# ANALYSIS OF LANDSAT ETM AND TM MULTI-TEMPORAL DATA FOR IPCI - BASED WETLAND VEGETATION CONDITION CLASSES IN THE PRAIRIE POTHOLE REGION OF NORTH DAKOTA

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By

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# ABSTRACT

Mita, Dath Kakole, Ph.D., Program of Natural Resources Management, College of Graduate and Interdisciplinary Studies, North Dakota State University, November 2005. Analysis of Landsat ETM and TM Multi-Temporal Data for IPCI-Based Wetland Vegetation Condition Classes in the Prairie Pothole Region of North Dakota. Major Professor: Dr. Don Kirby.

In this study, geographic information systems (GIS), FRAGSTATS (landscape pattern analysis program), and satellite remotely sensed land cover data were used to (1) explore, quantify, and compare the spatial pattern of landscapes surrounding seasonal and temporary wetlands in the Prairie Pothole Region (PPR) of North Dakota; (2) determine the relationship of wetland landscape metrics to the Index of Plant Community Integrity (IPCI); and (3) develop a landscape-level wetland condition prediction model. Patch-based statistics, derived from multi-temporal (LANDSAT TM and ETM+) land cover data, were summarized at the class and landscape-level and used to characterize landscape spatial pattern. Non-Metric Multidimensional Scaling ordination was used to evaluate the dissimilarity in landscape metric space of wetlands of differing IPCI values. Statistical analysis confirmed differences in spatial patterns surrounding wetlands. Strong associations were also discovered between the IPCI condition of wetlands and 13 landscape metrics, largely among seasonal wetlands (surrounded by landscapes with relatively minimal human disturbance). The associations were relatively weaker among temporary wetlands (surrounded by landscapes subjected to repeated and considerable agricultural management). A data-driven model, the Landscape Wetland Analysis Model (LWAM), was developed and validated for rapid quantitative assessment of landscape structure, and prediction of potential wetland plant community condition. The modeling approach was based on (1) identification of metrics that displayed reasonable relationship(s) with wetland

condition classes, (2) establishment of threshold levels that significantly and consistently separated the IPCI wetland conditions, and (3) the development of decision rules for obtaining wetland modeled condition class membership. Three landscape metrics were selected and retained for model development: (1) grassland percent core area of landscape (C%LAND), (2) grassland largest patch index (LPI), and (3) the number of patches per unit area (NPA). The model provides two decision-making options for landscape-level assessment, understanding, and ultimately managing PPR wetlands: (1) three-level condition classification approach (i.e., poor, intermediate, and good: derived when the first two decision rules are applied), and (2) two-level classification approach (i.e., poor and good: derived when all decision rules are applied). Two aspects of the PPR landscape were discovered as important in this study contributing to the structure and plant community condition of wetland ecosystems: (1) grasslands, and (2) landscape fragmentation.