

THE NATIONAL WETLANDS INVENTORY - THE FIRST TEN YEARS

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ABSTRACT: In 1974, the U.S. Fish and Wildlife Service directed its Office of Biological Services to design and conduct an inventory of the Nation's wetlands. The mandate was to develop and disseminate a technically sound, comprehensive, database concerning the characteristics and extent of the Nation's wetlands. The purpose of this database is to foster wise use of the Nation's wetlands and to expedite decisions that may affect this important resource. To accomplish this, state-of-the-art principles and methodologies pertaining to all aspects of wetland inventory were assimilated and developed by the newly formed project. By 1979, when the National Wetlands Inventory Project (NWI) became operational, it was clear that two very different kinds of information were needed. First, detailed wetland maps were needed for site-specific decisions. Secondly, national statistics on the current status and trends of wetlands were needed in order to provide information to support the development or alteration of Federal programs and policies.

(KEY TERMS: Wetlands; inventory; status and trends; maps.)

INTRODUCTION

The Fish and Wildlife Service (Service) has always recognized the importance of wetlands to waterfowl and other migratory birds because 10-12 million ducks breed annually, and millions more overwinter, in the United States. Consequently, the Service has a direct interest in protecting wetlands, especially wetlands where waterfowl breed and overwinter.

We know that wetlands also play an integral role in maintaining the quality of human life through material contributions to our national economy (food supply; water supply and quality; flood control; fish, wildlife, and plant resources) and thus to the health, safety, recreation, and economic well-being of all our citizens:

Need for a National Wetlands Inventory

In 1954, the Service conducted a nationwide survey of wetlands that focused on important waterfowl wetlands. This survey covered roughly 40% of the lower 48 States. Although not a comprehensive wetlands inventory by today's standards, it was instrumental in stimulating public interest in the conservation of waterfowl wetlands. These findings were published in a well-known Service report - "Wetlands of the United States" - which is commonly referred to as Circular 39 (Shaw and Fredine 1956).

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Since this survey, however, wetlands have undergone many changes, both natural and man-induced. These changes, coupled with our increased understanding of wetland values, led the Service to establish the National Wetlands Inventory Project (NWI). The NWI goal is to generate and disseminate scientific information on the characteristics and extent of the Nation's wetlands. The purpose of this information is to foster wise use of the Nation's wetlands and to provide data for making quick and accurate resource decisions. Decisionmakers can not make informed decisions about wetlands without knowing how many, of what type, are where.

Two Types of Wetland Information Needed

Two very different kinds of information are needed; 1) detailed maps and 2) status and trends reports. First, detailed wetland maps are needed for impact assessment of site-specific projects. These maps serve a purpose similar to the Soil Conservation Service's soil survey maps, the National Oceanic and Atmospheric Administration's coastal geodetic survey maps, and the Geological Survey's topographic maps. Detailed wetland maps are used by local, State and Federal agencies as well as by private industry and organizations for many purposes, including comprehensive resource management plans, environmental impact assessments, facility and corridor siting, oil spill contingency plans, natural resource inventories, habitat surveys and other uses. Secondly, national estimates of the current status and trends (i.e., losses and gains) of wetlands are also needed to evaluate the effectiveness of existing Federal programs and policies, identify national or regional problems and increase general public awareness of wetlands.

PRE-OPERATIONAL PHASE

Prior to actually beginning wetlands mapping in 1979, the National Wetlands Inventory Project reviewed existing State and local wetland inventories and existing classification schemes to determine the best way to inventory wetlands. A remote sensing technique for the inventory was then selected.

Review of Existing Wetland Surveys

The first step of the pre-operational phase was to review existing wetlands inventories. The NWI consulted with Federal and State agencies to learn: 1) where and when wetland surveys had previously been completed, 2) what inventory techniques were employed, 3) where to obtain copies of any wetland maps that may have been produced, and 4) the status of State wetlands protection. Only a handful of States had inventoried their wetlands and most of these had only mapped coastal wetlands. These results were published in the 1976 Service report - "Existing State and Local Wetlands Surveys (1965-1975)."

Review of Existing Classifications Systems

Before the inventory could begin, the NWI had to decide how to classify wetlands. Thus, in 1975 the Service brought together 15 of the country's top regional wetland scientists to evaluate the utility of existing wetland classification schemes for the National Wetlands Inventory. They determined that none of the existing systems could be used or modified for this purpose and that a new classification needed to be developed.

The Service's wetlands classification system (Cowardin, et al. 1979) was developed by a team of wetland ecologists, with the assistance of local, State and Federal agencies as well as many private groups and individuals. It went through four major revisions and extensive field testing prior to its official adoption by the Service on October 1, 1980.

The purpose of the classification system is: 1) to describe ecological units having certain common natural attributes; 2) to arrange these units in a system that facilitates resource management decisions; 3) to furnish units for inventory and mapping; and 4) to provide uniformity in wetland concepts and terminology throughout the United States.

Wetlands are extremely diverse and complex. The Service's classification system defines the limits of wetlands according to ecological characteristics and not according to administrative or regulatory programs. In general terms, wetlands are defined in Cowardin et al. (1979), as lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface.

The classification system presents a method for grouping ecologically similar wetlands and is the state-of-the-art in wetland classification today. It is hierarchical with wetlands divided among five major systems at the broadest level: Marine, Estuarine, Riverine, Lacustrine and Palustrine. Each System is further subdivided by Subsystems that reflect hydrologic conditions, e.g., subtidal vs. intertidal in the Marine and Estuarine Systems. Below Subsystem is the Class level, which describes the appearance of the wetland in terms of vegetation (e.g., Emergent, Aquatic Bed, Forested) or substrate where vegetation is inconspicuous or absent (e.g., Unconsolidated Shore, Rocky Shore, Streambed). Each Class is further subdivided into Subclasses. The classification also included modifiers to describe hydrology (water regime), water chemistry (pH, salinity and halinity) and special modifiers relating to man's activities (e.g., impounded, partly drained, farmed, artificial).

Selecting a Remote Sensing Tool

Due to the magnitude of the Project, remote sensing was the obvious technique for inventorying the Nation's wetlands. The basic choice was between high altitude photography and satellite imagery (LANDSAT). After comparing LANDSAT's capabilities with the Service's and other agencies' needs for wetland information, it was evident that LANDSAT could not provide the needed data for classification detail and wetland determinations within the desired accuracy requirements.

The National Wetlands Inventory Project has continued the testing of satellite technologies. In conjunction with NASA's Jet Propulsion Laboratory, NWI conducted a year long test of the multispectral scanner to detect and map wetlands in Alaska. In conjunction with Ducks Unlimited, NWI also tested both thematic mapper data, as well as data from the French satellite called "SPOT." A year long test is now being conducted by the Earth Observation Satellite Company to test the feasibility of using thematic mapper satellite data to detect wetlands, map wetlands or update existing wetlands maps. None of these tests has provided any hope that present satellite configurations will provide the needed data for classification detail and wetness determinations within desired accuracy requirements of the National Wetlands Inventory Project and its State and Federal cooperators.

ORGANIZATIONAL STRUCTURE OF THE NATIONAL WETLANDS INVENTORY PROJECT

The Fish and Wildlife Service employs a small staff of biologists assembled into two basic groups: National Wetlands Inventory Central Control Group and Regional Wetland Coordinators. The NWI Project Leader works out of the Washington, D.C. Office and coordinates the budget, annual work plans and strategic planning.

The NWI Central Control Group at St. Petersburg, Florida, is the focal point for all operational activities of the NWI. It acquires all materials necessary for performing the inventory, provides technical assistance and work materials to the Regional Coordinators, and produces the wetlands maps. A private service support contractor is responsible for all map production and supplies needed personnel (about 100 technicians and professionals).

Regional Wetland Coordinators, located at the Service's seven Regional Offices, are responsible for inventorying wetlands within their Regions and ensuring that all NWI products meet Regional needs. They manage contracts for wetland photo-interpretation, coordinate interagency review of draft maps, secure cooperative funding from other agencies, and disseminate NWI products. Their addresses, phone numbers and areas of responsibility are provided in Appendix A.

Photo-interpretation and field work are performed by contractors hired by the Service. These contractors photo-interpret wetlands using stereoscopes, review soil maps, conduct field checks and examine existing information on a given area's wetlands to ensure accurate identification of wetlands.

OPERATIONAL PHASE

The operational phase of the NWI Project, initiated on October 1, 1979, involved two main efforts: wetland mapping and wetlands status and trends analysis. In addition to the wetlands maps and trends reports, other products are produced to compliment the mapping effort, including the preliminary list of hydric soils, "National List of Plant Species That Occur in Wetlands," numerous wetland reports, textual and geographic computerized data bases.

National Wetlands Inventory Maps

Primary products of the National Wetlands Inventory are large-scale maps 1:24,000 that show the location, shape, and characteristics of wetlands and deepwater habitats on U.S. Geological Survey base maps. These detailed maps are excellent for site-specific project evaluation.

To produce final National Wetlands Inventory maps, seven major steps must be completed: 1) preliminary field investigations, 2) photo-interpretation of high-altitude photographs, 3) review of existing wetlands information, 4) quality control of interpreted photos, 5) draft map production, 6) interagency review of draft maps, and 7) final map production. Evaluations of the National Wetland Inventory maps by Swartwout (1982) while at the University of Massachusetts and Crowley et al. (1988) for the Agency of Natural Resources Division of Water Quality, Vermont determined that the maps had accuracies of 95 and 91 percent respectively. Accuracy determinations included errors of omission as well as commission. This high accuracy was achieved because of the NWI technique, which involves a combination of field studies, photointerpretation, use of existing information and interagency review of draft maps.

Wetlands Status and Trends Reports

The national wetlands status and trends analysis study arose from the need for national estimates on the current extent of our Nation's wetland resources in the lower 48 States and on corresponding losses and gains over the past two decades. A statistical survey of U.S. wetlands in the mid-1950's and mid-1970's was conducted through conventional air photo-interpretation techniques. The status of wetlands in the mid-50's and mid-70's was determined, and estimates of losses and gains during that interval were computed. The results of this study were published in four major reports - "Status and Trends of Wetlands and Deepwater Habitats in the Conterminous United States, 1950's to 1970's" (Frayer, et al. 1983); "Wetlands of the United States: Current Status and Recent Trends" (Tiner 1984); "Wetlands: Their Use and Regulation" (U.S. Congress, Office of Technology Assessment 1984); and "The Impact of Federal Programs on Wetlands: Volume 1. The Lower Mississippi Alluvial Plain and the Prairie Pothole Region" (Goldstein 1988).

Approximately 215 million acres of wetlands existed in the conterminous U.S. (i.e., lower 48 States) at the time of the Nation's settlement. In the mid-1970's, only 99 million acres remained, leaving 46% of the original wetland acreage. The U.S. wetland resource for the lower 48 States encompassed 93.7 million acres of palustrine wetlands and 5.2 million acres of estuarine wetlands. Wetlands now cover about 5% of the land surface of the lower 48 States.

Between the mid-1950's and mid-1970's about 11 million acres of wetlands were lost, while 2 million acres of new wetlands were created. Thus, in that 20-year interval, a net loss of 9 million acres of wetland occurred. This is an average annual net loss of 458,000 acres. This annual loss equals an area about half the size of Rhode Island. Agricultural development was responsible for 87% of recent national wetland losses; Urban development and other development caused 8% and 5% of the losses, respectively.

The most extensive wetland losses occurred in Louisiana, Mississippi, Arkansas, North Carolina, North Dakota, South Dakota, Nebraska, Florida and Texas. Greatest losses of forested wetlands took place in the Lower Mississippi Valley with the conversion of bottomland hardwood forests to farmland. Shrub wetlands were hardest hit in North Carolina where pocosin wetlands were being converted to cropland or pine plantations or mined for peat. Inland marsh drainage for agriculture was most significant in the Prairie Pothole Region of the Dakotas and Minnesota, Nebraska's Sandhills and Rainwater Basin and Florida's Everglades. Between the mid-1950's and mid-1970's, estuarine wetland losses were heaviest in the Gulf States, i.e., Louisiana, Florida, and Texas. Most of Louisiana's coastal marsh losses were attributed to submergence by coastal waters. In other areas, urban development was the major direct man-induced cause of coastal wetland loss. Dredge and fill for residential development in coastal areas was most significant in Florida, Texas, New Jersey, New York, and California.

Hydric Soils List (Wetland Soils)

Hydric soils are defined by soil saturation for significant period or by frequent flooding for long periods during the growing season. To clarify the meaning of "hydric soils," the NWI in cooperation with the Soil Conservation Service developed the first list of the Nation's hydric soils. Since then, the Soil Conservation Service has become the chair of the Interagency National Technical Committee for Hydric Soils. The "National List of Hydric Soils of the United States, December 1987" is available from

the Soil Conservation Service. This soils list is useful for making wetland determinations in the field or in the office through use of soil survey maps.

List of Plants That Occur in Wetlands

The U.S. Fish and Wildlife Service published the "National List of Plants Species that Occur in Wetlands: 1988 National Summary." The plants in the list are divided into four indicator categories based on a plant's frequency of occurrence in wetlands: 1) obligate - always found in wetlands (greater than 99% of the time); 2) facultative wet - usually found in wetland (66-99% of the time); 3) facultative - sometimes found in wetlands (33-66%); and 4) facultative upland - seldom found in wetlands (less than 33%).

"The National List of Plants Species that Occur in Wetlands: 1988 National Summary" is available from the Superintendent of Documents, U.S. Government Printing Office. Thirteen regional subdivisions of the list are available on floppy disks in ASCII format from the Office of Conference Services, Colorado State University, Fort Collins, Colorado 80523; Comm. (303) 491-7767.

Wetland Reports

Two basic types of wetland reports are developed by NWI: map reports and State wetland reports. The map reports briefly outline NWI procedures and findings (e.g., list of wetland plant communities, photo-interpretation problems). Map reports are available for numerous areas. By contrast, the State wetland report is a comprehensive publication on the results of NWI in a given State. It is prepared upon completion of the wetlands inventory in each State. The State report includes wetland statistics and detailed discussions of NWI techniques, wetland plant communities, hydric soils and wetland values. To date, State reports have been produced for New Jersey and Delaware. NWI expects to prepare reports for Rhode Island, Connecticut, Pennsylvania, Hawaii and Washington when statistics become available.

Wetlands Values Citation Database

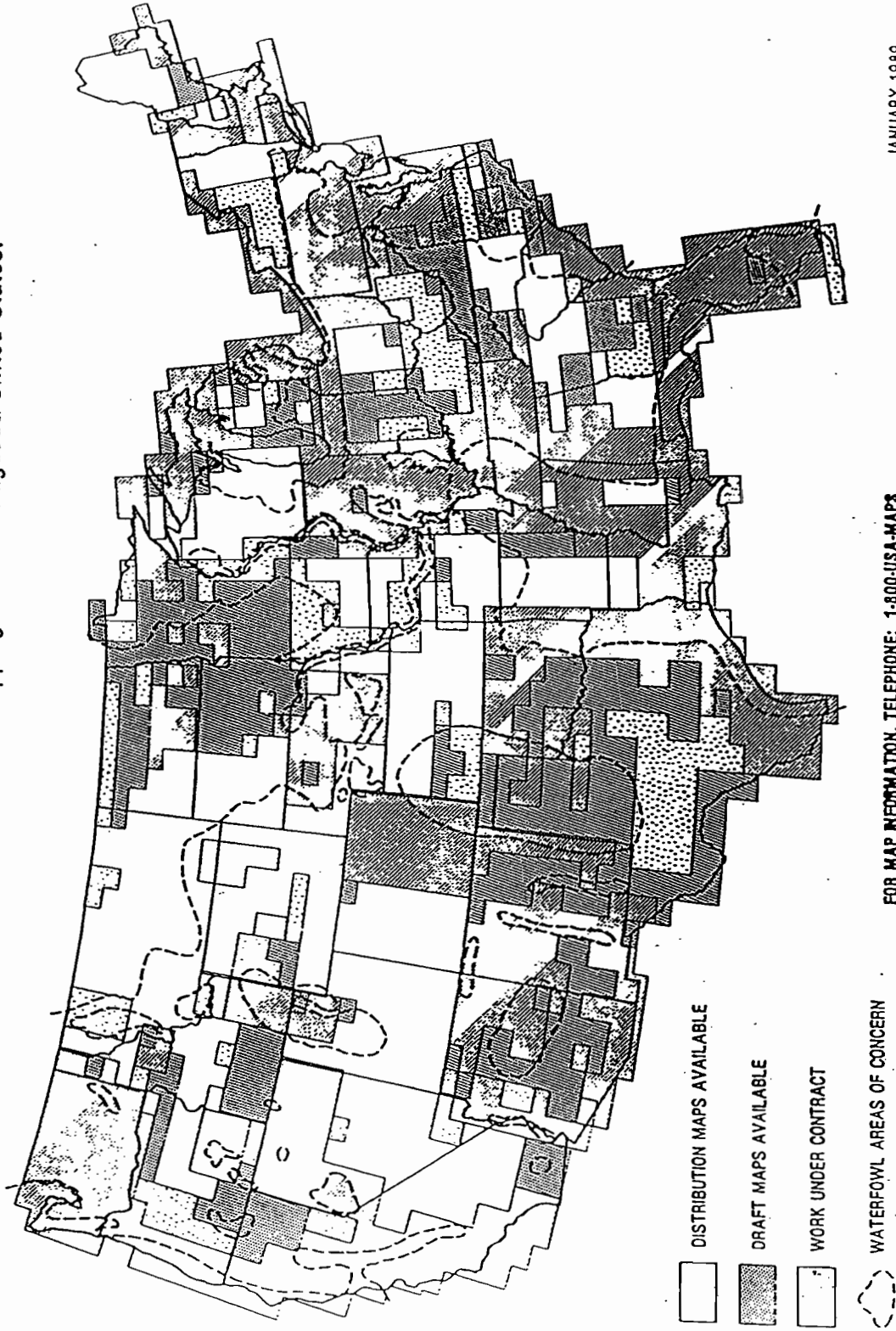
The wetlands values citation database is a listing of over 12,000 scientific articles concerning the functions and values of wetlands. Field names include author, year, sequence, title source and subject. The information is available on floppy disks in ASCII format for use on IBM PC/XT/AT compatible machines running the equivalent of MS-DOS 2.0 or higher from the Office of Conference Services, Colorado State University, Fort Collins, Colorado 80523; Comm. (303) 491-7767.

STATUS OF MAPPING

The National Wetlands Inventory has produced wetland maps for 61% of the lower 48 States and 18% of Alaska (Figures 1 and 2). Mapping priorities are based principally on the needs of the Service and other Federal and State agencies. They include the coastal zone (including the coastline of the Great Lakes), prairie wetlands, playa lakes, floodplains of major rivers and other areas that support the goals of the North American Waterfowl Plan.

The actual priority of mapping depends on the availability of funds and the existence of good quality aerial photography. Obtaining acceptable photographs for the Prairie Potholes Region has been particularly difficult because of the need to capture

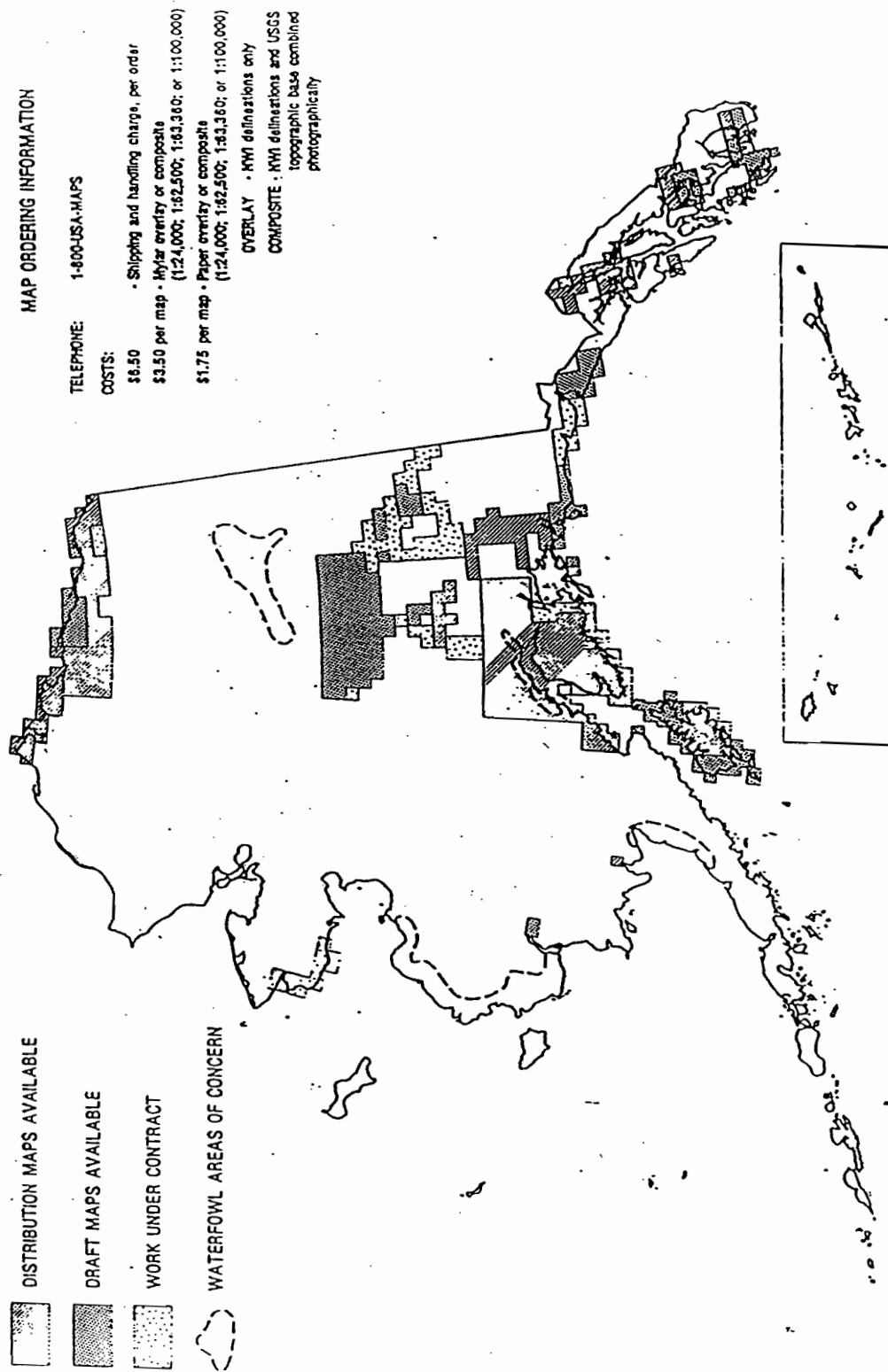
FIGURE 1: Status of wetland mapping in the contiguous United States.



FOR MAP INFORMATION, TELEPHONE: 1-800-USA-MAPS

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FIGURE 2: Status of wetland mapping in Alaska.



optimum water conditions. Consequently, NWI has established a special agreement with NASA to obtain this photography.

The National Wetlands Inventory produces wetland maps at a rate of 5% per year in the lower 48 States and at 2% annually in Alaska. This is the equivalent of 3,200 1:24,000 scale quads a year and 60 1:63,360 scale quads in Alaska.

Map Dissemination

Over 943,000 copies of draft and final wetlands maps have been distributed by NWI. This figure does not include the secondary distribution made through the State-run distribution centers in Connecticut, Delaware, Guam, Hawaii, Illinois, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Mississippi, Nebraska, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, South Carolina, Texas, Vermont, Washington, West Virginia, and Wyoming. Information on the availability of the National Wetlands Inventory maps and ordering information may be obtained by calling toll free 1-800-USA-MAPS.

National Wetlands Inventory Digital Database

The National Wetlands Inventory is constructing a georeferenced wetland database using geographic information system (GIS) technologies. Digitizing is done in arc-node format with attributes assigned to the left, center and right sides of each arc. Wetland attributes are coded according to Cowardin et al. (1979). As digitization occurs points are converted to latitude/longitude coordinates. As a result, all map data are stored in a common, ground-based geographic reference system.

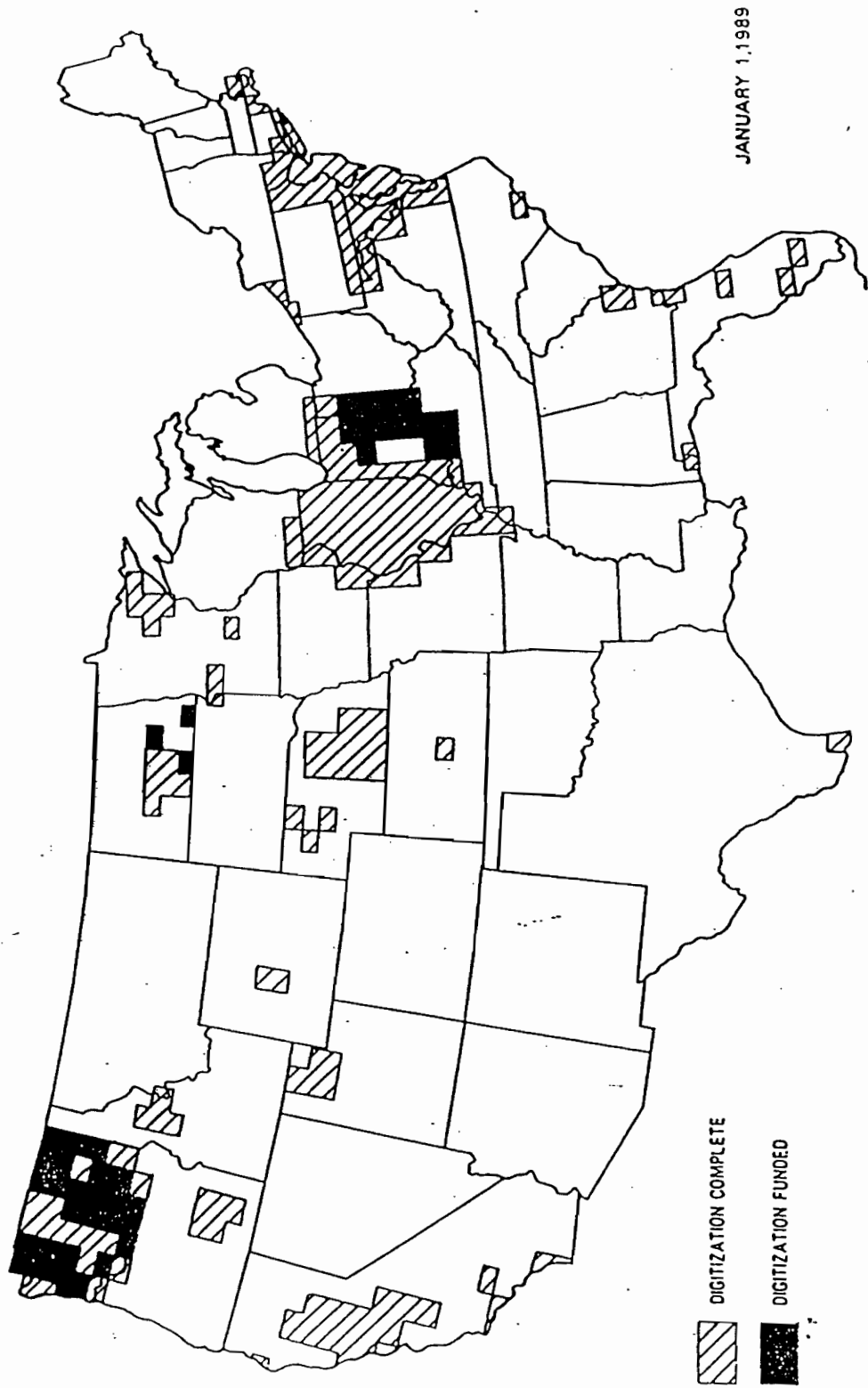
To date, more than 4,000 National Wetlands Inventory maps, representing 7.1 percent of the continental United States, have been digitized (Figure 3). Statewide databases have been built for New Jersey, Delaware, Maryland, and Illinois and are in progress for Indiana and Washington. NWI digital data also are available for portions of 14 other states.

Copies of database files can be purchased at cost from the National Wetland Inventory Offices in St. Petersburg, Florida, (813) 893-3873. The data are provided on magnetic tape in MOSS export, DLG3 optional, ELAS, or EGES format. Other products, available at cost from the database, include acreage statistics by quad, county or study area, and color-coded wetland maps. These digital data are being used for such applications as resource management planning, impact assessment, wetland trend analysis and information retrieval.

FUTURE ACTIVITIES

The Emergency Wetlands Resources Act of 1986 directs the Secretary of the Interior, through the Director of the Fish and Wildlife Service, to produce by September 30, 1990, and at 10-year intervals thereafter, reports to update and improve the information contained in the report entitled "Status and Trends of Wetlands and Deepwater Habitats in the Conterminous United States, 1950's to 1970's." The Act also requires the Fish and Wildlife Service to produce, by September 30, 1998, National Wetlands Inventory maps for the remainder of the contiguous United States and, as soon as practicable, wetland maps for Alaska and noncontiguous portions of the United States.

FIGURE 3; Status of National Wetlands Inventory digital data.



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ACKNOWLEDGMENTS

We wish to thank all the National Wetlands Inventory staff and contract personnel for their work over the last decade. The accomplishments presented in this paper could not have been achieved without the financial support of many Federal, State and local cooperators. The accuracy of the maps in good part is the result of the voluntary map review by many Federal, State, local and private sector agencies and organizations, as well as, individuals such as Mr. George Fore of Texas. We also thank Celecia Wilson for typing the manuscript and Michael Rees for his editorial review.

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APPENDIX A

REGION	GEOGRAPHIC	REGIONAL WETLAND COORDINATOR
1	California, Hawaii, Idaho, Nevada, Oregon, Washington	Regional Wetland Coordinator U.S. Fish and Wildlife Service Lloyd 500 Building, Suite 1692 500 N.E. Multnomah Street Portland, Oregon 97232 COM: 503/231-6154 FTS: 429-6154
2	Arizona, New Mexico, Oklahoma, Texas	Regional Wetland Coordinator U.S. Fish and Wildlife Service P.O. Box 1306 Albuquerque, New Mexico 87103 COM: 505/766-2914 FTS: 474-2914
3	Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, Wisconsin	Regional Wetland Coordinator U.S. Fish and Wildlife Service Federal Building, Fort Snelling Twin Cities, Minnesota 55111 COM: 612/725-3536 FTS: 725-3536
4	Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, N. Carolina, Puerto Rico, S. Carolina, Tennessee, Virgin Islands	Regional Wetland Coordinator U.S. Fish and Wildlife Service R.B. Russell Federal Building 75 Spring Street, S.W. Atlanta, Georgia 30303 COM: 404/331-6343 FTS: 242-6343
5	Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia	Regional Wetland Coordinator U.S. Fish and Wildlife Service One Gateway Center Newton Corner, MA 02158 COM: 617/965-5100 FTS 829-9379
6	Colorado, Kansas, Montana, Nebraska, N. Dakota, S. Dakota, Utah, Wyoming,	Regional Wetland Coordinator U.S. Fish and Wildlife Service P.O. Box 25486 Denver Federal Center Denver, Colorado 80225 COM 303/236-8180 FTS 776-8180
7	Alaska	Regional Wetland Coordinator U.S. Fish and Wildlife 1011 East Tudor Road Anchorage, Alaska 99503 COM: 907/786-3403 FTS: 8-907/786-3403

