THE IMPORTANCE OF WETLANDS IN THE NORTH CENTRAL AND NORTHEAST UNITED STATES TO NON-GAME BIRDS

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Abstract.--Over 200 migratory and year-round resident bird species use the diverse but limited wetland areas of the northeast and north central United States for part or all of their life requirements. Non-game and minor game (rails, coots) bird use is discussed by wetland type for both regions. Problems and causes of wetland and water bird decline are discussed; and managment recommendations for wetlands and forest managers are set forth.

INTRODUCTION

Wetland areas of the north central and northeast regions of the United States offer diverse habitats of great importance to many wildlife species, including over 200 migratory and year-round resident bird species. Nesting and feeding are the primary uses, but cover, resting, and breeding/staging uses are important. Most of these species are non-game, and have not been as intensively studied as game bird species. Over the years, however, numerous books and papers have been written in which non-game bird use of wetlands in the northern states was noted (Adams et al. 1973; Anderson 1978; Anderson and Hamerstrom 1967; Audubon 1844a and 1844b; Beecher 1942; Bent 1921 and 1926; Berger 1951; Bergman et al. 1970; Burger 1974; Burger 1977a and 1977b; Custer and Osborn 1977; Downing 1975; Golet and Larson 1974; Gromme 1963; Hardy 1957; Harris and Matteson 1975; Hill 1965; Johnson 1977; Kadlec and Drury 1968; Landin 1978a, 1978b, and 1978c; Martin et al. 1951; Moseley 1936; Nicklaus 1977; Palmer 1962; Partch 1972 and 1975; Scharf 1977; Shaw and Fredine 1956; Soots and Landin 1978; Thompson 1977; Thompson and Landin 1978; Weller and Spatcher 1965; and many others). These papers tend to emphasize large water and marsh birds rather than the many smaller passerine species that also use wetlands. Some of the more informative papers which mention non-game bird use in the northern United States have been environmental impact statements prepared for or by the Corps of Engineers for various reaches of the Mississippi River system, the Great Lakes, and other parts of the northern states (Miller and Krumm 1973; Nordstrom et al. 1974; River Studies Center 1975; Terpening et al. 1975; U. S. Army Engineer District St. Louis 1975; and U. S. Army Engineer District St. Paul 1974) and by the U. S. Energy Research and Development Administration (Wallace 1977).

The wetlands of these two regions are as varied as the avian wildlife that use them (Shaw and Fredine 1956). Such a large area, covering 19 states from Minnesota to the north Atlantic coast and from the Great Lakes to Chesapeake Bay and the mid-Mississippi River, can only be discussed by the use of generalities. The regions have within them a number of distinct wetland types which are discussed later in this paper.

Historically, the wetland areas of both regions were much more extensive than the present day wetlands (Niering 1966). The northeastern salt marshes have been altered greatly since the early 1700s, and the interior Great Lakes marshes, fresh water swamps, and river systems have faired little better. The only areas that resemble their former expanses are the prairie pothole areas of the north central states (Stewart and Kantrud 1971), which is largely due to the intense and active interest shown in these areas by waterfowl hunters. Shipping, urbanization, recreation, flood-control, and agricultural uses are responsible in most cases for these wetland losses (Shaw and Fredine 1956). Shaw and Fredine (1956) reported only 750,834 hectares remaining in all wetland types in the northeastern states and only 4,627,820 hectares remaining in the north central states in 1956. Wetland losses have continued to occur since that time at a slower pace (Conservation Foundation 1978), but is still taking place. Wetland hectares will continue to be nibbled away because they are owned by private citizens, are not protected in all areas, and are in fringe

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areas which will cause them to be destroyed through changes in the surrounding environment in spite of efforts by many concerned groups to protect and manage the remaining wetlands.

WETLAND TYPES

Shaw and Fredine (1956) described a wetland classification system that has now been outdated by the new operational draft U. S. Fish and Wildlife Service classification system of 1978 (Cowardin et al. 1977). Golet and Larson (1974) classified northeastern interior wetlands and Stewart and Kantrud (1971) did the same for the prairie pothole wetlands. For purposes of discussing bird use of these wetlands, a modification based on Shaw and Fredine (1956), Golet and Larson (1974), and Stewart and Kantrud (1971) has been devised and is used throughout this paper. Under this system, there are ten wetland types in the northeast and north central United States that are used by non-game and minor game birds during some phase of their life cycle: feeding, resting, nesting, breeding or staging, and migration.

Open Fresh Water

This wetland type is permanent fresh water 1.0-3.0 meters deep, such as ponds, lakes, rivers, and streams. It is almost always associated with other wetland types. Non-rooted aquatic macrophytes such as pondweeds (Potomogeton spp.), coontail (Ceratophyllum demersum), fanwort (Cabomba caroliniana), and other fresh water submergents, as well as duckweeds (Lemna spp.) in stillwater areas, are the usual plant species encountered in these habitats. They are used by migrating waterfowl, loons, grebes, cormorants, and coots for feeding and resting (Thompson and Landin 1978; Golet and Larson 1974). They are also used as feeding areas by fish-eating raptors, gulls, and terns (Ludwig 1968).

Deep Fresh Marsh

Permanent water areas 0.2-1.0 meters deep in areas of low energy that allow establishment of rooted aquatic plants characterizes this wetland type. This type frequently borders open water, and supports the above listed species as well as floating-leaved plants such as white water lily (Nymphaea odorata), watershield (Brasenia schreberi), and water smartweed (Polygonum amphibium). A few emergents such as cattails (Typha spp.) will occur in the shallower areas.

In addition to being the most valuable habitat for waterfowl, this type is very important to many species such as loons, grebes, and coots. It is also frequented by feeding bitterns, herons, and egrets in its shallower spots and dense floating mats. Franklin's gulls (Larus pipixcan), Forster's terns (Sterna forrteri), black terns (Sterna nigra), and American coots (Fulica americana) will seek these areas for nesting (Burger 1974; Thompson and Landin 1978).

When shrubs such as buttonbush (Cephalathus occidentalis) and willow (Salix spp.) occur in a deep marsh, the area is also used for nesting by red-winged blackbirds (Ageuaius phoeniceus) and yellow-headed blackbirds (Xanthocephalus xanthocephalus), and by small passerines for feeding and resting.

Shallow Fresh Marsh

This type of wetland is also highly valuable to waterfowl species for feeding, resting, and nesting. It is usually permanent water less than 0.2 meters deep, and is vegetated with cattails, wild rice (Zizania aquatica), bulrushes (Scirpus spp.), some sedges (Carex spp.), water willow (Decodon verticillatus), common reed (Phragmites australis), and other robust emergents (Golet and Larson 1974; Environmental Laboratory 1978). Shallow marshes are very important as nesting and feeding areas for red-winged blackbirds, yellow-headed blackbirds, swamp sparrows (Melospiza georgiana), and other passerines (Martin et al. 1951); for minor game water birds; common gallinules (Gallinula chloropus), soras (Parzana carolina), Virginia rails (Rallus limicola), king rails (Rallus elegans), American coots, and common snipes (Capella galinago); spotted sandpipers (Artitis macularis); and for all of the heron, egret, and bittern species (Hoffman 1978) which occur in the north central and northeast regions. Protected shallow marshes are also used by Forster's terns, black terns, common terns (Sterna hirundo), herring gulls (Larus argentatus), and ring-billed gulls (Larus delewarensis) for nesting if sufficient large vegetation is available for nest substrate and material (Burger 1974; Scharf et al. 1978).

Shallow marshes will frequently have some shrubs, usually buttonbush and willow. These shrubs, if not too dense, enhance wildlife value by increasing habitat diversity in the marsh.

Seasonally Flooded Flats

Bottomland and floodplain areas which flood more than 12 centimeters deep, usually in late fall, winter, and spring, are characteristic of this wetland type. In the summer there is little or no standing water. In this wetland type, a herbaceous cover of smartweeds (Polygonum spp.), sedges, and nutsedges (Cyperus spp.) abounds during the growing season, as well as cattails, soft rush (Juncus effusus), reed canary grass (Phalaris arundinacea), and loosestrife (Lythrum spp.). These plant communities are used by waterfowl and other ground nesting

marsh birds for nesting. If a seasonally flood-wetland becomes wooded (a shrub flat or bottomland hardwood), it will become useful to tree and shrub nesting species such as colonial waterbirds and many passerines. Climax trees in such a forest include American elm (Ulmus americana), silver maple (Acer saccharinum), swamp white oak (Quercus bicolor), pin oak (Quercus palustris), eastern cottonwood (Populus deltoides), and others. Intermediate plant species include willows, dogwoods (Cornus spp.) buttonbush, meadow-sweet (Spiraea latifolia), and red maple (Acer rubrum).

The presence of several life forms in this type of wetland increases its value, and many passerines such as yellowthroats (Geothlypis trichas), song sparrows (Melospiza melodia), swamp sparrows, yellow warblers (Dendroica petechia), and eastern kingbirds (Tyrannus tyrannus) nest there (Golet and Larson 1974). Such areas are also used extensively by and are important to migrating waterfowl and other marsh and water birds (in the southern United States, this wetland type is one of the most important, as it accomodates many thousands of overwintering waterfowl and other species).

Wet Meadows

This wetland type is seasonally flooded to less than 12 centimeters deep. Reed canary grass, blue joint grass (Calamagrostis canadensis), many species of sedges and nutsedges, boneset (Eupatorium perfoliatum), and Joe-pye weed (Eupatorium sp.) are common components of these communities. Composition of plant species, and therefore wildlife value, is strongly influenced by grazing. A heavily grazed meadow tends to consist almost entirely of soft rush, as cattle will not eat it. Wet meadows are used by several species of passerines for feeding, especially flocks of robins (Turdus migratorius), cowbirds (Molothrus ater), starlings (Sturnus vulgaris), grackles (Quiscalus quiscala), blackbirds, and sparrows (Martin et al. 1951); red-winged and yellow-headed blackbirds and song and swamp sparrows will nest there.

Shrub Swamp

Permanently flooded areas with shrub stands consisting of buttonbush, red maple, willows, silky dogwood (Cornus amomum), gray dogwood (Cornus racemosa), red-osier dogwood (Cornus stolonifera), highbush blueberry (Vaccinium corymbosum), viburnums (Viburnum spp.). and sweet-gale (Myrica gale) characterize this wetland type. Nesting passerines are the primary users of shrub swamp, but its value varies with the plant species composition and plant community structure.

Wooded Swamp

This wetland type is primarily hardwoods in river and stream floodplains which are seasonally flooded up to 1 meter deep. It also includes wooded areas which are permanently flooded, but these primarily occur in the southern United States and are characterized by bald cypress (Taxodium distichum) and Tupelo gum (Nyssa sylvatica). The wooded swamps of the north are largely composed of silver maple, swamp white oak, pin oak, green ash (Fraxinus pennsylvanica), American elm, eastern cottonwood, willow, and red maple. In the more permanently flooded swamps, red maple is the dominant species. These areas are valuable as breeding habitat for not only wood ducks (Aix sponsa) and black ducks (Anas rubripes), but for many species of herons, egrets, warblers, flycatchers, woodpeckers, thrushes, nuthatches, vireos, rose-breasted grosbeaks (Pheucticus ludovicianus), hawks, owls, grackles, and many passerines (Golet and Larson 1974).

Coniferous wooded swamps have red spruce (Picea rubens) and eastern hemlock (Tsuga canadensis) in highlands swamp areas, and Atlantic white cedar (Chamaecyparis thyoides) in the lowland swamps. These evergreen swamps provide nesting and feeding habitat for golden-crowned kinglets (Regulus satrapa), magnolia warblers (Dendroica magnolia), red-breasted nuthatches (Sitta canadensis), and other warblers (Golet and Larson 1974; Robbins et al. 1966).

Acid Bogs

Bogs are formed from deep accumulations of sphagnum moss and usually have very acid pH ranges. This acid, low oxygen environment is not conducive to good wildlife habitat. However, the bogs are used by some ducks for feeding and by warblers, flycatchers, nuthatches, and kinglets for nesting.

Characteristic vegetation of upland bogs included black spruce (Picea mariana), tamarack (Larix laricina), leatherleaf (Chamaedaphne calyculata), sheep laurel (Kalmia angustifolia), sweet-gale, and cranberries (Vaccinium marcocarpon). Lowland bogs are dominated by Atlantic white cedar with red maple and leatherleaf common.

Salt Marshes

This wetland type occurs in the north only on the Atlantic coast. It included brackish and salt marshes of all categories (deep, shallow, brackish, saline, but are all tidally influenced) occurring on the coast from Maine to Maryland. These salt marshes are dominated by smooth cordgrass (Spartina alterniflora) and glasswort (Salicornia spp.) in saline areas;

saltmeadow cordgrass (Spartina patens), saltgrass (Distichlis spicata), saltmarsh bulrush (Scirpus robustus), marsh elder (Iva frutescens) and other species in brackish marshes; and with common reed dominating fresh to slightly brackish coastal marshes (Environmental Laboratory 1978; Hunt et al. 1978).

The salt marshes are used extensively for feeding, nesting, and resting habitat by common terns, roseate terns (Sterna dougallii), great black-backed gulls (Larus marinus), herring gulls, laughing gulls (Larus articilla) (in the extreme southern parts of the northeast only), clapper rails (Rallus longirostris), black rails (Laterallus jamaicensis), all herons and egrets except cattle egrets (Bubulcus ibis) in the area, willets (Cataphrophorus semipalmatus) and glossy ibises (Plegadis falcinellus) (Burger 1977a; Robbins et al. 1966; Soots and Landin 1978). Least bittersn (Ixobrychus exilis) also inhabit brackish marshes, as do king rails (Meanley and Wetherbee 1962). Long-billed marsh wrens (Telmadytes palustris), short-billed marsh wrens (Cistothorus platensis), seaside sparrows (Ammospiza maritima), sharp-tailed sparrows (Ammospiza caudacuta) also use salt marshes for nesting, although sharp-tailed sparrows frequently only overwinter in salt marshes (Pettingill 1970; Robbins et al. 1966).

Open Salt Water

Low energy areas that allow growth of aquatics such as eelgrass (Zostera maritima) and wild celery (Vallisneria americana), and marine algae are characteristic of this wetland type. These areas are used extensively by overwintering waterfowl. They are also used heavily by overwintering coots, loons, and grebes. Open estuarine and bay waters are used extensively for feeding by royal terns (Sterna maxima), common terns, roseate terns, Caspian terns (Sterna caspia), least terns (Sterna albifrons), and herring and great black-backed gulls. These species nest on isolated high sites and islands within the wetland area, many of them on dredged material islands (Landin 1978b). The open water areas of this wetland type are generally behind barrier islands, and in bays, coves, and estuaries.

Ideal Wetlands

The ten wetland types are used in varying degrees by non-game and minor game bird species, with wooded swamps and deep and shallow permanent marsh offering the most valuable and diverse habitat. A reasonable generalization is that wetlands increase in value to wetland-using non-game and minor game birds if they:

a. Are located in bottomlands in a fairly large tract of land,
b. Are close to open water and have a stable water supply,
c. Have neutral pH and fertile soil,
d. Offer diversity of vegetation life forms,
e. Are isolated from human populations, and
f. Are free of contaminants.

A wetland is of least value if it is a small upland area with no open water nor permanent water supply, is subject to acidity from decaying vegetation, is in poor soils, has been contaminated from either point or non-point source, and is near urban areas or areas used for recreation. These two extremes of ideal and worst case northern wetlands are of course hypothetical, and most wetlands in the two regions lie between the extremes. The key to increasing non-game bird species use of a wetland lies with developing more of the remaining wetlands of the area into quality habitat and allowing less of it to fall toward the less valuable wetland extreme.

WATER BIRDS

While northern United States wetlands are undoubtedly of immense importance to passerine species, those bird species that will be affected most severely by continued loss or alteration of wetlands are those groups commonly called water birds (herons, egrets, cormorants, ibises, loons, gulls, terns, skimmers, bitterns, grebes, rails, and coots). In the northern states, these species are not abundant with the exception of the ring-billed gull in the Great Lakes and the herring gull on the northeast coast (Soots and Landin 1978).

Declines in populations of great blue herons and common egrets have been noted by Thompson (1977), Thompson and Landin (1978), and Norling (1977). The wading birds in the interior United States are often subjected to contaminated feeding areas (Konermann et al. 1978; Hoffman and Curnow 1977; Keith 1966) although the fish-eating terns and other species seem to encounter less problems from contamination than do the wading marsh feeders. This contamination effect is especially true in the large river systems (Thompson 1977) and the Great Lakes (Hoffman and Curnow 1977). The most frequently encountered problem in the northeast with species such as herons, egrets, terns, and skimmers is human disturbance and a reduction in the quality of their feeding areas (Soots and Landin 1978; Gochfeld 1977; Buckley and Buckley 1976). However, an increase in nesting great blue herons, glossy ibises, Louisiana herons (Hydranassa tricolor), snowy egrets (Leuciphoyx thula), common egrets, cattle egrets, black-crowned night herons (Nycticorax nycticorax) has been noted in the

New England area on offshore islands (Dick Forster, 1979, Massachusetts Audubon Society, personal communication. Forster also reported that common and roseate terns there are declining. Possible causes are similar to problems elsewhere; habitat loss, decline in water quality, and human disturbance.

The least tern is dwindling in numbers on the coasts, and the interior least tern has all but disappeared from its former nesting areas in the Mississippi River and its tributaries (Downing 1975; Hardy 1957). In the rivers, the loss is due to the lack of undisturbed sand bars suitable for nesting (Thompson and Landin 1978), and on the coast it is due almost entirely to lack of bare sand areas and human disturbance and its ramifications (pets roaming through colonies, motorcycle enthusiasts, campers, curious people wanting to "look at the bird eggs and the baby birds", and similar events) (Soots and Landin 1978. The need for bare undisturbed nesting areas is great throughout the least tern's range

Other tern species are either declining in population or are stable, but none are increasing even though Forster's tern has recently extended its range into the Mississippi River (Thompson and Landin 1978). Common terns that have difficulty successfully nesting in the Great Lakes are bothered by night heron, herring gull, and ring-billed gull predation, and lack of suitable nesting habitat. Common terns on the coast have become largely salt marsh nesters (Burger and Lesser 1977) because other suitable isolated sites do not exist (Landin 1978b).

Piping plovers (Charadrius melodus) are small shorebirds that have used upland sand areas and islands in or near Lake Superior wetlands for nesting; their numbers have diminished dramatically in that area because nesting habitat has not remained available to them (Robert Whiting, 1978, U.S. Army Engineer District, St. Paul, personal communication).

Double-crested cormorants (Phalacrocorax auritus) are listed as endangered in Wisconsin (Wallace 1977) and are quite limited in Michigan and other areas of the north central region. The primary cause of their demise has been human persecution and loss of nesting trees, not necessarily loss of wetlands habitat. In a colony of double-crested cormorants in the Upper Mississippi River, a set of nesting boxes have been erected to replace nest trees that have fallen in an old flooded stump field.

The night herons have never been common in the northern states, especially the yellow-crowned night heron (Nyctanassa violacea), and they have decreased in numbers over a period of years with the exception of the New England area, The reasons for this decline are unclear, but it is believed that the cause is contaminated feeding areas (Ohlendorf et al. 1978; Bull 1964).

Bitterns are elusive and an accurate estimate is hard to obtain (Willer 1961), but Wallace (1977) believes that the American bittern (Botaurus lentiginosus) is probably declining in numbers in the Great Lakes area. The least bittern is still common throughout northeast fresh marshes, but it possibly is declining in total numbers also.

Gulls and cattle egrets are the only species that seem to be having little problem adjusting to increasing human populations and decreasing wetland habitats. This is due largely to the fact that cattle egrets are primarily upland feeders, and gulls are scavengers of human garbage which adds large new food sources to their traditional fish/scavenge diet (Soots and Landin 1978; Schrieber and Schrieber 1978).

Ludwig and Tomoff (1966) studies reproductive success in an insecticide residue environment in Lake Michigan, but these residues have had no real effect on the total population in the Great Lakes.

The common loon (Gavia immer) and, less commonly, the red-throated loon (Gavia stellata) are species occurring in the northern states Although botulism die-off has killed large numbers in the past decade (Wallace 1977), populations are still not believed to be in serious trouble. These birds, especially the common loon, overwinters in marine waters, but nests near open water in fresh marshes (Robbins et al. 1966). Martin (1978) has indicated that loons are declining in New England.

PROBLEMS AND CAUSES

Almost all the problems affecting water bird populations and their survival are related to human causes. Increased human populations, especially in the already highly populated northeast and north central states, causes loss or alteration of wetlands due to:

a. Increased recreational use of wetlands (boating, fishing, hunting, bird-watching (Soots and Landin 1978);
b. Drain and fill operations for agricultural and urban use which include mosquito-ditching (Burger 1977b), draining and using former wetlands for agricultural lands (Shaw and Fredine 1956), dredged material fill for marinas and waterfront properties, and other alternatives;
c. Industrial, agricultural, and human wastes in wetlands which

include placement of dredged material from shipping channels on or near wetlands, excessive nutrient loands and pesticides from farming and sewage; and heavy metals and chemicals from industry (Hunt et al. 1978); and

d. Water table and lake level changes from the drawing of fresh water from underground reservoirs for urban use, and the damming, streamlining, or deepening of lakes that cause their level of water to fluctuate.

The wetlands in the nertheast and north central United States have been greatly affected by the above activities. Because wetlands are affected, the bird species that use wetland habitats for any part of their life cycle will decline or increase as a result of changes in those wetlands. Impacts on wetlands have impacted non-game and minor game bird species in several ways. Feeding habitat has decreased or become contaminated, especially in the interior areas (Hoffman and Curnow 1977; Konermann et al. 1978; Thompson 1977; Keith 1966). Nesting site disruption is caused by cutting or clearing vegetation from shrub and wooded swamps, making colony sites accessible to human activities or destroying those colonies, removing the water by draining, and for many other reasons. Resting and loafing sites are affected for the same reasons, except that isolation is not so critical.

All birds are vulnerable while nesting (Pettingill 1970), as they must remain in one location for the duration of the breeding season. Water birds (Herons, egrets, terns, gulls, and others) will nest in large conspicuous colonies and will fly for long distances to reach a desirable feeding area from their nesting site. The herons on West Sister Island in Lake Erie often fly several kilometers to natural and manmade marshes to feed (Soots and Landin 1978).

All birds need differing amounts of seclusion for reproduction to take place (Pettingill 1970). Strongly territorial nesters require this most; i.e., the bald eagle (Haliaeetus leucocephalus) which requires large land expanses around its nest before it will successfully reproduce. Colonial nesting birds, while nesting in dense colonies, still have territorial and nest spacing requirements before they can successfully raise a brood (Soots and Landin 1978; Wiese 1977 and 1978). These birds will tolerate more interference by human colony intruders and observers than non-colonial or solitary nesters (Anderson 1978), but more damage can be done to a given population by entering a colony than in any other way (Soots and Landin 1978).

Solitary nesting birds such as bitterns, rails, and others have a great need of seclusion and thus will tolerate little or no intrusion by humans (Bent 1926; Palmer 1962).

Migratory resting points for not only waterfowl but the numerous non-game and minor game birds which migrate are necessary for many species who stop periodically along their route rather than fly non-stop. Any alternation or destruction of these wetland resting points will have an impact on the number of birds that successfully complete the migration (Scharf 1977).

MANAGEMENT RECOMMENDATIONS

The losses of wetlands over the past 200 years have been tremendous, and the damage is not likely to ever be undone, even in future generations. The wetlands that are now urban and recreational sites, farm lands, and reservoirs will undoubtedly remain as they are now. Pressures are still being placed that put existing wetlands in question, in spite of the Clean Water Act and its Section 404 regulations.

It should be noted that, realistically speaking, a wetlands manager cannot expect to expand the wetlands outside the land he can control, whether it is refuges, game farms, game management areas, or commercial forest operations. In spite of these limitations, even a modest impact by that manager would be of benefit when it was grouped with efforts throughout the region for the benefit of wetlands as wildlife habitat.

Broad Recommendations

There are several obvious recommendations for wetlands that can be made to all wetlands managers and people concerned with the continued existence of wetland areas. First, all the remaining wetlands in the northeast and north central United States should be maintained and enhanced where possible for the benefit of non-game as well as game species. A great deal of emphasis is still placed only on game bird species that use wetlands. Fortunately for the non-game birds, management of areas for waterfowl has helped preserve some habitat for them as well.

Second, the possibility of converting some lands under federal, state, or public ownership back to wetlands from their present status should be investigated, and where it is possible to create quality habitat by this

method, it should be done. There are marginal lands in public ownership that could be managed to bring them up to quality habitat by such methods as planting suitable vegetation (Environmental Laboratory 1978); by changing the water level using low-head dams or dikes; and by posting or fencing them to prevent human intrusion (Soots and Landin 1978).

A third broad recommendation is for agencies to continue to do as they have recently begun, and continue to seek and acquire blocks of land from private owners that can be preserved or returned to wetland habitat. These lands are usually under the control of the state conservation agencies, and can be managed to increase their wildlife value. One of the drawbacks in the U. S. Fish and Wildlife Service's acquisition program has been such problems as state agencies not having the funds and the personnel to manage these blocks of land that have come under their control. Another drawback in the same program has been emphasis on mangement for waterfowl only, with not much regard for the non-game birds that would use these areas. In spite of these problems, the program is well worth continuing.

A study that is beginning at the U. S. Army Engineer Waterways Experiment Station which may aid managers in taking marginal poor quality lands and developing and managing them to become higher quality habitat should aid in mitigation efforts of wildlife habitat to be displaced by Corps activities. The research station is also continuing research begun under the auspices of the Dredged Material Research Program (DMRP) on habitat development and management of land areas created from dredged material.

Specific Recommendations

Most specific recommendations can be directed to forest managers who have wetland areas within their control. Close examination of all wetland areas in control and determination of their use and quality could be based on the criteria perviously discussed. If there is quality habitat within an area, it should be maintained and stabilized as it then exists.

Since acid, non-fertile areas are not conducive to wildlife use, these areas could be changed possibly by raising the pH and fertility levels of the wetland, as has been done in areas of the south. This should be approached carefully, however, as this recommendation would also apply to acid bogs, and these areas are often unique. They usually have plant species found in few other places, and any unusual plants should not be disturbed if it is determined that they are in fact rare or endangered.

Building low-head dams or dikes to allow intermittent ponds to become shallow marshes and ponds and to control water levels is another fairly simple way to increase the habitat value. This has already been done in many areas of the northeast and in the southern states (Landin 1978a).

In large open areas where wave action causes erosion problems and prevents much wildlife use, erection of wave barriers or dikes may be necessary to allow marsh formation and to create stillwater areas for feeding birds (Environmental Laboratory 1978). This has been done during the creation of a large new disposal site by the U. S. Army Engineer District, Detroit, in which they deliberately built the disposal dike in an area where a natural marsh would be protected and its eroded parts allowed to rebuild. The area will provide feeding habitat for water birds both behind the site in the existing marsh and inside the dike after it is competed (Richard Gutleber, 1978, U. S. Army Engineer District, Detroit, personal communication). An inovative wave barrier built of floating tire breakwaters in marine areas is being tested in research at the University of Rhode Island.

A fairly inexpensive way to increase the wetland's value is to plant suitable plant species that will be of value to target wildlife species as feeding, resting, and/or nesting habitat (Hunt et al. 1978; Environmental Laboratory 1978). If too many plants are there, as in the case of a thick shrub swamp, shallow marsh, or overgrown bird colony site that has been overtaken by undesirable or an excess of plants, a thinning of these plants to bring back open areas and a diversity in habitat would be of benefit (Soots and Landin 1978).

Precedents for providing nesting areas for birds, such as nesting platforms for ospreys (Pandion haliaetus) in New Jersey and open nesting boxes for cormorants in the Upper Mississippi River (Thompson and Landin 1978), have already been made. In areas of diminishing nesting habitat where birds will not move but slowly decrease in population, this action may be necessary. This may also be the case where an all-out effort to bring back a species, such as the osprey program in New Jersey, needs to be made (Joan Galli, 1976, New Jersey Nongame Biologist, Trenton, personal communication).

One of the most critical needs for nongame bird management is the creation of seclusion and isolation from humans by fencing, posting, law enforcement, or whatever other actions are necessary to insure that colonies and sensitive nesters are undisturbed (Soots and Landin 1978; Buckley and Buckley 1976). Those non-game birds that need this effort most crit-

ically are all species of terns, especially the least tern; the herons and egrets of the Great Lakes and interior areas; and the cormorants in the river systems and Great Lakes. These birds are all declining in population. Provision of undisturbed nesting sites which are lacking at the present time for least terns, common terns, roseate terns, and black skimmers (Rynchops nigra) needs to be made. One of the determinations of best use of dredged material by the DMRP has been the placement of fresh dredged material on Corps and other islands for the use of these nesters. The main drawback to this placement has been and probably will continue to be the immediate use by humans of these new sand areas for recreational purposes, especially in the river systems (Richard Baker, 1977, U. S. Army Engineer District, Rock Island, personal communication), which does not give the birds a chance to nest.

Another practice that is recommended and can be implemented by forest managers is leaving vegetation on stream banks, lakesides, and marshes; clearcutting of these areas removes the cover that had been present for many bird species. Numerous passerines nest in the edge of wooded areas adjacent to open water. Wading birds use these areas as cover while hunting for food, and they depend upon the clarity of the water to see their prey. Cutting of streambanks has been shown to greatly increase the muddiness of the water. The recommendation that a 15-20 meter deep fringe to streams, lakes, rivers, and marshes be left would allow critical habitat to remain and protection of the water quality (Russell 1966).

Water levels can be raised or lowered to manipulate vegetation to increase non-game bird habitat. The provision of open water in a marsh area or wooded swamp allows feeding areas for not only waterfowl and the species previously discussed, but allows belted kingfishers (Megaceryle alcyon) and above-water feeding swallows and martins feeding habitat not otherwise provided.

SUMMARY

Wetlands as they existed when this country was settled will never be regained; however, there is much that can be done to not only save that which is left but to enhance its value to wildlife. A continuing and dedicated effort to protect and manage existing wetlands; acquire any new wetland or potential wetland areas for preservation; increase the quality of wildlife habitat, especially for non-game species; and to prevent increasing human populations from intruding into wildlife areas, especially during the critical nesting season, to the detriment of that wildlife must be made by all wetlands and forest managers everwhere. The concern of all persons and responsible agencies is vital to the continuation of the wildlife species which depend upon wetlands for their life requirements. Only when everyone works together will these efforts be successful.

LITERATURE CITED

Adams, A. M., J. Bunn, B. S. Davis, A. L. Jones, and L. W. Odne. 1973. A study of the Pig's Eye Lake heron colonies. Loon:32-45.

Anderson, J. M. 1978. Protection and managment of wading birds. National Audubon Society Research Report No. 7, pp. 99-104.

Anderson, D. W. and F. Hamerstrom. 1967. The recent status of Wisconsin cormorants. Passenger Pigeon 29:3-15.

Audubon, J. J. 1844. The Birds of America, Vol. VI. Dover Reprint Publ, New York. 457 pp.

Audubon, J. J. 1844. The Birds of America, Vol. VII. Dover Reprint Publ, New York. 360 pp.

Beecher, W. J. 1942. Nesting birds and the vegetation substrate. Chicago Ornithological Society, Chicago. 69 pp.

Bent, A. C. 1921. Life Histories of North American Gulls and Terns. Dover Reprint Publ., New York.

Bent, A. C. 1926. Life Histories of North American Marsh Birds. Dover Reprint Publ, New York. 392 pp.

Berger, A. J. 1951. Nesting density of Virginia and sora rails in Michigan. Condor 53:202.

Bergman, R. D., R. Swain, and M. W. Weller. 1970. A comparative study of nesting Forster's terns and black terns. Wilson Bull. 82:435-444.

Buckley, P. A. and F. G. Buckley. 1976. Guidelines for the protection and management of colonially nesting waterbirds. North Atlantic Regional Office, National Park Service. Boston, Mass.

Bull, J. 1964. Birds of the New York Area. Harper and Row, New York.

Burger, J. 1974. Breeding adaptations of Franklin's gulls to a marsh habitat. Animal Behavior 22:521-567.

Burger, J. 1977a. Factors determining colony and nest site selection in white-faced and glossy ibises. Auk, in press.

Burger, J. 1977b. Nesting behavior of herring gulls: invasion into Spartina salt marsh areas of New Jersey. Condor 79(2):162-169.

Burger, J. and F. Lesser. 1977. Determinants of colony site selection in common terns. IN Proc. 2nd Colonial Waterbird Cong. pp. 118-127.

Burger, J. and J. Shisler. 1977. The effects of ditching a salt marsh on colony and nest site selection in herring gulls (Larus argentatus). American Midland Naturalist 100(1):54-63.

Conservation Foundation. 1978. Efforts to save wetlands systems are bogged down. Monthly Report (October). Washington, D. C. 8 pp.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1977. Classification of wetlands and deep-water habitats of the United States, an operational draft. U. S. Fish and Wildlife Service, Washington. 100 pp.

Custer, T. W. and R. G. Osborn. 1977. Wading birds as biological indicators: 1975 colony survey. Special Scientific Report - Wildlife No. 206. U. S. Fish and Wildlife Service, Washington, D. C.

Downing, R. L. 1975. Survey of interior least tern nesting populations. Unpublished report. Denver Wildlife Research Center, U. S. Fish and Wildlife Service. 7 pp.

Environmental Laboratory. 1978. Wetland habitat development with dredged material: engineering and plant propagation. Technical Report DS-78-16. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Golet, F. C. and J. S. Larson. 1974. Classification of freshwater wetlands in the glaciated northeast. U. S. Dept. of Interior Resources Publ. No. 116. Washington, D. C. 56 pp.

Gochfeld, M. 1977. Colony and nest site selection by black skimmers. IN Proc. Colonial Waterbird Conf. pp. 78-90.

Gromme, O. J. 1963. Birds of Wisconsin. Univ. of Wisc. Press, Madison. 220 pp.

Hardy, J. W. 1957. The least tern in the Mississippi Valley. Public Museum, Michigan State University Biological Services 1:1-60.

Harris, J. and S. Matteson. 1975. Gulls and terns as indicators of man's impact upon Lake Superior. Univ. of Wisc. Sea Grant College Program. Technical Report 227, Madison.

Hill, N. 1965. The Birds of Cape Cod. William Morrow Publ., New York.

Hoffman, R. D. 1978. The diets of herons and egrets on southwestern Lake Erie. National Audubon Society Research Report No. 7.

Hoffman, R. D. and R. D. Curnow. 1977. Total mercury in Lake Erie herons and their foods. IN Proc. 2nd Colonial Waterbird Conference.

Hunt, L. J., M. C. Landin, A. Ford, and B. J. Wells. 1978. Upland habitat development with dredged material: engineering and plant propagation. Technical Report DS-78-17. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Johnson, R. M. 1977. The breeding ecology of three species of herons at two rookeries in Dodge County, Wisconsin. Wisc. Dept. of Natural Resources, Madison. Unpublished manu.

Kadlec, J. A. and W. H. Drury. 1968. Structure of the New England herring gull population. Ecology 49(4):464-476.

Keith, J. O. 1966. Insecticide contaminations in wetland habitats and their effects of fish-eating birds. J. Appl. Ecol. 3:71-85.

Konermann, A. D., L. D. Wing, and J. J. Richard. 1978. Great blue heron nesting success in two Iowa Reservoir ecosystems. National Audubon Society Research Report No. 7.

Landin, M. C. 1978a. Wading birds and wetlands management. U. S. Forest Service General Technical Report SE-14. pp. 135-141.

Landin, M. C. 1978b. National perspective of colonial waterbirds nesting on dredged material islands. IN Proc. 43rd North American Wildlife and Natural Resources Conference, Pheonix. In press.

Landin, M. C. 1978c. A selected bibliography of the life requirements of colonial nesting waterbirds and their relationship to dredged material islands. Misc. Paper D-78-5. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Ludwig, J. P. and C. Tomoff. 1966. Reproductive success and insecticide residues in Lake Michigan herring gulls. Jack-Pine Warbler 44:77-89.

Ludwig, J. P. 1968. Dynamics of ring-billed gull and Caspian tern populations of the Great Lakes. PhD Dissertation. University of Michigan, Ann Arbor. 73 pp.

Martin, A. C., H. S. Zim, and A. L. Nelson. 1951. American Wildlife and Plants: a Guide to Wildife Food Habits. Dover Reprint Publ., New York. 500 pp.

Martin, P. 1978. Are New England's loons slipping away? Bird Observer of East Massachusetts 6(3):83-87.

Meanley, B. and D. K. Wetherbee. 1962. Ecological notes on mixed populations of king rails and clapper rails in Delaware Bay marshes. Auk 79:453-457.

Miller, E. F. and K. Krumm. 1973. Environmental impact assessment study of Pool 3 of the northern section of the Upper Mississippi River. U. S. Army Engineer District, St. Paul, Minn.

Moseley, E. F. 1936. Blue heron colonies in northern Ohio. Wilson Bull. 48:3-11.

Nicklaus, R. H. 1977. Heron-egret-cormorant rookery directory. In-house document of the Upper Mississippi River Conservation Committee, Wildlife Technical Section. St. Paul.

Niering, W. A. 1966. The Life of the Marsh - - the North American Wetlands. McGraw-Hill, New York.

Nordstrom, K. F., R. W. Hastings, and S. Bonsall. 1974. An environmental impact assessment of maintenance dredging of the New Jersey Intracoastal Waterway. Technical Report No. 74-1. Marine Sciences, Rutgers Univ., New Brunswick, New Jersey.

Norling, W. 1977. Report on great blue heron and great egret nesting. Ecological Studies, 1976 Annual Report, Prairie Island Nuclear Generative Plant Environmental Monitoring Program.

Ohlendorf, H. M., E. E. Klaas, and T. E. Kaiser. 1978. Environmental pollutants and eggshell thinning in the black-crowned night heron. National Audubon Society Res-

search Report No. 7, pp. 63-82.
Palmer, R. S. 1962. Handbook of North American Birds, Vol. I. Yale University Press, New Haven, Conn.
Partch, M. 1972. The 1972 great blue heron migration in Minnesota. Loon 44:85-87.
Partch, M. 1975. The 1973 great blue heron migration in Minnesota. Loon 47:66-69.
Pettingill, O. S. Jr. 1970. Ornithology. Burgess Publ. Co, Minneapolis. 524 pp.
River Studies Center. 1975. Revegetation study, Island 117, Navigation Pool No. 8, Upper Mississippi River. Contribution No. 8, River Studies Center, Univ. of Wisc.,LaCrosse.
Robbins, C. S., B. Bruun, H. S. Zim, and A. Singer. 1966. Birds of North America. Western Publishing Company, New York. 340 pp.
Russell, M. 1966. A survey of streambank wildlife habitat. IN 20th Southeastern Game and Fish Commissionsers Conference. pp. 37-41.
Scharf, W. C. 1977. Nesting and migration areas of birds in the U. S. Great Lakes. Interim report, USFWS/OBS 77-2. Office of Biological Services, Bay St. Louis, Mississippi.
Scharf, W. C., G. Shugart, and M. Chamberlin. 1978. Colonial birds nesting on manmade and natural sties in the U. S. Great Lakes. Technical Report D-78-10. U. S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
Schrieber, R. S. and E. A. Schrieber. 1978. Colonial bird use and plant succession of dredged material islands in Florida, Vol 1: Sea and wading bird colonies. Technical Report D-78-4. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.
Shaw, S. P. and G. C. Fredine. 1956. Wetlands of the United States. Circular No. 30. U.S. Fish and Wildlife Service, Washington. 67 pp.
Siegfried, W. R. 1978. Habitat and the modern range expansion of the cattle egret. National Audubon Society Research Report No. 7.
Soots, R. F. Jr. and M. C. Landin. 1978. Development and management of avian habitat on dredged material islands. Technical Report DS-78-18. U. S. Army Engineer Waterways Expiment Station, Vicksburg, Mississippi.
Stewart, R. E. and H. A. Kantrud. 1971. Classification of natural ponds and lakes in the glaciated prairie region. U. S. Dept. of Interior Resource Publ. 92, Washington, D.C. 57 pp.
Terpening, V. A., J. A. Nawrot, M. J. Sweet, and D. L. Damrau. 1975. Environnental inventory and assessment of navigation pools 24, 25, and 26, Upper Mississippi and Lower Illinois Rovers. Contract Report Y-75-2. U. S. Army Engineer Waterways Experiment Station, Vicksburg.
Thompson, D. H. 1977. Declines in populations of waterbirds nesting within the floodplain of the Upper Mississippi River. IN Proc. 2nd Colonial Waterbird Conf. pp. 26-37.
Thompson, D. H. and M. C. Landin. 1978. An aerial survey of waterbird colonies along the Upper Mississippi River and their relationship to dredged material deposits. Technical Report D-78-13. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.
U. S. Army Engineer District, St. Louis. 1975. Environmental impact statement, Pools 24, 25, and 26, Mississippi and Illinois Rivers. U. S. Army Engineer District, St. Louis, Mo.
U. S. Army Engineer District, St. Paul. 1974. Environmental impact statement, 9-foot navigation channel, Upper Mississippi River: head of navigation to Guttenburg, Iowa. U. S. Army Engineer District, St. Paul, Minn. 596 pp.
Wallace, G. J. 1977. Environmental status of the Lake Michigan region. Volume 14: Birds of the Lake Michigan drainage basin. U. S. Energy Resources and Development Administration. 112 pp.
Weller, M. W. 1961. Breeding biology of the least bittern. Wilson Bulletin 76(1):11-35.
Weller, M. W. and C. S. Spatcher. 1965. Role of habitat in the distribution and abundance of marsh birds. Special Report No. 43, Iowa Agricultural and Home Economics Station, Iowa State University of Science and Technology. Ames, Iowa. 31 pp.
Wiese, J. H. 1977. A study of the reproductive biology of herons, egrets, and ibises nesting on Pea Patch Island, Delaware. Report for Delmarva Power and Light Company, Wilmington, Delaware. 179 pp.
Wiese, J. H. 1978. Heron nest-site selection and its ecological effects. National Audubon Society Research Report No. 7. pp.27-34.