5-1990

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Research Report 83, May 1990

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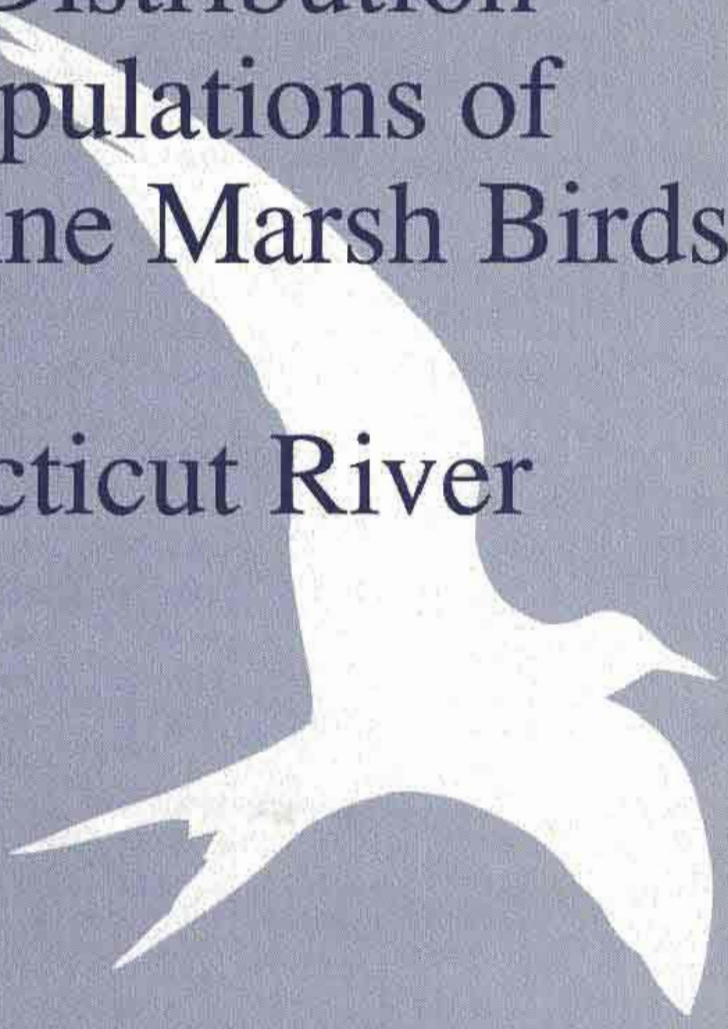

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I dedicate this paper to the memory of Margaret Ertman, whose affection for all wild creatures I will always remember.

Contents

Acknowledgments

I gratefully acknowledge G. Clark, Jr., M.W. Lefor and P. Rich for their insights concerning this study. J. Barclay, D. Duffy, B. Lussier, N. Proctor and F. Sibley also contributed useful ideas and data. J. Dowhan and L. Mehrhoff of the Natural Resources Center, Connecticut Department of Environmental Protection, provided field companionship and encouragement. W. Burt, J. Burt, S. Craig, M. Focazio, and J. Suchecki assisted with field work, and Governor and Mrs. C. Bowles, Mr. and Mrs. I. Ertman, and Dr. and Mrs. W. Southwick assisted with logistic support. M. Hubbard prepared the figure. Financial support was provided in part by The University of Connecticut Research Foundation.

Introduction

Historic Trends in the Distribution and Populations of Estuarine Marsh Birds of the Connecticut River

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The Connecticut River is the only major northeastern river without a city at its mouth. Whereas most of the region's estuaries have been dramatically manipulated, the lower Connecticut River remains largely unchanged from its original physical condition. The marshes of the river thus provide sites for studying avifaunal distributions in an estuarine marsh system that otherwise survives only in scattered remnants. In this study, I report on the summer distribution of marsh birds of the lower Connecticut River for the period 1974 to 1987. For species that nest in these marshes, I also document their known historic distributions along the estuary.

Habitat factors known to influence marsh bird communities include: (1) tract size (Brown and Dinsmore 1986), (2) habitat diversity (Weller and Spatcher 1965, Weller and Fredrickson 1973, Kantrud and Stewart 1984), (3) isolation (Brown and Dinsmore 1986), (4) interspecific competition (Miller 1968, but see Nudds 1982) and (5) history, including human impacts (Cottam and Bourne 1952, Clarke *et al.* 1984). Other habitat-related factors that affect marsh birds include marsh-water interspersion (Weller and Spatcher 1965), water level (Jackson 1983), tides (Burger 1985, Swift 1988) and water salinity (Poulson 1969). I report on the effects of some of these factors on marsh birds in the Connecticut River system.

Previous investigators of the Connecticut River avifauna include Clark (1884, 1897), who described the nest of the Black Rail (*Laterallus jamaicensis*), and Poulson (1969), who studied the physiology of the Seaside (*Ammodramus maritima*) and Sharp-tailed (*A. caudacuta*) sparrows. Ames and Mersereau (1964), Ames (1966), Wiemeyer *et al.* (1975), Spitzer (1977), Spitzer *et al.* (1978), and Spitzer and Poole (1980) studied nesting Ospreys (*Pandion*

haliaetus), and Peterson (1969) briefly discussed population changes of raptorial and fish-eating birds of the river.

In more general works, Bagg and Eliot (1937) discussed birds of the Connecticut Valley in Massachusetts, Bull (1964) and Craig (1979) discussed distributions of some species of the lower river, and Lefor and Tiner (1972, 1974) provided distributional notes on birds of the tidal marshes. General studies giving insights into the historic status of the river's birds include those by Linsley (1843), who made the first comprehensive survey of Connecticut birds, Nuttall (1832-1834), Merriam (1877), Stearns and Coues (1881-1883), Baird *et al.* (1874, 1884), Capen (1886), Bendire (1892, 1895), Allen (1909), Sage *et al.* (1913), Eaton (1910-1914), Forbush (1925-1929), and Jones (1931). Sage, in particular, concentrated his studies in the Portland-Cromwell portion of the Connecticut River.

Methods

Study areas

The Connecticut River estuary is bordered by a series of marshes totalling about 1200 ha. Gradients in the physical environment influence the marshes along the estuary. During the low river flows of late summer, tidal amplitude, which averages 1.1 m at the river mouth, declines to 0.5 m 60 km north in Hartford (NOAA 1983). Similarly, maximum water salinity varies from 17 ppt near the river mouth to 0 ppt 23 km upriver (Meade 1966), and the salinity of marsh soil drops from 10.50 ppt near the river mouth to 0.02 ppt 14 km upriver (Hill and Shearin 1970).

A vegetation gradient parallels gradients in tidal amplitude and salinity. Five principal associations occur which are each structurally distinct because the diversity of dominant species is low. Around the river mouth are (1) shortgrass salt meadows composed largely of *Spartina patens*, *Distichlis spicata*, and *Juncus gerardi*, only occasionally inundated by tides (high salt marsh) and (2) rank intertidal cordgrass marshes of *Spartina alterniflora* and *Scirpus robustus* (low salt marsh). At about 2.6 km upriver, salt meadows are invaded by (3) strong-stemmed cattail-reed (*Typha angustifolia*, *Phragmites australis*, respectively) patches, which by 6.5 km upriver almost completely dominate the marshes. By 14 km upriver freshwater communities occur, particularly (4) relatively soft-stemmed bulrush-tuckahoe-horsetail (*Scirpus fluviatilis*, *Peltandra virginica*, *Equisetum fluviatile*, respectively) marshes; and (5) floating-leaved pickerel-weed-bullhead lily (*Pontederia cordata*, *Nuphar variegatum*, respectively) associations. Additional habitat subdivisions can be identified (Metzler and Damman 1985), but I believe these five are the principal ones important for bird distributions.

The 11 marshes chosen for intensive investigation ranged from tidal salt marshes near the river mouth to nontidal freshwater marshes 52 km upriver (Fig. 1, page 28). Four principal marsh types were represented among these: (1) salt marshes, containing predominantly high and low salt marsh; (2) transitional marshes, containing high and low salt marsh and cattail-reed habitats; (3) brackish cattail marshes, containing cattail-reed and low salt marsh; and (4) freshwater marshes, containing softstem bulrush and floating-leaved habitats. In addition to these sites, I observed at 11 additional marshes, most described by Craig (1975), to clarify the distributions of certain species. Habitats of the 11 principal sites are as follows (Table 1, page 29):

Great Island–Most of this marsh is dominated by salt meadow grasses. In areas inundated daily by tides taller cord grasses (*Spartina alterniflora*, *S. pectinata*) and bulrushes (*Scirpus robustus*, *S. maritimus*) predominate. In drier areas and particularly at the island's upriver end a mixture of black grass (*Juncus gerardi*), bulrush (*Scirpus pungens*, *S. americanus*), reed and cattail occurs. High tide bush (*Iva frutescens*) is scattered throughout, but is particularly common along mosquito ditches.

Black Hall River–Vegetationally similar to Great Island, this marsh differs primarily in having limited cover by reeds and cattails and in having two small

islands of pure *Spartina alterniflora*. These marsh islands are unusual in their lack of mosquito ditches.

Upper Island–The vegetation of Upper Island consists of patches of salt meadow grass, but black grass is a more common associate than on Great Island. Stands of cattails and reeds are extensive, and in areas inundated daily by tides cordgrasses and bulrushes are common. The vegetation may be thought of as transitional between salt meadow and cattail marshes.

Ragged Rock Creek–This marsh is vegetationally similar to Upper Island. As at Upper and Great Island several small oak copses occur on rocky outcrops; and, similar to all marshes discussed thus far, Ragged Rock Creek is bordered by extensive tidal flats. At the beginning of this study a landfill, now closed, operated at the site's southern end.

Ayer's Point–This marsh is dominated by cattails except along large creeks where cordgrasses form a fringe. Small patches of short sedges (*Carex spp. Eleocharis smallii*) occur along the upland border.

Lord's Cove– This marsh is largely dominated by cattails. Along creek edges cordgrasses predominate, particularly at Goose Island, which is here considered part of the Lord's Cove complex. In shallow water near creeks, bulrushes (*Scirpus fluviatilis, S. validus*) occur; and along the western border cattails merge with a damp switchgrass-sedge (*Panicum virgatum, Eleocharis smallii*, respectively) meadow. An extensive tidal flat is present at the southern end and, like all sites discussed thus far, the marsh is dissected by numerous tidal creeks.

Whalebone Creek–Much of this marsh is submerged over 1 m at high tide. Pickerelweed and bullhead lily cover these deepwater portions, but shallower areas are vegetated by river bulrush (*S. fluviatilis*), tuckahoe (*Peltandra virginica*), arrowhead (*Sagittaria latifolia*), and small patches of cattail and calamus (*Acorus calamus*). Creeks divide the marsh, and extensive mudflats are exposed at low tide.

Pecausett Meadows–This site is also largely submerged at high tide. Pickerelweed borders the pond that occupies the marsh center, but in the shallower water (under 1 m) covering much of the marsh, mixtures of river bulrush, water horsetail, sensitive fern (*Onoclea sensibilis*), calamus, tuckahoe, and arrowhead occur. As at all freshwater marshes, sensitive fern is particularly abundant in drier areas. There is an operating landfill on the site's northern border.

Cromwell Meadows–Known in the 19th century as the Little River Marshes, this site is vegetated by a mixture of river bulrush, tuckahoe, arrowhead, and water horsetail. In areas bordering creeks, pickerelweed and bullhead lily predominate. Much of the marsh has little standing water even at high tide, but the portion known as Round Meadow is covered daily by approximately 0.5 to 1.0 m of water. Round Meadow also differs in having a boggy, quaking surface and small cattail stands. Some mud is exposed along creeks at low tide, and an operating landfill occupies the western border of the site.

Dead Man's Swamp–Even though adjacent to the Connecticut River, this marsh is not directly influenced by tides. River bulrush, tuckahoe, arrowhead, and water horsetail dominate much of it, but several extensive cattail stands also occur. The water depth is mostly over 1 m, and it has a quaking surface that can-

not be negotiated on foot.

Wethersfield Meadows–This site, with standing water 0.5 to 1.0 m deep, is not influenced by tides. Most of it is vegetated by river bulrush, tuckahoe, arrowhead and water horsetail. Calamus is locally common, several cattail stands occur, and reed canarygrass (*Phalaris arundinacea*) is abundant in shallow water. Several small areas of open water occur, and black willows (*Salix nigra*) are scattered through the marsh.

In 1982 and 1984, heavy June rains flooded the Connecticut River system, and freshwater marshes in the Wethersfield-Cromwell area were completely submerged for over a week. This greatly slowed vegetation growth, retarding the nesting season and probably eliminating some breeding species from those sites during those years. Although not as drastically affected, saline marshes also experience some flooding and apparent failure of early nests at such times. Otherwise, vegetation patterns showed relatively little change during the study period.

The above descriptions apply to the marshes only during the nesting season. By late summer vegetation is taller and water levels are usually lower at freshwater sites. Moreover, wild rice (*Zizania aquatica*) and several other species that are inconspicuous in early summer assume dominance by late summer.

Bird censuses

Marsh bird distributions were studied from 1974 to 1987, with most observations made on breeding birds in 1974, 1983, 1984, 1986, and 1987. Most breeding data were gathered between early May and mid-July, but observations were made throughout the year. I spent 1073 hr observing birds, including 29-81 hours of summer observations at each of the principal study areas.

During each visit to a site, I recorded all species of birds encountered while I crossed the marsh on foot or by boat. By 1983, taped calls were used to elicit responses from secretive species like rails. I did not attempt to quantify rigorously the abundance of species but, similar to Christmas Bird Count procedures (Drennan 1981), I counted all individuals of species encountered while visiting a site. In 1974 I also counted individuals of abundant species found during two hours, usually between 06:00 and 09:00 EDT.

I used data from all visits to prepare lists of summering species at each site. Based on my data and those of collaborators, species were divided into those that were: (1) breeders–species that spent their entire day in marshes, nesting there and using marsh vegetation, creeks or tidal flats, and (2) users–species that used marshes or associated creeks and flats primarily for feeding, but which nested elsewhere. In most cases, breeding evidence was confirmed (nests, eggs, nestlings, fledglings, family groups) for those species termed breeders. However, I classified summering individuals of several characteristically marsh-nesting species as breeders even if it was unclear that nesting had occurred (e.g., Northern Harrier, *Circus cyaneus*) because I believed they still functioned as community members by feeding and apparently attempting to nest in marsh habitats (courtship observed). Wood Ducks (*Aix sponsa*) were considered breeders because they spent essentially all their time in marshes even though they nested in tree holes or boxes near the marshes. Although Common Yel-

lowthroats (*Geothlypis trichas*) and Song Sparrows (*Melospiza melodia*) were often associated with marsh edge shrubs, they nested regularly in the drier parts of marshes and in cattail-reed associations; therefore, they were also classified as marsh breeders. In contrast, I called the Osprey a user even though it occasionally nested on salt meadows because most feeding occurred away from marshes. Other species like the Yellow Warbler (*Dendroica petechia*) and Willow Flycatcher (*Empidonax traillii*) confined most of their activities and nesting to shrubs along marsh edges, so they were not considered marsh breeders. Furthermore, I did not include postbreeding flocks (e.g. swallows, herons), migrants, or summer vagrant species in this study, but focused solely on birds of the breeding season.

I ranked the relative abundance of species at each study site using data from two hour counts, my additional field observations, and observations of collaboraters. Breeding species were separated at each site into abundance categories: 1) abundant–constituting > 15% of the individuals present, 2) characteristic–three or more pairs present 90% of years, 3) uncommon–one or two pairs present 90% of years, and 4) irregular–summering 2% of the years studied. These categories are not mutually exclusive, but serve as guidelines for classifying species. In those few cases where species were difficult to classify, I used my knowledge of the system as a whole and reports of collaborators in making classifications. Especially with secretive species, different portions of a marsh were surveyed over a series of years in order to gain a clearer understanding of a species' abundance. For users, I considered individuals rather than pairs in defining the characteristic and uncommon abundance categories.

To gain some perspective about population trends and habitat affinities, I examined normalized count data. My methods of normalization were similar to those used for Christmas Bird Count data (Bock and Root 1981). For relatively common species I computed birds observed/ 10 or 100 hr at each site. For less common or strongly flocking species, I computed birds/ year, birds/ site, birds/ marsh type and sites/species. To assess populations and habitat affinities of abundant species, I used data from two hour counts. Population trends were assessed for 1974, 1983-4, and 1986-7, and habitat affinities were determined for salt, transitional, brackish cattail and freshwater marshes. In evaluating population and habitat trends, I looked for changes in relative abundance of at least an order of magnitude of 1.5.

Results and Discussion

Between 1974 and 1987 I found 28 marsh-breeding species and an additional 23 marsh-using species summering in the Connecticut River marshes (Table 2, page 30). The distributions, populations, and habitat affinities of each species are summarized below.

Breeders

Pied-billed Grebe (*Podilymbus podiceps*)–I found a summering individual only in 1974, at the nontidal bulrush marsh Dead Man's Swamp. This calling bird may have bred. Sage *et al.* (1913), Forbush (1925), and Bagg and Eliot (1937) described Pied-billed Grebes as very local breeders in the Connecticut area since at least the late 19th century. Sage *et al.* (1913) reported Connecticut nesting, but Nuttall (1834) and Audubon (1839) thought they bred principally further north.

American Bittern (*Botaurus lentiginosus*)–Seven of 10 summering birds observed at the 11 sites were at freshwater marshes. I observed them in bulrushes, cattails, and floating vegetation. They were present consistently only at Dead Man's Swamp. I did not record a bird near the river mouth until 1984, when I observed an individual on Great Island. However, no clear population trend emerged; I found 1.6 birds/100 hr in 1974 (N = 246 hr) , 2.5/100 hr in 1983-4 (N = 121.8 hr) and 1.9/100 hr in 1986-7 (N = 161.8 hr).

Sage *et al.* (1913) considered breeding American Bitterns rare, but Eaton (1910) thought them to be common in summer on eastern Long Island, and Merriam (1877), Stearns and Coues (1883), and Capen (1886) also listed them as common. Bagg and Eliot (1937) thought they were rare in the Connecticut Valley in the early 20th century but that they had increased thereafter. Elsewhere in the northeast, Baird and Baird (1844) found them rare in Pennsylvania and both Wilson and Bonaparte (1832) and Nuttall (1834) called them "nowhere numerous." Giraud (1844) considered them to be uncommon, and reported no nests from Long Island. Audubon (1839) never found a nest, but mentioned courtship in Massachusetts. Linsley (1843) was the first to indicate Connecticut nesting. Sage *et al.* (1913) reported a nest in Portland, and J.H. Sage took a recently fledged bird in Portland in 1913 (UCM 137). However, both records may have been from Cromwell Meadows in Middletown; Sage often recorded specimens taken at Cromwell Meadows as being from Portland.

Recently, Tate and Tate (1982) warned that American Bittern populations were declining. Peterson (1969) noted that they formerly bred near the mouth of the Connecticut River, but had since disappeared, probably because of pesticide pollution. They have declined as breeders in Connecticut (Craig 1979).

Maximum: 2 together–22 May 1974, Wethersfield Meadows; 2 together–23 May 1987, Lord's Cove.

Least Bittern (*Ixobrychus exilis*)–These were noted at all marsh types, with a possible slight increase in populations after 1974. They occurred most commonly in brackish cattail marshes, and predominantly used cattail-reed habitats (42 of 54 observations at the 11 sites) at other marsh types (Table 3, page 33). I

observed two birds in high salt marsh, none in floating-leaved habitats, and 10 in bulrushes. At South Windsor Meadows, a nontidal freshwater marsh along the Connecticut River exhibiting predominantly floating-leaved vegetation, I also observed birds perching in shrubs of the marsh border. Their absence from Black Hall River was likely because cover was unsuitable.

Audubon (1839) considered Least Bitterns generally uncommon, but common in the Everglades. Wilson and Bonaparte (1832) believed they were common, but mentioned that only a few bred in eastern Pennsylvania. Both described them as rare in salt marshes. Giraud (1844) listed them as uncommon on Long Island, Nuttall (1834) reported breeding north rarely to New Hampshire, and Baird *et al.* (1884) described them as common in eastern Massachusetts but rare around Springfield. Sage *et al.* (1913) reported a population decline in the early 20th century. Merriam (1877) thought them regularly occurring and listed an 1873 nest from what was probably Cromwell Meadows, and C.H. Neff (University of Connecticut, hereafter UCM, nest records) found an 1896 nest at Cromwell Meadows in a clump of pickerelweed. Neff (1883) also reported a Portland nest, and Gabrielson (1917) located summering birds near the Connecticut River in South Windsor.

Maximum: 7–10 July 1984, Lord's Cove.

Mute Swan (*Cygnus olor*)–Feral birds were largely confined to brackish portions of the river, where adults and young congregated into at least two flocks. These flocks most frequently used the sheltered coves near Ragged Rock Creek, Upper Island, and Lord's Cove. Populations increased after 1974, when I estimated 83 adults to be present, compared with 201 tallied in 1983-4 and 199 in 1986-7. Mute Swans have been established in the northeast possibly since 1875, and several dozen were present in Connecticut by 1950 (Palmer 1962). However, Sage *et al.* (1913) did not report them from Connecticut.

Maximum: 137- 20 June 1987, Lord's Cove.

Canada Goose (*Branta canadensis*)–Feral birds were mainly in brackish portions of the river, where most formed a single flock, which was often present near Lord's Cove. Population size showed no clear trend during this study, with estimates varying from 39 adults in 1974, to 45 in 1983-4, to 32 in 1986-7. Although native breeders originally occurred in Massachusetts (Audubon 1839), current nesters became established from captive stock by the 1920s (Bagg and Eliot 1937). Connecticut nesting was unknown to early observers, but Audubon (1839) speculated that the species may once have been more widespread.

Maximum: 26 adults and 32 juveniles–20 June 1984, Ayer's Point.

Wood Duck (*Aix sponsa*)–Wood Ducks were restricted to freshwater marshes, where populations exhibited no consistent trend (Table 3). They were particularly abundant at Wangunk Meadows, a freshwater marsh outside the principal study area with predominantly floating-leaved vegetation, where I observed 18.6 adults/10 hr (N = 21 hr). Wilson and Bonaparte (1832) and Audubon (1839) found Wood Ducks common throughout the United States. Allen (1864) reported them common in the Connecticut Valley, and Merriam (1877) found them fairly common during summer in Connecticut. However, by the early 1900s they had declined in southern New England, probably due to excessive hunting, (Sage *et al.* 1913, Bagg and Eliot 1937), and Forbush (1925) reported

them rare in Connecticut. Populations in the Connecticut Valley began to rebound by the 1930s (Bagg and Eliot 1937). Sage *et al.* (1913) reported Wood Duck nests on 28 May 1875 from Portland and 18 June 1891 from Chester.

Maximum: 19 adults and juveniles–16 July 1987, Cromwell Meadows.

Green-winged Teal (*Anas crecca*)–At least three individuals were present at brackish cattail and freshwater marshes in 1974, but except for a possible 1983 sighting of a pair at Lord's Cove, I did not see any in subsequent years. Although now a local northeastern breeder, with the first nesting in eastern Massachusetts occurring in 1954 (Bull 1964), there is no evidence that this northern and prairie species originally bred in Connecticut.

Maximum: 2–5 July 1974, Lord's Cove.

American Black Duck (*A. rubripes*)–This species declined in numbers from salt to freshwater marshes. Populations also appeared to decline during the study period (Table 3), a trend paralleling that reported for winter populations along the east coast (Steiner 1984). The trend has been linked to competitive replacement of Black Ducks by Mallards (Heusmann 1974, 1988). Evidence from Wilson and Bonaparte (1832), Audubon (1839), and DeKay (1844) suggests that Black Ducks were originally common northeastern breeders. Merriam (1877) cited Morton, who described Black Ducks as abundant in 1632. However, Baird and Baird (1844) said that they were abundant except in summer, and Linsley (1843) called them occasional Connecticut breeders. Later, Allen (1869) considered them extirpated in Massachusetts, Brewer (1869) listed them as occasional Massachusetts nesters, and Sage *et al.* (1913) called them rare, even though reporting two nests from Old Saybrook. The view of these later authors may reflect the widespread overhunting of the 19th century, but others, including Baird *et al.* (1884), Stearns and Coues (1883), Capen (1886), and Forbush (1925) considered Black Ducks common New England breeders.

Maxima: 24–12 June 1974, Great Island; 54, probably including postbreeding wanderers–1 Aug. 1974, Upper Island.

Mallard (*A. platyrhyncos*)–This introduced prairie species was most common in brackish cattail marshes but was about equally common in other marsh types. It occurred about as frequently as Black Ducks in salt marshes, but outnumbered them in other marsh types. Populations appeared to decline after 1974, but have shown relatively little change since 1983-4 (Table 3). Although the species was probably absent in the northeast originally (Bagg and Eliot 1937, Heusmann 1974), Giraud (1844) collected possible breeders on Long Island as early as 1837, and Audubon (1839) suspected nesting in eastern Pennsylvania. Coues (1883) found nesters in Massachusetts by the 1880s, and Mallards were known as regular New England nesters by the 1920s (Forbush 1925).

Maxima: 18 adults and 14 juveniles–12 June 1974, Great Island; 53, probably including postbreeding wanderers–20 July 1974, Lord's Cove.

Blue-winged Teal (*A. discors*)–This species occurred at salt, transition, and freshwater marshes, including two freshwater marshes outside the principal study area. At the 11 principal sites in 1974, I estimated nine pairs at brackish marshes and one pair at a freshwater site. However, by 1985 I found only one bird (at Great Island), and in 1987 I had only one possible sighting (at Lord's

Cove). Though Wilson and Bonaparte (1832), Nuttall (1834), and Audubon (1839) knew of no northeastern breeding, Swainson and Richardson (1831) thought Blue-winged Teal were common in summer around Philadelphia, and Giraud (1844) found breeders on Long Island. In Connecticut Merriam (1877) mentioned no breeding, and Sage *et al.* (1913) knew of only one summer record, but Bagg and Eliot (1937) suspected breeding along the Connecticut River in the 1880s. Eliot (1934) also reported two pairs in South Windsor. Bull (1964) documented an increase in breeding in the New York City area during the twentieth century.

Maximum: 7–19 May 1974, Great Island.

Gadwall (*A. strepera*)–This species was present in declining numbers from salt to brackish cattail marshes. I also found birds in 1974 and 1987 at the freshwater South Windsor Meadows, where they have occurred sporadically since 1931 (Bagg and Eliot 1937). Populations appeared to increase in 1986-7 (Table 3). Audubon (1839) and DeKay (1844) mentioned breeding by Gadwalls in Massachusetts and New York, but Linsley (1843), Merriam (1877), and Sage *et al.* (1913) knew of no Connecticut breeding, and Giraud (1844) reported no nesting on Long Island. Bagg and Eliot (1937) reported the first probable Connecticut nesting in 1931, at South Windsor. Bull (1964) stated that breeding Gadwall populations had increased in the New York City area as they ranged further east during the twentieth century.

Maxima: 5–26 May 1974, 5 June 1987, Black Hall River.

Northern Harrier (*Circus cyaneus*)–Northern Harriers were present predominantly in brackish portions of the river. Of six records of summering birds, three were at Lord's Cove, the largest study site, and two were birds commuting between Great and Upper Island, which have a combined area greater than that of Lord's Cove. I suspected occasional nesting in the vast Lord's Cove marshes, where I observed summering birds in 1974, 1983, and 1987. I also observed a courting pair there in March, 1985. Outside the principal study area at the freshwater Wangunk Meadows, I saw a single bird once in 1974. No clear population trend emerged during the study, with 0.8 birds/100 hr (N = 246 hr) in 1974, 0.8/100 hr (N = 121.8) in 1983-4 and 1.2/100 hr (N = 161.8 hr) in 1986-7.

This species was known to Audubon (1839) and DeKay (1844) as a U.S. breeder, but Wilson and Bonaparte (1832) believed that in Pennsylvania it had declined from previous years. Giraud (1844) found it summering on Long Island salt marshes, and Merriam (1877) and Sage *et al.* (1913) listed it as a common Connecticut nester, particularly in salt marshes. Later, Forbush (1925) stated that the Nothern Harrier was declining, and Bagg and Eliot (1937) found it had become a rare breeder in the Connecticut valley. J. H. Sage collected a recently fledged specimen in 1880 (UCM 936), possibly from Cromwell Meadows, and recorded an 1886 nest from near the Connecticut River in East Hampton (UCM nest records). Bendire (1892) reported J. N. Clark's nesting dates for birds that were probably from Old Saybrook.

More recently, Bull (1964) described breeding as greatly decreased around New York City, and Tate and Tate (1982) considered northeastern populations threatened. Early declines were attributed to shooting (Bagg and Eliot 1937), but more drastic recent declines have been linked to pesticide pollution

(Hamerstrom 1969). In Connecticut, where no recent nesting has been confirmed, habitat loss due to reversion of farmland to forest is also a likely cause for the decrease (Craig 1979).

Black Rail (*Laterallus jamaicensis*)–Despite repeated searches, I was unable to locate Black Rails until 1987, when I found calling birds at Ragged Rock Creek and Cromwell Meadows, where they inhabited high salt marsh and bulrushes, respectively. A summering bird at freshwater Dead Man's Swamp was also reported in 1980 (Proctor 1981). Formerly, Black Rails nested on Great Island and in the salt marshes of Old Saybrook (Clark 1897), which was thought to be near the species' northern range limit (Bent 1926). A 19th century breeding record for Enfield is considered by Bull (1964) to be unsatisfactory. The birds I found at Ragged Rock Creek were the first summer residents reported in that vicinity since 1876, and the first noted for the lower Connecticut River since 1884 (Clark 1897). Their reappearance along the Connecticut River and on Long Island suggests that Black Rails have reoccupied northern portions of their range vacated when tidal marsh ditching caused habitat deterioration (Post and Enders 1969).

Maximum: 2–24 May 1987, Ragged Rock Creek.

Clapper Rail (*Rallus longirostris*)–Clapper Rails inhabited salt and transitional marshes, where they predominantly used tidal creeks, tidal flats, and high and low salt marsh, although they occasionally used cattails and reeds near salt meadow patches (Table 3). Bent (1926) cited Old Saybrook as the northeastern range limit of the Clapper Rail, and Merriam (1877), Stearns and Coues (1883), Baird *et al.* (1884), Sage *et al.* (1913) considered the species rare to uncommon in Connecticut. Audubon (1839) said it was rare or absent north of Long Island. However, Linsley (1843) stated it bred abundantly in Stratford, and Purdie (1873) cited J. N. Clark, who found it breeding regularly in Old Saybrook. More recently, E. A. Bergstrom (unpubl. ms.) was uncertain of nesting in Old Lyme during the 1950s, but nesting was documented at Old Saybrook in 1950 (Parker 1950).

Maximum: as many as 8 (some heard only; identity thus presumed)–27 May 1974, Ragged Rock Creek.

King Rail (*R. elegans*)–This species appeared chiefly at transitional marshes, where I had six of my nine definite sightings at the 11 principal study sites. I also observed one bird in high salt marsh and two birds in brackish cattail marshes. In 1974 I flushed a possible King Rail from a marsh in South Windsor Meadows where Vibert (Bagg and Eliot 1937) flushed one in 1933. Birds in transitional marshes occurred in cattail-reed areas, along tidal creeks and flats, in low salt marsh, and in patches of high salt marsh. Density of King-Clapper Rails (data combined because calling birds of the two species were not distinguishable) appeared greatest in salt marshes, which were inhabited almost entirely by Clapper Rails. Total density of both species was nearly as great in transitional marshes, although because they co-occurred, Clapper Rails were clearly less frequent there than they were at salt marshes. Clapper Rails were absent from brackish cattail marshes, which were also used by King Rails only rarely. King-Clapper Rail populations appeared to decline after 1974, when I found fewer birds despite using taped calls after 1982 (Table 3). In 1974 W. Burt (pers.

comm.) found the nest of a King-Clapper Rail pair on Great Island that was located among salt meadow grasses. In 1984 I found a King Rail nest on Upper Island in a 20 m patch of salt meadow surrounded by bulrushes and reeds. An adult King Rail with young was reported at Lord's Cove in 1985 by collaborators.

Wilson and Bonaparte (1832) confused the King with the Clapper Rail (Audubon 1839). Audubon believed King Rails were rare east of Pennsylvania, and Giraud (1844) described them as extremely rare on Long Island. Linsley (1843) found them breeding in Stratford, the first New England record, Merriam (1877) called them rare in Connecticut, and Sage *et al.* (1913) uncovered few breeding records for Connecticut. Bent (1926) cited Old Saybrook as the species' northeastern range limit, and Bagg and Eliot (1937) also considered King Rails rare. Clark (1897) reported an 1897 nest on Great Island, and Sage *et al.* (1913) mentioned a 1 Sept. 1895 specimen from Cromwell Meadows, which may have been a resident. E. A. Bergstrom (unpubl. ms.) recorded probable breeding in South Windsor, Bloomfield and Rocky Hill (1950s?).

Maximum: 2–26 June 1986, Ragged Rock Creek.

Virginia Rail (*R. limicola*)–This species was at all marsh types. Birds occurred with increasing frequency from salt to freshwater marshes, and appeared to increase in numbers during the study (Table 3). Part of the apparent population buildup was a result of using taped calls to find birds after 1982, but the continued increase from 1983-4 to 1986-7 was probably real. Habitats used included brackish cattail marshes, sometimes adjacent to salt meadows, with little to 0.6 m of standing water and often with nearby tidal creeks. Although I found no evidence of Virginia Rails inhabiting salt marsh vegetation, Post and Enders (1970) found Virginia Rails nesting in unditched salt marshes on Long Island and suggested that ditching for mosquito control has made salt marshes unsuitable for nesting. In freshwater marshes I found birds in: 1) mixed river bulrush and tuckahoe with water to 0.6 m deep and sometimes with nearby pools, 2) abundant tuckahoe with river bulrush, calamus, and mannagrass (*Glyceria canadensis*, *G. acutiflora*) and little standing water, 3) nearly pure water horsetail with water 0.1 to 0.3 m deep, 4) mixed cattail, sedge, calamus, sensitive fern, and pickerelweed in boggy spots, and 5) mixed tuckahoe, dock (*Rumex verticillatus*) and water horsetail with water 0.2 m deep. Virginia Rails seemed to favor boggy freshwater habitats such as those at Dead Man's Swamp. Conversely, marshes with over one m of tidal range, over one m of standing water, or predominantly floating vegetation seemed less suitable. I located no individuals in deepwater of portions Pecausett Meadows or Whalebone Creek.

Audubon (1839), DeKay (1844), Merriam (1877) and Stearns and Coues (1883) indicated that Virginia Rails were common, widespread and bred in fresh and salt marshes. Wilson and Bonaparte (1832), although describing them as less common than Soras, implied that they were regular northeastern breeders. They also described them as breeding in salt marshes where fresh springs enter. Despite the existence of several breeding records, Sage *et al.* (1913) believed them to be rare, and Allen (1864) found them uncommon as breeders around Springfield, Massachusetts. Both Allen (1909) and Forbush (1925) considered them common Connecticut breeders. Sage *et al.* (1913) reported an 1892 nest, perhaps from Cromwell Meadows. C. H. Neff (UCM nest records) found

Portland nests in 1892 and 1894. The latter came from Hall and Goodrich Meadows, which may be part of the present Wangunk or Pecausett Meadows. In addition, H. R. Buck (UCM nest records) found a Great Island nest in 1899, and Clark (1884) found nests on Great Island and in Old Saybrook. E. A. Bergstrom (unpubl. ms.) reported a 1941 nesting in South Windsor. Billard (1948) estimated three pairs of Virginia Rails/ha at Wethersfield Meadows and 0.8 pairs/ha at Cromwell Meadows. She found density at Cromwell Meadows greatest in the portion called Round Meadow, which she attributed to water pollution present elsewhere in the marsh. I also found highest density at Round Meadow, but suspect Round Meadow's more boggy substrate and denser vegetation provided more suitable habitat.

Maximum: 11–2 July 1974, Dead Man's Swamp.

Sora (*Porzana carolina*)–Soras occurred regularly only at nontidal freshwater marshes, where I made all of my 13 observations, although collaborators reported breeding at Great Island. I also found a Sora in the largely floating-leaved freshwater marsh Wangunk Meadows, which had minimal tidal influence. Because breeders were largely silent after late May (Johnson and Dinsmore 1986), my data were insufficient to assess population trends. All birds were found in habitats with water from 0.3 to over 1 m deep, and vegetated by: 1) mixed tuckahoe, burreed (*Sparganium spp.*), mannagrass, and smartweed (*Polygonum spp.*) 2) cattail and water horsetail or 3) mixed river bulrush, tuckahoe, and water horsetail. Their absence from these habitats at Pecausett Meadows, Cromwell Meadows, and Whalebone Creek might have been due to substantial tidal fluctuations at these marshes. I began finding apparent migrants in atypical (e.g., saline) habitats by 22 July, and in August Soras became common migrants at many sites.

Audubon (1839) and DeKay (1844) considered Soras uncommon to rare breeders in the vicinity of Connecticut. On Long Island Giraud (1844) knew them only as migrants and Sage *et al.* (1913) called them rare Connecticut breeders. However, Merriam (1877) and Stearns and Coues (1883) indicated that Soras were common, and Bent (1926) reported commonly finding nests in eastern Massachusetts during the 1880s. Moreover, Wilson and Bonaparte (1832) described them as common in summer around Philadelphia, although less abundant than formerly, but some of these latter authorities may have confused breeders with migrants. Sage *et al.* (1913) listed an early 1860s nest in Portland, possibly from Wangunk Meadows, Gabrielson (1917) found summering birds in Glastonbury and South Windsor, and Bagg and Eliot (1937) reported probable breeding in Windsor. Bergstrom (unpubl. ms.) listed a 1949 nest from Wethersfield, and Billard (1948) estimated two pairs of Soras/ha at Wethersfield Meadows; but found no Soras at Cromwell Meadows. Billard's (1948) and Bent's (1926) reports suggest that Soras formerly bred more commonly in Connecticut.

Maxima: 3–6 June 1974, 19 May 1987, Dead Man's Swamp.

Common Moorhen (*Gallinula chloropus*)–At the principal study sites I found a single bird once, on 20 June 1974 at Lord's Cove. Because I never observed another bird I believe nesting was unlikely there. I also found a summering bird at South Windsor Meadows in 1984. Nuttall (1834), Audubon

(1839), DeKay (1844), Giraud (1844), Allen (1869), and Baird *et al.* (1884) considered summering Common Moorhens very rare in the vicinity of Connecticut, and Linsley (1843) said they were unknown in the state. However, Merriam (1877), citing G. B. Grinnell, listed them as common in Connecticut. Most likely this report is in error; Sage *et al.* (1913) knew of only one summer specimen and Forbush (1925) believed them to be only local Connecticut breeders. Lucas (1891) reported an 1891 nest at Stratford and Bagg and Eliot (1937) listed breeding at South Windsor Meadows in 1930.

Willet (*Catoptrophorus semipalmatus*)–Only a single summering individual occurred on Great Island in 1974, but by 1984 at least two pairs used the salt marshes and tidal creeks and flats of Great Island. Both Linsley (1843) and Merriam (1877) knew of breeding Willets in Connecticut, and Nuttall (1834), Audubon (1839), and Brewer (1869) stated that Willets bred sparingly north to Massachusetts. Giraud (1844), however, knew of no Long Island breeding, although Baird *et al.* (1874) later reported nesters. Capen (1886) still considered Willets residents along the New England coast, but Sage *et al.* (1913) listed no Connecticut breeding after 1873, and Eaton (1910) stated nesters no longer occurred on Long Island. Bent (1927) attributed the decline of northeastern Willets to overhunting and egg collecting. After disappearing by the late 19th century, breeders did not return to Connecticut until 1976 (D. Duffy pers. comm.).

Maxima: 4–25 May, 15 June 1984, 14 June 1985, 24 June 1986, 26 May 1987, Great Island.

Spotted Sandpiper (*Actitus macularia*)–This species occurred at all marsh types, especially freshwater marshes. At Great Island they frequented the edges of a sand dune at the island's south end, whereas at other marshes they used the drier upland borders, tidal flats, and creeks. They occurred most frequently at Cromwell Meadows. I detected no consistent population trend (Table 3). Audubon (1839), citing Nuttall, stated that Spotted Sandpipers were common in New England. Merriam (1877), Sage *et al.* (1913), Forbush (1925) and Bagg and Eliot (1937) also found them common breeders in the vicinity of Connecticut.

Maximum: at least 11–23 May 1974, Cromwell Meadows.

Common Snipe (*Gallinago gallinago*)–I observed a potential breeder in a smartweed stand at Wangunk Meadows on 1 July 1974. Another individual flushed along the Lieutenant River on 11 July 1974 was more likely an early migrant. Wilson and Bonaparte (1832), Audubon (1839), and Baird *et al.* (1884) found Common Snipes to be infrequent breeders in the Middle Atlantic States. Giraud (1844) thought they might breed on Long Island, Nuttall (1832) mentioned Massachusetts breeding, and Allen (1864) stated a few nested about Springfield, Massachusetts. Both Merriam (1877) and Sage *et al.* (1913) considered them rare Connecticut breeders. However, Stearns and Coues (1883) thought they bred only in northern New England. Sage *et al.* (1913) reported an 1874 Portland nest that was perhaps from Wangunk Meadows.

Short-eared Owl (*Asio flammeus*)–I found no summering birds during this study, although individuals were fairly common along the river in winter. No Connecticut nesting is known since 1876 (Sage *et al.* 1913), but even Swainson and Richardson (1831), Wilson and Bonaparte (1832), Audubon (1839) and

Giraud (1844) considered them rare or absent as breeders in the vicinity of Connecticut. .

Sedge (Short-billed Marsh) Wren (*Cistothorus platensis*)–I discovered no Sedge Wrens during my study, but W. Burt (pers. comm.) found them in late summer (early 1970s) at Lord's Cove, where they inhabited a damp switchgrass-spikerush meadow bordering the marsh. A similar area across the river at Great Meadows also may provide suitable habitat for occasional individuals. The Sedge Wren was undescribed until found nesting in Massachusetts by Nuttall (1826). Audubon (1839) later cited Nuttall, who found the species rare in New York. Giraud (1844) did not find it on Long Island. Sage *et al.* (1913), Eaton (1914) and Bagg and Eliot (1937) believed it was a local breeder; more recently, it has become rare in the northeast (Tate and Tate 1982), probably because of habitat loss (Bull 1964). Baird *et al.* (1874) reported breeding in marshes of the Connecticut River near Hartford, J. H. Sage collected a 23 May 1904 specimen at Brush Meadow Pond, Portland (UCM 3129), and Gabrielson (1917) found a nesting colony in South Windsor. Ely, who lived next to Lord's Cove, reported Sedge Wrens to be abundant in Lyme (Merriam 1877), but he likely mistook the abundant Marsh Wrens of Lord's Cove for this species. Sedge Wrens nest in drier portions of salt marshes (Bull 1964) and may have once done so along the lower Connecticut River.

(Long-billed) Marsh Wren (*Cistothorus palustris*)–Marsh Wrens appeared at all marsh types, but were absent from high salt marsh and floating vegetation. They only invaded low salt marsh after mid-July, when stiff-stemmed plants like salt marsh bulrush (*Scirpus robustus*) and tall cordgrass (*Spartina pectinata, S. cynosuroides*) assumed dominance in some brackish areas. They were most abundant in cattail-reed habitats, including those at transitional marshes (Table 4, page 35). Unlike bulrushes, which are frequently flattened by winter ice and flooding, cattails and reeds usually provide a hardstem nesting substrate for birds returning in spring (see also Saunders 1922). They were uncommon to absent at Pecausett Meadows, which is superficially similar to other bulrush habitats in which they were numerous. The extent of tidal inundation around the central marsh pond of this site appeared greater than at most of Cromwell Meadows, but outer portions of the marsh were similar to Cromwell Meadows. Marsh Wrens were abundant throughout this study.

Wilson and Bonaparte (1832), Audubon (1839) and Giraud (1844) knew Marsh Wrens as abundant breeders from Long Island south. Nuttall (1826) originally believed they bred only as far north as Connecticut, but he later found them in eastern Massachusetts (Nuttall 1832-1834). However, Allen (1869) did not locate any around Springfield. Baird *et al.* (1874), Stearns and Coues (1881), Capen (1886), and Forbush (1929) all reported Marsh Wrens breeding in Massachusetts, and Merriam (1877) and Sage *et al.* (1913) found them common to abundant in Connecticut marshes and reported a 1905 nest from Portland. C. H. Neff (UCM nest records) found nests at Cromwell Meadows in 1874, 1891 and 1893, and H. R. Buck (UCM nest records) found an 1899 nest on Great Island. Other birds collected during the breeding season include W. E. Treat's 1894 specimen from Lyme (UCM 3051; probably from Lord's Cove) and J. H. Sage's 1873 specimen from Wethersfield (UCM 3049; probably from Wethersfield Meadows).

Maximum: 83–30 June 1983, Ragged Rock Creek.

Common Yellowthroat (*Geothlypis trichas*)–These became increasingly common from salt to freshwater marshes, occurring most frequently along upland marsh borders, where territories often included shrubby upland vegetation. They were also regular in tall marsh vegetation, particularly cattail-reed stands, but they were absent from high salt marsh and floating-leaved habitats. Population appeared to change little during the study (Table 3). Wilson and Bonaparte (1832) and Audubon (1839) found Common Yellowthroats most abundant in the mid-Atlantic states, but Allen (1864) also reported them to be abundant around Springfield, Massachusetts. Linsley (1843), Baird *et al.* (1874), Merriam (1877), Sage *et al.* (1913) and Bagg and Eliot (1937) found them common to abundant in New England.

Maxima: 20–16 July 1974, Wethersfield Meadows; 19 June 1986, Cromwell Meadows.

Sharp-tailed Sparrow (*Ammodramus caudacuta*)–These were abundant only in extensive salt marsh habitat, where they used high and low salt marsh and tidal creeks, although I most often saw them in high marsh. They were also regular in salt marsh patches at transitional marshes, where birds made some use of directly adjacent reeds and cattails (Table 4). Populations at salt marshes were high throughout the study period, but numbers declined at transitional sites, with counts averaging 33.5 birds/10 hr in 1974, 0.9 birds/10 hr in 1983-4, and 6.0 birds/10 hr in 1986-7. This was likely a consequence of the shrinkage of patches of salt marsh at transitional sites during this time (unpubl. data) which, in turn, may be linked to long-term lunar cycles that drive salt water further upriver during certain years. In 1974, I encountered a single bird in a damp spikerush meadow at Lord's Cove, an area that has since largely grown up to shrubs, but birds generally ranged only as far upriver as the salt meadows of Calves Island (Fig. 1).

Audubon (1839), Baird *et al.* (1874), Merriam (1877) and Sage *et al.* (1913) knew Sharp-tailed Sparrows as abundant coastal breeders in the Connecticut vicinity, although Capen (1886) called them locally distributed in New England, and Audubon (1839) stated they ranged north only to Boston. Nuttall (1832) and Giraud (1844) described them as less abundant than Seaside Sparrows, but Purdie (1873), citing J. N. Clark, reported the reverse true in Old Saybrook. Stearns and Coues (1881), citing C. H. Merriam, also reported them more abundant than the Seaside Sparrows in New Haven. Clark (1884) found Sharp-tailed Sparrows nesting abundantly on Great Island in 1876, and H. R. Buck (UCM nest records) found a nest at Saybrook Point in 1899. W. E. Treat collected spring and summer specimens (UCM) in what he labeled as Lyme, but early collectors often did not distinguish between Old Lyme and Lyme, and it is more likely that the specimens came from Great Island. J. H. Sage collected a June 1889 specimen (UCM 6004) in Old Saybrook.

Maximum: 78 in 2 hr–12 June 1974, Great Island.

Seaside Sparrow (*A. maritimus*)–Seaside Sparrows were less common than Sharp-tailed Sparrows in salt marshes (Table 4), where they used high and low salt marsh with about equal frequency. They also fed along tidal creeks. At transitional marshes they used salt marsh patches, but they also made some use of

adjacent reeds and cattails. They appeared to have declined at transitional marshes also, where I found 12.6 birds/10 hr in 1974, 4.4 birds/10 hr in 1983-4 and 6.9 birds/10 hr in 1986-7. They remained abundant at salt marshes through- out the study period. None inhabited Calves Island, but a single individual appeared once on the cordgrass fringe of Goose Island (Fig. 1). Audubon (1839), Giraud (1844), Merriam (1877) and Sage *et al.* (1913) knew this species as an abundant coastal breeder in the vicinity of Connecticut but Nuttall (1832), DeKay (1844), Allen (1864) and Baird *et al.* (1874) noted that only a few bred in Massachusetts. In 1876 Clark (1884) found Seaside Sparrows nesting abundantly on Great Island, and J. H. Sage and W. E. Treat took spring and summer specimens (UCM) in Old Saybrook.

Maximum: 40 in 2 hr–12 July 1974, Great Island.

Song Sparrow (*Melospiza melodia*)–Song Sparrows became increasingly common from salt to freshwater marshes. They were most frequent at marsh edges, where they used bordering shrubs, but like Common Yellowthroats they also inhabited cattail-reed stands. They were absent from extensive areas of high salt marsh and floating vegetation. Populations showed no consistent trend during the study period (Table 3). Wilson and Bonaparte (1832) and Audubon (1839) found Song Sparrows abundant throughout their range. Giraud (1844) reported them abundant on Long Island, and Linsley (1843), Allen (1864), Merriam (1877), Sage *et al.* (1913) and Bagg and Eliot (1937) all found them abundant in southern New England. Merriam (1877) reported a June, 1877 nest in Portland.

Maximum: 22–19 June 1986, Cromwell Meadows.

Swamp Sparrow (*M. georgiana*)–This species occurred at all marsh types, becoming most abundant in brackish cattail marshes (Table 4). They were absent from high and low salt marsh and floating vegetation. Like the Marsh Wren, Swamp Sparrows were unexpectedly uncommon at Pecausett Meadows. However, they were also scarce at Whalebone Creek, where Marsh Wrens were abundant. Swamp Sparrows were numerous at other cattail-reed and bulrush habitats throughout the study period. Moreover, individuals inhabited the cattails at the northern tip of Great Island. The stable hardstem cattail-reed vegetation probably provided the most secure nesting substrate, whereas floating vegetation provided poor nesting cover.

DeKay (1844), Giraud (1844), Merriam (1877), and Stearns and Coues (1881) indicated that Swamp Sparrows commonly bred in the vicinity of Connecticut. Sage *et al.* (1913) found them nesting primarily in northern Connecticut and along the upper reaches of tidal rivers. However, Allen (1864) never found them summering in Massachusetts, and Allen (1869), Brewer (1869) and Forbush (1929) considered them only locally common. Sage *et al* (1913) reported a 1907 nest from Portland, and J. H. Sage collected a juvenile in 1910 (UCM 6524) at Brush Pond, Portland.

Maximum: 33- 21 June 1983, Cromwell Meadows.

Red-winged Blackbird (*Agelaius phoeniceus*)–These were at all marsh types. In salt marshes nesting frequently occurred in high tide bush (Iva frutescens); in extensive areas of floating vegetation nests were often in shrubs bordering the marsh. I found counting Red-winged Blackbirds difficult, so variability

in estimates was great, but their numbers appeared similar for all marsh types (Table 4). Most birds at marshes with floating vegetation nested in surrounding shrubbery, however. Therefore, greatest nesting density was probably reached in cattail and bulrush marshes. The species was abundant at all marshes throughout the study period. Nuttall (1832), Wilson and Bonaparte (1832), Audubon (1839) and Linsley (1843) all knew this species as a common to abundant breeder in the northeast. Though Allen (1876) thought it was declining in Massachusetts, Baird *et al.* (1874), Merriam (1877), Stearns and Coues (1881), Capen (1886), Bendire (1895) and Sage *et al.* (1913) found it common in New England. C. H. Neff (UCM nest records) collected five nests in the Portland area from 1873 to 1894, including one from Cromwell Meadows (1873) and one from Wangunk Meadows (1874). J. H. Sage collected an 1877 nestling (UCM 4943) in Portland.

Maximum: 111 in 2 hr–21 May 1974, Lord's Cove.

Users

Great Blue Heron (*Ardea herodias*)–This species became increasingly common from transitional to freshwater marshes, with summering birds essentially absent from salt marshes (one seen at Great Island in 1985). Like all herons, they used tidal creeks, flats, pools and shallows for feeding. Counts increased from 1974 to 1983-4, thereafter changing little (Table 3), which coincided with a statewide increase in nesting during the same period (pers. obs.).

Maximum: 4–10 July 1984, Lord's Cove.

Great Egret (*Casmerodius albus*)–Although absent in summer during 1974, Great Egrets became irregular summer residents by 1983-4. Of eight birds seen at the 11 marshes, four were in salt marshes, four in transitional marshes (one bird flew from Great to Upper Island), and one was in a brackish cattail marsh. The birds occurred at freshwater marshes only as postbreeding wanderers. The increase in summer occurrence was coincident with the increase in northeastern breeding populations (Erwin 1979). Numbers are apparently still rebounding from the severe population depletion brought about by the nineteenth century millinery trade (Bull 1964).

Maximum: 2–9 June 1986, Black Hall River.

Snowy Egret (*Egretta thula*)–These were present in decreasing numbers from salt to brackish cattail marshes. In summer they were absent from freshwater marshes, although postbreeding birds wandered upriver to these sites after mid-July. I found them with increasing frequency during the study period (Table 3), which is probably due to increasing northeastern breeding populations (Erwin 1979). Like the previous species, populations are apparently still recovering from the depletion brought on by the millinery trade (Bull 1964).

Maximum: 12–9 June 1986, Black Hall River.

Tricolored (Louisiana) Heron (*E. tricolor*)–Although absent in 1974 and apparently initially absent in the northeast (Bull 1964), this species first appeared on summer censuses in 1983. Of three birds seen, one was in a salt marsh and two were in transitional marshes. As with many other waders, northeastern breeding populations are increasing (Erwin 1979), apparently as a result

of protection from hunting and egg collecting (Bull 1964).

Green-backed Heron (*Butorides virescens*)–Green-backed Herons were at all marsh types, but were relatively uncommon in brackish cattail marshes. Populations changed little during the study period (Table 3).

Maxima: 5–14 June 1974, 21 June 1983, Cromwell Meadows; 30 June 1987, Ragged Rock Creek.

Black-crowned Night Heron (*Nycticorax nycticorax*)–This species was present in decreasing numbers from salt to freshwater marshes. Unlike other waders, they appeared to decline during the study period (Table 3). Furthermore, unlike many other species of waders, northeastern breeding populations did not clearly increase during the 1970s (Erwin 1979).

Maximum: 28 overhead at dusk–4 June 1974, Great Island.

Yellow-crowned Night Heron (*N. violaceus*)–Occurring only as post-breeding wanderers in 1974, by 1984 Yellow-crowned Night Herons were irregular summer residents. Of six birds seen, three were in salt marshes and three in brackish cattail marshes. Like other waders, their local breeding populations have increased (Erwin 1979).

Maximum: 2–1 July 1986, Lord's Cove; 5 June 1987, Black Hall River.

Glossy Ibis (*Plegadis falcinellus*)–Largely absent in the northeast before 1944 (Bull 1964), Glossy Ibises were present in decreasing numbers from salt to transitional marshes, where they frequently travelled in flocks. In summer, individuals sometimes flew upriver, such as three birds seen overhead at the Chester marshes in 1974, and two observed overhead at Cromwell Meadows in 1986. Population numbers showed no consistent trend (Table 3) despite a build-up in northeastern breeding populations (Erwin 1979).

Maximum: 26 in flock–19 May 1974, Great Island.

Osprey (*Pandion haliaetus*)–Only one pair of Ospreys remained at Great Island in 1974, down from over 200 pairs present near the Connecticut River in 1938 (Ames and Mersereau 1964). By 1984 I found eight nests near salt marshes and two on transitional marshes, and in 1987 I found 10 nests near salt marshes, three on transitional marshes, and one being constructed at a brackish cattail marsh (Lord's Cove). Hence, by 1987 Ospreys had regained the breeding range Ames and Mersereau (1964) recorded between 1957 and 1963, but only about 10% of their former numbers (however, H.R. Buck [1897; UCM nest records] found a nest at South Meadows, Hartford, in 1892). Ames and Mersereau (1964) documented a 31%/yr decline in Osprey populations of the Connecticut River, which they linked to pesticide pollution. To offset the decline, Spitzer and Poole (1980) transferred eggs and nestlings from areas of low pesticide contamination to nests along Long Island.

Maximum: 14 adults–26 May 1987, Great Island.

Great Black-backed Gull (*Larus marinus*)–This species decreased in numbers from salt to brackish cattail marshes, with none detected on censuses at freshwater marshes (Table 4), although individuals were present, particularly near dumps. Estimating numbers of gulls proved difficult, so I am uncertain of population trends, but the species remained a common inhabitant of brackish portions of the river throughout the study. Before 1920, in contrast, Great Black-

backed Gulls were largely absent in summer in the northeast (Bull 1964). Gull populations have benefited from the presence of garbage dumps (Hunt 1972).

Maximum: 21–19 June 1974, Upper Island.

Herring Gull (*L. argentatus*)–Although generally declining in numbers upriver (Table 4), Herring Gulls had large concentrations around dumps. At freshwater sites away from dumps, Herring and Great Black-backed Gulls were generally infrequent. Herring Gulls remained abundant throughout the study, but were predominantly winter residents in Connecticut into the early twentieth century (Sage *et al.* 1913).

Maximum: 154–27 May 1974, Ragged Rock Creek.

Ring-billed Gull (*L. delawarensis*)–Principally occurring only as a migrant in Connecticut in the early twentieth century (Sage *et al.* 1913), in 1974 I found only two birds near marshes (at dumps). By 1983 I noted a bird away from a dump at Lord's Cove, and by 1986-7 at least five were near salt marshes, two were near transitional marshes, and several were at the dump near Cromwell Meadows.

Maximum: 4–24 June 1986, Great Island.

Common Tern (*Sterna hirundo*)–Although Common Terns were present from salt to brackish cattail marshes in 1974, they appeared only at salt marshes by 1983. In 1974 I also found occasional summer birds in the freshwater marshes at Deep River (Pratt and Post Coves) and Chester. Populations declined even at salt marshes during the study (Table 3), although they generally increased along the Connecticut coast during this period (F. Sibley pers. comm.). This may mean that Common Terns on the Connecticut River commute from Long Island colonies. Terns fed in tidal creeks, shallows and in the open river.

Maximum: 14- 1 Aug. 1974, Great Island.

Least Tern (*S. albifrons*)–This species declined in abundance from salt to brackish cattail marshes, with postbreeding birds wandering upriver to freshwater marshes. I detected no change in occurrence during the study (Table 3), a trend similar to that of Connecticut breeding populations (F. Sibley pers. comm.). Terns of all species have rebounded from the plume trade of the nineteenth century, but are now negatively affected by loss of nesting habitat (Bull 1964, Craig 1979).

Maxima: 5- 19 May 1974, Great Island; 17 July 1974, Upper Island.

Belted Kingfisher (*Megaceryle alcyon*)–This species increased in abundance from salt to freshwater marshes, where birds fed principally in creeks and in the river itself. Populations appeared to increase during this study (Table 3).

Maximum: 4–16 July 1987, Cromwell Meadows.

Eastern Kingbird (*Tyrannus tyrannus*)–These were much more common at brackish cattail and freshwater marshes than in salt and transitional marshes, with the greatest numbers recorded at freshwater sites. Birds foraged from snags on and at the edges of marshes. Populations appeared to decline during this study (Table 3).

Maximum: 8–30 July 1974, Cromwell Meadows.

Purple Martin (*Progne subis*)–Purple Martins were regular only at Whalebone Creek, where I found at least one individual in four of five years in which I visited the site. Of nine birds seen, three were at transitional marshes and six were at the freshwater Whalebone Creek. This species has declined in abundance from former years as the Connecticut landscape has been altered (Craig 1979).

Maxima: 2–8 July 1974, Whalebone Creek; 11 June 1987, Upper Island.

Tree Swallow (*Iridoprocne bicolor*) I found it difficult to estimate swallow numbers, which varied considerably between days even at the same site, but this species occurred regularly at all marsh types, perhaps being least common near salt marshes (Table 4). They were generally common throughout the study and, like all swallows, they congregated over the marshes to feed on emerging aquatic insects.

Maximum: 391 in postbreeding flock–2 Aug. 1974, Lord's Cove.

Northern Rough-winged Swallow (*Stelgidopteryx ruficollis*)–This species was irregular at most marshes, occurring frequently only at Whalebone Creek. At the 11 principal sites I found them at three in 1974, seven in 1983-4 and four in 1986-7, indicating no clear trend in populations. There was also no obvious habitat preference, with observations divided among the marshes as follows: 5.0/ marsh at salt marshes, 7.5/ marsh at transitional marshes, 6.5/ marsh at brackish cattail marshes and 4.6/ marsh at freshwater sites.

Maximum: 10–1 July 1983, Lord's Cove.

Bank Swallow (*Riparia riparia*)–Regularly occurring at all marsh types, Bank Swallows were perhaps most common at transitional and brackish cattail marshes (Table 4). I noted little change in frequency during this study, with birds occurring at 10 sites in 1974, seven sites in 1983-4 and eight sites in 1986-7.

Maximum: 50–2-4 June 1987, Dead Man's Swamp.

Barn Swallow (*Hirundo rustica*)–Also regular at all marsh types and generally common throughout the study, Barn Swallows were apparently most common in brackish portions of the river (Table 4).

Maximum: at least 50- 16 July 1987, Cromwell Meadows.

Fish Crow (*Corvus ossifragus*)–Several individuals occurred near salt marshes, occasionally ranging upriver to the transitional marshes. Birds fed on salt marshes and tidal flats. I found no consistent trend in populations during this study (Table 3).

Maximum: probably 3–19 May 1974, Great Island.

Common Grackle (*Quiscalus quiscula*)–Although present at all marsh types, Common Grackles were most common at freshwater marshes, where birds used marsh vegetation and mudflats when feeding. Numbers appeared to increase after 1974 (Table 3), although I found censusing difficult because of the species' flocking behavior and wide-ranging movements.

Maximum: 35 adults–15 June 1983, Pecausett Meadows.

Population summary

The long-term perspective of this study offers insights into the role of temporal change in this system, and cumulative data provide clues about habitat preferences. My data on population densities have limited precision, but summary statistics derived from them are instructive in that they show several general patterns pertaining to habitat preference and populations.

Among the breeding birds of the 11 principal study sites, 21 of 26 species (81%) showed at least some habitat affinities as measured by their population densities (Table 5, page 36). Five species (19%) preferred freshwater marshes, with one of these restricted to such sites, whereas 14 species (54%) preferred marshes where there was some brackish influence. Of the latter group, five (19%) preferred salt marshes and four (15%) preferred transitional or cattail marshes; none were restricted to a single marsh type. For users, 20 of 23 species (87%) showed habitat affinities, with 14 species (61%) preferring brackish marshes. Of this latter group, four (17%) preferred salt marshes and one (4%) preferred transitional or cattail marshes. One species (4%) preferred freshwater marshes. No users were restricted to a single marsh type. Whether patterns of species distribution along the estuary relate to vegetation or physical environmental variables is the subject of a separate analysis.

Between 1974 and 1987, seven (28%) of the 25 breeders (Clapper and King Rail data combined) inhabiting the 11 principal sites increased, whereas seven (28%) species declined. In contrast, of 23 user species, nine species (39%) increased and only three (13%) declined (Table 5). Hence, breeders have suffered most from population declines, but both breeders and users had a relatively high proportion of species undergoing increases.

Of the declining species, the Green-winged Teal and Clapper-King Rail were at the periphery of their range where populations might be expected to fluctuate (Thompson and Nolan 1973), the Black Duck was apparently suffering at least in part from competition with the introduced Mallard (Heusmann 1974, 1988), and the Common Tern may have been affected by the regional loss of nesting sites (Bull 1964, Buckley and Buckley 1976). In addition, Seaside and Sharp-tailed Sparrows contracted their range along the estuary as salt meadows shrank toward the river mouth.

Increasing species included nine that were responding to human-associated environmental change, rebounding from overhunting, or rebounding from artificial habitat alterations, including the Black Rail, Willet, five species of herons, Osprey and Ring-billed Gull. Increases in Gadwall populations appear related to a range extension of this principally midwestern breeder, which is perhaps related to continent wide habitat changes. Two other increasing species, the Mute Swan and Canada Goose, have been introduced into this system.

A comparison of present populations of marsh breeders with historically reported populations indicates that of 30 total species, four (13%) have probably increased, although some of these appear to have only recovered from earlier population declines, seven (23%) have declined or become extinct, and four (13%) have either colonized or been introduced into the system. Species like the American Bittern and Northern Harrier have undergone historic declines

because of environmental pollution and habitat change (Peterson 1969, Craig 1979). The Black Rail does not appear to have fully rebounded from the effects of previous habitat alterations, and the Short-eared Owl and Sedge Wren have been extirpated due to wholesale changes that have occurred in the Connecticut landscape since the nineteenth century (Craig 1979). Wood Duck (Bagg and Eliot 1937) and Willet (Bent 1927) populations, once depleted due to overhunting, appear to have largely recovered.

From the perspectives offered by both this study and from historic data, the Connecticut River's estuarine marsh bird communities appear to have changed principally in response to human-caused perturbations. At least 22 (45%) of the 49 total species at the 11 principal study sites have been affected by human activity either during the study period or historically, and others probably have been as well.

The only obvious instance of natural change affecting the system involved the range contraction of Seaside and Sharp-tailed Sparrows, although the severe summer floods of 1982 and 1984 may have decreased the nesting density of some species. Other species, such as the Clapper-King Rail, Blue-winged Teal Belted Kingfisher, Eastern Kingbird and Common Grackle appeared to undergo population changes during the study period, but the mechanisms driving such changes were unclear. Population increases in the system were largely the result of species introductions, human-related habitat enhancement and species reoccupying former range that they had been extirpated from, and declines were largely related to habitat deterioration brought about by human activity.

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Figure 1

The principal marshes of the Connecticut River.

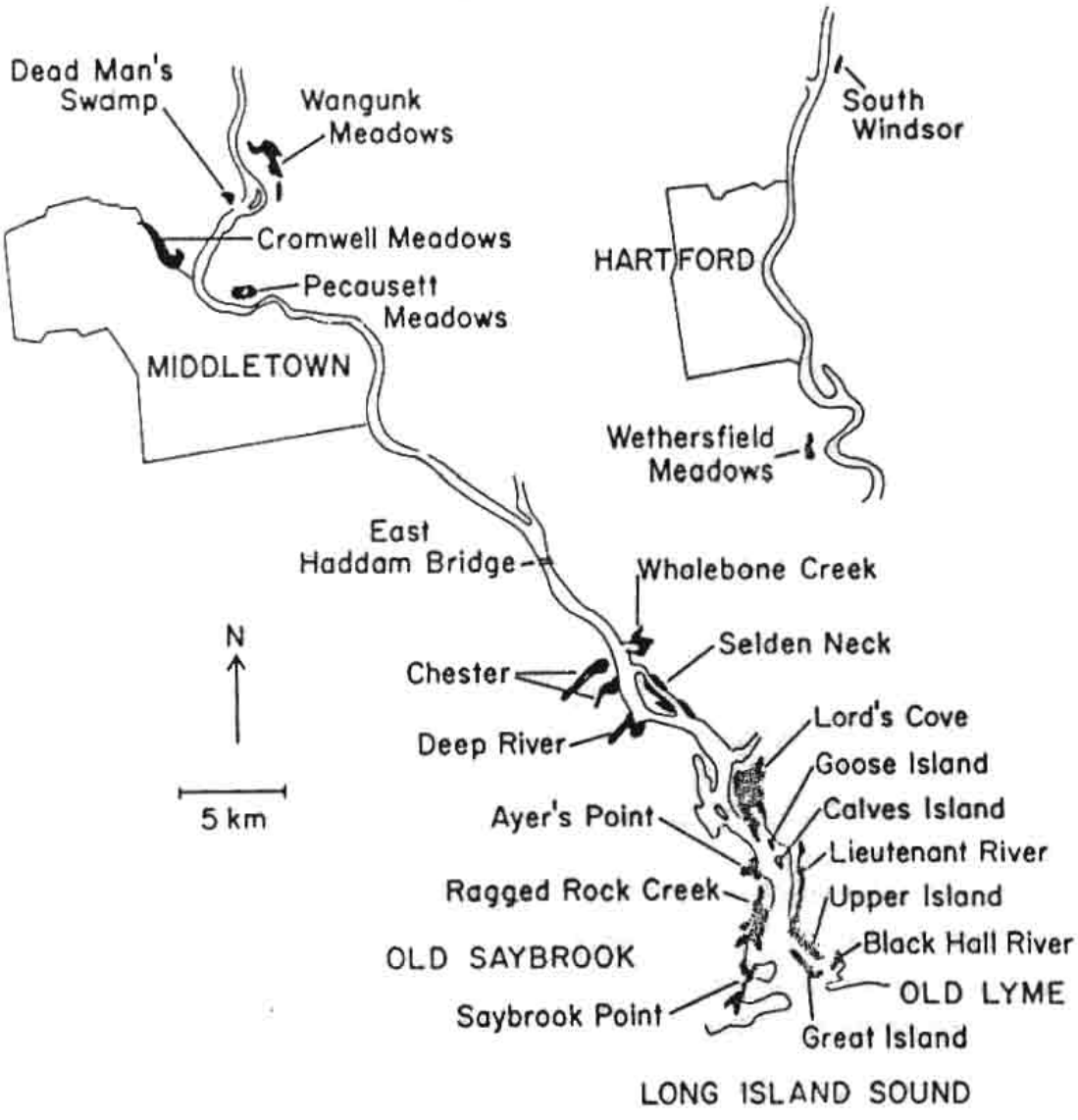

Table 1

Summary of habitat features of the Connecticut River marshes.

Abbreviations of marsh names used in subsequent tables in parentheses.

Site	Type	Tides	Water salinity	Area (ha)
Principal study sites:				
Great Island (GI)	salt marsh	yes	high	145.6
Black Hall River (BH)	salt marsh	yes	high	56.4
Upper Island (UI)	transitional	yes	moderate	121.6
Ragged Rock Creek (RR)	transitional	yes	moderate	155.4
Ayer's Point (AP)	brackish	yes	low	39.5
Lord's Cove (LC)	brackish	yes	low	215.2
Whalebone Creek (WC)	freshwater	yes	none	23.1
Pecausett Meadows (PM)	freshwater	yes	none	21.6
Cromwell Meadows (CM)	freshwater	yes	none	119.7
Dead Man's Swamp (DM)	freshwater	no	none	26.9
Wethersfield Meadows (WE)	freshwater	no	none	30.7
Other marshes mentioned in text:				
Pratt and Post Coves	freshwater	yes	slight	42
Chester	freshwater	yes	slight	34
Wangunk Meadows	freshwater	no	none	30
South Windsor Meadows	freshwater	no	none	25
Lieutenant River	transitional	yes	moderate	69

Table 2

Occurrence of summering birds at eleven marshes of the Connecticut River

A=abundant, C=characteristic, U=uncommon, I=irregular (see text).

Habitat:	Salt		Trans.		B. cattail		Freshwater				
Site:	GI	BH	UI	RR	AP	LC	WC	PM	CM	DM	WE
Breeders:											
Pied-billed Grebe										I	
American Bittern	I					I		I	I	U	I
Least Bittern	U		C	C	I	C	U		I	U	U
Mute Swan	C	U	C	C	I	C	U				
Canada Goose	I		I	C	U	C			I		
Wood Duck							U	U	C	U	C
Green-winged Teal						I			I		
Am. Black Duck	C	C	C	C	U	C		I	U	U	I
Mallard	C	C	C	C	C	C	C	C	C	U	I
Blue-winged Teal	I	I	I	I					I		
Gadwall	U	U	U	I		I					
Northern Harrier	I		I			U					
Black Rail				I					I	I	
Clapper Rail	C	C	C	C							
King Rail	I		C	C		I					
Virginia Rail	C		C	C	C	C		U	C	C	C
Sora	I									C	C
Willet	U										
Spotted Sandpiper	U		U	U	I	I	I	U	C		U
Marsh Wren	A	U	A	A	A	A	A	C	A	A	A
Common Yellowthroat	C	C	C	C	C	C	C	C	C	C	C
Sharp-tailed Sparrow	A	A	C	C							

Habitat:	Salt		Trans.		B. cattail			Freshwater			
Site:	GI	BH	UI	RR	AP	LC	WC	PM	CM	DM	WE
Seaside Sparrow	A	A	C	C							
Song Sparrow	C	C	C	C	C	C	C	C	C	C	C
Swamp Sparrow	C		A	A	A	A	U	C	A	A	A
Red-winged Blackbird	A	A	A	A	A	A	A	A	A	A	A
Total breeders:	22	12	19	19	12	17	10	11	16	14	13
Total regular breeders:	16	11	16	16	9	12	9	9	10	12	10
Total breeders/ habitat:	salt: 22		trans.: 21		brackish: 17			freshwater: 20			
Users:											
Great Blue Heron	I		U			U	I	U	U		I
Great Egret	I	I	I	I		I					
Snowy Egret	C	C	C	C	U	C					
Tricolored Heron		I	I	I							
Green-backed Heron	U	U	U	C	U	U	U	U	U	U	U
Black-crowned Night Heron	C	C	U	U	I	U		I	I		
Yellow-crowned Night Heron		I				I					
Glossy Ibis	U	C		C					I		
Osprey	C	C	C	U	I	U	I				
Ring-billed Gull	I	I	I	I		I		I	I		
Herring Gull	A	A	A	A	A	A	C	C	A		
Great Black-backed Gull	C	C	C	C	C	C	I	U	C		
Common Tern	U	U	I	I		I					
Least Tern	C	C	C	U		I					
Belted Kingfisher	I	U	U	U	U	U	U	U	U	I	U
Eastern Kingbird	I	U	I	I	U	C	U	U	U	U	U
Purple Martin			I				U				
Tree Swallow	C	C	C	C	U	C	C	C	C	C	C
Rough-winged Swallow	U	I	U	I	I	I	C	I	I	I	

Habitat:	Salt		Trans.		B. cattail			Freshwater			
Site:	GI	BH	UI	RR	AP	LC	WC	PM	CM	DM	WE
Bank Swallow	C	I	C	C	I	C	I	U	C	C	I
Barn Swallow	C	C	C	C	C	C	C	U	C	C	C
Fish Crow	U	U	I	I							
Common Grackle	C	C	C	C	C	C	C	C	C	C	C
Total users:	20	21	21	20	13	19	13	13	14	8	8
Total regular users:	15	15	14	13	9	13	9	10	10	6	6
Total users/ habitat:	salt: 22		trans.: 22		brackish: 19			freshwater: 16			

Table 3

Habitat affinities and population trends of selected species

Counts in birds/10 hr, N=total hours of observation.

Species	Habitat				Year		
	Salt	Trans.	B. cattail	Fresh	1974	1983-4	1986-7
Breeders:							
Least Bittern	0.5	1.3	2.0	0.7	0.9	1.5	1.3
N	120.8	110.3	97.8	200.8	246.0	121.8	161.8
Wood Duck				4.8	4.6	2.5	6.4
N				194.8	90.5	40.0	64.3
Am. Black Duck	11.2	7.6	3.9	2.4	8.0	6.1	4.8
N	120.8	96.5	97.8	200.8	232.3	121.8	161.8
Mallard	10.6	11.0	13.7	9.9	14.0	7.7	8.8
N	120.8	96.5	75.3	200.8	232.3	121.8	153.0
Gadwall	2.2	0.9	0.4		0.9	0.7	2.0
N	120.8	110.3	97.8		246.0	121.8	161.8
Clapper-King Rail	4.1	3.3	0.2		3.3	1.6	1.9
N	115.0	110.3	97.8		240.3	121.8	161.8
Virginia Rail	0.2	0.8	2.7	3.6	1.4	1.8	2.5
N	120.8	110.3	97.8	200.8	246.0	121.8	161.8
Spotted Sandpiper	0.8	0.6	0.9	2.3	1.4	0.6	1.1
N	115.0	110.3	97.8	200.8	240.3	121.8	161.8
Common Yellowthroat	2.7	5.7	10.8	15.0	8.1	8.2	8.5
N	107.0	103.5	92.5	166.5	240.3	113.8	133.5
Song Sparrow	6.2	6.4	7.2	14.3	9.2	7.7	8.6
N	115.0	110.3	89.5	182.0	240.3	118.8	137.8

Species	Habitat				Year		
	Salt	Trans.	B. cattail	Fresh	1974	1983-4	1986-7
Users:							
Great Blue Heron		0.4	0.8	1.2	0.4	1.1	0.9
N		110.3	97.8	200.8	180.5	99.5	128.8
Snowy Egret	7.7	4.2	3.3		3.8	5.6	6.4
N	115.0	110.3	97.8		149.8	81.8	91.5
Green-backed Heron	2.1	3.1	1.2	3.3	2.4	2.5	2.4
N	115.0	110.3	97.8	200.8	240.3	121.8	161.8
Black-crowned Night Heron	4.0	2.7	1.3	0.2	2.5	2.3	1.3
N	112.8	110.3	97.8	200.8	238.0	121.8	161.8
Glossy Ibis	4.9	3.8			3.5	7.4	2.1
N	120.8	110.3			110.0	54.8	66.3
Common Tern	3.4				5.4	1.3	1.2
N	115.0				59.8	22.3	33.0
Least Tern	3.5	2.6	0.6		2.2	2.2	2.2
N	115.0	110.3	97.8		149.8	81.8	91.5
Belted Kingfisher	0.6	1.4	1.4	2.0	0.8	1.5	1.8
N	120.8	110.3	97.8	200.8	246.0	121.8	161.8
Eastern Kingbird	0.6	0.2	2.5	3.5	2.3	1.5	1.3
N	120.8	110.3	97.8	200.8	246.0	121.8	161.8
Fish Crow	1.5				1.7	0.4	1.8
N	115.0				59.8	22.3	33.0
Common Grackle	10.9	7.4	7.2	17.1	6.5	12.4	13.1
N	93.3	91.5	82.0	182.5	246.0	101.0	102.3

Table 4

Relative population densities of selected species based on 1974 two hour counts.

N=total hours of observation.

Species	Habitat			
	Salt marsh	Transitional	B. cattail	Freshwater
Breeders:				
Marsh Wren	3.1	14.3	11.9	7.0
Sharp-tailed Sparrow	18.6	8.0		
Seaside Sparrow	8.5	2.6		
Swamp Sparrow		2.8	6.0	3.0
Red-winged Blackbird	24.0	26.8	27.6	30.7
Users:				
Great Black-backed Gull	2.4	1.6	1.3	
Herring Gull	21.3	12.8	18.1	5.3
Tree Swallow	0.9	2.3	2.0	1.8
Bank Swallow	0.3	2.9	2.5	0.4
Barn Swallow	3.0	3.7	2.0	1.1
N	16	12	20	28

Table 5

Summary of population trends and habitat affinities of marsh breeder and user species along the Connecticut River.

Species	1974-1987	Historic	Marsh preference
Breeders:			
Pied-billed Grebe	no trend	no trend	uncertain
American Bittern	no trend	decline	freshwater
Least Bittern	increase?	no trend	transitional-cattail
Mute Swan	increase	introduced	all brackish
Canada Goose	increase	introduced	all brackish
Wood Duck	no trend	recovery	freshwater
Green-winged Teal	decline	colonized	uncertain
Am. Black Duck	decline	decline	salt-transitional
Mallard	decline	introduced	all
Blue-winged Teal	decline	increase	all brackish
Gadwall	increase	increase	salt
Northern Harrier	no trend	decline	all brackish
Black Rail	increase	decline	uncertain
Clapper-King Rail	decline	no trend	
Clapper			salt
King			transitional
Virginia Rail	increase	no trend	cattail-freshwater
Sora	no trend?	decline	freshwater
Common Moorhen	no breeders	no trend	uncertain
Common Snipe	no breeders	no trend	uncertain
Willet	increase	recovery	salt
Spotted Sandpiper	no trend	no trend	freshwater

Species	1974-1987	Historic	Marsh preference
Short-eared Owl	absent	extinct	uncertain
Sedge Wren	absent	extinct	uncertain
Marsh Wren	no trend	no trend	transitional-cattail
Common Yellowthroat	no trend	no trend	cattail-freshwater
Sharp-tailed Sparrow	decline	no trend	salt
Seaside Sparrow	decline	no trend	salt
Song Sparrow	no trend	no trend	freshwater
Swamp Sparrow	no trend	no trend	cattail
Red-winged Blackbird	no trend	no trend	all
Users:			
Great Blue Heron	increase		cattail-freshwater
Great Egret	increase		all brackish
Snowy Egret	increase		salt
Tricolored Heron	increase		all brackish
Green-backed Heron	no trend		salt, transitional, fresh
Black-cr. Night Heron	decline		salt-transitional
Yellow-cr. Night Heron	increase		all brackish
Glossy Ibis	no trend		salt-transitional
Osprey	increase		salt
Great Black-backed Gull	no trend		salt-cattail
Herring Gull	no trend		salt-cattail
Ring-billed Gull	increase		uncertain
Common Tern	decline		salt
Least Tern	no trend		salt-transitional
Belted Kingfisher	increase		transitional-freshwater
Eastern Kingbird	decline		cattail-freshwater
Purple Martin	no trend		uncertain
Tree Swallow	no trend		transitional-freshwater

Species	1974-1987	Historic	Marsh preference
Rough-winged Swallow	no trend		all
Bank Swallow	no trend		transitional-cattail
Barn Swallow	no trend		all brackish
Fish Crow	no trend		salt
Common Grackle	increase		freshwater