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The US Fish and Wildlife Service's National Wetlands Inventory Project

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Abstract

In 1974, the US 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 data base concerning the characteristics and extent of the Nation's wetlands. The purpose of this data base 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 (NWI) Project became operational, it was clear that two very different kinds of information were needed. First, detailed wetland maps were needed for site-specific decisions. Second, national statistics developed through statistical sampling 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. The NWI has produced wetland maps (scale = 1:24 000) for 74% of the conterminous United States. It has also produced wetland maps (scale = 1:63360) for 24% of Alaska. Nearly 9000 of these wetland maps, representing 16.7% of the continental United States, have been computerized (digitized). In addition to maps, the NWI has produced other valuable wetland products. These include a statistically-based report on the status and trends of wetlands that details gains and losses in United States wetlands that have occurred from the mid-1970's to the mid-1980's. Other wetland products include a list of wetland (hydric) soils, a national list of wetland plant species, wetland reports for certain individual States such as New Jersey and Florida, and a wetland values data base.

Introduction

Wetlands provide a variety functions and values. Many people use wetlands for recreational activities, ranging canoeing to bird watching. A wetland's natural beauty and solitude can be experienced in these unique natural settings. Wetlands also play an integral role in maintaining the quality of human life via material contributions to the national economy (through food supply; water quality improvement; flood control; and fish, wildlife, and plant resources) and thus to the health, safety, recreation, and economic well-being of all United States citizens.

Wetlands also act as natural filtration systems which have the capacity to purify the water that flows through them. The sediments in the wetland act as nutrient sinks, absorbing the nutrients released by plant decomposition. As water flows through the wetland system, the plants, animals, and sediments absorb, assimilate or change the chemical form of many of the contaminants and heavy metals introduced by human activities in the watershed. In addition, significant amounts of suspended sediments are removed from the water as it flows slowly through the wetland.

Wetlands have the ability to slow the flow of water and to store large amounts of water in organic deposits and basins. This includes such functions as erosion and flood control, flow stabilization, discharge of ground water to the surface, and recharging of underground aquifers. Wetlands perform food chain support by producing tremendous amounts of detritus which is consumed by many of the organisms which inhabit wetland

ecosystems. Thus, detritus forms the base of a complex food web which cycles energy and nutrients within the wetland environment, and also exports nutrients into adjacent areas.

During the 1780's the conterminous United States contained an estimated 221 million acres of wetlands. Over a 200-year period, wetlands have been drained, dredged, filled, leveled and flooded. Twenty-two States have lost 50 percent or more of their original wetlands since the 1780's (Dahl 1990). Wetlands represent only 5.0 percent of the land area in the conterminous United States. These wetlands provide a wide variety of habitats for some very unique and diverse plant and animal communities. With the current emphasis by many government agencies of preserving biodiversity, it is crucial that these wetland areas be protected. The US Fish and Wildlife Service (FWS) has always recognized the importance of wetlands to waterfowl and other migratory birds, in part because 10-12 million ducks breed annually in the United States, and millions more overwinter here. Consequently, the FWS has a direct interest in protecting wetlands, especially wetlands where waterfowl breed and overwinter.

In 1954, the FWS conducted a nationwide wetlands survey covering roughly 40 percent of the conterminous United States and focusing on important waterfowl wetlands. Although this survey was 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 FWS report - 'Wetlands of the United States', commonly referred to as Circular 39 (Shaw & Fredine 1956).

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

The Emergency Wetlands Resources Act (Act) of 1986 directs the Secretary to the US Department of the Interior, through the Director of the FWS, to produce at lO-year intervals, 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' (Frayer *et al.* 1983). The first update of this report was produced in 1991 and was entitled 'Wetlands Status and Trends in the Conterminous United States, Mid-1970's to Mid-1980's (Dahl & Johnson 1991). The next update is due in the year 2000. This Act also requires the FWS to produce, by September 30, 1998, National Wetlands Inventory maps for the remainder of the contiguous United States and, as soon as practicable after 1998, wetland maps for Alaska and noncontiguous portions of the United States. In 1989 the Act was amended to require an assessment of the estimated total number of acres of wetland habitat as of the 1780's in the areas that now comprise each State, an assessment of the estimated total number of acres of wetlands in each State as of the 1980's, and the percentage of the loss of wetlands in each State between the 1780's and the 1980's. This requirement was met by the publication of 'Wetlands Losses in the United States, 1780's to 1980's' (Dahl 1990). NWI mapping mandates under the Emergency Wetlands Resources Act have recently been amended under the Wild Bird Conservation Act of 1992. This Act requires the FWS to: produce NWI maps for Alaska and other noncontiguous portions of the United States by September 30, 2000; produce a digital wetlands data base for the United States by September 30, 2004 based on the final NWI maps and; to archive and make available for dissemination digitized wetlands maps and data as such maps and data become available.

Two different kinds of information are mandated by this legislation: (1) detailed wetland maps; and (2) status and trends reports. Detailed wetland maps are needed for assessing the effects of site-specific projects. These maps serve a purpose similar to the US Department of Agriculture (USDA) Soil Conservation Service's soil survey maps, the US National Oceanic and Atmospheric Administration's coastal geodetic survey maps, and the US Geological Survey's (USGS) 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, and habitat surveys. National estimates of the current status and trends (i.e., losses and gains) of wetlands, developed through statistical sampling will be used to evaluate the effectiveness of existing Federal programs and policies, identify national or region-

al problems and increase general public awareness of wetlands.

National Wetlands Inventory pre-operational phase

Before actually beginning wetland mapping in 1979, the NWI Project reviewed existing State and local wetland inventories and existing classification schemes to determine the best way to inventory wetlands. Researchers determined that a remote sensing technique would be the best method to inventory wetlands. The first step of the pre-operational phase was to review existing wetland inventories. The NWI consulted with Federal and State agencies to learn where and when wetland surveys had previously been completed, what inventory techniques were employed, where to obtain copies of any wetland maps that may have been produced, and the status of State wetlands protection. Only a handful of States had inventoried their wetlands, and most of these had only mapped coastal wetlands. This information was published in a 1976 FWS report -- 'Existing State and Local Wetlands Surveys (1965-1975)' (US Department of the Interior 1976).

Before the inventory could begin, NWI researchers had to decide how to classify wetlands. In 1975 the FWS brought together 15 of the Nation's top wetland scientists to evaluate the usefulness of existing wetland classification schemes for the NWI. These scientists determined that none of the existing systems could be used or modified for the NWI and that a new classification system should be developed. The FWS's wetlands classification system (Cowardin *etal.* 1979) was developed by a team of four wetland ecologists, one each from the FWS, the USGS, the US National Oceanic and Atmospheric Administration, and the University of Rhode Island, with the assistance of local, State and Federal agencies as well as many private groups and individuals. The new system went though four major revisions and extensive field testing before to its official adoption by the FWS on October 1, 1980. This classification system describes ecological units having certain common natural attributes, arranges these units in a system that aids resource management decisions, furnishes units for inventory and mapping, and provides uniformity in wetland concepts and terminology throughout the United States. Although it is not an evaluation system, it does provide information upon which evaluations can be made.

Wetlands are extremely diverse and complex. The FWS 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 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. This includes open water and deep water areas. Under the FWS classification system, wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year (Cowardin *et al. 1979).*

The Cowardin *et al.* system presents a method for grouping ecologically similar wetlands. The system is hierarchical, with wetlands divided among five major Systems at the broadest level: Marine, Estuarine, Riverine, Lacustrine and Palustrine. Each System is further subdivided into Subsystems that reflect hydrologic conditions, such as 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 wetland, aquatic bed, forested wetland) or substrate if vegetation is inconspicuous or absent (e.g. unconsolidated shore, rocky shore, streambed). Each Class is further divided into Subclasses which are used to describe finer differences in life forms and are named on the basis of the predominant life form (e.g. broadleaved deciduous, moss, floating vascular) or the substrate (e.g. mud, bedrock, rubble). The classification also includes modifiers to describe hydrology (water regime), water chemistry (pH, salinity and halinity) and special modifiers relating to human activities (e.g. impounded, partly drained, farmed, artificial).

Below the Class level, the classification system is open-ended. The Dominance Type is the taxonomic category subordinate to Subclass. Dominance Types are determined on the basis of dominant plant species, dominant sedentary or sessile animal species, or dominant plant and animal species. Cowardin *et al. (1979)* only provides examples of the many dominance types possible. Users of this classification system may iden-

tify these dominance types and use them as part of the hierarchical classification system. It is also able that as the system is used in more detail to meet the user's site-specific needs, the need for additional Subclasses and special modifiers will become clear.

The Cowardin *et al.* wetland classification system has been adopted by many national and international organizations. The States of Illinois, Michigan, Minnesota, Oregon and Vermont have passed State wetlands legislation that relies heavily on NWI wetland information for implementation. The work of NWI was the first phase of a long-range State wetland plan for Illinois. Most States in the Northeast US use NWI wetland information as the primary source for their wetland regulatory guidance policies. The State of Maryland is using the Cowardin *et al.* system and NWI specifications to produce color infrared 1:12 000 scale orthophoto maps.

When the first International Wetlands Conference met in New Delhi, India, on 10-17 September 1980, conference participants passed a motion to adopt the Cowardin *et al.* classification system (Gopal *et al.* 1982). The basic concept and hierarchy of the Cowardin *et al.* system has been adopted for use in Central America, Brazil, Poland, India, Greece, and Russia. The wetland classification system used by the Convention on Wetlands of International Importance (the Ramsar Convention) is based upon Cowardin *et al.* In addition, the International Waterfowl and Wetlands Research Bureau uses the same wetland classification system as the Ramsar Convention. International interest in the Cowardin *et al.* system is still active. For example, the NWI gave a 1 week seminar in Mexico on the use of Cowardin *et al.* Next year, representatives from Hungary will be coming to the United States to visit the NWI offices and to learn about the Cowardin *et al.* system.

The main advantage of the Cowardin *et al.* system is its versatility. Since the Cowardin *et al.* system is hierarchical, a country has a variety of choices when deciding upon which level of wetland classification to pursue. For example, a country interested in classifying their wetlands on a very broad level would select Cowardin *et al.'s* five major Systems as the basis for that country's wetland classification program. This general inventory could be done on existing aerial photography and transferred to existing base maps using inexpensive transfer equipment. A major limitation for the international use of Cowardin *et al.* is that it has not been translated into other languages.

Selecting a remote sensing tool

Because of the magnitude of performing an inventory covering the entire geographic area of the United States, remote sensing was the obvious choice of techniques for inventory of the Nation's wetlands. The basic choice was between high-altitude photography and satellite imagery (Landsat). After comparing Landsat's capabilities with the FWS'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. Therefore the inventory is being conducted using mid- and high-altitude color infrared aerial photography.

The NWI Project has continued testing of satellite technologies. In conjunction with the National Aeronautic and Space Administration's (NASA) Jet Propulsion Laboratory, NWI conducted a year-long test of the multispectral scanner to detect and map wetlands in Alaska. With Ducks Unlimited, NWI also tested Thematic Mapper data, as well as data from the French satellite 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 wetland maps. None of these tests has provided any hope that present satellite configurations can provide the needed data for classification detail and wetness determinations within desired accuracy requirements of the NWI Project and its State and Federal cooperators. The Federal Geographic Data Committee (FGDC) is an interagency effort that 'promotes the coordinated development, use, sharing, and dissemination of geographic data'. The Wetlands Subcommittee of the FGDC published a report called 'Application of Satellite Data for Mapping and Monitoring Wetlands' which supports the use of aerial photography instead of satellites for obtaining accuracy in wetland mapping (Federal Geographic Data Committee 1992).

National Wetlands Inventory operational phase

The FWS employs a small, full time staff of 40 persons that include biologists, photointerpreters, cartographers, computer technicians and computer analysts who are assembled into three basic groups: NWI Project Leader, Central Control Group, and Regional Wetland Coordinators. The NWI Project Leader and his Assistant work out of the Washington, DC office

and coordinate the budget, annual work plans and strategic planning. The budget for NWI is $8 million annual1y, with $5 million spent on wetland mapping and the remaining $3 million spent on wetland status and trends work. The NWI Central Control Group in St. Petersburg, Florida is the focal point for al1 operational activities of the NWI. It acquires al1 materials necessary for performing the inventory, provides technical assistance and work materials to the Regional Wetland Coordinators, and produces the wetlands maps. A pri vate service support contractor is responsible for map production, and provides needed personnel (about 140 technicians and professionals).

Regional Wetland Coordinators and their Assistants at FWS's seven Regional Offices are responsible for the inventory of wetlands within their regions and ensuring that al1 NWI products meet regional needs. They manage contracts for wetland photo-interpretation, coordinate interagency review of draft maps, secure cooperative funding from other agencies, produce regional wetland reports, and provide training in the use of products.

Photo-interpretation and field work are performed by approximately 150 contract personnel hired by FWS. These contractors photo-interpret wetlands with stereoscopes, and, in addition, review soil maps, conduct field checks, and examine existing information on an area's wetlands to ensure accurate identification of wetlands.

The operational phase of the NWI, initiated on 1 October 1979, involves two main efforts: (1) wetlands mapping, and (2) wetlands status and trends analysis. In addition to the wetlands maps and the trends reports (produced through statistical analysis), NWI has produced other products that compliment the mapping effort, including the 'National List of Plant Species That Occur in Wetlands' (Reed 1988), numerous wetland reports, and textual and geographic computerized data bases. NWI has also contributed to a list of hydric soils (USDA, Soil Conservation Service 199\).

The primary map product of the NWI is large-scale (1:24000) maps that show the location, shape, and characteristics of wetlands and deepwater habitats on USGS base topographic maps. These detailed maps are excellent for site-specific project evaluation (Figs 1 and 2).

To produce a final map, NWI undertakes the following steps: (1) Review of aerial photography to identify obvious wetland types and problematic areas; (2) selection of sites for possible field-checking and layout of a route for a field trip; (3) preliminary field investigations and collection of site specific data resol ving photo-interpretation questions; (4) review of field sites on aerial photos in stereo; (5) stereoscopic photo-interpretation of high-altitude photographs, delineation of wetland boundaries, classification of each polygon, and review of existing wetland information; (6) follow-up field trip if necessary; (7) regional and national consistency quality control of interpreted photos; (8) draft map production; (9) interagency review of draft map, conduct field checking; (10) preparation of edited draft map; and (11) final map production. The cost of map production varies with each map based on the amount of wetlands present in a given area. Costs can be as low as $200 to a high of $1000 for a single 7.5 minute quadrangle covering approximately 50 square miles. Swartwout (1982) and Crowley *et al.* (1988) evaluated NWI maps and determined that the maps were 95 and 91 percent accurate, respectively. Accuracy determinations included errors of omission and commission. This high accuracy was achieved because the NWI technique involves a combination of field studies, photo-interpretation, use of existing information and interagency review of draft maps.

The NWI has produced wetland maps for 74% of the conterminous United States and 24% of Alaska (Figs 3 and 4). Mapping priorities are based principall yon the needs of the FWS 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 reflect the goals of the joint US-Canadian North American Waterfowl Management Plan. The actual priority of mapping depends on the availability offunds and the existence of high-quality aerial photography. Obtaining acceptable photographs for the Prairie Potholes region of the US was particularly difficult because of the need to capture optimum water conditions. Consequently, NWI established a special agreement with NASA to obtain that photography. The NWI produces wetland maps at the rate of 5% of the conterminous United States and 2% of Alaska annually. This is the equivalent of 3200 1:24 OOO-scale quads a year in the conterminous United States and 60 1:63 360-scale quads in Alaska.

The FWS has established a 3-tiered distribution system for NWI maps composed of State-run distribution centers, regional centers, and a national toll free number 1-800-USAMAPS. The State-run tier consists of 29 State-run centers covering 36 States. The second

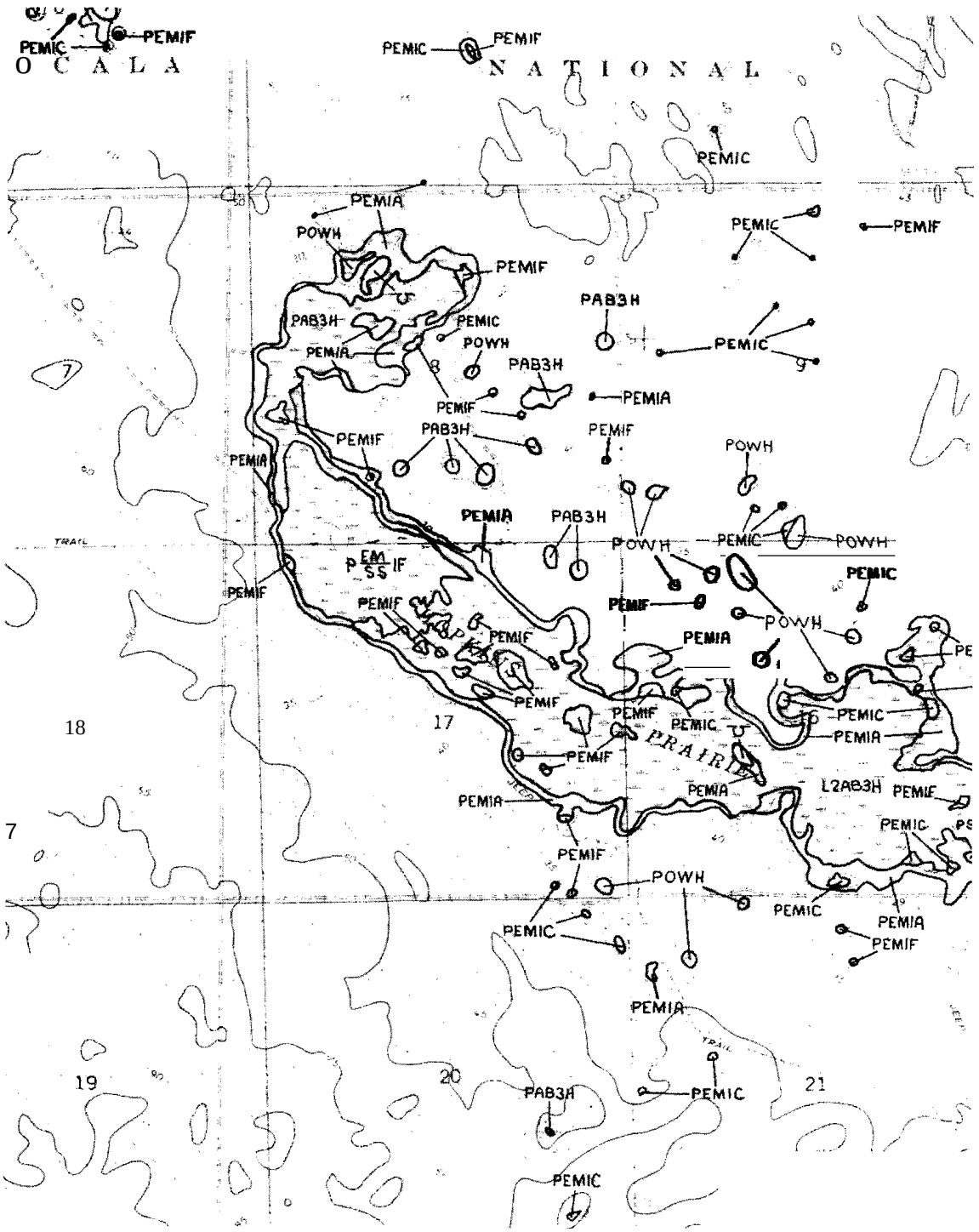


Fig. 1. National Wetlands Inventory map in the State of Florida: close-up of a delineated wetland. Alpha-numeric designations represent wetland classification codes as described in Cowardin *et al.* (1979). Example of alpha-numeric code: PEMI C. P = palustrine; EM = emergent; 1 = persistent; C = seasonally flooded. PAB3H: P = palustrine; AB = aquatic bed; 3 = rooted vascular; H = permanently flooded.

tier consists of regional centers. Information on NWI wetland map availability may be obtained and maps can be ordered through the 6 USGS's Earth Science Information Center regional offices. All these Earth Science Information Center offices have an on-line computer link into the NWI's office in St. Petersburg, Florida to allow greater efficiency of the map ordering process. The third tier is the toll free number from which the user can obtain information on map availability and ordering information. More than 1560250 copies of draft and final wetlands maps have been distributed by the NWI. This figure does not include the secondary distribution made through the State-run distribution centers covering Alabama, Arizona, Arkansas, Connecticut, Delaware, Florida, Georgia, Guam, Hawaii, Illinois, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Washington, West Virginia, and Wyoming.

National Wetlands Inventory digital data base

The NWI is constructing a georeferenced wetland data base 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, almost 9000 NWI maps, representing 16.7% of the continental United States, have been digitized (Fig. 5). Statewide data bases have been built for New Jersey, Delaware, Maryland, Illinois, Washington, and Indiana and are in progress for and Virginia, Minnesota, and South Carolina. NWI digital data also are available for portions of the 25 other States. The graphic map products can be combined with other GIS layered information such as soils and land-use planning, and transportation routes. These digital data are \being used for such applications as resource management planning, impact assessment, facility siting, wetland trend analysis and information retrieval. Copies of data base files can be purchased at cost from the NWI Office in St. Petersburg, Florida at telephone (813) 893-3624. The data are provided on magnetic tape in Map Overlay and Statistical System (MOSS) export, Digital Line Graph 3 (DLG3) optional, and Digital Exchange File (DXF), International Graphic Exchange Standard (IGES), or Geographic Resources Analysis Support System (GRASS) formats. Other digital products available at cost include acreage statistics by quadrangle, county, or study area, and color-coded wetland maps.

Map and digital data: Users and uses

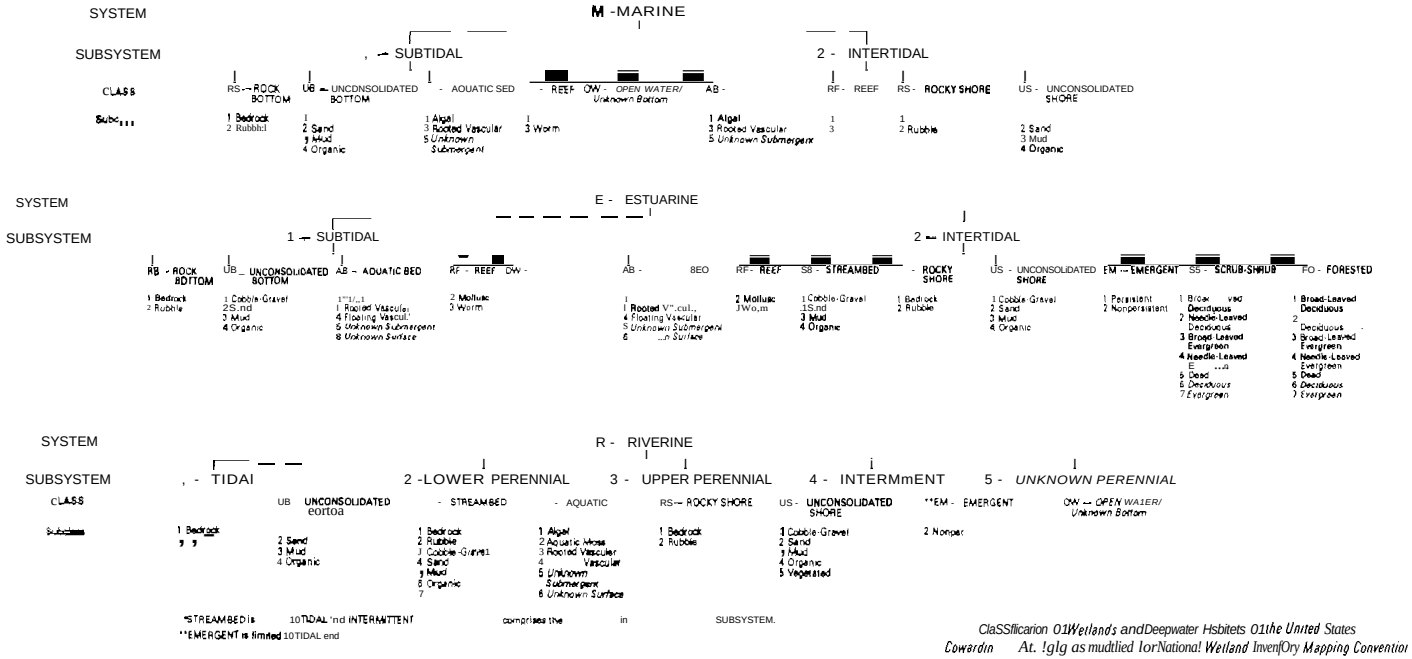
The number of users has grown steadily since the maps were first introduced. Requests are common from individuals, private organizations, industry, consulting firms, developers, agencies from all levels of government (municipal, town, county, State, Federal), and educational/research groups (universities, colleges). User surveys have documented over 100 different uses of the wetland maps. Resource managers in the FWS and in the States are provided with information on wetland location and type, which is essential to effective habitat management and acquisition of important wetland areas. These areas are needed to perpetuate waterfowl populations and other migratory bird populations as called for in the North American Waterfowl Management Plan.

Regulatory agencies use the maps to help in advanced identification, determining wetland values, and mitigation requirements. For example, the USDA uses the maps as a major tool in the identification of wetlands for the administration of the 'Swampbuster' provisions of the 1985 Food Security Act. Copies of more than 74260 draft and final NWI maps have been sent to the Soil Conservation Service's county offices as of July 1993. Private sector planners use the maps to determine the location and nature of wetlands to aid in framing alternative plans to meet regulatory requirements. These maps are instrumental in preventing problems that arise because the maps eliminate confusion over whether an area is a wetland. They are also instrumental because they provide facts that allow sound business decisions to be made quickly, accurately, and efficiently.

Map of the nation's wetlands

The National Wetlands Inventory has produced a 3.5 x 5.5 feet. color wall map that shows the relative location and abundance wetlands present in the conterminous United States, Hawaii and Puerto Rico. The map is called 'Wetland Resources of the United States' (Dahl 1991) and is at a scale of 1 inch equals 50 miles. The purpose of this color map is to increase the pub-

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION



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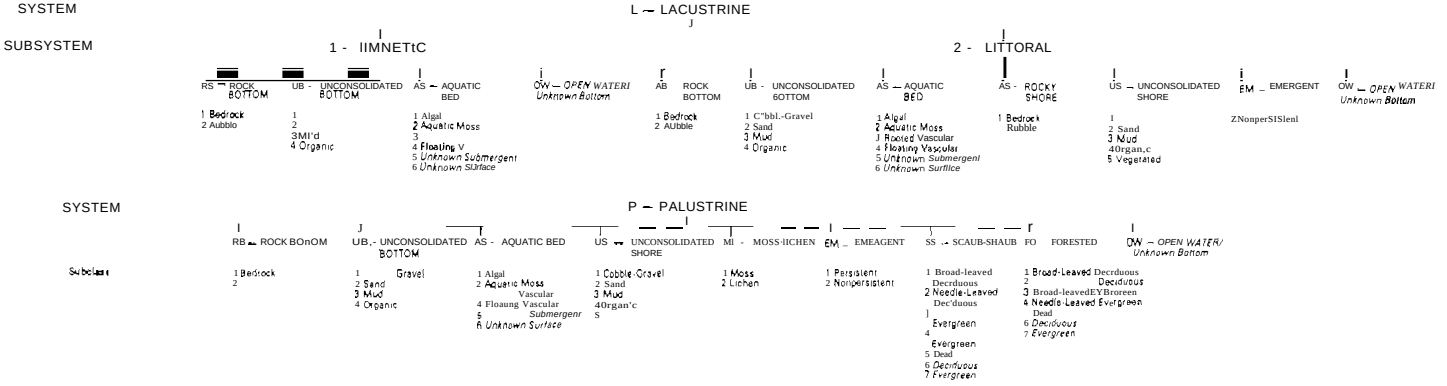

MODIFIERS

In order to more adequately describe wetland and deepwater habitats coe or more of the water r"!l,me. water cberrusrrv, 50,1. or special modiliers may be apphed at the class or lower level ,n tne hierarchy. The jarmed modifier may also be applied 10 lhe ecological system.

WATER REGIME

Non-Tidal

- A Temporalll1yFlooded
- B Saturated
- C Seasonally Flooded
- O *Seasonally Flooded/ WelIDramed*
- E *Seasonally Flooded/ Saturated*
- F Semipermanently Flooded
- G Intermittently Exposed
- H Permanently Flooded
- J Intermittently Flooded
- K Artificially Flooded
- W Intermittently Flooded/Tempolary
- . Saturated/Semipermanent/ Seasonal
- Z Intermittently Exposed/Permanent
- U *Unknown*

Tidal

- K *Afiificially Flooded*
- L Subtidal
- M Irregularly Exposed
- N Regularly Flooded
- P Irrenularly Flooded
- *S Temporary-Tidal
- *A Seasonal-T,dal
- *T Semipermanent-Tidal
- *V Permanent-Tidal
- U *Unknown*

*These water reg,mes are only usee 'n tidally influenced, freshwater 'ySlems

WATER CHEMISTRY

Coastal Halinity

- 1 Hype,halJne
- 2 Euhaline
- 3 Mixohaline *(Brackish)*
- 4Polyhahne
- 5 Mesohaline
- 6 Oligohaline
- *D* Fresh

Inland Salinity

- 7 Hypersaline
- BEusalJne
- *D* fresh

pH Modifiers for all Fresh

- a Acid
- 1 Cncumneullal
- i Alkaline

SOIL

- H Organic
- n Mineral

SPECIAL MODIFIERS

- b Beave,
- d *Pamally Drained/Ditched*
- 1 Farmed
- h *D,Aed/Impounded*
- r Artificial Substrate
- s *Spoil*
- K Excavated

Fig. 2. National Wetlands Inventory map legend

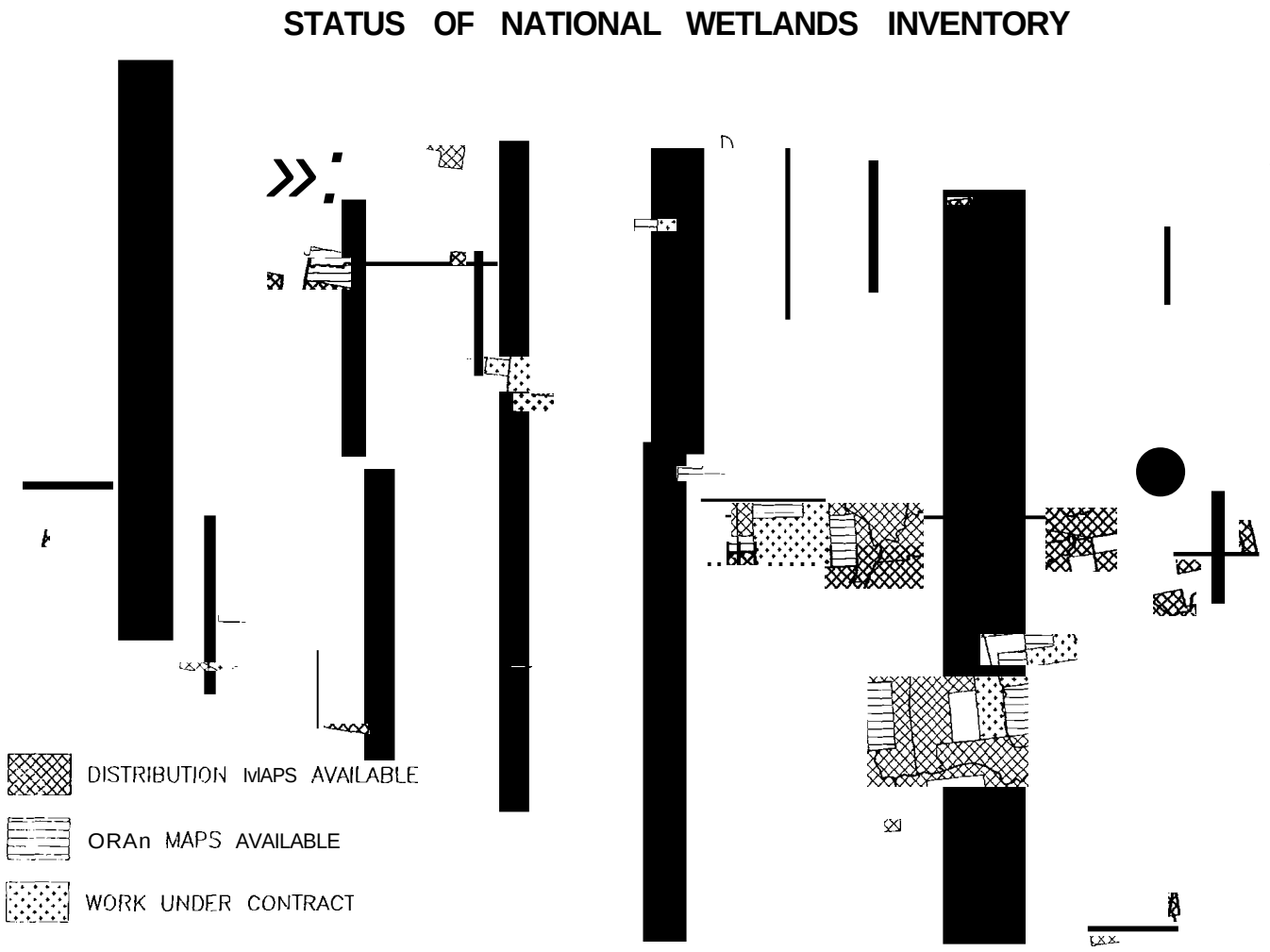

Fig. 3. Status of the National Wetlands Inventory: conterminous United States

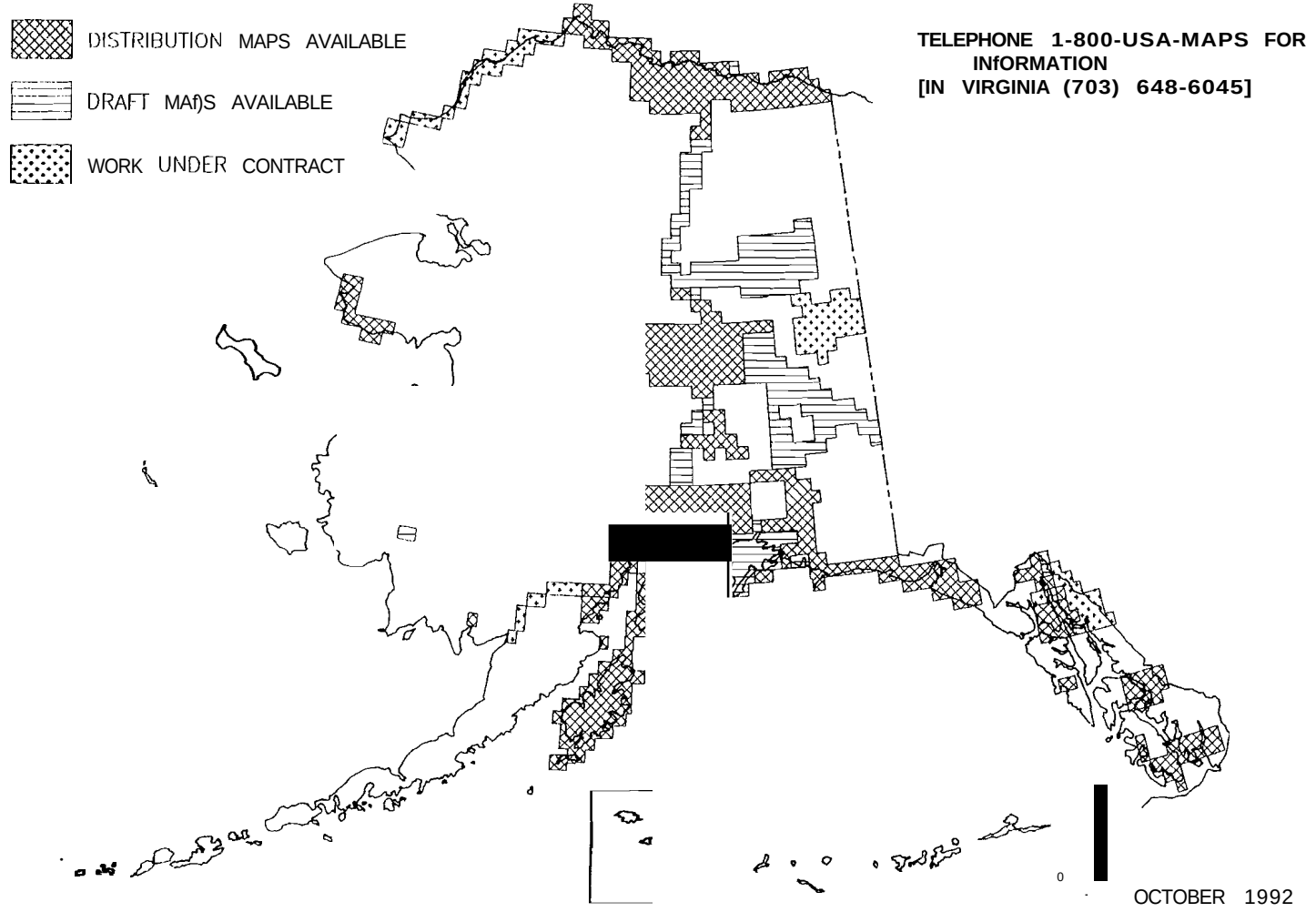

Fig. 4. Status of the National Wetlands Inventory: Alaska

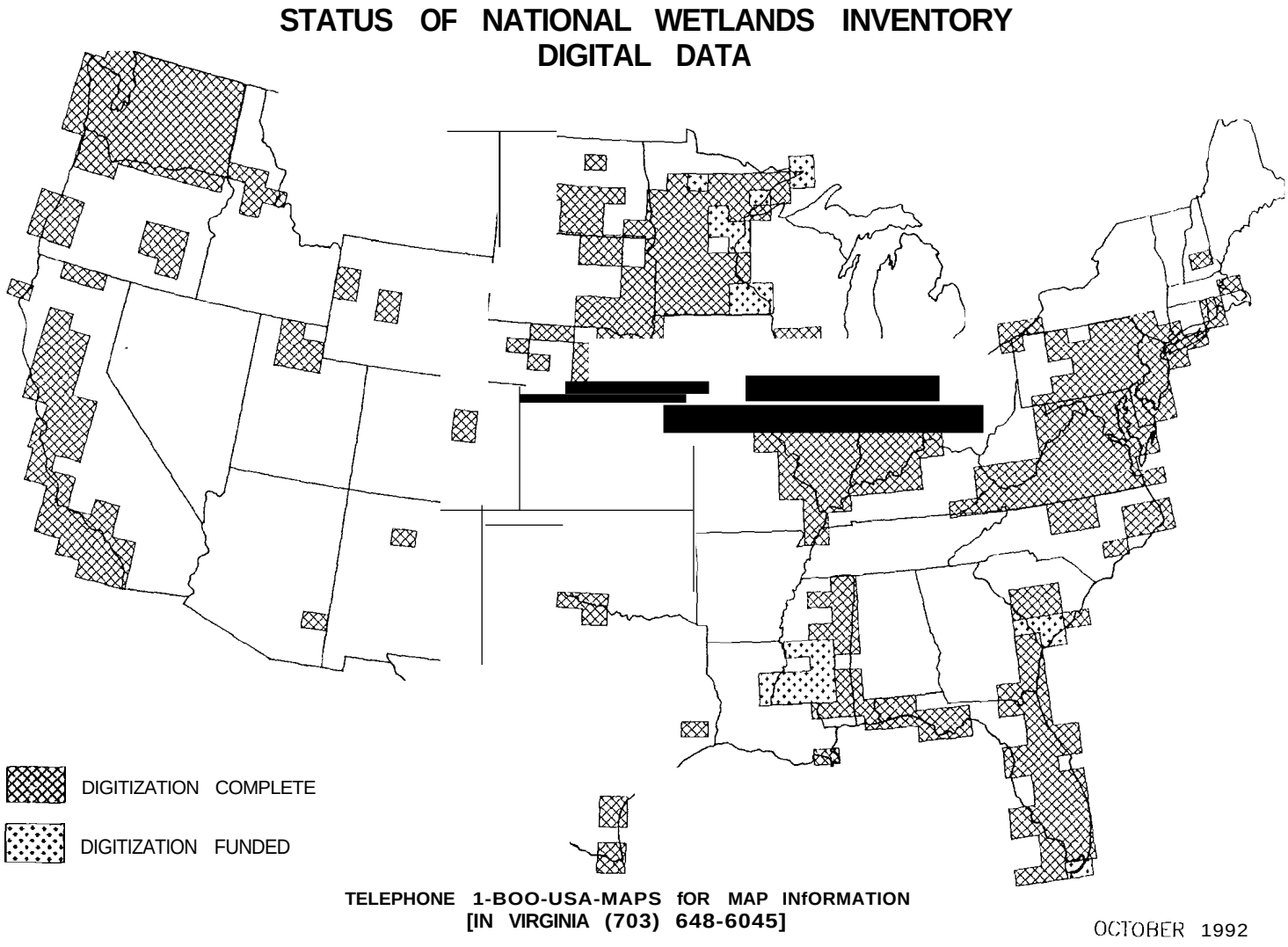

Fig. 5. Status of National Wetlands Inventory; digital map products

lie's understanding of our nation's wetlands. The map was compiled in cooperation with the Water Resources Division of the USGS. A companion map of Alaska's wetland resources has also been published. It is called 'Wetlands Resource Map of Alaska' (Hall 1991). This map is also a color wall sized map measures approximately 3 x 4 feet and shows Alaska's wetlands at a scale of 1 inch equals 40 miles. Copies of both the United States and Alaska maps are available from the USGS's Earth Science Information Centers. For further ordering information, call 1-800-USA-MAPS.

National wetland status and trends study

The national wetlands status and trends analysis study originated from the need for national estimates on the present extent of our Nation's wetland resources in the conterminous United States, and on corresponding losses and gains over the past 20 years. A statistical survey of United States 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-1950's and mid-1970's was determined, and estimates of losses and gains during that interval were computed. The national sampling grid consists of a stratified random sample of 3635 permanent, 4-square-mile plots distributed within strata being formed by State boundaries, and the 35 physical subdivisions described by Hammond (1965). Additional strata were added to include: (1) a coastal zone stratum encompassing estuarine wetlands and, (2) the area immediately adjacent to the Great Lakes. Sample units were allocated to strata in proportion to the expected amount of wetland and deepwater habitat acreage estimated as determined by the earlier work of Shaw and Fredine (Shaw & Fredine 1956). 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' (US 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).

Results of the mid-1970's to mid-1980's study

The following information on study results is taken from Dahl and Johnson (1991). In the mid-1970's, there were an estimated 105.9 million acres of wetlands in the conterminous United States. In the mid-1980's, an estimated 103.3 million acres of wetlands remained. These data indicate a net loss of 2.6 million acres over the nine-year study period. The study design recognized that aerial photography is not available in each successive year for the same plot or necessarily in the same year for all plots. For these reasons, estimates of average annual rates of wetland loss have not been developed by this study. One possible way of calculating an average annual net loss of wetlands for the study period would be to use the wetland acreage estimate for the mid-1980's (1983) minus the acreage estimate for the mid-1970's (1974) and divide by the nine-year study period. Using this method, the average annual loss of wetlands for this period would be approximately 290 thousand acres per year. By comparison, during the mid-1950's to mid-1970's study period, the average annual net loss was 458 thousand acres per year.

Of the remaining wetland acreage in the conterminous United States, 97.8 million acres or 95.0 percent were freshwater wetlands. Another 5.5 million acres (5.0 percent) were estuarine. wetlands. The acreage of deepwater habitats was also included in this study. There were an estimated 63.0 million acres of deepwater habitat in the lacustrine (lake) and riverine systems in the mid-1980's. This represents an increase of 271.2 thousand acres from the mid-1970's estimate and was primarily due to the construction of reservoirs and lakes in the States of Alabama, Florida, Georgia, Mississippi, and South Carolina. If wetlands and deepwater acres were combined, about 9.3 percent of the land area in the conterminous United States is made up of these areas.

Wetland losses from the mid-1970's to the mid-1980's were more evenly distributed between agricultural land use (54 percent) and 'other' land use (41 percent) than losses from the 1950's to the 1970's. A substantial portion of the lands classified as 'other' were wetlands that had been cleared and drained, but not yet put to an identifiable use. Conversion to urban land uses (5 percent) were responsible for net loss of an estimated 59.9 thousand acres of palustrine forested wetlands, 37.5 thousand acres of palustrine emergent wetlands, and 21.0 thousand acres of palustrine scrub-shrub wetlands, about 5.0 percent of the total wetlands loss. Overall, wetland acreage in the mid-1980's con-

stituted 5.0 percent of the land area of the conterminous United States.

Comparison with the mid-1950's to mid-1970's shows that the acreage of wetlands continued to decline, at about two-thirds of the loss rate measured from the 1950's to the 1970's. During the study period covering the mid-1950's to mid-1970's, a net loss of 9 million acres occurred. There is a substantial decrease in rates of wetland loss documented previously from the mid-1950's to the mid-1970's in which agricultural conversion represented 87.0 percent of all wetland losses, 'other' development caused 5 percent of the losses, and urban development accounted for 8 percent of the losses.

The acreage of estuarine wetlands declined 1.0 percent between the mid-1970's and the mid-1980's. Losses in the estuarine system were evidenced by the decrease in estuarine vegetated wetlands, which declined by 71.0 thousand acres. The majority of these losses occurred in the Gulf Coast States, and most of the loss (about 57 percent) was due to change from emergent wetlands to open salt water (bays). Estuarine nonvegetated wetlands increased by an estimated 11.6 thousand acres from the mid-1970's to the mid-1980's. Similarly, between the mid-1950's to mid-1970's estuarine wetland losses were heaviest in the Gulf States of Louisiana, Florida, and Texas. During that time most of Louisiana's coastal marsh losses were attributed to submergence by coastal waters. In other areas, urban development was the major direct human-induced cause of coastal wetland loss.

By the 1980's, there were significant differences in the status of freshwater and estuarine wetlands based on vegetative cover type: 73.1 percent of all coastal wetlands were estuarine emergent whereas inland 52.9 percent of freshwater wetlands were forested. Freshwater emergent marshes and shrubs made up 25.1 and 15.7 percent of all freshwater wetlands, respectively. Freshwater wetlands experienced 98.0 percent of the losses that occurred during the study period. By the mid-1980's, an estimated 97.8 million acres of freshwater wetlands and 5.5 million acres of estuarine wetlands remained.

Palustrine forested wetlands suffered the biggest loss during the study period. An estimated 3.4 million acres were converted, primarily in the southern portion of the country, representing an annual net loss of 378.2 thousand acres. Over 2.1 million acres of these wetlands were converted to non-wetland land uses, including about 1.0 million acres that were lost to agriculture. Most of the remaining acreage was converted from forested wetland to other wetland categories.

Palustrine emergent wetlands increased by 220.2 thousand acres during the nine-year study period, despite significant losses. About 375.2 thousand acres of emergent wetlands were converted to agricultural land uses, 151.2 thousand acres were converted to 'other' land uses, and 37.5 thousand acres were converted to urban land uses. An additional 49.1 thousand acres of emergent wetlands were converted to non-vegetated wetlands. At the same time, 722.2 thousand acres of forested wetlands and 68.6 thousand acres of scrub-shrub wetlands were converted to emergent wetlands, more than offsetting the losses in emergent wetland acreage.

About 249.0 thousand acres of palustrine scrub-shrub wetlands were converted to agricultural land uses and 265.0 thousand acres were converted to 'other' land uses. These losses were partially offset by the conversion of 482.8 thousand acres of forested wetlands to scrub-shrub wetlands, resulting in a net loss of 161.1 thousand acres of scrub-shrub wetlands. During the mid-1950's to mid-1970's scrub-shrub wetlands were hardest hit in North Carolina, where pocosins in wetlands were being converted to cropland, pine plantations, or mined for peat.

Palustrine nonvegetated wetlands increased by 794.0 thousand acres. There were 6.1 million acres of palustrine nonvegetated wetlands in the mid-1980's. Gains in this wetlands category, which were well distributed throughout the conterminous United States, totalled 792.4 thousand acres. Almost all of this increase occurred in palustrine unconsolidated bottoms (primarily ponds) and mainly resulted from ponds built on former upland areas.

Other national wetlands inventory products

Hydric (wetland), soils list

Hydric soils are defined by soil saturation for a 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 USDA Soil Conservation Service, developed the first list the Nation's hydric soils. Since then, the Soil Conservation Service has chaired of the Interagency National Technical Committee for Hydric Soils. The 'National List of Hydric Soils of the United States' (USDA, Soil Conservation Service 1991) 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 FWS published the 'National List of Plants Species that Occur in Wetlands: 1988 National Summary' (Reed 1988). The plants in the list are divided into four indicator categories based on plant's frequency of occurrence in wetlands: (1) obligate - always found in wetlands more than 99% of the time); (2) facultative wet - usually found in wetlands (66-99% of the time); (3) facultative - sometimes found in wetlands (33-66%); and (4) facultative upland - seldom found in wetlands (less than 33%). This list is available from the Superintendent of Documents, US Government Printing Office, Washington, DC, 20402, telephone (202) 783-3238. When ordering use Stock Number 024-010-00682-0. Thirteen regional subdivisions of the national wetland plant list as well as individual State lists are available from the National Technical Information Service, 5285 Port Royal Rd., Springfield, Virginia, 22161, telephone (703) 487-4650.

Two wetland plant list data bases have been developed based on the National List of Plant Species that Occur in Wetlands. The first is the wetland plant list data base is a listing of plants associated with wetlands, as defined by the FWS's wetland definition and classification system (Cowardin *et at.* 1979). It lists scientific and common names of plants, distribution, and regional wetland indicator status of almost 6700 species. It can be accessed by plant name, region, State, and wetland indicator status. The data base is updated as additional information is received. Regional and State subdivisions of the wetland plant list data base are available on floppy disks in ASCII format for use on IBM XT/AT-compatible computers running the equivalent of MS-DOS 2.0 or higher. Contact BIO-DATA, Inc., 13950 West 20th Ave., Golden, Colorado, 80401, telephone (303) 278-1046.

The second is the wetland plant species data base which is comprised of two parts. The first part, PLANTS, contains detailed taxonomic, distributional and habitat information on more than 6200 wetland plants found in the United States and its territories. The second part, BOOKS, contains bibliographic citations for more than 280 sources such as floras, checklists, and botanical manuals used to compile PLANTS.

Wetland reports

Two basic 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 all mapped area. By contrast, the State wetland report is a comprehensive publication on the results of wetlands inventory in a given State. It is prepared upon completion of the wetlands acreage summary in a 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, Delaware, Rhode Island, Connecticut, Maryland, Pennsylvania and Florida. NWI expects to prepare reports for Hawaii, Washington, Indiana, Illinois and Alaska when statistics become available.

Wetland values data base

The Wetland Values Data Base is a bibliographic listing of nearly 15000 scientific articles about the functions and values of wetlands. It is intended to support the Fish and Wildlife Service's efforts to identify and map wetlands. Field names include author, year, hydrologic unit number (USGSlWater Resources Council geographic area descriptor), land surface form, location, State, US Army Corps of Engineers District Codes, wetland classification (Cowardin *et at.* 1979), ecoregion codes (Bailey 1980), and subject keywords. For further information or to request a search of the data base contact: Wetland Values Data Base Administrator, US Fish & Wildlife Service, National Wetlands Inventory, 9720 Executive Center Dr. Monroe Bld. Suite 101, St. Petersburg, Florida, 33702-2440, telephone (813) 893-3865.

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