO5/4C	4	0.0	1.7	0.0	0.57
	PFO5/EM1	1	0.0	1.1	0.0	1.05
	PFO5C	4	0.0	1.0	0.0	0.34
	PFO5F	3	0.0	0.3	0.0	0.16
	PFO5Y	1	0.0	4.7	0.0	4.73
	PFO5Z	14	0.2	26.3	0.2	1.88
	PFO5ZH	1	0.0	0.5	0.0	0.53
	PFOC	1640	20.3	5149.0	32.5	3.36
	PFOCB	2	0.0	1.1	0.0	0.53
	PFOCD	5	0.1	42.0	0.3	8.39
	PFOCH	3	0.0	10.3	0.1	3.43
	PFOCX	1	0.0	1.6	0.0	1.59
	PFOF	2	0.0	4.1	0.0	2.04
	PFOFH	2	0.0	1.3	0.0	0.64
	PFOHH	1	0.0	3.5	0.0	3.47
	PFOY	1	0.0	0.2	0.0	0.18
	PSS/EM1C	6	0.1	17.6	0.1	2.93
	PSS/EM1Y	29	0.4	81.1	0.5	2.80
	PSS/EMC	58	0.7	240.0	1.5	4.61
	PSS/EMCB	7	0.1	28.7	0.2	4.11
	PSS/EMF	5	0.1	53.3	0.3	13.33
	PSS/EMFB	1	0.0	2.7	0.0	2.72
	PSS/FOC	16	0.2	87.6	0.6	5.47
	PSS/FOF	1	0.0	6.6	0.0	6.63
	PSS/USCX	1	0.0	1.7	0.0	1.72
	PSS1/4Y	14	0.2	127.1	0.8	9.08
	PSS1/FLY	5	0.1	10.3	0.1	5.14

		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PFO/SSC	PSS1/OWY	2	0.0	8.9	0.1	4.46
	PSS1C	75	0.9	51.8	0.3	3.24
	PSS1FH	1	0.0	0.1	0.0	0.10
	PSS1Y	308	3.8	511.6	3.2	1.71
	PSS1YB	1	0.0	0.4	0.0	0.42
	PSS1YH	1	0.0	1.2	0.0	1.18
	PSS3/EM1	1	0.0	10.3	0.1	10.34
	PSS3Y	1	0.0	1.3	0.0	1.25
	PSS4/1Y	20	0.2	95.0	0.6	4.75
	PSS4C	1	0.0	1.7	0.0	1.68
	PSS4Y	23	0.3	38.6	0.2	1.68
	PSS5/EM1	2	0.0	0.9	0.0	0.43
	PSS5/OWZ	1	0.0	3.5	0.0	3.45
	PSS5Z	41	0.5	40.7	0.3	1.13
	PSS5ZB	1	0.0	0.6	0.0	0.61
	PSSC	5153	63.6	7688.4	48.5	1.63
	PSSCB	78	1.0	150.2	0.9	2.21
	PSSCD	5	0.1	18.5	0.1	3.70
	PSSCH	22	0.3	25.3	0.2	1.20
	PSSCX	13	0.2	11.8	0.1	0.91
	PSSF	83	1.0	134.8	0.9	1.64
	PSSFB	12	0.1	2.8	0.0	0.24
	PSSFH	5	0.1	11.8	0.1	2.94
PL	L2EM/OWF	1	0.2	3.1	0.2	3.14
	L2EMFH	1	0.2	4.6	0.3	4.64
	L2EMH	4	0.7	0.6	0.0	0.14
	PAB/OWH	1	0.2	0.9	0.1	0.86
	PABH	3	0.5	2.8	0.2	0.95
	PEM/ABH	1	0.2	4.3	0.3	4.28
	PEM/SSC	2	0.4	4.8	0.3	2.38
	PEM/SSF	8	1.4	21.3	1.4	3.04
	PEM1W	2	0.4	1.9	0.1	0.96
	PEM1Y	10	1.8	27.6	1.8	2.76
	PEM1YH	1	0.2	0.7	0.0	0.65
	PEMA	2	0.4	0.5	0.0	0.23
	PEMAH	7	1.3	32.3	2.1	4.62
	PEMC	84	15.1	299.4	19.6	3.84
	PEMCH	59	10.5	130.6	8.6	2.29
	PEMCX	1	0.2	1.6	0.1	1.63
	PEMF	49	8.8	84.2	5.5	1.79

		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PL	PEMFH	12	2.1	19.7	1.3	1.64
	PEMH	3	0.5	0.8	0.1	0.28
	PFO/EMC	1	0.2	1.5	0.1	1.53
	PFO/SSC	5	1.0	12.8	0.8	4.26
	PFO1W	1	0.2	2.1	0.1	2.08
	PFO4A	1	0.2	3.8	0.2	3.78
	PFOA	24	4.2	96.2	6.3	4.58
	PFOAH	6	1.0	6.0	0.4	1.19
	PFOC	36	6.5	84.6	5.5	2.42
	PFOCH	9	1.5	28.2	1.8	9.40
	POWH	2	0.4	1.5	0.1	0.74
	POWHH	1	0.2	0.2	0.0	0.20
	POWHX	1	0.2	0.1	0.0	0.09
	POWZ	2	0.4	0.5	0.0	0.26
	PSS/EMC	11	2.0	105.7	6.9	10.57
	PSS/EMF	1	0.2	2.0	0.1	1.95
	PSS/FOC	1	0.2	0.9	0.1	0.93
	PSS1Y	3	0.5	2.0	0.1	0.67
	PSS1YH	2	0.4	5.5	0.4	2.74
	PSSA	3	0.5	5.9	0.4	1.96
	PSSAH	2	0.4	7.4	0.5	3.70
	PSSC	130	23.2	452.2	29.6	3.65
	PSSCH	59	10.6	51.3	3.4	0.97
	PSSCX	1	0.2	2.2	0.1	2.20
	PSSF	5	0.9	6.9	0.5	1.39
	PSSFH	1	0.2	5.2	0.3	5.16
PS	PAB/EMF	5	0.1	5.1	0.1	1.02
	PAB/EMH	19	0.3	31.5	0.9	1.75
	PAB/EMHH	2	0.0	8.4	0.2	4.22
	PAB/OWH	19	0.3	48.7	1.3	2.57
	PAB/OWHX	1	0.0	0.8	0.0	0.77
	PAB/USN	1	0.0	1.2	0.0	1.16
	PAB4/OWH	3	0.1	1.9	0.1	0.62
	PAB4/OWZ	2	0.0	8.2	0.2	4.09
	PAB4Z	16	0.3	19.7	0.5	1.23
	PAB5/OWZ	1	0.0	2.6	0.1	2.60
	PABF	66	1.1	47.9	1.3	0.90
	PABFB	10	0.2	0.6	0.0	0.06
	PABFH	4	0.1	0.9	0.0	0.23
	PABFX	5	0.1	1.5	0.0	0.31

		Number	Percent Number1	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PS	PABG	1	0.0	0.7	0.0	0.74
	PABH	279	4.8	269.7	7.4	1.04
	PABHB	3	0.1	1.3	0.0	0.44
	PABHH	25	0.4	18.4	0.5	0.88
	PABHX	46	0.8	33.1	0.9	0.72
	PFLW	1	0.0	1.8	0.0	1.76
	POW/ABH	27	0.5	44.8	1.2	2.04
	POW/ABHH	3	0.1	8.3	0.2	2.77
	POW/ABHX	6	0.1	4.7	0.1	0.94
	POW/EM1F	1	0.0	0.1	0.0	0.11
	POW/EMH	7	0.1	4.2	0.1	0.70
	POW/EMHB	1	0.0	3.1	0.1	3.12
	POW/EMHX	3	0.1	0.9	0.0	0.28
	POWAX	2	0.0	0.9	0.0	0.90
	POWF	270	4.7	54.3	1.5	0.21
	POWFB	15	0.3	9.0	0.2	1.80
	POWFH	3	0.1	0.8	0.0	0.25
	POWFX	27	0.5	9.0	0.2	0.35
	POWG	2	0.0	0.6	0.0	0.28
	POWGB	5	0.1	1.3	0.0	0.25
	POWGX	1	0.0	0.1	0.0	0.08
	POWH	2213	38.1	1328.2	36.6	0.64
	POWHB	26	0.4	8.3	0.2	0.33
	POWHH	140	2.4	57.3	1.6	0.50
	POWHX	423	7.3	197.0	5.4	0.60
	POWY	16	0.3	4.3	0.1	0.27
	POWYH	2	0.0	0.5	0.0	0.26
	POWZ	258	4.5	216.6	6.0	0.94
	POWZB	3	0.1	3.8	0.1	1.27
	POWZH	219	3.8	119.7	3.3	0.55
	POWZX	17	0.3	4.5	0.1	0.27
	PUBC	1	0.0	0.2	0.0	0.16
	PUBCX	3	0.1	3.3	0.1	1.11
	PUBF	47	0.8	15.4	0.4	0.33
	PUBFB	9	0.2	2.0	0.1	0.34
	PUBFH	16	0.3	4.7	0.1	0.30
	PUBFX	48	0.8	19.5	0.5	0.42
	PUBG	2	0.0	5.0	0.1	2.49
	PUBGH	3	0.1	0.4	0.0	0.12
	PUBGX	1	0.0	0.4	0.0	0.41

EMAP	NWI	Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
PS	PUBH	464	8.0	387.8	10.7	0.86
	PUBHB	40	0.7	6.3	0.2	0.23
	PUBHH	183	3.1	59.8	1.6	0.34
	PUBHX	485	8.4	244.7	6.8	0.53
	PUBHXR	2	0.0	0.9	0.0	0.43
	PUSA	8	0.1	22.5	0.6	2.81
	PUSC	219	3.8	165.2	4.6	0.79
	PUSCH	4	0.1	1.2	0.0	0.40
	PUSCS	10	0.2	69.3	1.9	13.85
	PUSCX	53	0.9	30.0	0.8	0.62
	PUSCXS	1	0.0	0.2	0.0	0.23

Appendix E

Table summarizing the EMAP classes after aggregating the NWI classes for the Prairie Pothole region

Table E. Summary of NWI classes mapped to each EMAP class for the Prairie Pothole Region.

EMAP	NWI	Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
PEMAR	PEM/FOA	56	48.7	298.3	35.9	5.33
	PEMA	57	49.6	517.4	62.4	9.08
	PEMAd	2	1.7	14.0	1.7	7.02
PEMA	PEM/FOA	119	0.1	91.2	0.1	0.77
	PEM/FOAD	6	0.0	64.9	0.1	10.81
	PEM/FOAH	1	0.0	7.8	0.0	7.84
	PEM/FOAd	1	0.0	43.4	0.1	43.36
	PEM/SSA	15	0.0	15.5	0.0	1.04
	PEM/SSAD	1	0.0	1.4	0.0	1.35
	PEM1A	3	0.0	0.6	0.0	0.21
	PEMA	77605	96.2	63717.2	94.4	0.82
	PEMAD	2048	2.5	2696.1	4.0	1.32
	PEMAH	52	0.1	114.7	0.2	2.21
	PEMAX	25	0.0	10.6	0.0	0.42
	PEMAd	818	1.0	724.1	1.1	0.89
	PEMAh	6	0.0	1.8	0.0	0.29
	PEMAx	3	0.0	0.3	0.0	0.10
PEMB	PEMB	2	100.0	48.0	100.0	23.98
PEMCR	PEM/ABF	12	10.7	271.3	10.0	22.61
	PEM/FOC	16	14.3	55.1	2.0	3.44
	PEMC	84	75.0	2384.7	88.0	28.39
PEMC	PEM/ABF	3417	4.3	17434.1	17.2	5.10
	PEM/ABFD	66	0.1	545.6	0.5	8.27
	PEM/ABFH	31	0.0	140.5	0.1	4.53
	PEM/ABFX	6	0.0	2.3	0.0	0.38
	PEM/ABFd	8	0.0	31.2	0.0	3.90
	PEM/ABFh	3	0.0	5.7	0.0	1.91
	PEM/ABFx	3	0.0	0.5	0.0	0.16
	PEM/FOC	153	0.2	143.1	0.1	0.94
	PEM/FOCD	2	0.0	19.9	0.0	9.96
	PEM/FOCH	11	0.0	23.6	0.0	2.15
	PEM/FOCX	1	0.0	0.6	0.0	0.57
	PEM/FOCd	1	0.0	3.1	0.0	3.08
	PEM/FOCh	1	0.0	0.7	0.0	0.71
	PEM/FOFH	1	0.0	1.4	0.0	1.37
	PEM/SSC	4	0.0	4.8	0.0	1.19
	PEM/UBFH	1	0.0	2.3	0.0	2.29
	PEM/UBFX	1	0.0	0.8	0.0	0.79
	PEM1C	3	0.0	0.5	0.0	0.18
	PEM1F	1	0.0	14.2	0.0	14.23
	PEMC	72007	90.6	73016.9	71.9	1.01
	PEMCD	986	1.2	2037.3	2.0	2.07
	PEMCH	96	0.1	190.7	0.2	1.99

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		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PEMC	PEMCX	98	0.1	77.2	0.1	0.79
	PEMCd	193	0.2	265.3	0.3	1.37
	PEMCh	4	0.0	4.1	0.0	1.02
	PEMCx	12	0.0	3.2	0.0	0.27
	PEMF	2243	2.8	7176.7	7.1	3.20
	PEMFD	75	0.1	364.2	0.4	4.86
	PEMFH	23	0.0	27.2	0.0	1.18
	PEMFX	12	0.0	12.1	0.0	1.01
	PEMFd	1	0.0	3.6	0.0	3.56
	PEMFx	1	0.0	1.4	0.0	1.44
PFO/SSAR	PFO/EMA	8	8.7	44.5	24.0	5.56
	PFOA	84	91.3	141.2	76.0	1.68
PFO/SSA	PFO/EMA	61	6.4	61.9	16.0	1.01
	PFO/EMAD	3	0.3	8.4	2.2	2.80
	PFO/EMAX	1	0.1	0.7	0.2	0.68
	PFO/SSA	2	0.2	1.2	0.3	0.58
	PFO/SSAD	1	0.1	1.0	0.3	1.02
	PFO1A	5	0.5	2.4	0.6	0.48
	PFO1AH	2	0.2	0.5	0.1	0.24
	PFOA	794	83.7	269.6	69.6	0.34
	PFOAD	8	0.8	7.5	1.9	0.94
	PFOAH	6	0.6	3.1	0.8	0.52
	PFOAX	1	0.1	0.1	0.0	0.11
	PFOAd	9	0.9	2.7	0.7	0.30
	PFOAh	2	0.2	0.2	0.1	0.12
	PSS/EMA	1	0.1	0.3	0.1	0.28
	PSS/EMAD	1	0.1	0.7	0.2	0.72
	PSS/FOA	9	0.9	7.0	1.8	0.78
	PSS/FOAD	1	0.1	1.5	0.4	1.46
	PSSA	40	4.2	12.9	3.3	0.32
	PSSAD	2	0.2	5.9	1.5	2.93
PFO/SSCR	PFO/EMC	21	26.9	105.3	51.3	5.02
	PFOC	57	73.1	100.1	48.7	1.76
PFO/SSC	PFO/EMC	78	26.1	117.0	47.7	1.50
	PFO/EMCH	1	0.3	4.6	1.9	4.64
	PFO/EMCh	1	0.3	0.6	0.3	0.64
	PFO/SSC	1	0.3	0.8	0.3	0.79
	PFOC	193	64.5	100.5	41.0	0.52
	PFOCD	5	1.7	4.3	1.8	0.86
	PFOCH	6	2.0	6.8	2.8	1.14
	PFOCd	1	0.3	0.1	0.1	0.14

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		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PFO/SSC	PFOCh	1	0.3	0.6	0.2	0.59
	PFOCx	1	0.3	0.1	0.0	0.09
	PSS/EMC	3	1.0	1.3	0.5	0.44
	PSS/FOC	1	0.3	6.5	2.6	6.46
	PSSC	7	2.3	1.7	0.7	0.25
PL	PAB/EMF	2	0.1	23.3	0.1	11.63
	PAB/EMFH	2	0.1	146.8	0.8	73.38
	PAB/EMFh	4	0.1	37.8	0.2	9.45
	PABF	13	0.4	13.9	0.1	1.07
	PABFH	6	0.2	3.3	0.0	0.54
	PABFX	99	3.2	12.7	0.1	0.13
	PABFh	6	0.2	7.6	0.0	1.27
	PABFx	35	1.1	5.5	0.0	0.16
	PABGX	1	0.0	0.2	0.0	0.24
	PEM/ABF	149	4.8	1433.8	7.9	9.62
	PEM/ABFH	36	1.2	4917.5	27.0	136.60
	PEM/ABFX	7	0.2	1.3	0.0	0.19
	PEM/ABFh	2	0.1	10.3	0.1	5.15
	PEM/FOA	3	0.1	5.6	0.0	1.88
	PEM/FOC	3	0.1	5.8	0.0	1.93
	PEM/FOCH	4	0.1	1.3	0.0	0.34
	PEM/FOCx	1	0.0	0.3	0.0	0.28
	PEM/USA	1	0.0	21.8	0.1	21.76
	PEM1F	1	0.0	2.6	0.0	2.57
	PEMA	1566	50.0	1982.3	10.9	1.27
	PEMAD	29	0.9	25.1	0.1	0.87
	PEMAH	10	0.3	10.1	0.1	1.01
	PEMAd	8	0.3	14.1	0.1	1.76
	PEMAh	1	0.0	0.4	0.0	0.41
	PEMC	662	21.2	6968.7	38.2	10.53
	PEMCD	13	0.4	22.7	0.1	1.74
	PEMCH	2	0.1	1.4	0.0	0.71
	PEMCX	9	0.3	0.7	0.0	0.08
	PEMCd	11	0.4	6.4	0.0	0.58
	PEMCh	2	0.1	1.8	0.0	0.88
	PEMF	362	11.6	2365.2	13.0	6.53
	PEMFD	1	0.0	122.5	0.7	122.53
	PEMFH	7	0.2	29.8	0.2	4.26
	PEMFX	2	0.1	0.4	0.0	0.20
	PEMFh	4	0.1	2.3	0.0	0.57
	PFO/EMA	3	0.1	3.6	0.0	1.21

Prairie Pothole Region

		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PL	PFO/EMAH	1	0.0	0.5	0.0	0.45
	PFO/EMC	1	0.0	0.6	0.0	0.57
	PFOA	20	0.6	5.8	0.0	0.29
	PFOAH	1	0.0	1.9	0.0	1.87
	PFOAh	11	0.4	2.3	0.0	0.21
	PFOC	3	0.1	0.9	0.0	0.29
	PFOCH	3	0.1	2.3	0.0	0.76
	PSS/EMC	2	0.1	0.7	0.0	0.37
	PSS/FOA	2	0.1	0.9	0.0	0.44
	PSSA	3	0.1	6.5	0.0	2.16
	PUBFHX	1	0.0	0.1	0.0	0.11
	PUBFX	13	0.4	1.7	0.0	0.13
	PUS/FOCX	1	0.0	0.2	0.0	0.23
	PUSA	1	0.0	0.6	0.0	0.57
PS	PAB/EMF	161	1.5	1255.8	23.6	7.80
	PAB/EMFD	3	0.0	104.1	2.0	34.70
	PAB/EMFH	9	0.1	122.5	2.3	13.61
	PAB/EMFd	4	0.0	20.1	0.4	5.03
	PAB/EMFh	4	0.0	12.0	0.2	3.01
	PABF	551	5.2	1420.8	26.7	2.58
	PABFD	5	0.0	8.8	0.2	1.76
	PABFH	255	2.4	200.1	3.8	0.78
	PABFHX	19	0.2	3.9	0.1	0.21
	PABFX	4212	39.8	649.6	12.2	0.15
	PABFh	80	0.8	110.3	2.1	1.38
	PABFhx	9	0.1	1.4	0.0	0.15
	PABFx	2052	19.4	307.9	5.8	0.15
	PABG	3	0.0	5.5	0.1	1.83
	PABGH	5	0.0	10.8	0.2	2.16
	PABGX	15	0.1	20.4	0.4	1.36
	PABGh	2	0.0	4.9	0.1	2.46
	PABGx	34	0.3	68.8	1.3	2.02
	PUB/EMFH	1	0.0	1.2	0.0	1.21
	PUB/FOFH	1	0.0	0.9	0.0	0.92
	PUB/FOFX	1	0.0	0.2	0.0	0.18
	PUBF	3	0.0	0.3	0.0	0.11
	PUBFH	333	3.2	417.5	7.8	1.25
	PUBFHX	72	0.7	27.4	0.5	0.38
	PUBFX	2640	25.0	422.8	7.9	0.16
	PUBFx	15	0.1	3.9	0.1	0.26
	PUBGH	39	0.4	97.9	1.8	2.51

Prairie Pothole Region

		Number	Percent Number	Area (ha) Total	Area (ha) % Total	Area (ha) MEAN
EMAP	NWI					
PS	PUBGHX	2	0.0	1.0	0.0	0.52
	PUBGX	24	0.2	18.4	0.3	0.76
	PUSA	4	0.0	1.7	0.0	0.44
	PUSCH	1	0.0	0.1	0.0	0.07
	PUSCX	10	0.1	4.1	0.1	0.41
	PUSFH	1	0.0	1.6	0.0	1.61

Appendix F

Tables for each region showing the tile identifier number and the percentage of each tile (640 km^2 hexagon) and each hexagon (40 km^2 hexagon)

Table F1. Illinois Region. Percentage of tiles and hexagons included in the study.

Tile Identifier	Percentage in Tile	Percentage in Hexagon
7363	100.00	100.00
7364	99.65	100.00
7365	69.08	75.56
7366	69.33	100.00
7367	79.45	100.00
7368	82.13	100.00
7519	100.00	100.00
7520	100.00	100.00
7521	100.00	100.00
7522	100.00	100.00
7523	100.00	100.00
7524	96.15	100.00
7525	93.43	100.00
7669	100.00	100.00
7676	100.00	100.00
7677	100.00	100.00
7678	100.00	100.00
7680	100.00	100.00
7681	100.00	100.00
7826	100.00	100.00
7827	100.00	100.00
7834	100.00	100.00
7836	100.00	100.00
7837	100.00	100.00
7838	100.00	100.00
7839	100.00	100.00
7840	73.52	97.83
7979	100.00	100.00
7984	100.00	100.00
7985	100.00	100.00
7994	100.00	100.00
7995	100.00	100.00
7996	100.00	100.00
7997	90.45	100.00
7998	54.48	99.01
8137	93.66	100.00
8138	100.00	100.00
8139	100.00	100.00
8142	100.00	100.00
8144	100.00	100.00
8145	100.00	100.00
8153	100.00	100.00
8154	100.00	100.00
8155	100.00	100.00
8298	100.00	100.00

Illinois Region

Tile Identifier	Percentage in Tile	Percentage in Hexagon
8299	100.00	100.00
8300	100.00	100.00
8301	100.00	100.00
8302	100.00	100.00
8303	100.00	100.00
8304	100.00	100.00
8306	100.00	100.00
8314	100.00	100.00
8315	100.00	100.00
8459	100.00	100.00
8460	100.00	100.00
8461	100.00	100.00
8462	100.00	100.00
8463	100.00	100.00
8464	100.00	100.00
8465	100.00	100.00
8467	100.00	100.00
8468	100.00	100.00
8475	100.00	100.00
8476	100.00	100.00
8477	71.43	100.00
8622	100.00	100.00
8623	100.00	100.00
8624	100.00	100.00
8625	100.00	100.00
8626	100.00	100.00
8628	100.00	100.00
8630	100.00	100.00
8631	97.84	100.00
8639	75.70	100.00
8786	100.00	100.00
8787	100.00	100.00
8788	100.00	100.00
8789	100.00	100.00
8792	100.00	100.00
8793	100.00	100.00
8950	99.87	100.00
8951	100.00	100.00
8952	100.00	100.00
8953	100.00	100.00
8954	100.00	100.00
8959	100.00	100.00
9116	100.00	100.00
9117	100.00	100.00
9118	100.00	100.00

Illinois Region

Tile Identifier	Percentage in Tile	Percentage in Hexagon
9119	100.00	100.00
9120	100.00	100.00
9125	100.00	100.00
9282	62.46	95.78
9283	100.00	100.00
9286	95.19	100.00
9287	100.00	100.00
9450	90.56	100.00
9454	65.47	100.00

Table F2. Washington Region. Percentage of tiles and hexagons included in the study.

Tile Identifier	Percentage in Tile	Percentage in Hexagon
25612	47.54	44.37
25613	68.90	78.84
25614	46.96	31.20
25615	35.13	0.01
25616	23.40	0.00
25617	12.51	0.00
25729	21.00	0.00
25730	100.00	100.00
25731	100.00	100.00
25732	100.00	100.00
25733	100.00	100.00
25734	100.00	100.00
25735	94.09	100.00
25736	100.00	100.00
25846	88.65	100.00
25847	100.00	100.00
25848	100.00	100.00
25849	100.00	100.00
25850	100.00	100.00
25851	100.00	100.00
25852	30.23	50.60
25961	44.65	0.00
25962	100.00	100.00
25963	100.00	100.00
25964	100.00	100.00
25965	100.00	100.00
25966	100.00	100.00
25967	78.98	100.00
26077	100.00	100.00
26078	100.00	100.00
26079	100.00	100.00
26080	100.00	100.00
26081	100.00	100.00
26082	9.39	0.00
26189	78.08	53.42
26190	100.00	100.00
26191	100.00	100.00
26192	100.00	100.00
26193	100.00	100.00
26194	100.00	100.00
26195	50.02	100.00
26301	23.20	0.00
26302	100.00	100.00
26303	100.00	100.00
26304	100.00	100.00

Washington Region

Tile Identifier	Percentage in Tile	Percentage in Hexagon
26305	100.00	100.00
26306	100.00	100.00
26307	93.22	100.00
26308	100.00	100.00
26413	100.00	100.00
26414	100.00	100.00
26415	100.00	100.00
26416	100.00	100.00
26417	100.00	100.00
26418	100.00	100.00
26419	26.25	33.21
26523	47.92	0.00
26524	100.00	100.00
26525	100.00	100.00
26526	100.00	100.00
26527	100.00	100.00
26528	100.00	100.00
26529	72.87	100.00
26633	100.00	100.00
26634	100.00	100.00
26635	100.00	100.00
26636	100.00	100.00
26637	100.00	100.00
26742	100.00	100.00
26744	100.00	100.00
26745	100.00	100.00
26746	100.00	100.00
26747	46.02	100.00
26848	26.75	0.00
26849	100.00	100.00
26850	100.00	100.00
26851	100.00	100.00
26852	100.00	100.00
26853	100.00	100.00
26953	52.44	63.08
26954	34.66	0.93
26955	94.13	100.00
26956	100.00	100.00
26957	100.00	100.00
26958	100.00	100.00
26959	100.00	100.00
26960	100.00	100.00
27058	65.01	33.05
27060	100.00	100.00
27061	100.00	100.00

Washington Region

Tile Identifier	Percentage in Tile	Percentage in Hexagon
27062	100.00	100.00
27063	100.00	100.00
27064	100.00	100.00
27065	100.00	100.00
27066	67.20	100.00
27162	21.89	0.00
27163	100.00	100.00

Table F3. Prairie Pothole Region. Percentage of tiles and hexagons included in the study.

Tile Identifier	Percentage in Tile	Percentage in Hexagon
14717	9.36	0.00
14718	50.99	53.94
14719	70.98	100.00
14720	89.18	100.00
14721	80.32	100.00
14906	73.73	100.00
14907	100.00	100.00
14908	100.00	100.00
14909	100.00	100.00
15088	100.00	100.00
15089	86.20	100.00
15095	100.00	100.00
15096	100.00	100.00
15097	100.00	100.00
15274	60.39	89.32
15275	100.00	100.00
15276	46.61	33.71
15281	71.98	100.00
15282	68.36	63.76
15283	100.00	100.00
15284	73.68	100.00
15460	86.15	100.00
15461	73.89	100.00
15462	45.68	28.68
15463	63.18	96.84
15469	100.00	100.00
15647	100.00	100.00
15648	83.39	100.00
15653	100.00	100.00
15654	97.76	100.00
15830	63.83	98.05
15831	100.00	100.00
15836	34.71	29.69
15837	60.87	91.38
16013	98.38	100.00
16014	100.00	100.00

Appendix G

Tables containing raw data values (i.e., no expansion factor correction applied).

Table G1. Changes in the numbers of wetlands when mapping from the NWI level classification to the EMAP level classification.

NUMBERS OF WETLANDS

	Illinois		Washington		Prairie Pothole	
EMAP Class	NWI	EMAP	NWI	EMAP	NWI	EMAP
E2EM	0	0	1031	819	0	0
E2FO/SS	0	0	16	15	0	0
PEMAR	1045	923	583	478	115	101
PEMA	11005	10923	2320	2235	80703	79676
PEMBR	5	5	35	34	0	0
PEMB	105	103	193	190	2	2
PEMCR	1223	1101	2319	1934	112	101
PEMC	16426	15741	11301	10812	79465	78102
PFO/SSAR	9971	7240	2597	1933	92	92
PFO/SSA	9752	8970	2071	1978	949	932
PFO/SSBR	1	1	18	17	0	0
PFO/SSB	9	9	136	128	0	0
PFO/SSCR	2818	2384	5578	4033	78	78
PFO/SSC	6701	6089	9891	8496	299	296
PL	3489	1757	720	586	3130	2399
PS	59625	59312	7773	7639	10570	10405
TOTAL	122175	114558	46582	41327	175515	172184

AVERAGE SIZE (in hectares)

	Illinois		Washington		Prairie Pothole	
EMAP Class	NWI	EMAP	NWI	EMAP	NWI	EMAP
E2EM	0	0	7.18	9.03	0	0
E2FO/SS	0	0	2.29	2.45	0	0
PEMAR	2.49	2.82	5.40	6.59	7.21	8.21
PEMA	0.84	0.85	2.36	2.45	0.84	0.85
PEMBR	18.00	18.00	0.94	0.97	0	0
PEMB	3.81	3.89	1.18	1.19	23.98	23.98
PEMCR	3.54	3.93	3.44	4.12	24.21	26.84
PEMC	1.20	1.26	1.53	1.60	1.28	1.30
PFO/SSAR	7.67	10.56	2.99	4.02	0.02	2.02
PFO/SSA	3.59	3.90	2.45	2.56	0.41	0.42
PFO/SSBR	0.42	0.42	0.84	0.89	0	0
PFO/SSB	2.99	2.99	0.85	0.90	0	0
PFO/SSCR	7.56	8.93	2.94	4.07	2.63	2.63
PFO/SSC	2.91	3.21	2.33	2.72	0.82	0.83
PL	5.29	10.51	3.18	3.91	5.83	7.60
PS	0.42	0.42	0.63	0.64	0.50	0.51

Table G2. Percentages of the number and areas of wetlands for each EMAP class for each of the three regions. Values reported are percentages based on raw data values. NP identifies EMAP classes not present in the region.

	Illinois		Washington		Prairie Pothole	
EMAP Class	%No.	%Area	%No.	%Area	%No.	%Area
E2EM	NP	NP	2.0	7.3	NP	NP
E2FO/SS	NP	NP	0.0	0.0	NP	NP
PEMAR	0.8	1.1	1.2	3.1	0.1	0.4
PEMA	9.5	4.0	5.4	5.4	46.3	34.2
PEMBR	0.0	0.0	0.1	0.0	NP	NP
PEMB	0.1	0.2	0.5	0.2	0.0	0.0
PEMCR	1.0	1.9	4.7	7.9	0.1	1.4
PEMC	13.7	8.5	26.2	17.1	45.4	51.5
PFO/SSAR	6.3	32.9	4.7	7.7	0.1	0.1
PFO/SSA	7.8	15.1	4.8	5.0	0.5	0.2
PFO/SSBR	0.0	0.0	0.0	0.0	NP	NP
PFO/SSB	0.0	0.0	0.3	0.1	NP	NP
PFO/SSCR	2.1	9.2	9.8	16.2	0.0	0.1
PFO/SSC	5.3	8.4	20.6	22.8	0.2	0.1
PL	1.5	8.0	1.4	2.3	1.4	9.2
PS	51.8	10.8	18.5	4.8	6.0	2.7

Table G3. Population summary by size for each of the regions. Values reported are percentages based on raw data values.

A. Percentage of the Number of Wetlands

	Illinois		Washington		Prairie Pothole	
Size Class (ha)	NWI	EMAP	NWI	EMAP	NWI	EMAP
0.0 - 0.25	43.4	45.5	27.1	26.9	51.5	51.9
0.25 - 0.5	16.7	16.8	17.3	17.9	17.7	17.7
0.5 - 1	13.5	13.0	17.9	17.8	13.3	13.2
1 - 2	10.6	9.9	15.5	15.0	8.8	8.5
2 - 5	9.1	8.4	13.1	12.7	5.8	5.7
5 - 10	3.5	3.3	5.1	5.2	1.8	1.8
10 - 25	2.0	2.0	2.9	3.1	0.8	0.8
25 - 50	0.6	0.6	0.7	0.9	0.2	0.2
50 - 100	0.3	0.3	0.3	0.4	0.1	0.1
>100	0.2	0.2	0.1	0.1	0.1	0.1

B. Percentage of Wetlands Surface Area

	Illinois		Washington		Prairie Pothole	
Size Class (ha)	NWI	EMAP	NWI	EMAP	NWI	EMAP
0.0 - 0.25	2.9	2.8	1.6	1.5	5.8	5.7
0.25 - 0.5	3.1	2.9	2.9	2.6	5.6	5.5
0.5 - 1	5.1	4.5	5.9	5.2	8.4	8.1
1 - 2	7.9	6.9	10.1	8.7	10.9	10.4
2 - 5	15.0	13.0	18.9	16.2	15.9	15.3
5 - 10	12.9	11.2	16.2	14.8	11.0	10.6
10 - 25	16.1	15.2	20.5	19.6	10.9	10.9
25 - 50	11.0	10.4	11.6	12.2	5.5	5.7
50 - 100	9.6	9.8	8.4	10.6	4.4	4.9
>100	16.5	23.0	3.8	8.5	21.6	22.8

Table G4. Sample estimates for number and areas of wetlands by EMAP class for the Illinois region. "*" indicates that the true population value is contained within the estimate's confidence interval. The values below were computed from the raw data values. NP identifies EMAP classes not present in the region. "--" denotes that the estimates were not obtainable for that EMAP class.

A. -------------- Number of Wetlands --------------

						90% Conf. Int.	
EMAP Class	Number	Est. Number	Rel. Diff.	SE	CV	Lower Bound	Upper Bound
E2EM	NP	--	--	--	--	--	--
E2FO/SS	NP	--	--	--	--	--	--
PEMAR	923	1072	0.16	208	0.19	731	1413*
PEMA	10923	11504	0.05	1396	0.12	9208	13800*
PEMBR	5	0	-1.00	--	--	--	--
PEMB	103	64	-0.38	44	0.68	-8	136*
PEMCR	1101	1280	0.16	214	0.17	928	1632*
PEMC	15741	16288	0.03	2508	0.15	12162	20414*
PFO/SSAR	7240	8240	0.14	1194	0.14	6275	10205*
PFO/SSA	8970	10224	0.14	1192	0.12	8263	12185*
PFO/SSBR	1	0	-1.00	--	--	--	--
PFO/SSB	9	0	-1.00	--	--	--	--
PFO/SSCR	2384	3104	0.30	940	0.30	1557	4651*
PFO/SSC	6089	7840	0.29	1237	0.16	5806	9874*
PL	1757	1776	0.01	533	0.30	900	2652*
PS	59312	60320	0.02	7289	0.12	48330	72310*
TOTAL	114558	121712	0.06				

B. --------- Area of Wetlands in Hectares ---------

						90% Conf. Int.	
EMAP Class	Area (ha)	Est. Area	Rel. Diff.	SE	CV	Lower Bound	Upper Bound
E2EM	NP	--	--	--	--	--	--
E2FO/SS	NP	--	--	--	--	--	--
PEMAR	2605	4073	0.56	1288	0.32	1954	6192*
PEMA	9237	9838	0.07	1526	0.16	7327	12349*
PEMBR	90	0	-1.00	--	--	--	--
PEMB	400	93	-0.77	84	0.90	-45.37	232
PEMCR	4325	4369	0.01	1660	0.38	1638	7101*
PEMC	19760	18233	-0.08	4381	0.24	11026	25440*
PFO/SSAR	76428	80390	0.05	25232	0.31	38883	121897*
PFO/SSA	34989	41919	0.20	9653	0.23	26040	57798*
PFO/SSBR	0	0	--	--	--	--	--
PFO/SSB	27	0	--	--	--	--	--
PFO/SSCR	21297	22399	0.05	7097	0.32	10725	34074*
PFO/SSC	19529	19938	0.02	4044	0.20	13286	26591*
PL	18464	14816	-0.20	6497	0.44	4129	25503*
PS	25085	26099	0.04	2936	0.11	21269	30929*
TOTAL	232236	242167	0.04				

Table G5. **Sample estimates for number and areas of wetlands by EMAP class for the Washington region. "*" indicates that the true population value is contained within the estimate's confidence interval. The values below were computed from the raw data values. "--" denotes that the estimates were not available for that EMAP class.**

A. ---------------- Number of Wetlands ----------------

EMAP Class	Number	Est. Number	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
E2EM	819	800	-0.02	260	0.33	372	1228*
E2FO/SS	15	48	2.20	34	0.72	-9	105*
PEMAR	478	368	-0.23	130	0.35	154	582*
PEMA	2235	1808	-0.19	530	0.29	935	2681*
PEMBR	34	16	-0.53	15	0.97	-9	41*
PEMB	190	160	-0.16	113	0.71	-26	346*
PEMCR	1934	1536	-0.21	350	0.23	971	2111*
PEMC	10812	9600	-0.11	1886	0.20	6498	12702*
PFO/SSAR	1933	2208	0.14	433	0.20	1495	2921*
PFO/SSA	1978	2000	0.01	394	0.20	1353	2647*
PFO/SSBR	17	0	-1.00	--	--	--	--
PFO/SSB	128	176	0.38	88	0.50	32	320*
PFO/SSCR	4033	4368	0.08	901	0.21	2886	5850*
PFO/SSC	8496	8496	0.00	1392	0.16	6207	10785*
PL	586	656	0.12	238	0.36	264	1048*
PS	7639	6640	-0.13	1145	0.17	4757	8523*
TOTAL	41310	38880	-0.06				

B. ---------- Area of Wetlands in Hectares ----------

EMAP Class	Area (ha)	Est. Area	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
E2EM	7398	11785	0.59	5244	0.44	3159	20411*
E2FO/SS	37	92	1.50	63	0.69	-12	196*
PEMAR	3148	4348	0.38	3544	0.81	-1481	10178*
PEMA	5478	2919	-0.47	1270	0.44	830	5009
PEMBR	33	1	-0.95	1	0.97	-1	4
PEMB	227	111	-0.51	96	0.87	-48	269*
PEMCR	7966	6281	0.21	2249	0.36	2581	9981*
PEMC	17346	12960	-0.25	3594	0.28	7047	18872*
PFO/SSAR	7767	7033	-0.09	1880	0.27	3940	10125*
PFO/SSA	5072	5627	0.11	1624	0.29	2956	8299*
PFO/SSBR	15	0	-1.00	--	--	--	--
PFO/SSB	115	99	-0.14	78	0.78	-28	227*
PFO/SSCR	16399	21171	0.29	8387	0.40	7375	34968*
PFO/SSC	23067	31685	0.37	9061	0.29	16781	46590*
PL	2290	1851	-0.19	857	0.46	441	3261*
PS	4901	3467	-0.29	608	0.18	2467	4466
TOTAL	105752	109430	0.03				

Table G6. Sample estimates for number and areas of wetlands by EMAP class for the Prairie Pothole region. "*" indicates that the true population value is contained within the estimate's confidence interval. The values below were computed from the raw data values. NP identifies EMAP classes not present in the region. "--" denotes that the estimates were not obtainable for theat EMAP class.

A. -------------- Number of Wetlands --------------

EMAP Class	Number	Est. Number	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
E2EM	NP	--	--	--	--	--	--
E2FO/SS	NP	--	--	--	--	--	--
PEMAR	101	16	-0.84	15	0.97	-9	41
PEMA	79676	102704	0.29	13144	0.13	81082	124326
PEMBR	NP	--	--	--	--	--	--
PEMB	2	0	-1.00	--	--	--	--
PEMCR	101	0	-1.00	--	--	--	--
PEMC	78102	84640	0.08	10836	0.13	66815	102465*
PFO/SSAR	92	0	-1.00	--	--	--	--
PFO/SSA	932	1232	0.32	261	0.21	802	1662*
PFO/SSBR	NP	--	--	--	--	--	--
PFO/SSB	NP	--	--	--	--	--	--
PFO/SSCR	78	0	-1.00	--	--	--	--
PFO/SSC	296	352	0.19	87	0.25	209	495*
PL	2399	944	-0.61	469	0.50	173	1715
PS	10405	12032	0.16	1360	0.11	9794	14270*
TOTAL	172184	201920	0.17				

B. ---------- Area of Wetlands in Hectares ----------

EMAP Class	Area (ha)	Est. Area	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
E2EM	NP	--	--	--	--	--	--
E2FO/SS	NP	--	--	--	--	--	--
PEMAR	830	46	-0.94	44	0.97	-27	118
PEMA	67490	59671	-0.12	6631	0.11	48763	70579*
PEMBR	NP	--	--	--	--	--	--
PEMB	48	0	-1.00	--	--	--	--
PEMCR	2711	0	-1.00	--	--	--	--
PEMC	101555	93345	-0.08	10686	0.11	75767	110924*
PFO/SSAR	186	0	-1.00	--	--	--	--
PFO/SSA	387	519	0.34	159	0.31	257	781*
PFO/SSBR	NP	--	--	--	--	--	--
PFO/SSB	NP	--	--	--	--	--	--
PFO/SSCR	206	0	-1.00	--	--	--	--
PFO/SSC	245	201	-0.18	72	0.36	82	321*
PL	18234	4532	-0.75	2219	0.49	882	8182
PS	5327	6105	0.15	1434	0.23	3747	8464*
TOTAL	197219	164419	-0.17				

Table G7. Sample estimates by size class for the Illinois region. "*" indicates that the true population value is contained within the estimate's confidence interval. The values below were computed from the raw data values.

A. -------------- Number of Wetlands --------------

Size Class (ha)	Number	Est. Number	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper
0 - 0.25	52130	54256	0.04	6359	0.12	43796	64716*
0.25 - 0.50	19199	20240	0.05	1835	0.09	17222	23258*
0.50 - 1.0	14865	15920	0.07	1384	0.09	13643	18197*
1 - 2	11336	12624	0.11	1162	0.09	10712	14536*
2 - 5	9680	10768	0.11	1038	0.10	9061	12475*
5 - 10	3784	4048	0.07	473	0.12	3270	4826*
10 - 25	2304	2496	0.08	391	0.16	1852	3140*
25 - 50	707	832	0.18	148	0.18	588	1076*
50 - 100	327	384	0.17	94	0.24	230	538*
>100	226	144	-0.36	63	0.43	41	247*

B. --------- Area of Wetlands in Hectares ---------

Size Class (ha)	Area (ha)	Est. Area	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
0 - 0.25	6570	6869	0.05	767	0.11	5608	8130*
0.25 - 0.50	6832	7268	0.06	658	0.09	6186	8350*
0.50 - 1.0	10553	11233	0.06	983	0.09	9616	12849*
1 - 2	16033	17824	0.11	1650	0.09	15110	20538*
2 - 5	30265	34137	-0.11	3416	0.10	28518	39755*
5 - 10	26061	27651	0.06	3309	0.12	22207	33095*
10 - 25	35353	38381	0.09	6105	0.16	28339	48424*
25 - 50	24237	28771	0.19	5413	0.19	19866	37676*
50 - 100	22823	25346	0.11	6066	0.24	15367	35325*
>100	53509	44688	-0.16	25404	0.57	2899	86477*

Table G8. Sample estimates by size class for the Washington region. "*" indicates that the true population value is contained within the estimate's confidence interval. The values below were computed from the raw data values.

A. --------------- Number of Wetlands ---------------

						90% Conf. Int.	
Size Class (ha)	Number	Est. Number	Rel. Diff.	SE	CV	Lower Bound	Upper Bound
0 - 0.25	11101	10656	-0.04	1751	0.16	7776	13536*
0.25 - 0.50	7396	7520	0.02	904	0.12	6034	9006*
0.50 - 1.0	7364	6688	-0.09	868	0.13	5260	8116*
1 - 2	6214	4992	-0.20	780	0.16	3709	6275*
2 - 5	5239	4944	-0.06	839	0.17	3564	6325*
5 - 10	2159	2096	0.03	463	0.22	1334	2858*
10 - 25	1284	1296	0.01	375	0.29	680	1912*
25 - 50	357	400	0.12	194	0.48	81	719*
50 - 100	161	208	0.29	109	0.53	28	388*
>100	52	80	0.53	40	0.51	13	147*

B. --------- Area of Wetlands in Hectares ---------

						90% Conf. Int.	
Size Class (ha)	Area (ha)	Est. Area	Rel. Diff.	SE	CV	Lower Bound	Upper Bound
0 - 0.25	1521	1483	-0.02	233	0.16	1099	1867*
0.25 - 0.50	2668	2740	0.02	327	0.12	2202	3278*
0.50 - 1.0	5311	4807	-0.09	630	0.13	3772	5843*
1 - 2	8846	7122	-0.19	1130	0.16	5263	8982*
2 - 5	16423	15460	-0.06	2656	0.17	11091	19829*
5 - 10	14945	14917	<0.01	3347	0.22	9412	20422*
10 - 25	19819	20843	0.05	5968	0.29	11024	30661*
25 - 50	12372	13739	0.11	6863	0.50	2450	25028*
50 - 100	11734	15060	0.40	8005	0.53	1891	28228*
>100	8622	13261	0.54	7128	0.54	1536	24986*

Table G9. Sample estimates by size class for the Prairie Pothole region. "*" indicates that the true population value is contained within the estimate's confidence interval. The values below were computed from the raw data values.

A. ---------------- Number of Wetlands ----------------

Size Class (ha)	Number	Est. Number	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
0 - 0.25	89394	106128	0.19	12619	0.12	85369	126887*
0.25 - 0.50	30473	35968	0.18	3893	0.11	29564	42372*
0.50 - 1.0	22705	27584	0.21	2595	0.09	23315	31853
1 - 2	14710	16144	0.10	1775	0.11	13223	19065*
2 - 5	9864	11216	0.14	1041	0.09	9503	12929*
5 - 10	3056	2976	-0.03	361	0.12	2382	3570*
10 - 25	1415	1472	0.04	230	0.16	1093	1851*
25 - 50	327	304	-0.07	79	0.26	174	434*
50 - 100	144	96	-0.33	47	0.49	18	174*
>100	96	32	-0.67	22	0.68	-4	68

B. ---------- Area of Wetlands in Hectares ----------

Size Class (ha)	Area (ha)	Est. Area	Rel. Diff.	SE	CV	90% Conf. Int. Lower Bound	90% Conf. Int. Upper Bound
0 - 0.25	11327	135660	0.20	1531	0.11	11049	16084*
0.25 - 0.50	10832	12827	0.18	1384	0.11	10551	15104*
0.50 - 1.0	16065	19490	0.21	1854	0.10	16439	22540*
1 - 2	20561	22452	0.09	2484	0.11	18366	26538*
2 - 5	30137	33907	0.13	3151	0.09	28724	39091*
5 - 10	20944	19943	-0.05	2442	0.12	15925	23960*
10 - 25	21401	20756	-0.03	3293	0.16	15340	26172*
25 - 50	11335	10442	-0.08	2857	0.27	5743	15141*
50 - 100	9737	7312	-0.25	3623	0.50	1352	13273*
>100	44879	3724	-0.92	2518	0.68	-418	7865

Appendix H

List of participants at the October 1990 informal workshop in Warrenton, VA

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Appendix I

Description and location of the data files used in this study

Two data files were necessary for the analyses in each of the three regions.

xxxCOD.DAT	Contains data that retains the integrity of the NWI polygons and relabels polygons with EMAP codes.
xxxECO.DAT	Contains data that aggregates contiguous polygons with like EMAP class codes (i.e., dissolve coincident boundaries between like classes). The ECO stands for EMAP Code.

Variable	Field Number COD	ECO
Hexagon Number	1	1
Area	2	2
Perimeter	3	3
NWI Code	4	-
EMAP Code	5	4
Latitude	6	5
Longitude	7	6
In 40 Hex Flag	8	7

Information regarding these data files can be obtained by contacting:

EMAP-Wetlands Technical Director
U.S. Environmental Protection Agency
Environmental Research Laboratory
200 SW 35th Street
Corvallis, OR 97333

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