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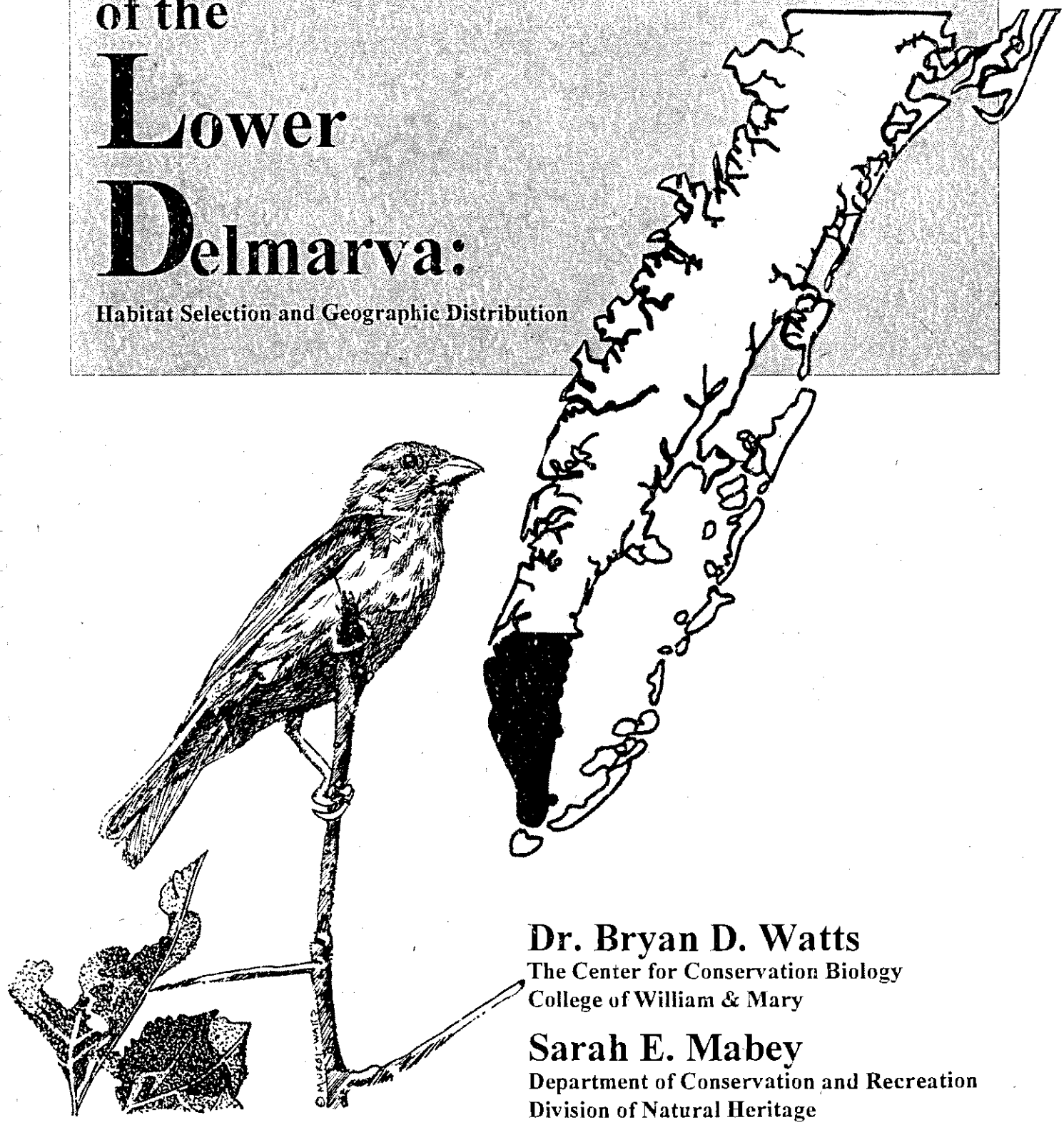
Habitat Selection and Geographic Distribution



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MIGRATORY LANDBIRDS OF THE LOWER DELMARVA:

HABITAT SELECTION AND GEOGRAPHIC DISTRIBUTION

FINAL REPORT

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EXECUTIVE SUMMARY

Each year billions of landbirds migrate between the northern and southern hemispheres of the New World. During the spring and fall, migrants may be seen over most of North America. However, large numbers of these birds follow broadly defined routes known as flyways. Within these routes, significant physical barriers such as mountain ridges and large bodies of water act as migration bottlenecks concentrating large numbers of birds within relatively small land masses. These "concentration" areas may have tremendous conservation significance to bird populations that depend on them for rest, refueling, and protection from predators. For southbound migrants, the Chesapeake Bay is one of the largest physical barriers along the east coast. Migrants that reach the mouth of the Bay in the hours just before dawn settle out near the tip of the Delmarva Peninsula. On mornings following strong cold fronts, millions of birds may be concentrated near the tip of the peninsula. Because birds passing through the Eastern Shore are members of breeding communities throughout northeastern North America and winter communities throughout the Caribbean and Latin America, local land use decisions may have far-reaching consequences.

Managing human population growth while conserving sensitive natural resources is a major challenge confronting land-use decision makers throughout the coastal zone. The two-year Northampton Migratory Bird Project (NMBP) was initiated under Northampton County's Special Area Management Plan (SAMP) to provide information to guide the development of enforceable policies that will protect and enhance migratory songbird habitat. This information will also be used in the development of a nature-based tourism industry. Several field projects were conducted between August and November of 1992 and 1993.

The results that address the primary SAMP objectives suggest:

1. Both long- and short-distance migrants become concentrated within the lower 10 km of the peninsula, particularly along the shoreline of the Bay.

2. The majority of migrants appear to select habitats based on the density of understory vegetation.

3. Long-distance migrants pass through the peninsula in late summer and early fall, while short-distance migrants pass through the peninsula in mid to late fall.

Management and policy implications are formulated for three general areas:

1. Zoning ordinances.

2. Vegetation protection standards.

3. Development of nature-based tourism initiatives.

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INTRODUCTION

Over the past several years, concern for the status of many North American bird populations has been greatly heightened within both the general populous and the scientific community. This concern has been fueled by the growing realization that the decline in many breeding populations is likely linked to the phenomenal acceleration in land-use changes within both temperate and tropical zones. This pattern is particularly evident in those species that breed in North America and migrate south to Latin America and the Caribbean, birds known as neotropical migrants. Fragmentation of temperate forests has been shown to negatively affect many migrant species by exposing them to higher rates of predation and brood parasitism resulting in lower productivity and survivorship. Additionally, the restricted winter ranges of many neotropical migrants, mainly confined to eastern Central America and the Caribbean, translate into higher concentrations of birds per unit area. Thus, loss of specific tropical habitats may affect relatively large proportions of whole populations. In addition to breeding and winter habitats, many migrant species depend on habitats positioned along migration routes for rest and refueling. As with winter habitats, changes in the availability of habitats needed during migration may contribute to population declines.

Each year billions of landbirds migrate between the northern and southern hemispheres of the New World. Over two thirds of all birds that breed in the northern United States migrate south for the winter. Migration affords birds the opportunity to exploit seasonal feeding opportunities while living in favorable climates throughout the year. Summers are spent nesting in the rich habitats of the temperate zone while winters are spent

in more moderate climates to the south. Travelling long distances between summer and winter areas comes with considerable risks. To be successful, migrants must negotiate large obstacles and take advantage of habitats within unfamiliar landscapes. Fully one half of all migrants flying south for the winter will not return to breed in the spring. High mortality rates are the result of the extreme energetic demands of migration, the hazards of long flights over water, and high predation pressures confronted en route.

The physical demands of migrating between summer and winter quarters may be extreme. Most passerines cover a one-way distance of one to three thousand kilometers but distances of twice that amount are not uncommon. Migration over these distances requires a great deal of physical preparation. As the breeding season draws to a close, birds may build up as much as fifty percent of their normal body weight in fat reserves before departing. Even so, for many species, energy requirements needed to reach their destination will exceed this amount several times over. For this reason, distances are typically covered during several nonstop, long-distance flights that are separated by one to three days of rest and refueling. Many of the passerine species migrate at night, taking off one hour after sunset and flying continuously throughout the night. These birds may cover from three to six hundred kilometers per night, and use one to four percent of their body weight per hour of flight. In the early morning after long flights, migrants must quickly locate habitats within unfamiliar landscapes that provide cover from predators while maintaining a positive energy budget. Daylight hours are spent resting and foraging to replenish energy stores.

During the spring and fall, migrants may be seen over most of North America. However, particularly in the fall, a large number of landbirds follow broadly defined routes

known as flyways. Within these routes, significant physical barriers such as mountain ridges, deserts, large bodies of water, and others may act as migration bottlenecks concentrating large numbers of birds within relatively small land masses. These "stopover" or "concentration" areas may have tremendous conservation significance to bird populations that depend on them for rest, refueling, and protection before leaving for the next leg of their journey.

Some of the most significant concentration areas for migrating landbirds in eastern North America occur in coastal habitats along the Atlantic Flyway. A combination of geographical, biological, and meteorological conditions serve to concentrate birds and keep them bottled up for short periods of time in the mid-Atlantic region. For southbound migrants, the Delaware and Chesapeake Bays are the largest physical barriers along the east coast. Migrants that reach the mouth of these bays in the hours just before dawn fall out and become highly concentrated near the tips of the Cape May and Delmarva Peninsulas. On mornings following strong cold fronts, millions of birds may be funneled into small areas. Habitats within these stopover concentration areas should be considered critical to the persistence of bird populations that depend on them in passage.

The lower Delmarva Peninsula (including Northampton County) has long been recognized as a significant stopover area for migrating shorebirds, waterfowl, raptors, and songbirds. Because of the large number of migrating shorebirds, this area is included in the Western Hemisphere Shorebird Reserve Network and is the location of The Nature Conservancy's Virginia Coast Reserve, a United Nations designated international biosphere reserve. The Kiptopeke Hawkcatch was established in the late 1970's to monitor the

migration of diurnal raptors. Since this time volunteer observers have documented the passage of over 200,00 birds. Currently, four sites are operated annually to capture and band hawks and falcons. These sites preocess an average of 1,500 birds each fall. Kiptopeke Beach Banding Station was established on the lower bayside in 1963 by the Virginia Society of Ornithology to monitor migrating songbirds. It is one of the longest continuously run migration monitoring sites in eastern North America. To date, volunteer banders have processed over 250,000 songbirds at the site.

NORTHAMPTON COUNTY

I. PHYSICAL DESCRIPTION AND LANDSCAPE CHARACTERISTICS

Northampton County, Virginia (Lat. 37° 07' - 30') is located on the lower Delmarva Peninsula, a thin ridge of land bordered by the Chesapeake Bay to the west and the Atlantic Ocean to the east. As stated above, this unique formation acts as a trap for southbound migrants, funneling millions of birds into Northampton County every fall. The county itself covers 209 square miles of peninsular mainland, marshes, tidal creeks, and barrier islands. The mainland portion of the County comprises less than one third of the total area. Creeks and marshes cover over one half the area and barrier islands constitute the rest.

Mainland Northampton is covered extensively by fertile sedimentary soils deposited over thousands of years of dynamic interaction with the seas. Consequently, the landscape has been dominated by agriculture for more than a century. Today over 60% of mainland Northampton is cropland and the remainder of the uninhabited area is primarily forested (appx. 14,245 ha in 1984). Most farm fields are still relatively small (<50 ha) and

separated by hedgerows or woodlots maintained for timber harvest.

Forest cover is highly fragmented, characterized by two substantial corridors following the Bayside and Seaside coastlines and many small forest patches. A survey of forest patches south of Eastville revealed that over 85% of forest patches are less than 20 ha in size. Almost 90% of forest in the area is dominated by pine or a pine/hardwood (loblolly pine/oak) overstory with mixed evergreen/deciduous understory. At present, clear cuts and loblolly pine plantations are uncommon. Other significant forest types include bottomland hardwoods located mainly within the Seaside forest corridor and maritime forest found exclusively along the Bayside. The amount of cropland in the county has remained relatively constant for decades. Forest cover, however, is beginning to be lost to development at an increasing rate. Dramatic landscape changes will undoubtedly occur in the future.

SPECIAL AREA MANAGEMENT PLAN (SAMP) PROJECT

I. BACKGROUND

Geographically separated from the rest of the Commonwealth, Northampton County has remained rural and undeveloped in sharp contrast to other communities in coastal Virginia. The County's current population of approximately 13,000 is well below the century's recorded high of 18,565 in 1930. The largest town in the county, Cape Charles, has a population under 1,500. In sum incorporated towns cover less than 3% of Northampton's total land area.

The local economy reflects the area's rural character and tradition of capitalizing on an abundance of natural resources. Agriculture is the area's biggest industry, valued at $68

million/year and supporting 450 full time jobs on almost 120 commercial farms. The local seafood industry has always played a significant role both the Northampton and statewide economies. Presently, the Northampton shell and finfishing contribute an estimated 10-20% to the Chesapeake Bay seafood industry as a whole. The local industry generates approximately 6.8 million/year and sustains 478 local jobs. Forestry has the potential for being the third most important economic base in the county but provided only $500,00 directly to the community in 1988, although the estimated "value" of timber sales for that year is over fourteen million dollars.

Despite bountiful natural resources, Northampton ranks 135th in poverty measures out of Virginia's 136 localities (Virginia 1990 Census Data). Twenty-seven percent of the Northampton's citizens live below the poverty line and unemployment for 1991 measured 9.4%. Substandard housing is not uncommon in the county -- 12% of inhabited houses lack indoor plumbing. There is critical need for employment opportunities and a concomitant increase in standard of living. These factors make Northampton vulnerable to unplanned development pressures and actions that could negatively affect existing valuable resources.

Although stable landuse patterns have persisted for decades, rapid change is on the horizon. In the past eight years (particularly prior to the passage and implementation of the Chesapeake Bay Preservation Act), there has been a rush to subdivide waterfront property, especially on the Bayside. Seven out of the southernmost eleven miles of Bayside shoreline have been subdivided for development. The recession has slowed realestate development, however, and today the majority of platted lots (over 4,400) stand empty. Northampton County will face a radical population shift if proposed vacation and retirement homes are

built over the nest 5-10 years.

II. MANAGING THE FUTURE: THE SPECIAL AREA MANAGEMENT PLAN

The inhabitants of Northampton have, however, taken a proactive approach to managing their future. The County's comprehensive plan, passed in 1990, clearly states the County's intention to protect natural resources and even mentions migratory birds specifically. In 1992, a partnership of county, state, federal, and private interests formed to pursue a four-year Special Area Management Plan (SAMP) project for Northampton County. The SAMP was funded by the National Oceanographic and Atmospheric Administration under the Coastal Zone Management Act, Section 309, through the Virginia Department of Environmental Quality's Coastal Zone Management Program. The partnership was designed to allow for a comprehensive approach to the SAMP's specific goal of protecting and enhancing coastal resources within the County through new and enforceable policies. The plan presented four major objectives:

1. Control cumulative and secondary impacts of coastal growth and development by maintaining maximum vegetation cover for wildlife habitat and nutrient removal from non-point runoff.

2. Control cumulative and secondary impacts of coastal growth and development by steering development away from sensitive wildlife habitat and groundwater recharge areas and toward areas with greatest carrying capacity.

3. Reduce use conflicts within the barrier island lagoon system, protect water quality of the most important portions of the system, and promote aquaculture and seafood product development in the most appropriate areas of the seaside and lower bayside.

4. Increase public access and promote appropriate nature tourism.

The SAMP set forth a strategy of outlining target program changes, compiling available data, collecting new data, generating public support, and pursuing program

changes. Target program changes include, among others, modification of the existing subdivision ordinance to maintain maximal vegetative cover; creation of a MOU to amend state road design criteria to minimize impervious surface requirements and clearing of vegetation in road right-of-ways; creation of a MOU to pursue appropriate management of vegetation in power line right-of-ways for wildlife habitat protection; modification of local zoning ordinances and/or establishment of incentive programs to encourage cluster development in areas with adequate water supply and to reward habitat enhancement; and development of a MOU creating public access rules.

The SAMP partners agreed that a better understanding of the distribution of critical migratory bird habitat within lower Northampton County would contribute substantially to successfully attaining SAMP goals 1, 2, and 4 and the above stated program changes. To this end, a two-year study of migratory landbird distribution and habitat associations within Northampton County was initiated by the Virginia Department of Conservation and Recreation's Division of Natural Heritage and the VA Department of Game and Inland Fisheries' Nongame and Endangered Species Program. The specific rationale behind the study was that it would help guide decisions regarding which geographic areas merit special attention, which elements within habitats should be protected, and provide information that could be used to help promote nature-based tourism.

This last application of the study's results was seen as necessary to generating support for the proposed program changes. As stated earlier, Northampton County faces extreme economic difficulties that in turn increase pressures on coastal resources. The SAMP partners reasoned that alleviating some of the economic hardship would be critical to

protecting resources. One avenue with a great deal of potential in Northampton County is heritage tourism (nature-, culture-, and history-based tourism). In fact, heritage tourism, including bird-oriented recreation is being actively explored in the county. As a result of many Special Area Management Plan activities, Community leaders, including members of the Accomac-Northampton Chamber of Commerce, the NC Board of Supervisors, and the A-N Planning District Commission, are becoming acquainted with the real possibilities of simultaneously protecting and capitalizing on existing abundant natural resources.

THE NORTHAMPTON MIGRATORY LANDBIRD STUDY

I. OBJECTIVES

The objectives of this study reflect the interdependent relationship between protecting habitat for migratory landbirds and improving the economic profile of Northampton County. As the SAMP strategy recognizes, conserving and enhancing native vegetation, and hence stopover habitat, to moderate the secondary impacts of coastal growth and development requires key actions on several different levels. The two primary levels can be classified as voluntary action and policy directed action. Both require a significant measure of public awareness of the value of a resource and support for its protection. In the specific case of migratory landbird stopover habitat in Northampton County, this requirement can be met through capitalization of the area's substantial bird-based heritage tourism potential. As community members begin to experience economic benefit from the presence of migrant concentrations, as they have for the past two falls during the Eastern Shore Birding Festival, they may begin to take action to protect the habitat that supports those concentrations.

Consistent with these considerations and the specific goals and proposed program changes of the SAMP, this study focused on the following primary objectives:

1. Describe large scale geographic distribution patterns in order to identify areas of special concern as well as those areas of low value to migrants.
Relevance to SAMP:

a. Help guide development and public access away from the most sensitive areas to the most robust by providing information to the County and the public that can be applied to zoning decisions.

b. Inform private and public landowners of the relative value of their region of the County for migratory birds.

c. Focus limited conservation resources for easements or acquisition on the most sensitive areas.

2. Define critical habitat factors associated with abundance of migrants.
Relevance to SAMP:

a. Inform private and public landowners of the potential positive and negative impacts of their actions on migrant landbirds.

b. Provide information to be used for management standards for proposed MOUs that would protect wildlife habitat and native vegetation in right-of-ways.

c. Establish minimum standards for removal and installation of vegetation to be included in proposed revisions of county ordinances.

3. Document general landbird migration patterns within Northampton County for the promotion of bird-based heritage tourism industry.
Relevance to SAMP:

a. Increase local, state and national interest in protecting Northampton County's natural resources.

b. Define the "migration resource" for the public sector so that any citizen may capitalize on this shared resource without diminishing it.

c. Provide information regarding timing and location of special events (i.e. Bird Festival) designed to increase public appreciation of migration.

II. OVERVIEW OF PROJECTS

Several field projects were conducted within lower Northampton county during the 1992 and 1993 fall migration periods. These projects were designed and executed to support the primary objectives of the SAMP. Initially, an inventory of all forested patches within the study area was conducted to determine the feasibility of various design options. A systems approach was then used to locate critical information needs and to plot a deliberate course to reach what we believed to be essential information endpoints. This approach resulted in remarkable information returns over the two-year period.

In terms of the broad range of objectives, the spatial scales of concern range from individual layers of vegetation to the entire management area. Meeting the information needs of these objectives requires a design capable of collecting and integrating data over a broad area but with a fine level of resolution. This was accomplished using a single type of information gathering unit (30 m fixed-radius point count) designed to resolve distribution differences at the finest scale and then aggregating these units to reveal information over broader scales. This approach allows for the assessment of spatial patterns within a given scale and the simultaneous integration of patterns between scales. Throughout the system of field projects, efforts were made to ensure that adequate samples were taken to discern patterns at the broadest scale to a reasonable degree of certainty. Because smaller scale investigations were nested within the framework of larger investigations, a tremendous

amount of information was collected on fine-scale patterns.

Below is a brief overview of the various field projects conducted, a list of scientific objectives for each, and their relevance to the overall SAMP policy objectives. Results directly relevant to policy objectives will be included in this report.

Main Study - The "main study" formed the core of the bird investigation. In addition to examining distribution patterns over the two focal scales (geographic, vegetation-level), we identified a series of intermediate scales relevant to the ultimate policy objectives of the SAMP. This study examined distribution patterns within four nested scales including: 1) within vegetational strata, 2) within forest patches, 3) between forest patches, and 4) between geographic areas. Experimental units were balanced both within and between spatial levels using a hierarchical experimental design.

To examine broad-scale distribution patterns, the study area was divided into six "geographic zones". Boundaries for these zones were established at 5 km intervals moving up the peninsula from the tip and the two upper zones where the peninsula widens were split down the center. Two spatial replicates of both small (4-8 ha) and large (9-12 ha) forest patches were chosen for study within each geographic zone. Six survey plots were arranged along a "survey route" for all forest patches. In order to examine the distribution of birds within forest patches, the six survey plots were divided evenly between "edge" plots (survey plots with centers 30 m from edges such that plot edges were tangent to the forest edge) and "interior" plots (survey plots with centers positioned away from patch edges). All birds detected were identified to species and placed in 2 m intervals up to 8 m. Birds detected

above 8 m were placed either in the canopy proper or in the remaining subcanopy depending on their vertical position. Vegetation was systematically measured up to a height of 8 m within each survey plot. All forest patches within the design were surveyed two days per week (all points were surveyed on the same day). The same forest patches and points were used in both field seasons. Patches were surveyed in the morning and again in the afternoon in 1992 to detect time of day patterns. Only morning surveys were conducted in 1993.

This study was designed to address aspects of all three SAMP objectives.

Objectives

- To detect broadly defined geographic locations within the lower peninsula that regularly support significant numbers of migrants.

- To detect any relationship between bird abundance/diversity and the size of forest patches within the lower peninsula.

- To detect geographic patterns in vegetation structure and/or floristics.

- To detect any relationship between migrants and the characteristics of vegetation within forest patches.

- To detect seasonal patterns of passage for migrant groups and species.

- To detect any changes in distribution, habitat use, etc. with time of day.

- To detect possible interactions and/or derivatives of above relationships.

Bayside/seaside Forested Corridor Study - The forested corridor study was designed to detect differences in migrant abundance between the prominent bands of forested habitat along the two edges of the peninsula. The study used the same sampling approach (30 m fixed radius point counts and 6 point survey routes) as the main study. Six spatial replicates of survey routes were chosen within each forest corridor. As with the main study, all birds detected

were placed in vertical strata and vegetation was measured within each plot. This design was implemented in 1992 only. Patches were surveyed in the morning and again in the afternoon on two days per week.

This study was designed to address aspects of all three SAMP objectives.

Objectives

- To detect differences in abundance/diversity of birds between the forested corridors located along the bayside and seaside shorelines of the peninsula.

- To detect differences in vegetation structure and/or floristics between the forested corridors located along the bayside and seaside shorelines of the peninsula.

- To detect any relationship between migrants and the characteristics of vegetation within bayside/seaside corridors (information to be used to supplement data from the main study).

- To detect any changes in distribution, habitat use, etc. with time of day (information to be used to supplement data from the main study).

- To detect seasonal patterns of passage for migrant groups and species (information to be used to supplement data from the main study).

"Large Patch" Study - The initial forest patch inventory determined that a full geographic design was only possible within a narrow range of patch sizes. However, during the course of the inventory, six forest patches were located that were greater than 20 ha in size. The large patch study was designed to investigate patch size effects that may not be detected within the limited patch sizes used in the main study. The study used the same sampling approach (30 m fixed radius point counts and 6 point survey routes) as the main study. Two

survey routes were established within 4 "large" patches. As with the main study, all birds detected were placed in vertical strata and vegetation was measured within each plot. This design was implemented in 1992 only. Patches were surveyed in the morning and again in the afternoon on two days per week.

This study was designed to address aspects of all three SAMP objectives.

Objectives

- To detect any relationship between bird abundance/diversity and forest patch size beyond the bounds of the patch sizes in the main study.

- To detect differences in vegetation structure and/ or floristics between the forested corridors located along the bayside and seaside shorelines of the peninsula.

- To detect any relationship between migrants and the characteristics of vegetation within bayside/seaside corridors (information to be used to supplement data from the main study).

- To detect seasonal patterns of passage for migrant groups and species (information to be used to supplement data from the main study).
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Bayside Watch Study - The lower Delmarva Peninsula has been long known to be a reverse migration area. Birds that fall out near the tip in the early morning are often observed flying north along the bayside corridor throughout the morning. This study was designed to investigate the timing of these northward flights as well as their spatial extent. Volunteers were stationed within four distinct breaks (Wise Point, Sunset Beach, Kiptopeke State Park, and Picketts Harbor) in the forested corridor to record the number of birds flying over.

Birds observed at each location were recorded in ten minute intervals during the first four hours after sunrise. This study was conducted on weekends only during the 1992 field season.

This study was designed to address aspects of SAMP objectives one and three.

Objectives

- To determine the direction of the morning movement of birds along the bayside of the peninsula.

- To detect any temporal patterns in morning movement of birds along the bayside.

- To detect any seasonal patterns in the morning movement of birds along the bayside.

Bayside Transect Study - Results from the Bayside/seaside corridor study conducted in 1992 indicated that the migrant groups, as a whole, were concentrated within the forested band along the bayside of the peninsula. These results led to a more focused investigation on the bayside in 1993. The bayside transect study was designed to investigate patterns in distribution and habitat use within the bayside corridor. The study used a different approach to sample birds than the main study. Thirty 100 m transects were established in forested habitats between the peninsula tip and Elliotts Creek. Transects were grouped in five "bundles" of six (each transect within the bundle was separated from the adjacent transect by 100 m). Each transect started on the bayside edge of a forest stand and extended into the forest running due east. Each transect was subdivided into 10 m segments. All birds detected were placed in vertical strata and assigned to east/west segments. Vegetation was systematically measured within each segment. Transects were surveyed two days per week

as in the main study.

This study was designed to address aspects of all three SAMP objectives.

Objectives

- To detect any spatial patterns in the north/south distribution of migrants along the bayside.

- To detect any spatial patterns in the east/west distribution of migrants within the forested corridor along the bayside.

- To detect any relationship between migrants and the characteristics of vegetation within the forested corridor along the bayside (information to be used to supplement data from the main study).

- To detect seasonal patterns of passage for migrant groups and species (information to be used to supplement data from the main study).

Bayside Foraging Study - This study was designed to describe resource use by migrants using forests along the bayside. The study was done in conjunction with the Bayside Transect Study. Observers followed birds through the forest habitats for two minute intervals, recording feeding attempts, behaviors, substrates, and prey items taken. Observation periods were subdivided into 15 sec intervals in order to estimate foraging rates. Attempts were made to observe relatively common migrants. Foraging observations were made two days per week during 2 hr time blocks.

This study was designed to address aspects of SAMP objectives two and three.

Objectives

- To describe foraging rates for selected migrant species.

- To determine the relationships between foraging rate, habitat characteristics, and environmental conditions.

- To determine the relative use various food items for selected migrant species.

- To describe the use of foraging substrates and behaviors for selected migrant species.

- To determine the vertical location of foraging activities for comparison to patterns of strata use described from studies above.

Kiptopeke Banding Study - This study was designed to accumulate information on the condition of migrants arriving on the peninsula, their length of stay, and any changes in condition while in residence. Data was collected in conjunction with the banding operations at the Kiptopeke Beach Banding Station. One technician was assigned to assist banders each day from Monday through Friday. All birds captured were measured, weighed and assigned a fat class based on subcutaneous fat stores. To assess changes in body condition, these measurements were taken again for all recaptured birds. This study was conducted during the 1993 field season only.

This study was designed to address aspects of SAMP objective number three.

Objectives

- To determine the physical condition of migrants passing through the peninsula.

- To determine the residency times for selected migrants.

- To detect any changes in physical condition of migrants during stopover periods on the peninsula.

III. OVERVIEW OF RESULTS

During the course of this two year study, we counted over 46,000 birds in forested habitats of lower Northampton County. In twelve weeks of 1992, we observed 22,582 birds

during over 10,800 point counts (main study: 13,770; big patches: 3,649; bayside/seaside corridors: 5,163). In the fourteen week field season of 1993, we conducted 4,032 point counts and 840 transect counts (totaling more than 92 km) and detected a total of 23,479 (main study: 16,790; bayside transects: 6,686). During the 9 weeks of banding at Kiptopeke in 1993, 4,412 birds were captured, weighed, and measured. Nearly 8,000 hours of field work were needed to accomplish the tasks of observing and banding birds and measuring vegetation (927 hrs of field preparation and 6,627 hrs of data collection). Data entry required approximately 676 hours. We present these numbers to emphasize the magnitude of the migration phenomenon on the Delmarva peninsula.

One hundred and thirty-seven species were observed during this study. Long-distance migrants were the most diverse, representing 49.6% of all species, short-distance migrants accounted for 21.2%, and residents, 22.2% (68, 29, and 30 species respectively; Appendix 1, Table A.). Extrapolating from our data, we estimate over 6.8 million forest-associated landbird migrants move through lower Northampton County between the months of August and October (estimated from 1993 point counts: 446.4 birds/ha x 14,621 ha of forest land in the county). This number does not account for the majority of short-distance migrants moving through the area in mid-November thru early December and migrants associated with grasslands and marshes such as sparrows and swallows which may also number in the millions.

We present here results of our two year study arranged as they relate to the scientific and policy objectives outlined in the previous two sections. In almost all cases, we present general patterns for resident birds, short-distance migrants, and long-distance migrants

followed by selected examples of species for each group.

Large Scale Distribution Patterns

Geographic Patterns -- Based on 1992 and 1993 combined data from the main study, all three of the general bird groups showed distribution patterns on a geographic scale that were significantly different from that expected by chance (Appendix 2). Both short- and long-distance migrants, as a whole, appear to concentrate within 10 km of the peninsula tip with relatively fewer birds detected with increasing distance from the tip. This distribution pattern is consistent with the idea that migrants of both types are using habitats near the tip of the peninsula before crossing the mouth of the Chesapeake Bay. Resident birds, as a group, showed the opposite distribution and reached their highest densities in those areas farthest from the tip. A clear explanation of their tip-avoidance patterns is not readily apparent except that forested habitats within the lower, narrow portion of the peninsula may be of poor quality for breeding due to low soil moisture and frequent salt spray.

With few exceptions, distribution patterns for selected species examined were in agreement with their respective groups. Northern Cardinals were most abundant in between 15-20 km from the peninsula tip. One resident species, Red-bellied Woodpecker, shifted farther from the tip when 1993 data were combined with 1992. Flickers, Golden-crowned Kinglets, and Hermit Thrush are the only short-distance migrants examined that are not significantly associated with the tip. All long-distance migrant species except Ovenbird are significantly associated with the lower 10 km. For most species, patterns detected in 1992 were the same as those observed for both years combined. Notable changes are seen for Golden-crowned Kinglet, Hermit Thrush, and Ovenbird. All three species now appear to

have even distributions throughout the study area.

Bayside and Seaside Corridors -- Data collected in 1992 within the bayside and seaside corridors indicate that all bird groups were detected with significantly greater frequency on the bayside (Appendix 3). Although only 8 out of 23 individual species demonstrated significant differences between the two corridors, all of those were also more abundant on the bayside (Red-bellied Woodpecker, Carolina Wren, Golden-crowned Kinglet, American Robin, Blue-gray Gnatcatcher, Black-and-white Warbler, and American Redstart). Three species appear to be more abundant on the seaside but not significantly so (Carolina Chickadee, American Robin, and Yellow-rumped Warbler). This overall bayside preference may be associated with the somewhat higher subcanopy vegetation density within the bayside corridor or may be influenced by factors beyond the scope of this study (i.e., predation pressure, orientation, insect abundance, or social factors).

In 1992 we collected data that would allow us to determine the effect of patch size on bird distribution because this issue has received a great deal of attention from conservation biologists. We found no overall difference between bird abundance for groups or species among three different patch sizes (4-8 ha, 9-13 ha, and >20 ha). Only three species exhibited a significant difference in their distribution at this level. Red-bellied Woodpeckers were most frequently seen within small patches while Red-eyed Vireos and Yellow-billed Cuckoos appear to avoid small patches in favor of medium and large patches (Appendix 2, Table A.). The relatively low variation in patch size within lower Northampton County may produce a situation in which patch size is not an issue.

Within Bayside -- Based on the 1992 finding that all bird groups and many

species occurred in significantly higher abundances on the bayside of the peninsula, we collected data in 1993 that might elucidate distribution patterns within the bayside corridor close to the coast. Results of this study indicate that birds of both migrant groups are not evenly distributed within the bayside nor are they clearly distributing themselves along a south-north gradient (results of one-way ANOVA: resident: $F=0.597$, $p=0.668$; short-distance $F=2.527$, $p=0.066$; long-distance $F=3.669$, $p=0.017$). Short-distance migrants use bundle 1 significantly less than all other bundles and long-distance migrants were observed in bundles 2 and 4 significantly more than bundles 3 and 5 (Tukey's multiple range tests, $p < 0.05$ for all cases).

Vegetation Use -- To investigate bird-vegetation associations within the main study we classified plots as having either high or low vegetation density in the understory and subcanopy. The number of observations of selected species were then summed for each plot and tested against the expected distribution based on availability of high and low density understory and subcanopy vegetation. Appendix 4 illustrates the patterns in deviations between the observed and expected use of understory and subcanopy values. Most of the selected species examined exhibited significant deviations from expected distribution patterns based on both the understory and subcanopy densities. For residents, all species except the Tufted Titmouse over-utilized plots with high understory density and under-utilized plots with low understory density. All but one short-distance migrant were associated with plots that have high vegetation density significantly more than expected. Five species were associated with both high density understory and subcanopy. Hermit Thrush showed the unique pattern of being associated with low density subcanopy plots. Six of the nine selected long-distance

migrant species demonstrated significant over-utilization of plots with high vegetation density in either the understory, subcanopy, or both. The three species that showed no significant deviation from the expected were the Yellow-billed Cuckoo, Red-eyed Vireo, and Black-throated-blue Warbler.

We repeated this procedure for vegetation along the thirty bayside transects (Appendix 5). In large part, species-vegetation associations at this level within the bayside corridor are consistent with patterns observed in the main study. All resident species, including Tufted Titmouse, were detected on transects with high understory vegetation significantly more often than expected. Cardinals were also significantly associated with dense subcanopy. Notably, Golden-crowned Kinglets reversed their association from over-utilizing to under-utilizing high density understory sites and Hermit Thrush reversed their association from under-utilizing high density subcanopy in the main study to over-utilizing within the bayside. Black-and-white Warblers and Pine Warblers switched to under-utilizing high density subcanopy from over-utilization.

Strata use was investigated with 1992 data. Many selected species showed significant vertical distribution patterns within forests. These patterns are in general agreement with those known from the breeding season (Appendix 6).

Temporal Patterns -- The frequency of detection for all bird groups and all of the individual migrant species varied dramatically over the season (Appendix 7). Patterns between years demonstrate the year-to-year variation in the exact timing of migration but together indicate the peaks of passage within a range of dates. Resident birds as a group show only slight declines in abundance over the course of the season; a pattern probably

caused by juvenile dispersal and mortality and family dispersion during the period following breeding. Among the individual resident species presented, only Red-bellied Woodpeckers demonstrate a different pattern. In 1992 their rate of detection increased toward the end of the season while in 1993 it remained relatively stable.

Both short-distance and long-distance migrant groups have clear peaks in abundance during the fall. Short-distance migrants pass through Northampton County in greatest numbers towards the end of October and on into November. A second peak may occur beyond the time covered in this study. Flickers, Blue Jays, and Rufous-sided Towhees appear to peak somewhat earlier than short-distance migrants as a whole. Long-distance migrants show two peaks of abundance corresponding to late August/early September and late September/early October, dropping off rather quickly after the second peak. Of the individual long-distance migrant species, Yellow-billed Cuckoo, Blue-gray Gnatcatcher, Red-eyed Vireo, and Black-and-white Warbler can be considered early season migrants while the others peak later. An accounting of seasonal patterns for all species detected, 1992 and 1993, is presented in Appendix 7 (Tables A-C).

POLICY AND MANAGEMENT RECOMMENDATIONS

Managing human population growth while conserving sensitive natural resources is a major challenge confronting land-use decision makers throughout the coastal zone. Decisions are particularly difficult in those areas where strategies resulting in short-term gains compromise the potential for long-term benefits. This study was initiated not to impose regulations but to provide information to be used in the development of new opportunities.

A considerable body of information was collected over the two-year study period. Much of this information is relevant to the decisions now faced in determining the focus of future economic development in Northampton County. The study provides information that could be used in both the protection of sensitive resources and economic development based on these resources. The management recommendations listed below are intended to address these inter-related objectives.

Geographic distribution -- The results of this study show clear and statistically significant geographic distribution patterns for short- and long-distance migrants. In both cases, group abundances were greatest within the southernmost 10 km of Northampton County and greater along the Bayside forest corridor than the Seaside forest corridor. These results identify two well-defined migrant concentration areas and strongly suggest that geographic factors associated with migrant distribution may override habitat factors at this scale. Migratory bird stopover habitat should be afforded some protection throughout the county. However, we recommend that added protection for these two concentrations areas be pursued through policy initiatives and that sites within these areas be given priority for acquisition, conservation easements, management agreements, and natural area dedication.

<u>POLICY</u>

- Formulate overlay zones to provide special protection to areas of greatest migrant abundance.

  - Consideration should be given to the southernmost 10 km of the county and a 0.5 km wide strip of Bay front land from the tip to Elliot's Creek for inclusion in a special migratory bird habitat protection overlay zone.

- Standards for vegetation removal and installation associated with new development in this zone should be more rigorous than in other areas of the county.

- Northampton County should investigate and install appropriate standards for vegetation protection and enhancement, development density, and set-backs from the Bay shore.

- Education of citizens regarding the regional and international significance of this area will be essential to the successful implementation of this recommendation.

- Develop partnerships with private, state, and federal entities that control large landholdings within the lower 10 km and Bayside to ensure that rigorous standards are applied to lands beyond the County's jurisdiction through Memoranda of Understanding.

- Inform private, state, and federal entities interested in pursuing new conservation initiatives within the County of the significance of the lower 10 km and Bayside.

Vegetation associations -- Migrant landbirds are a large and diverse group of bird species, each with unique habitat and foraging preferences. For this reason, developing a specific definition of migratory landbird stopover habitat based on plant communities would be fruitless. This study avoided this problem by addressing a common feature of all habitats: relative vegetation density. Indeed, we found that both short-distance and long-distance migrants selected habitat for density of understory (0-4 m) and subcanopy (4-8 m) vegetation. In light of this clear finding, we recommend that existing natural vegetation within the entire county be protected to the greatest extent possible. We also recommend that the value

understory and subcanopy vegetation be noted in policy and education initiatives as these elements of forested habitats are often the first removed as a site is prepared for development.

POLICY

- Develop, approve, and implement appropriate enforceable design standards for county-wide vegetation protection; standards should be established for the protection of existing vegetation and installation of new or replacement vegetation for new developments and should be configured in such a way as to emphasize the value of densely vegetated areas.
- Pursue partnerships with state, federal, and corporate entities to develop and implement vegetation management guidelines that meet or surpass county standards through Memoranda of Understanding.
- Develop incentives for revegetation programs.
- Pursue partnerships with agricultural, forestry, and horticultural agencies to develop educational materials that would encourage private landowners to manage their land for the benefit of migratory landbirds.
- Develop guidelines for plantings on county properties and implement guidelines as demonstration projects.

SERVICE AND EDUCATION

- Provide list of appropriate vegetation for landscaping and restoration projects.

FACILITATION

- Encourage local nurseries to develop stocks of appropriate native plants that would accommodate the demands of vegetation installation design standards or restoration efforts.
- Encourage local nurserymen's association to develop materials to facilitate planting of native vegetation.

Promoting heritage tourism -- Nature-based tourism is growing rapidly and there are some projections that this industry may grow 25-30% during this decade. Birders alone spend billions of dollars annually on bird watching excursions, equipment, memberships, and other related paraphernalia. One study of the economics of bird watching in Cape May, N.J. indicates that birders spend over $5 million a year in Cape May, while another reports nearly equivalent expenditures for the Point Pelee, Ontario area. If Northampton County could build the eco-tourism industry to a similar level, it would place among the top five contributors to the local economy. In fact, bird oriented recreation in the form of the First and Second Annual Eastern Shore Birding Festivals has been used by the SAMP partners to demonstrate the potential for successful sustainable development within Northampton County. We recommend that such activities continue and that the county government continues to act as facilitator for private-sector initiatives by establishing education and outreach programs for the local community.

<u>POLICY</u>

- Pursue partnerships with private, state, and federal entities to develop guidelines to appropriately direct public access for low-impact tourism.

SERVICES AND EDUCATION

- Provide private-sector with information on the location of concentration areas and timing of migration for the potential development of tourism program.
- Distribute directory of heritage-tourism related services and educational/promotional materials to tour businesses and visitors.

FACILITATION

- Schedule year-round activities centered on bird-based recreation and encourage further investigation of other bird groups to take maximum advantage of bird resources in the County.
- Promote partnerships between local residents, businesses, and conservation groups to improve relations and identify mutual goals.

Northampton County and the SAMP partners have already begun to pursue some of the actions recommended above. A design standards for vegetation removal and installation are being incorporated into proposed revisions for the county's zoning ordinance (see Appendix 9 for a draft of the proposed standards). The County is currently engaged in negotiating a MOU with Delmarva Power to promote wildlife sensitive management of power line right-of-ways. One of Northampton's greatest steps towards protecting migratory landbird habitat has been its active Sustainable Development Initiative (SDI) which has brought together community members and partners from the private sector, federal and state resource agencies, academia, and non-governmental organizations. The SDI has made a

substantial contribution to educating the public and generating support for the concept of simultaneously protecting and capitalizing on natural resources. Given the current level of interest within the community for carefully managing growth, we encourage Northampton County to integrate the above recommendations into current initiatives.

Appendix 1: List of species detected in 1992 and 1993 combined, their scientific names, and assigned bird category. Bird categories are as follows: 1) permanent resident, 2) short-distance migrant, and 3) long-distance migrant.

Common Name	Scientific Name	Category 1	2	3
Great-blue Heron	Ardea herodias		x	
Green-backed Heron	Butorides Striatus		x	
American Woodcock	Scolopax minor		x	
Common Bobwhite	Colinus virginianus	x		
Sharp-shinned Hawk	Accipiter striatus			x
Cooper's Hawk	Accipiter cooperi			x
Red-tailed Hawk	Buteo jamaicensis		x	
Red-shouldered Hawk	Buteo lineatus	x		
Broad-winged Hawk	Buteo platypterus			x
Bald Eagle	Haliaeetus leucocephalis	x		
Osprey	Pandion haliaetus			x
Turkey Vulture	Cathartes aura	x		
Black Vulture	Coragyps atratus	x		
American Kestrel	Falco sparverius		x	
Merlin	Falco columbarius			x
Northern Harrier	Circus cyaneus		x	
Great-horned Owl	Bubo virginianus	x		
Screech Owl	Otus asio	x		
Mourning Dove	Zenaida macroura	x		
Yellow-billed Cuckoo	Coccyzus americanus			x
Black-billed Cuckoo	Coccyzus erythropthalmus			x
Chuck-will's Widow	Caprimulgus carolinensis			x
Ruby-throated Hummingbird	Archilocus colubris			x
Belted Kingfisher	Ceryle alcyon	x		
Red-headed Woodpecker	Melanerpes erythrocephalus	x		
Red-bellied Woodpecker	Melanerpes carolinus	x		
Yellow-bellied Sapsucker	Sphyrapicus varius		x	
Downy Woodpecker	Picoides pubescens	x		
Hairy Woodpecker	Picoides villosus	x		
Pileated Woodpecker	Dryocopus pileatus	x		
Northern Flicker	Colaptes auratus		x	
Eastern Wood Pewee	Contopus virens			x
Acadian Flycatcher	Empidonax virescens			x
Great-crested Flycatcher	Myiarchus crinitus			x
Least Flycatcher	Empidonax minimus			x
Yellow-bellied Flycatcher	Empidonax flaviventris			x
Eastern Phoebe	Sayornis phoebe			x
Eastern Kingbird	Tyrannus tyrannus			x
Tree Swallow	Tachycineta bicolor			x
Blue Jay	Cyanocitta cristata		x	
American Crow	Corvus brachyrhynchos	x		
Fish Crow	Corvus ossifragus	x		
Carolina Chickadee	Parus carolinensis	x		
Brown Creeper	Certhia americana		x	
Tufted Titmouse	Parus bicolor	x		
White-breasted Nuthatch	Sitta carolinensis	x		
Red-breasted Nuthatch	Sitta canadensis		x	

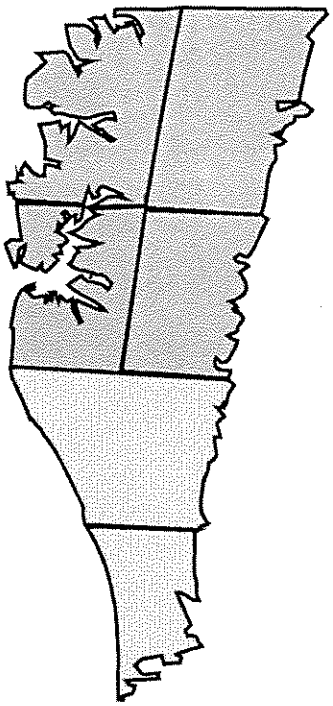
Brown-headed Nuthatch	Sitta pusilla	x		
House Wren	Troglodytes aedon			x
Winter Wren	Troglodytes troglodytes		x	
Carolina Wren	Thryothorus ludovicianus	x		
Ruby-crowned Kinglet	Regulus calendula		x	
Golden-crowned Kinglet	Regulus satrapa		x	
Blue-gray Gnatcatcher	Polioptila caerulea			x
Eastern Bluebird	Sialia sialis	x		
Wood Thrush	Hylocichla mustelina			x
Swainson's Thrush	Catharus ustulatas			x
Gray-cheeked Thrush	Catharus minimus			x
Hermit Thrush	Catharus guttata		x	
Veery	Catharus fuscescens			x
American Robin	Turdus migratorius		x	
Gray Catbird	Dumetella carolinensis			x
Mockingbird	Mimus polyglottis	x		
Brown Thrasher	Toxostoma rufum	x		
Cedar Waxwing	Bombycilla cedrorum		x	
Eastern Meadowlark	Sternella magna		x	
European Starling	Sturnus vulgaris	x		
White-eyed Vireo	Vireo griseus			x
Solitary Vireo	Vireo solitarius			x
Red-eyed Vireo	Vireo olivaceus			x
Warbling Vireo	Vireo gilvus			x
Philadelphia Vireo	Vireo philadelphicus			x
Blue-winged Warbler	Vermivora pinus			x
Golden-winged Warbler	Vermivora chrysoptera			x
Prothonotary Warbler	Protonotaria citrea			x
Tennessee Warbler	Vermivora peregrina			x
Nashville Warbler	Vermivora ruficapilla			x
Northern Parula	Parula americana			x
Black-and-white Warbler	Mniotilta varia			x
Black-throated Blue Warbler	Dendroica caerulescens			x
Cerulean Warbler	Dendroica cerulea			x
Blackburnian Warbler	Dendroica fusca			x
Chestnut-sided Warbler	Dendroica pensylvanica			x
Cape May Warbler	Dendroica tigrina			x
Magnolia Warbler	Dendroica magnolia			x
Yellow-rumped Warbler	Dendroica coronata		x	
Black-throated Greed Warbler	Dendroica virens			x
Yellow-throated Warbler	Dendroica dominica			x
Prairie Warbler	Dendroica discolor			x
Bay-breasted Warbler	Dendroica castanea			x
Blackpoll Warbler	Dendroica striata			x
Pine Warbler	Dendroica pinus			x
Palm Warbler	Dendroica palmarum			x
Mourning Warbler	Oporornis philadelphia			x
Connecticut Warbler	Oporornis agila			x
Kentucky Warbler	Oporornis formosus			x
Canada Warbler	Wilsonia canadensis			x
Wilson's Warbler	Wilsonia pusilla			x

Worm-eating Warbler	Helmitheros vermivorus			x
Ovenbird	Seiurus aurocapillus			x
Louisiana Waterthrush	Seiurus motacilla			x
Northern Waterthrush	Seiurus noveboracensis			x
Common Yellowthroat	Geothlypis trichas			x
Yellow-breasted Chat	Icteria virens			x
American Redstart	Setophaga ruticilla			x
Blue Grosbeak	Guiraca caerulea			x
Rose-breasted Grosbeak	Pheucticus melanocephalus			x
Northern Cardinal	Cardinalis cardinalis	x		
Indigo Bunting	Passerina cyanea			x
Rufous-sided Towhee	Pipilo erythrophthalmus		x	
Song Sparrow	Melospiza melodia		x	
Field Sparrow	Spizella pusilla		x	
Chipping Sparrow	Spizella passerina		x	
White-throated Sparrow	Zonotrichia albicolis		x	
White-crowned Sparrow	Zonotrichia leucophrys		x	
Swamp Sparrow	Melospiza georgiana		x	
Savannah Sparrow	Passerculus sandwichensis		x	
Dark-eyed Junco	Junco hyemalis		x	
Red-winged Blackbird	Agelaius phoeniceus	x		
Brown-headed Cowbird	Molothrus ater	x		
Common Grackle	Quiscalus quiscula	x		
Orchard Oriole	Icterus spurius			x
Northern Oriole	Icterus galbula			x
Scarlet Tanager	Piranga olivacea			x
Summer Tanager	Piranga rubra			x
Pine Siskin	Carduelis pinus		x	
American Goldfinch	Carduelis tristis	x		

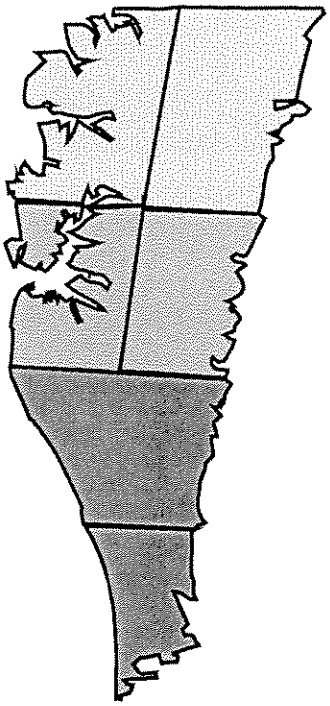
Appendix 2: Geographic patterns for bird groups and selected residents, short-distance, and long-distance migrants. Percentage values indicate the relative proportion of birds within the entire study area that were accounted for by particular regions. Patterns reflect data from the main study (1992 and 1993 combined). Significance values (resulting from Chi-square tests) are given by symbols located beside species names: no symbol indicates no significant difference from expected, (*) indicates significance to the 0.05 level, (**) indicates significance to the 0.01 level, and (***) indicates significance to the 0.001 level.

Geographic Patterns for Bird Groups

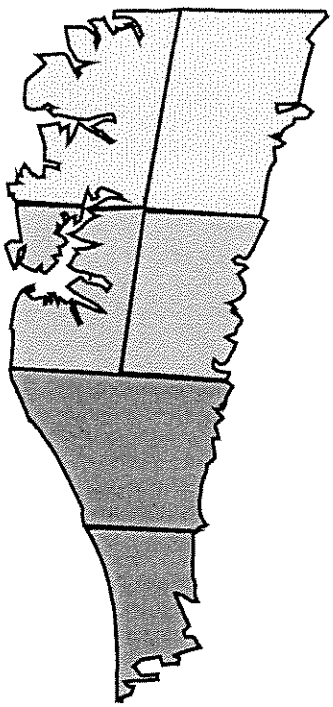
Resident ***



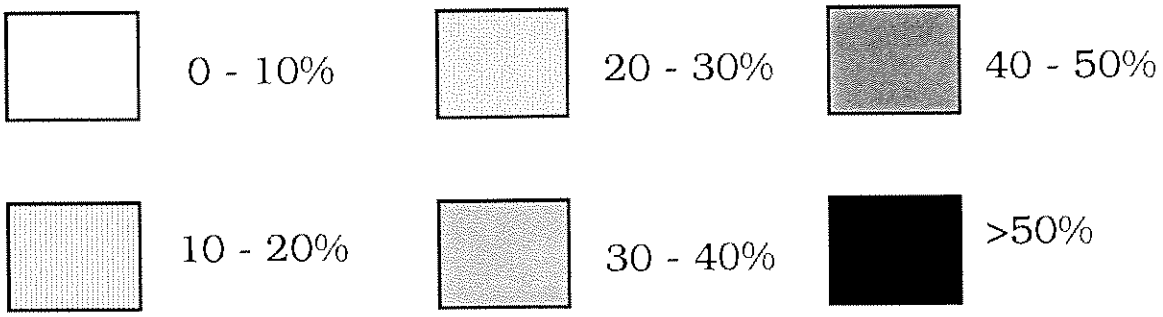
Short-distance ***



Long-distance ***

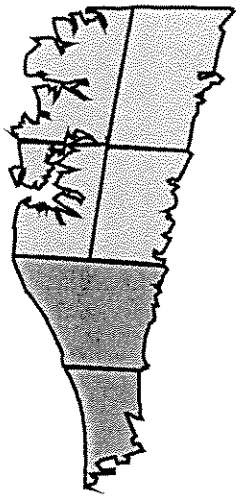


Key to Color Codes for Geographic Maps

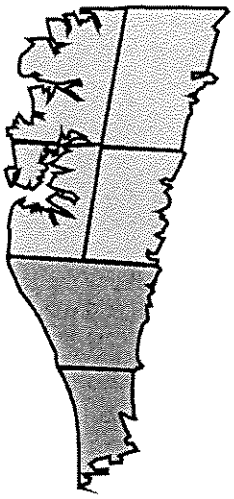


Geographic Patterns for Selected Short-distance Migrants

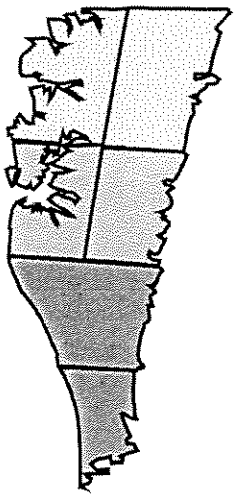
Flicker



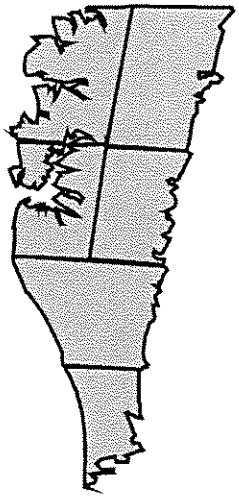
Blue Jay **



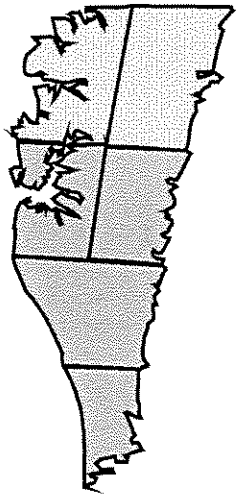
Win. Wren *



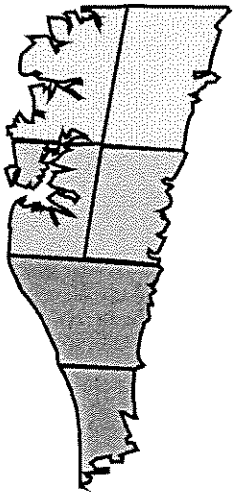
G-c Kinglet



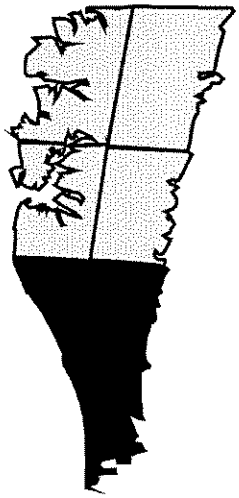
Hermit Thr.



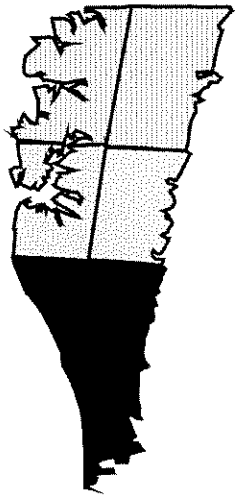
Robin ***



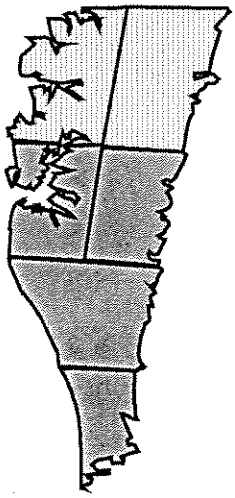
Y-r Warbler ***



Towhee***

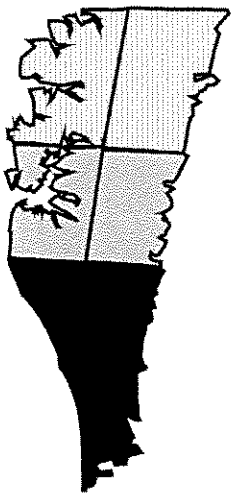


Wh-th Sparrow***

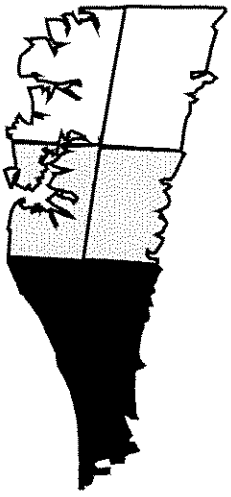


Geographic Patterns for Selected Long-distance Migrants

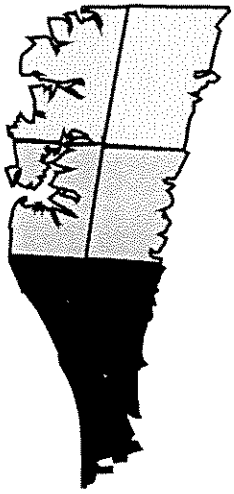
Y-b Cuckoo ***



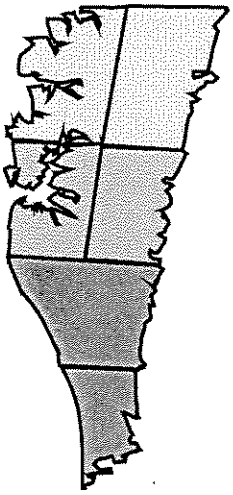
Gnatcatcher ***



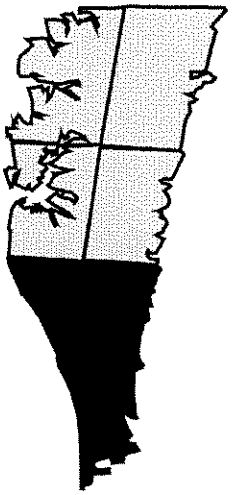
Catbird ***



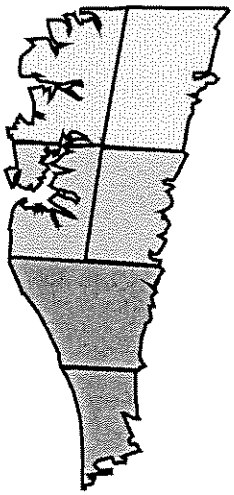
Red-e Vireo **



B&W Warbler ***



Bl-th-bl Warb.**



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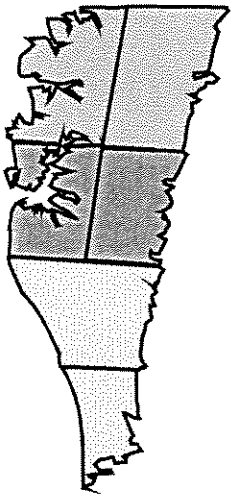
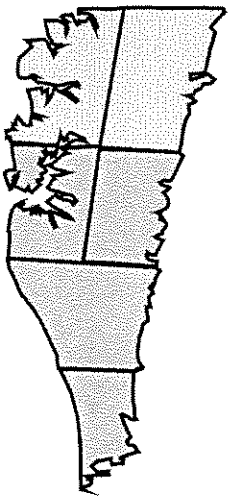


Ovenbird



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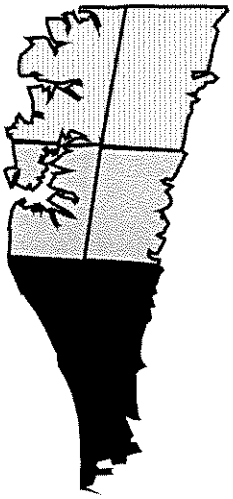
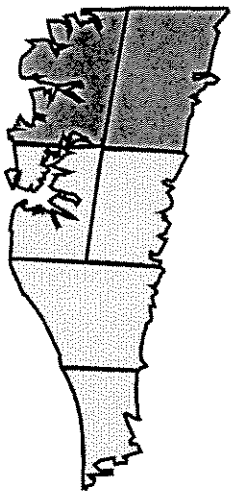
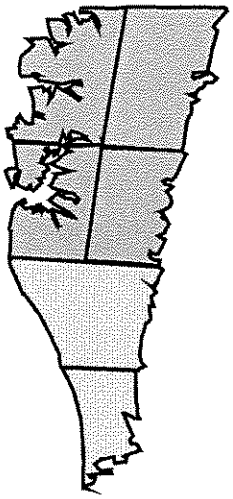


Geographic Patterns for Selected Resident Species

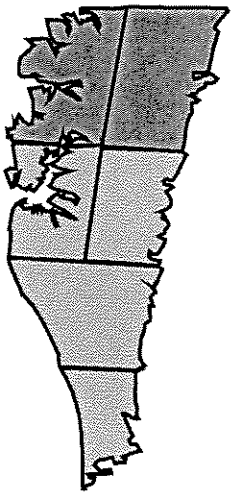
Red-bellied***



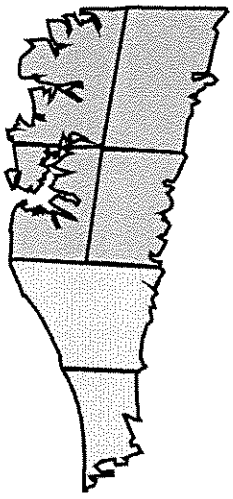
Chickadee ***



Titmouse **



Car. Wren *



Cardinal ***

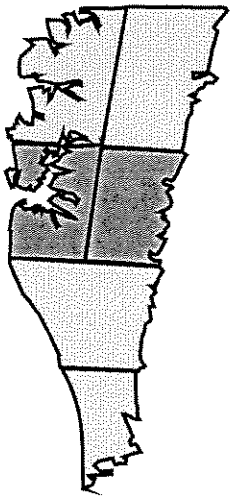
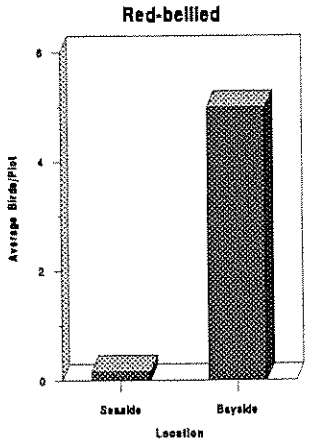


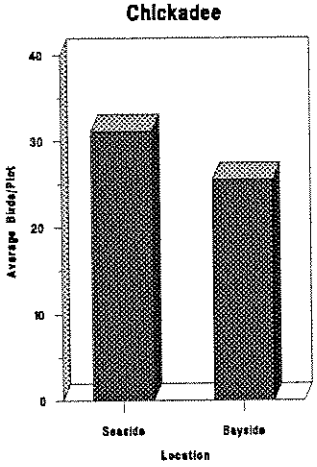
Table A. Descriptive statistics and results of one-way analysis of variance between small, medium, and large forest patches. Sample sizes = 12, 12, and * for small, medium, and large patches respectively.

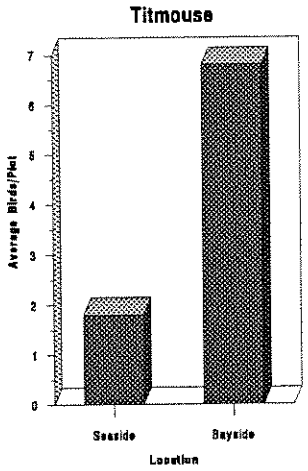
	Small	Medium	Large		
Bird Group	**X±SE**	**X±SE**	**X±SE**	**F**	***P***
Residents					
Red-bellied Woodpecker	5.2±1.94	8.8±1.55	12.3±1.42	3.86	<0.05
Carolina Chickadee	33.0±2.76	33.4±3.61	34.5±3.98	0.04	NS
Carolina Wren	43.2±3.08	52.1±4.88	48.6±6.47	0.92	NS
Northern Cardinal	17.8±3.08	18.6±2.56	11.6±3.02	1.45	NS
Richness	11.0±0.58	10.6±0.38	10.8±0.56	0.19	NS
All Residents	170.3±26.00	176.3±24.53	126.5±18.91	1.03	NS
Short-distance Migrants					
Common Flicker	9.8±3.29	12.7±3.10	17.3±3.30	1.16	NS
Blue Jay	32.7±5.80	29.8±3.20	19.6±3.33	1.94	NS
Winter Wren	1.0±0.51	1.3±0.51	1.9±0.74	0.54	NS
Golden-crowned Kinglet	23.3±4.44	20.9±3.58	17.9±2.72	0.44	NS
Hermit Thrush	2.1±0.75	2.5±0.62	1.3±0.25	2.91	NS
American Robin	18.2±7.65	14.8±7.47	8.5±6.26	0.38	NS
Yellow-rumped Warbler	32.3±9.94	25.2±14.80	28.8±6.69	0.12	NS
Rufous-sided Towhee	1.1±0.43	0.8±0.32	0.9±0.35	0.53	NS
White-throated Sparrow	2.0±1.04	3.8±1.82	0.9±0.35	1.05	NS
Richness	10.1±1.07	10.2±0.60	8.5±050	1.04	NS
All Short-distance	121.5±23.33	119.3±18.35	93.5±9.98	0.52	NS
Long-distance Migrants					
Yellow-billed Cuckoo	0.2±0.17	1.0±0.21	1.1±0.40	4.64	<0.05
Gray Catbird	4.3±1.66	3.8±1.30	2.5±0.89	0.35	NS
Red-eyed Vireo	1.3±0.43	4.3±0.82	4.6±1.30	4.99	<0.05
Black-and-white Warbler	4.4±0.87	5.2±1.31	7.9±3.18	0.98	NS
Black-throated Blue	1.7±0.53	2.8±0.57	1.8±0.41	1.36	NS
Pine Warbler	5.7±1.93	7.8±2.10	5.1±1.97	0.46	NS
Ovenbird	1.3±0.31	1.6±0.57	1.6±0.48	0.12	NS
American Redstart	14.5±6.39	11.6±2.71	9.6±3.48	0.25	NS
Richness	14.2±2.32	15.6±1.17	11.6±1.21	1.13	ns
All Long-distance	45.6±14.04	51.6±5.48	46.0±9.71	0.11	NS

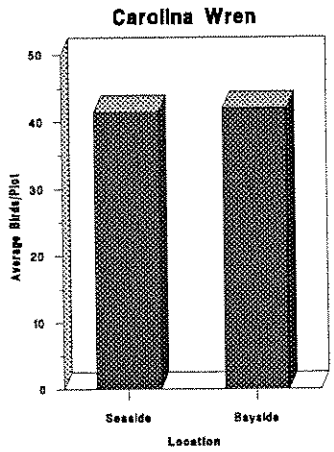
Appendix 3: Distribution patterns for bird groups and selected residents, short-distance, and long-distance migrants. Bars indicate the average number of birds observed/plot within the Bayside (N = 6) and seaside corridors (N = 6). Patterns reflect data from the Bayside/seaside corridor study (1992). Significance values (resulting from Mann-Whitney U tests, appendix **X**) are given by symbols located beside species names: no symbol indicates no significant difference from expected, (*) indicates significance to the 0.05 level, (**) indicates significance to the 0.01 level, and (***) indicates significance to the 0.001 level.

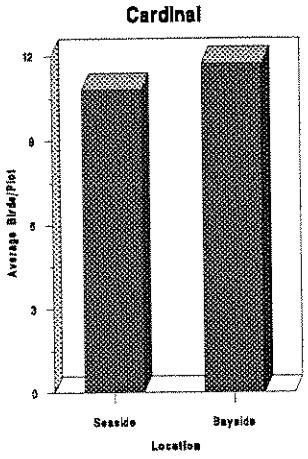
Distribution Between Bayside and Seaside Forest Corridors For Selected Residents



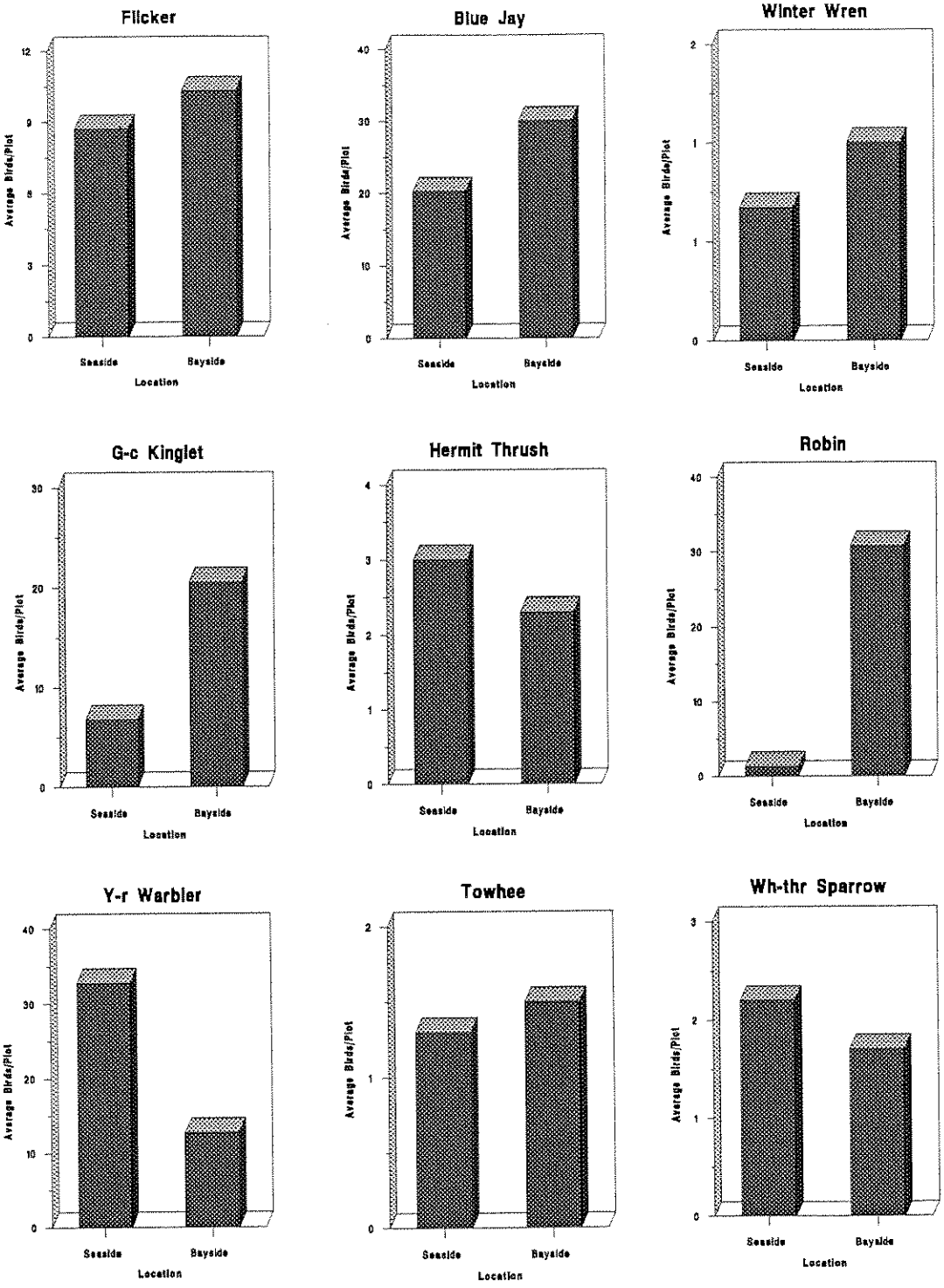




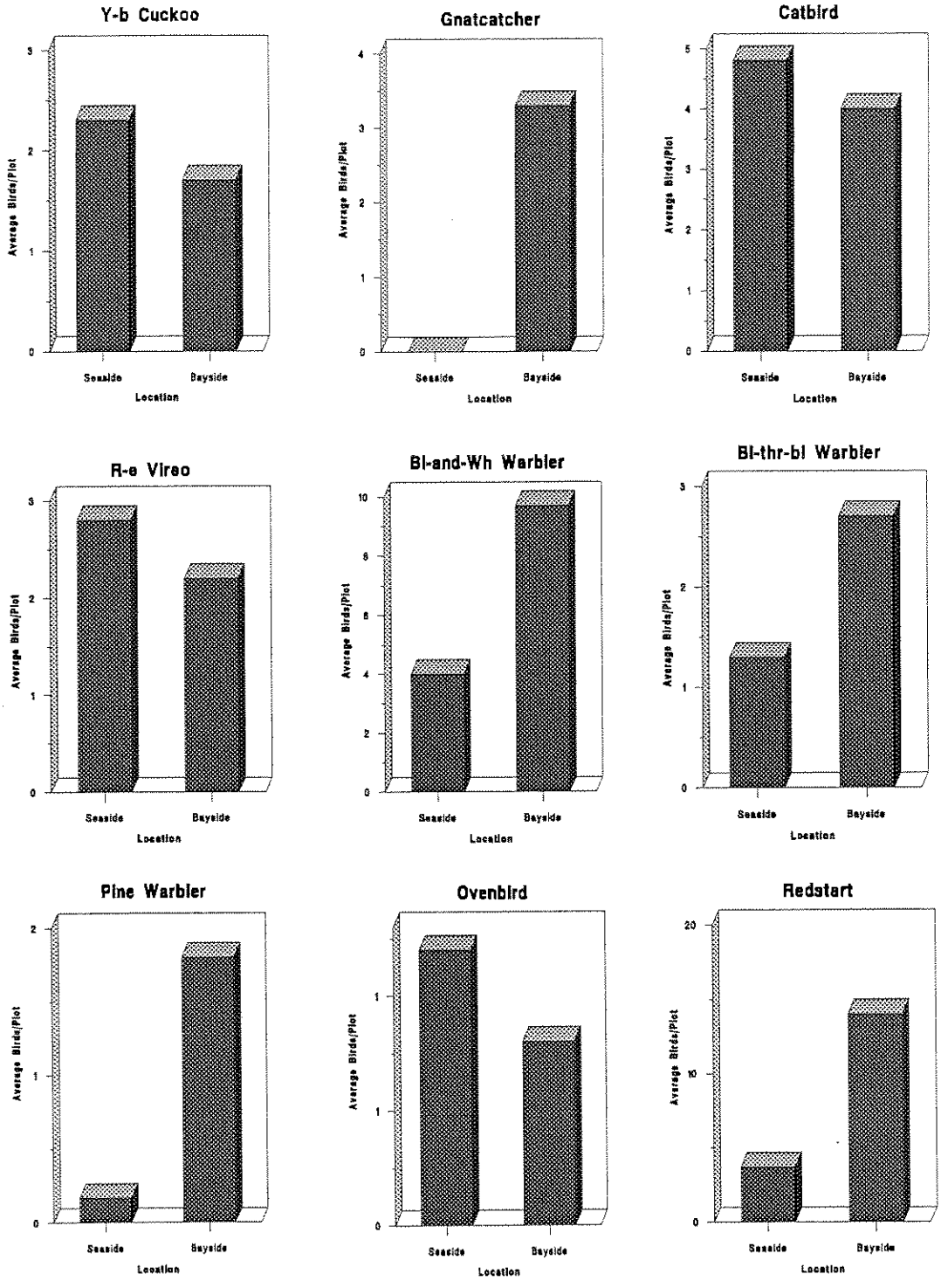




Distribution Between Bayside and Seaside Forest Corridors For Selected Short-distance Migrants



Distribution Between Bayside and Seaside Forest Corridors For Selected Long-distance Migrants



Distribution Between Bayside and Seaside Forest Corridors For Bird Groups

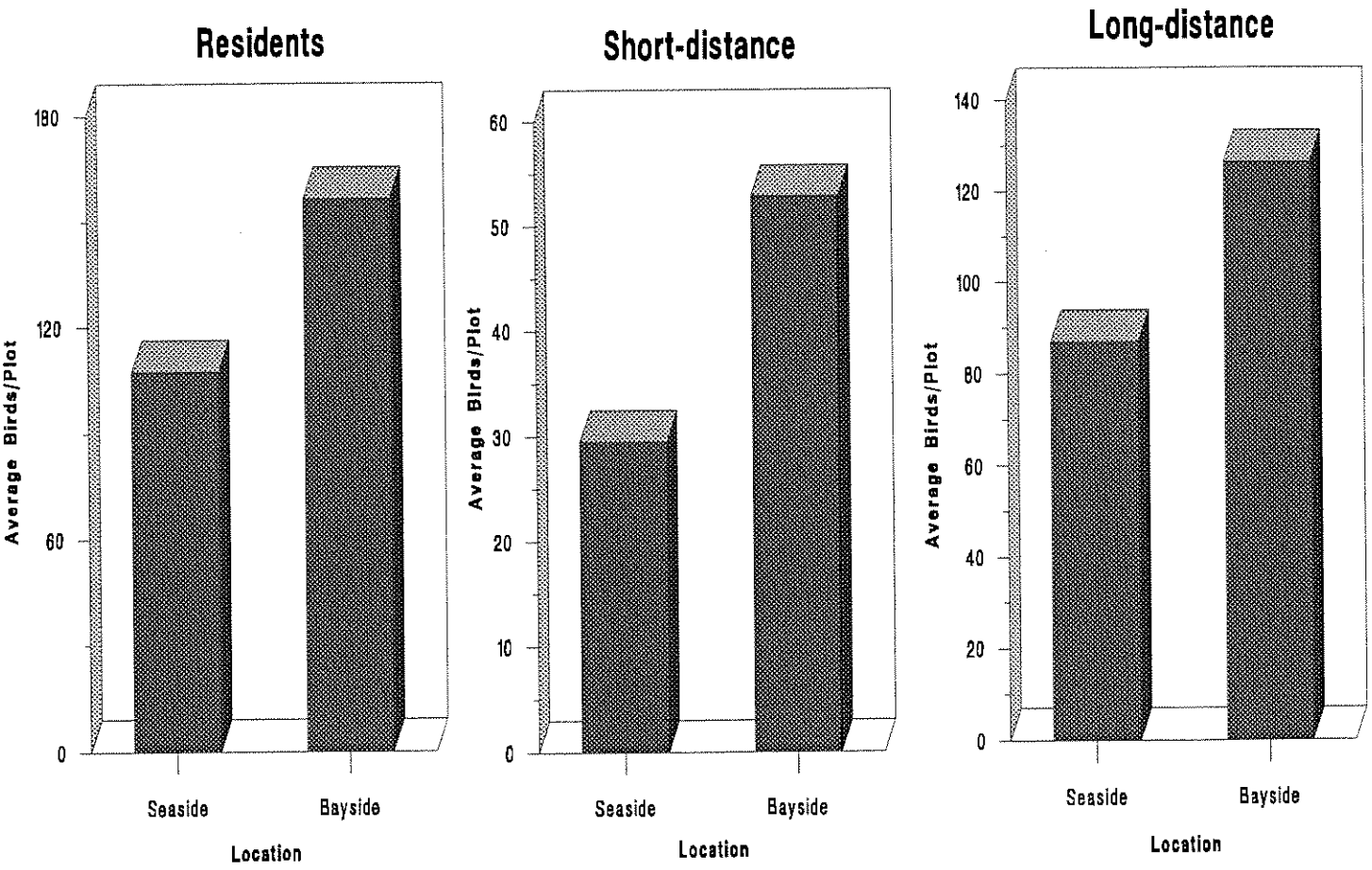


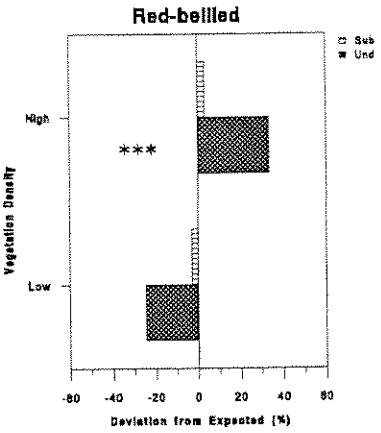
Table A. Descriptive statistics and results of Mann-Whitney U comparison between Bayside and Seaside survey routes. Sample sizes = 6 for both Bayside and Seaside routes.

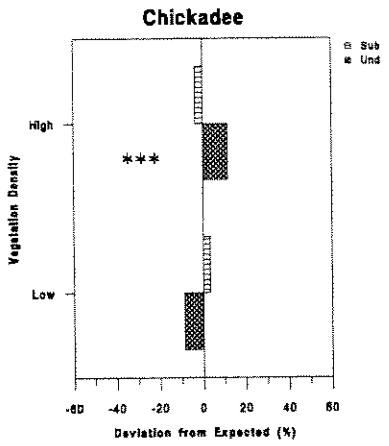
	Bayside	Seaside		
Bird Group	**X±SE**	**X±SE**	**U**	***P***
Residents				
Red-bellied Woodpecker	5.00±3.12	0.17±0.167	28.5	0.060
Carolina Chickadee	31.17±3.945	44.0±5.123	23.5	0.378
Tufted Titmouse	6.83±1.424	1.83±0.477	35.0	0.006
Carolina Wren	42.0±6.181	41.5±5.789	18.5	0.936
Northern Cardinal	11.67±3.084	10.83±3.341	21.0	0.628
All Residents	156.3±14.458	107.3±12.635	30.50	0.045
Short-distance Migrants				
Common Flicker	10.3±2.591	8.67±1.585	19.5	0.809
Blue Jay	30.00±5.033	20.17±4.942	28.0	0.108
Winter Wren*	1.00±0.365	0.67±0.211	22.0	0.484
Golden-crowned Kinglet	20.50±4.938	6.83±2.738	32.5	0.020
Hermit Thrush	2.33±0.715	3.00±1.862	21.0	0.624
American Robin	30.67±13.371	1.33±0.494	34.0	0.010
Yellow-rumped Warbler	12.67±4.652	32.83±11.553	9.50	0.173
Rufous-sided Towhee*	1.50±0.847	1.33±0.211	14.0	0.503
White-throated Sparrow	1.17±0.477	2.17±1.515	20.0	0.738
All Short-distance	126.33±14.167	87.00±8.660	29.0	0.078
Long-distance Migrants				
Yellow-billed Cuckoo	1.67±0.558	2.33±0.882	15.5	0.680
Blue-gray Gnatcatcher	3.33±1.498	0.00±0.000	30.0	0.022
Gray Catbird	4.00±1.880	4.833±2.738	14.5	0.571
Red-eyed Vireo	2.17±1.014	2.83±0.167	14.5	0.569
Black-and-white Warbler	9.67±1.498	4.00±1.713	32.0	0.024
Black-throated Blue	2.67±0.843	1.33±0.422	26.0	0.188
Pine Warbler*	1.83±1.138	0.17±0.167	25.0	0.181
Ovenbird*	0.83±0.307	1.17±0.601	17.5	0.930
American Redstart	14.0±2.852	3.67±0.803	36.0	0.004
All Long-distance	52.83±9.843	29.50±4.410	32.0	0.024

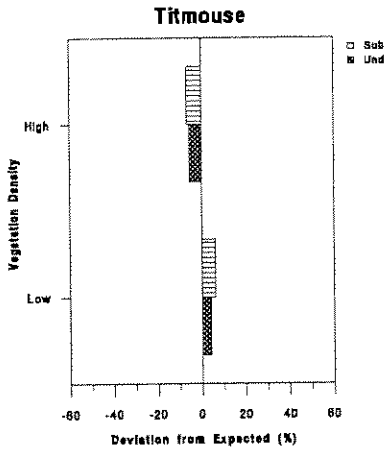
*Total number of observations less than 20

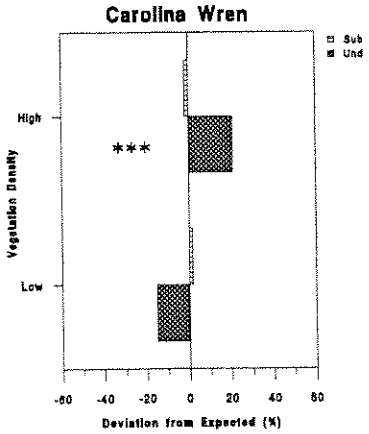
Appendix 4: Deviation patterns for selected resident, short-distance, and long-distance migrants. Bars indicate the difference between bird utilization patterns and those expected based on the availability of census points within a given range of understory/subcanopy density. Negative values indicate that points within the given vegetation range were underutilized relative to their availability. Positive values indicate that points within the given vegetation range were overutilized relative to their availability. Patterns reflect data from the main study (1992 and 1993 combined). Significance values (resulting from Chi-square tests) are given by symbols beside the respective bars: no symbol indicates no significant difference from expected, (*) indicates significance to the 0.05 level, (**) indicates significance to the 0.01 level, and (***) indicates significance to the 0.001 level.

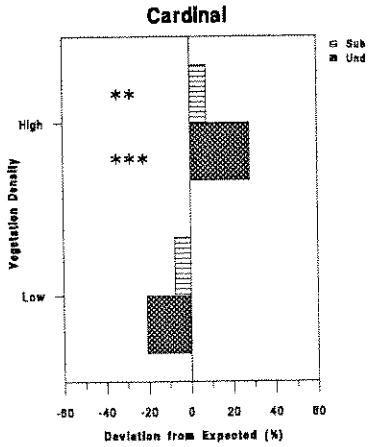
Use of High and Low Density Vegetation in The Understory and Subcanopy for Selected Residents: Main Study



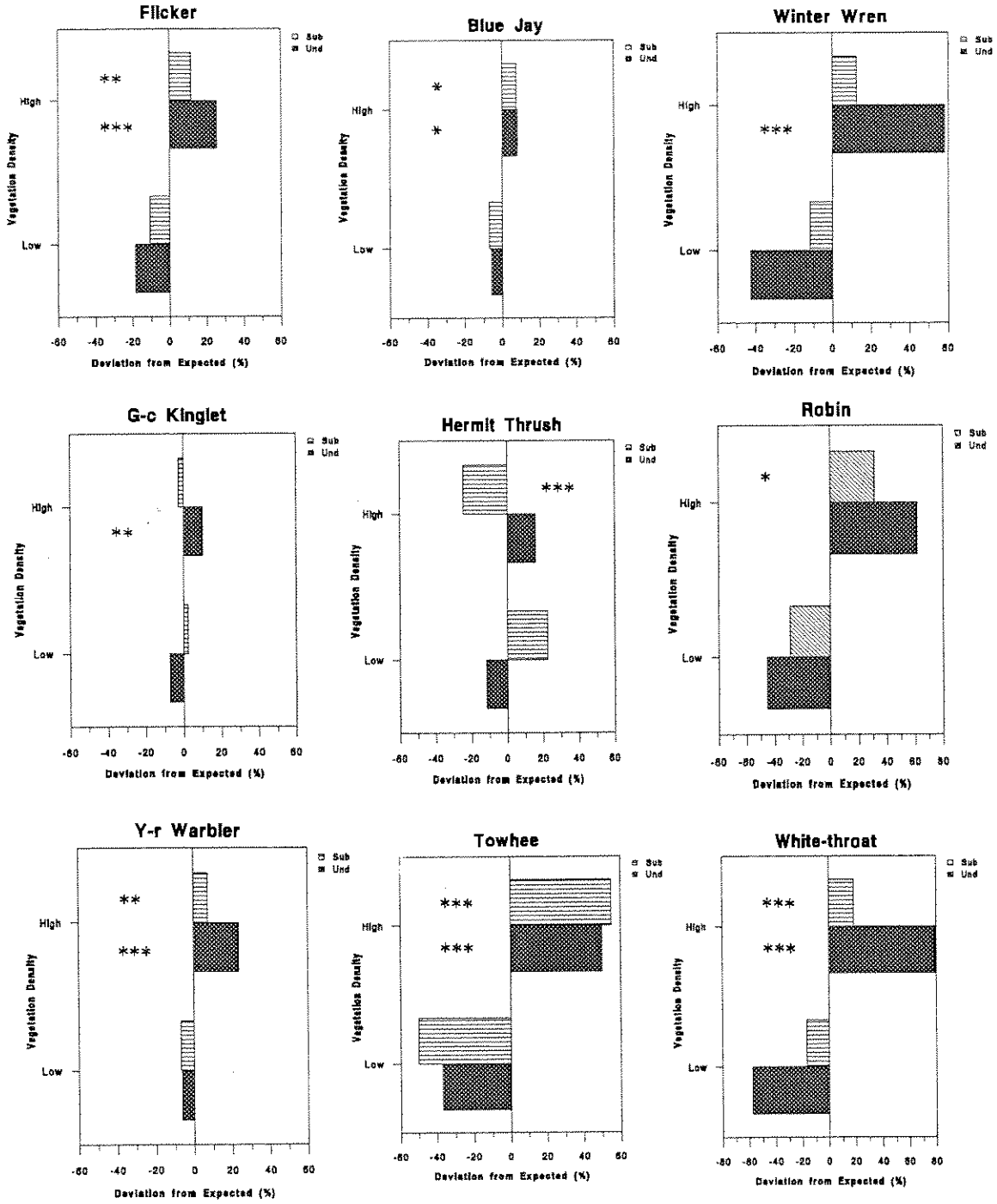




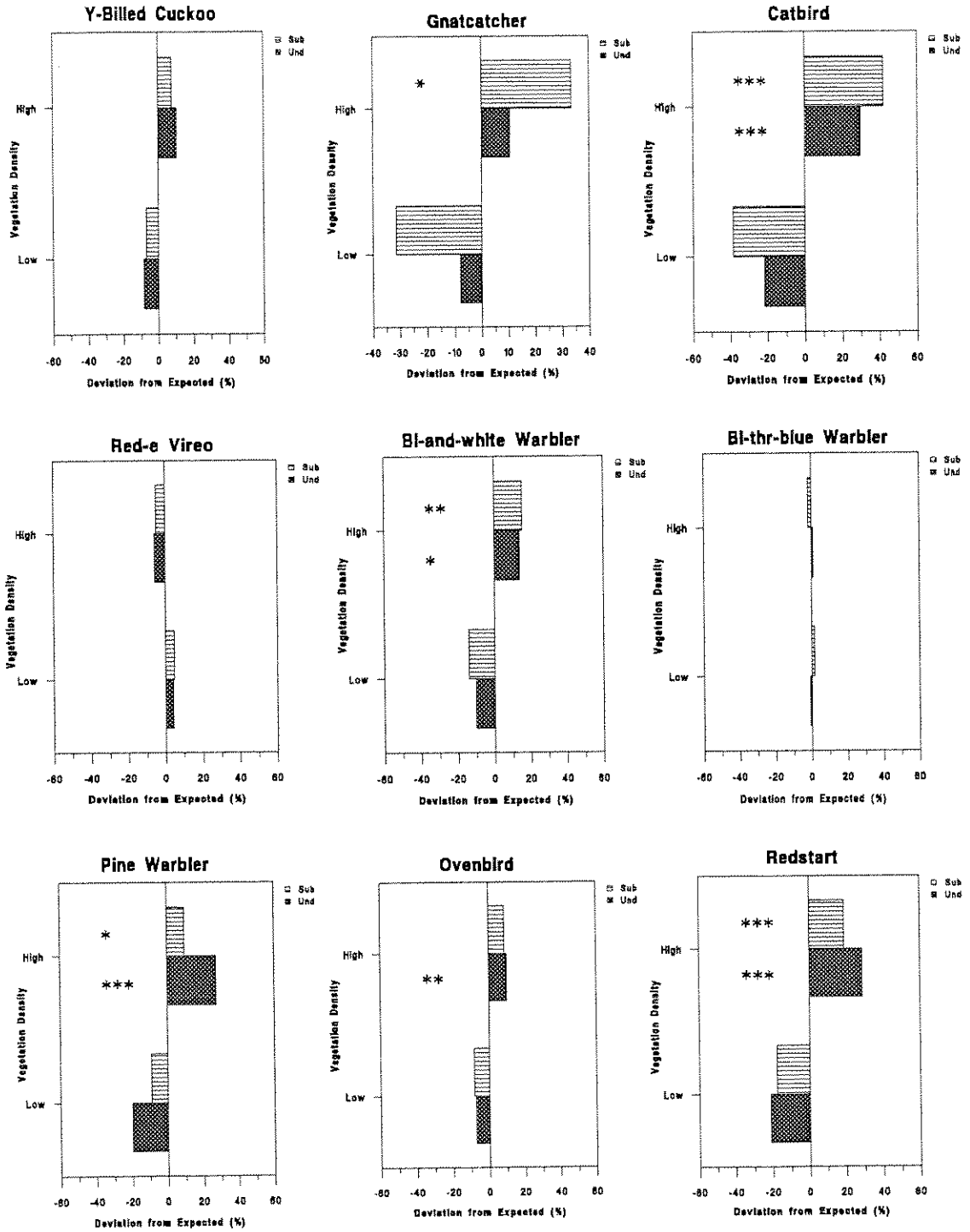




Use of High and Low Density Vegetation in the Understory And Subcanopy for Selected Short-distance Migrants: Main Study

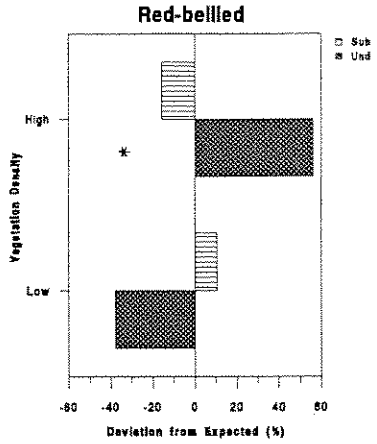


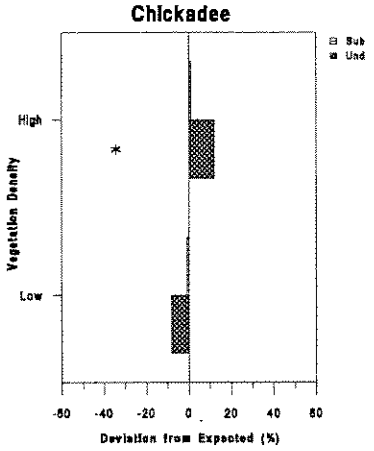
Use of High and Low Density Vegetation in the Understory And Subcanopy for Selected Long-distance Migrants: Main Study

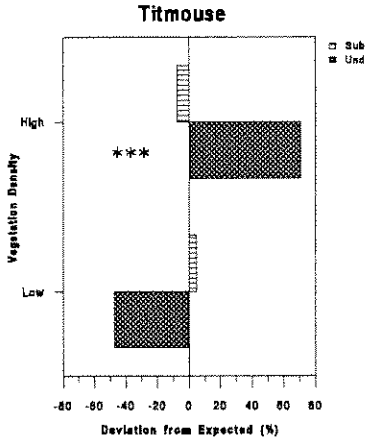


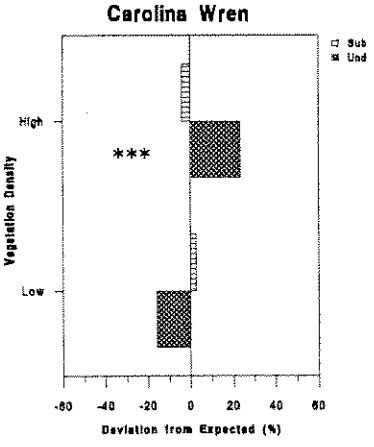
Appendix 5: Deviation patterns for selected resident, short-distance, and long-distance migrants. Bars indicate the difference between bird utilization patterns and those expected based on the availability of census points within a given range of understory/subcanopy density. Negative values indicate that points within the given vegetation range were underutilized relative to their availability. Positive values indicate that points within the given vegetation range were overutilized relative to their availability. Patterns reflect data from the bayside transect study (1993). Significance values (resulting from Chi-square tests) are given by symbols beside the respective bars: no symbol indicates no significant difference from expected, (*) indicates significance to the 0.05 level, (**) indicates significance to the 0.01 level, and (***) indicates significance to the 0.001 level.

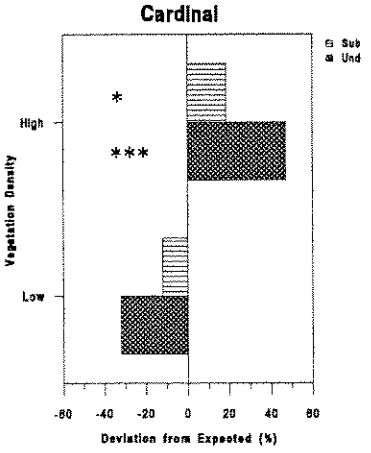
Use of High and Low Density Vegetation in The Understory and Subcanopy for Selected Residents: Bayside Transects



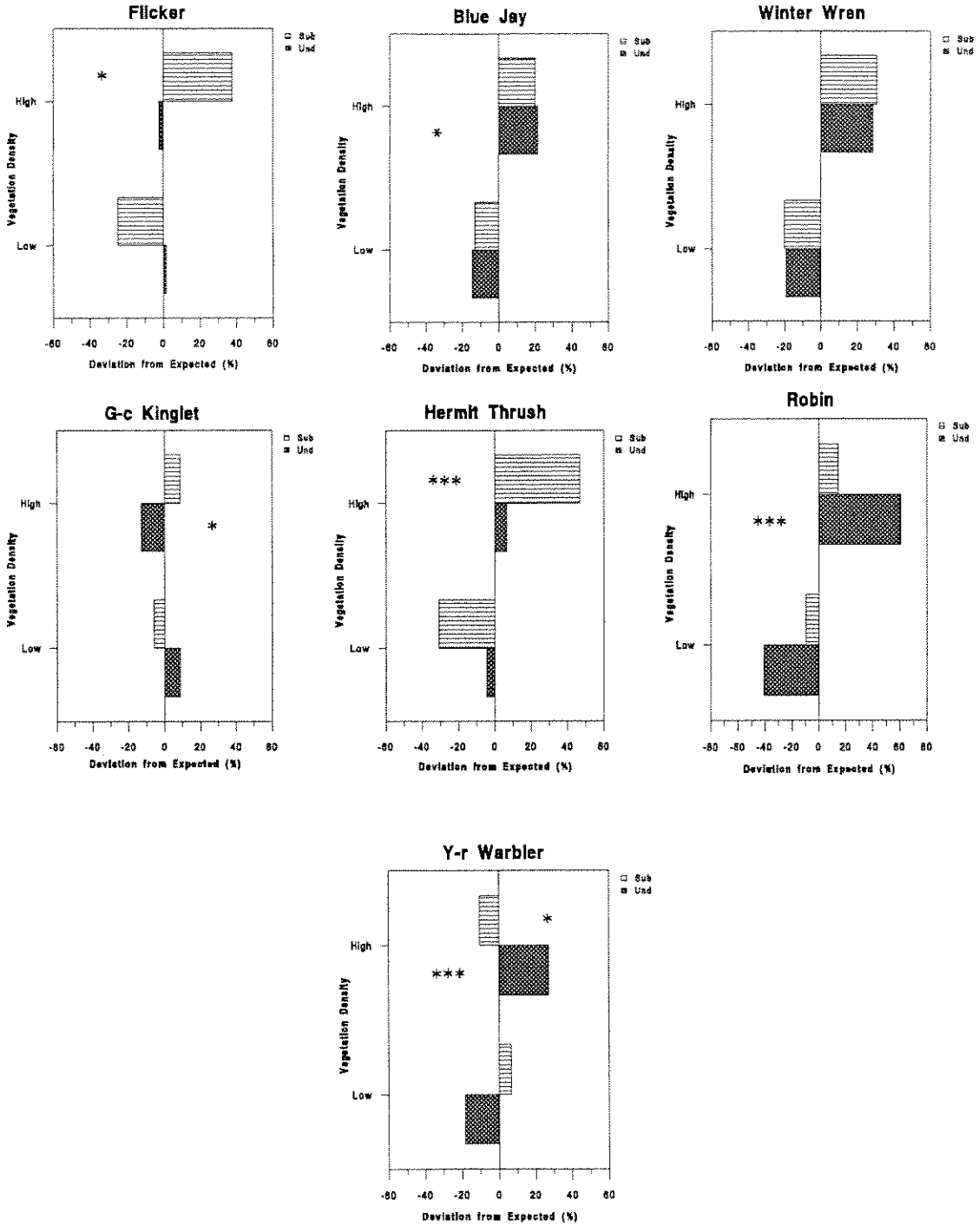




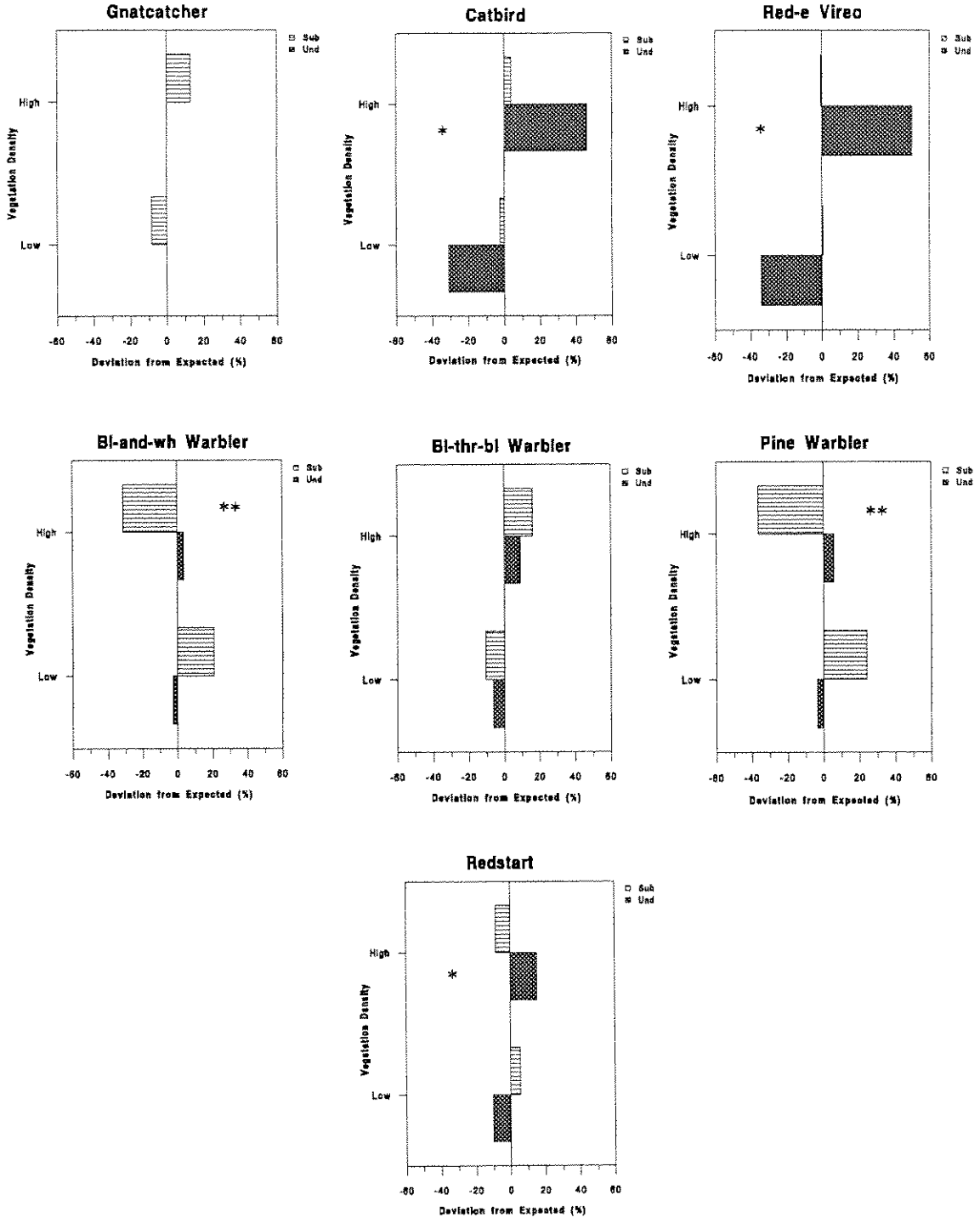




Use of High and Low Density Vegetation in the Understory And Subcanopy for Selected Short-distance Migrants: Bayside Transects



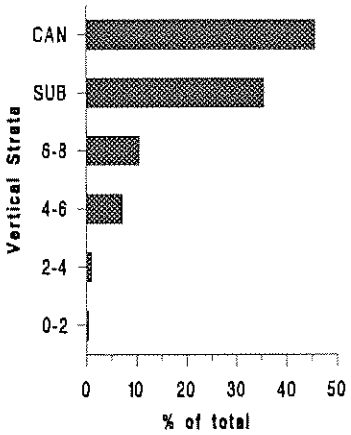
Use of High and Low Density Vegetation in the Understory And Subcanopy for Selected Long-distance Migrants: Bayside Transects



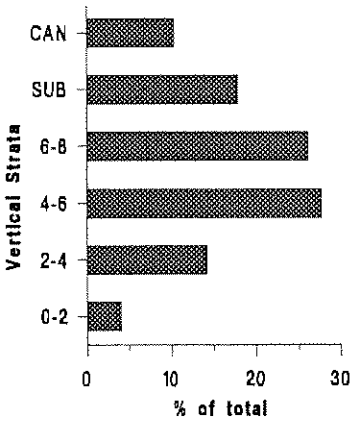
Appendix 6: Relative use of vertical strata by selected resident, short-distance, and long-distance migrants. Numeric strata categories represent ranges of heights above the ground in meters. "Sub" refers to the remaining subcanopy above 8 m in height. "Can" refers to the forest canopy. Patterns reflect data from the main study (1992 and 1993 combined), the large-patch study (1992), and the Bay/seaside corridor study (1992).

Patterns in Vertical Distribution For Selected Resident Species

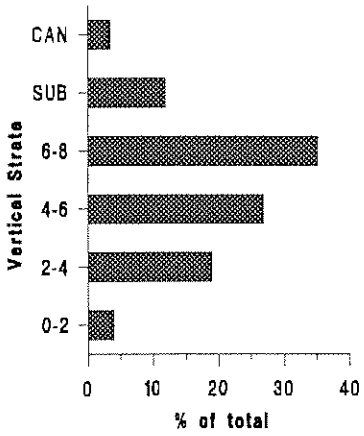
Red-bell (N=324)



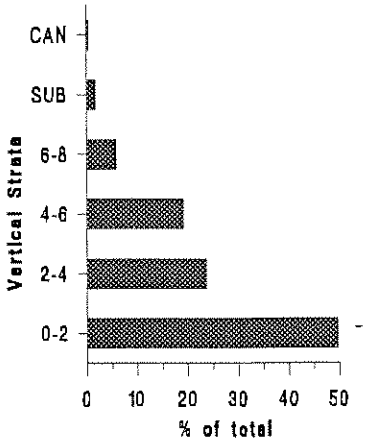
Chickadee (N=3608)



Titmouse (N=533)



Car. Wren (N=4760)



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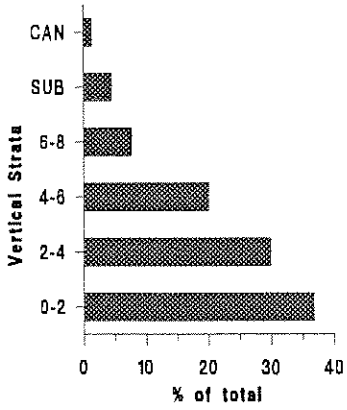
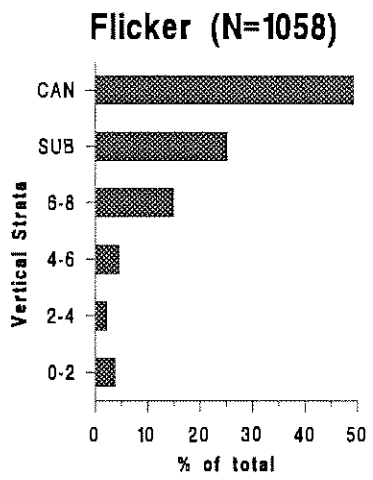
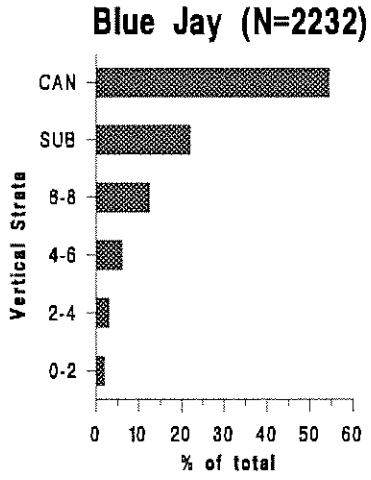
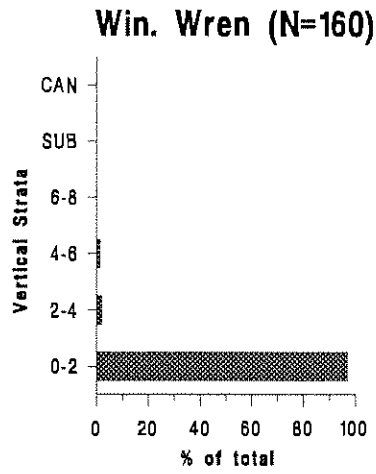
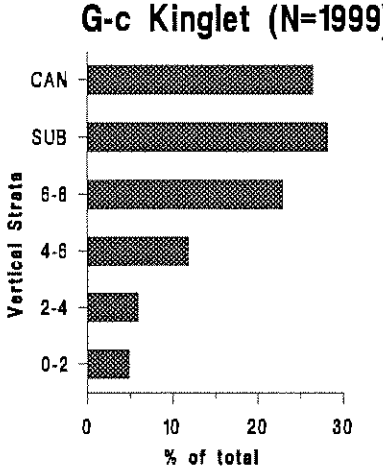


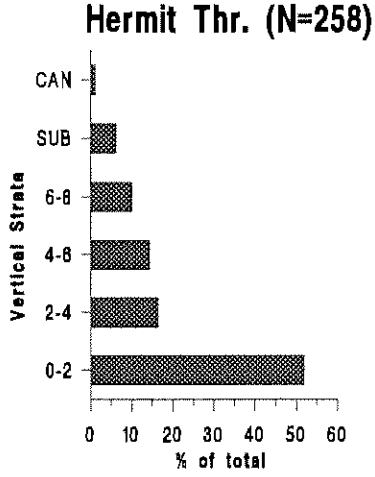
Patterns in Vertical Distribution For Selected Short-distance Migrants

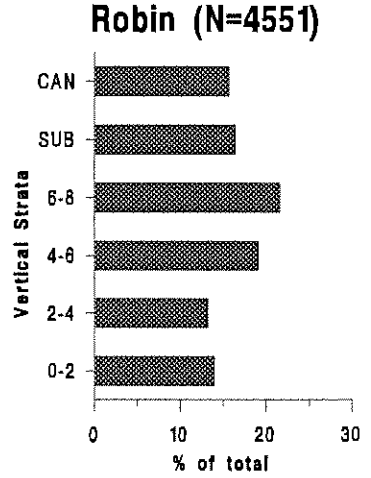


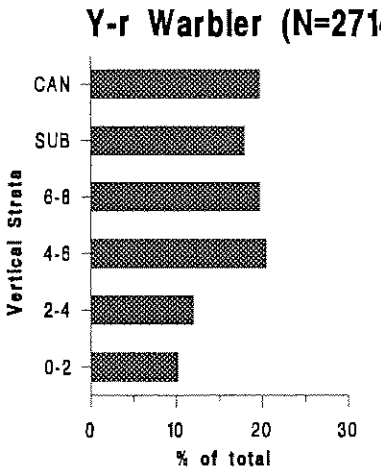


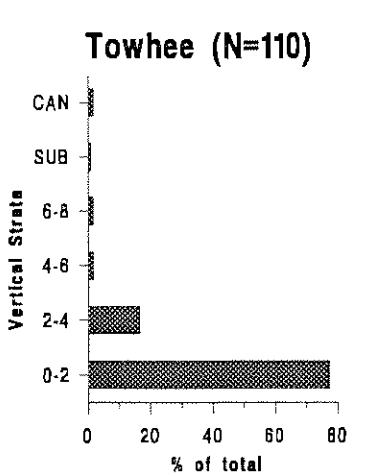


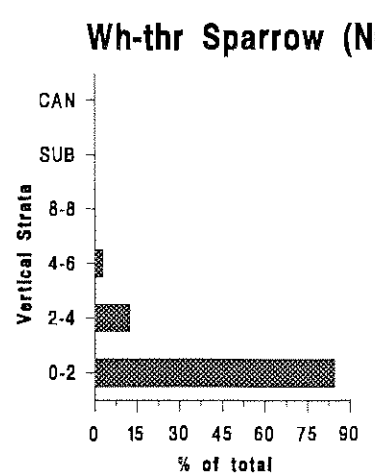




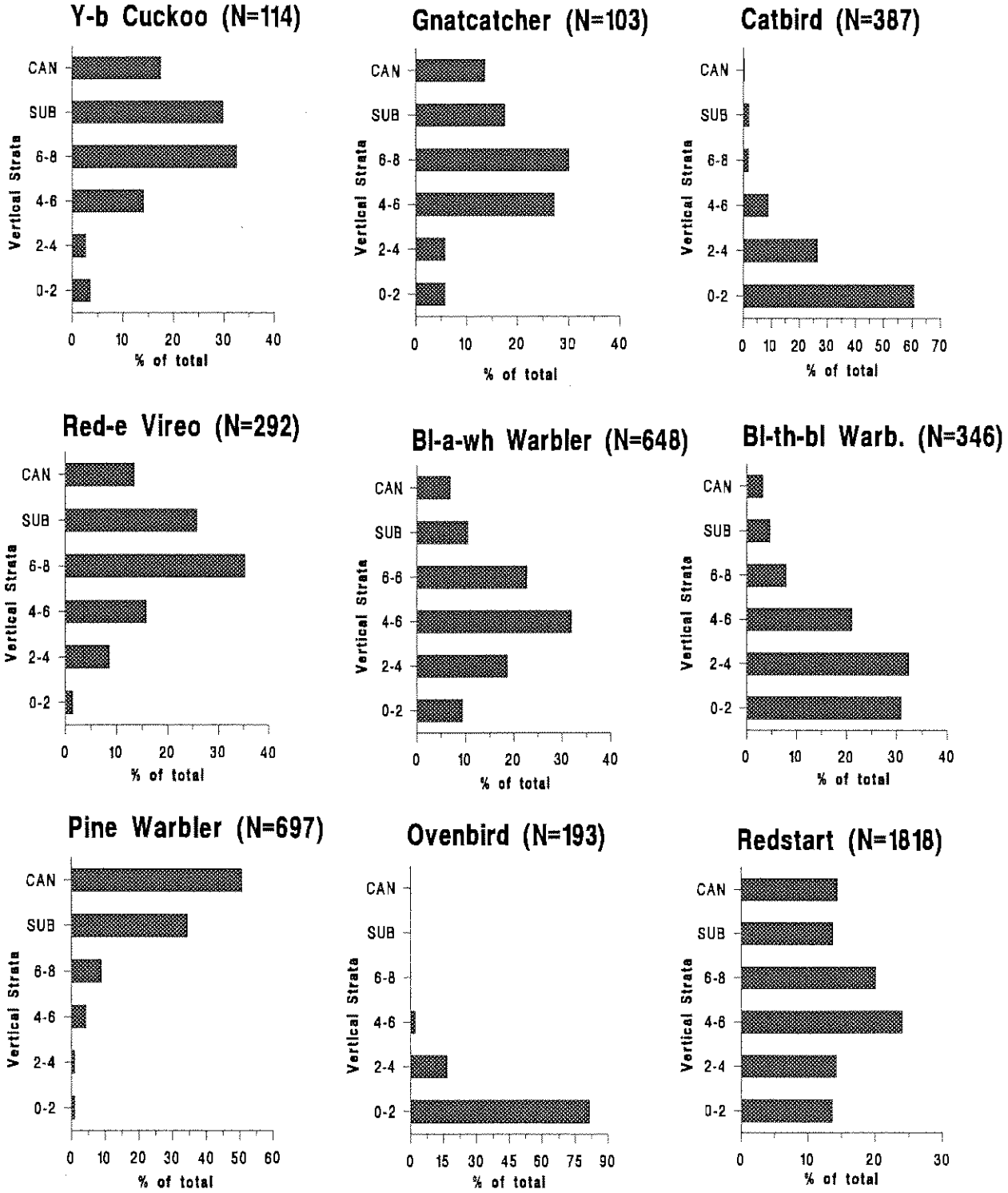








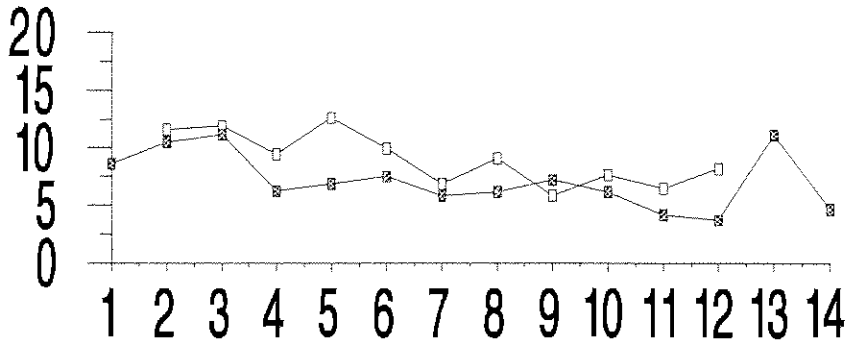
Patterns in Vertical Distribution
For Selected Long-distance Migrants



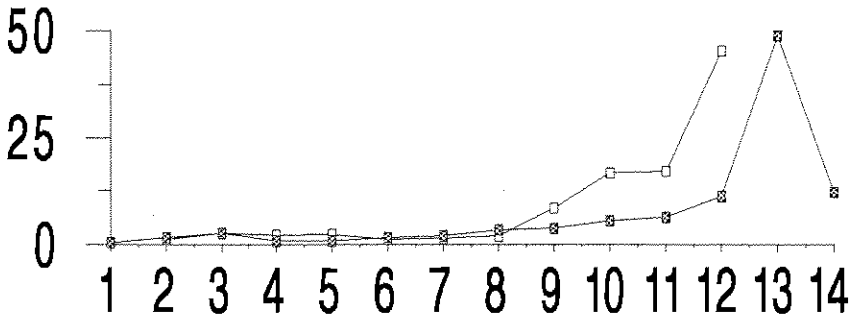
Appendix 7: Seasonal patterns in detection rates for bird groups and selected resident, short-distance, and long-distance migrants. Percent indicates the relative proportion of total observations accounted for by a given week. Week one is the second week of August and week 14 is the second week of November. Patterns in 1992 (open squares) reflect data from the main study, the large patch study, and the Bay/seaside corridor study. Patterns in 1993 (dark squares) reflect data from the main study.

Seasonal Patterns in Detection Frequency
For Bird Groups

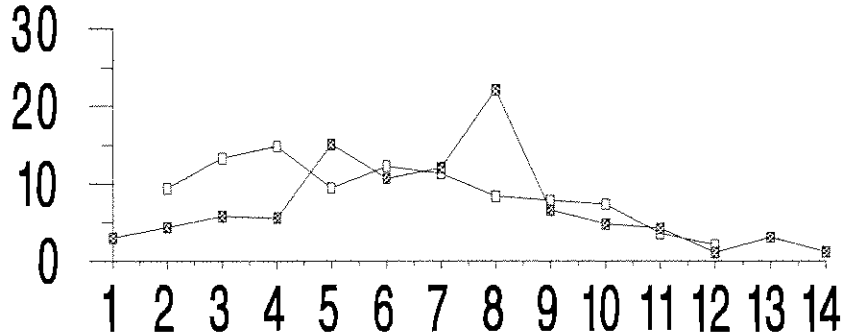
Residents



Short-dist.

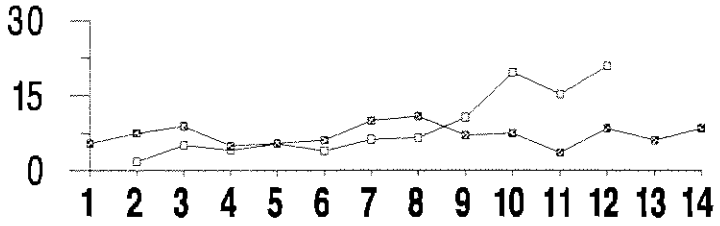


Long-dist.

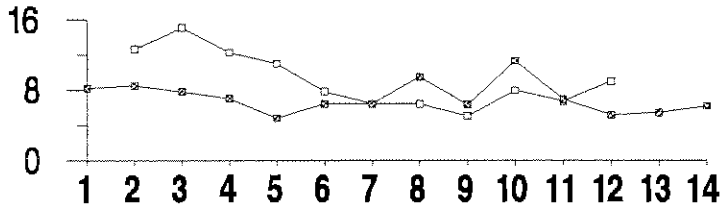


Seasonal Patterns in Detection Frequency
For Selected Resident Species

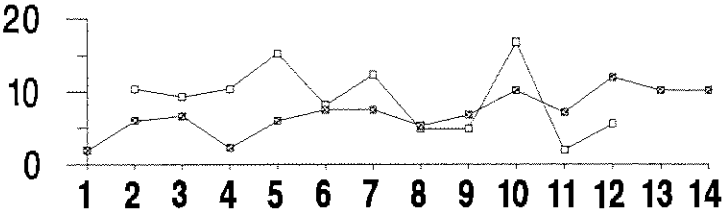
Red-bellied



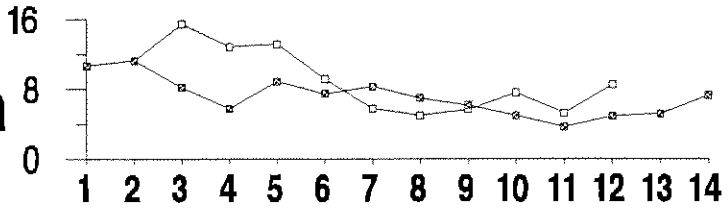
Chickadee



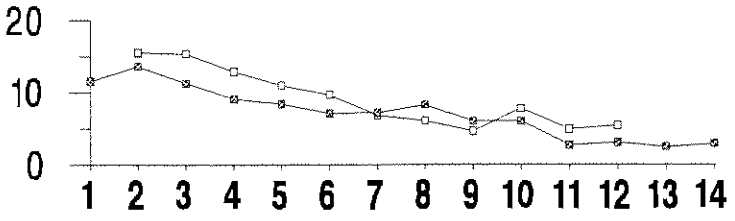
Titmouse



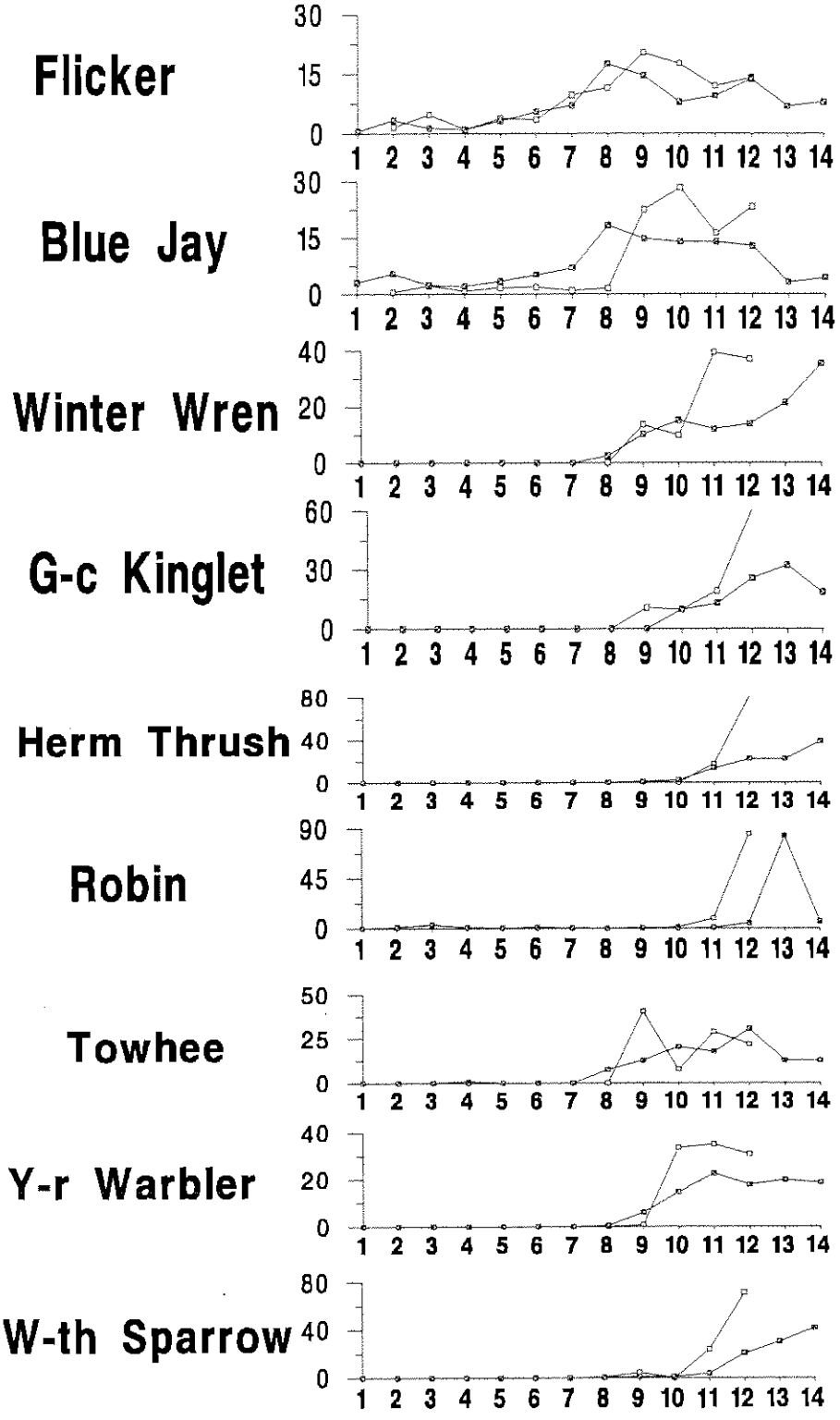
Carolina Wren



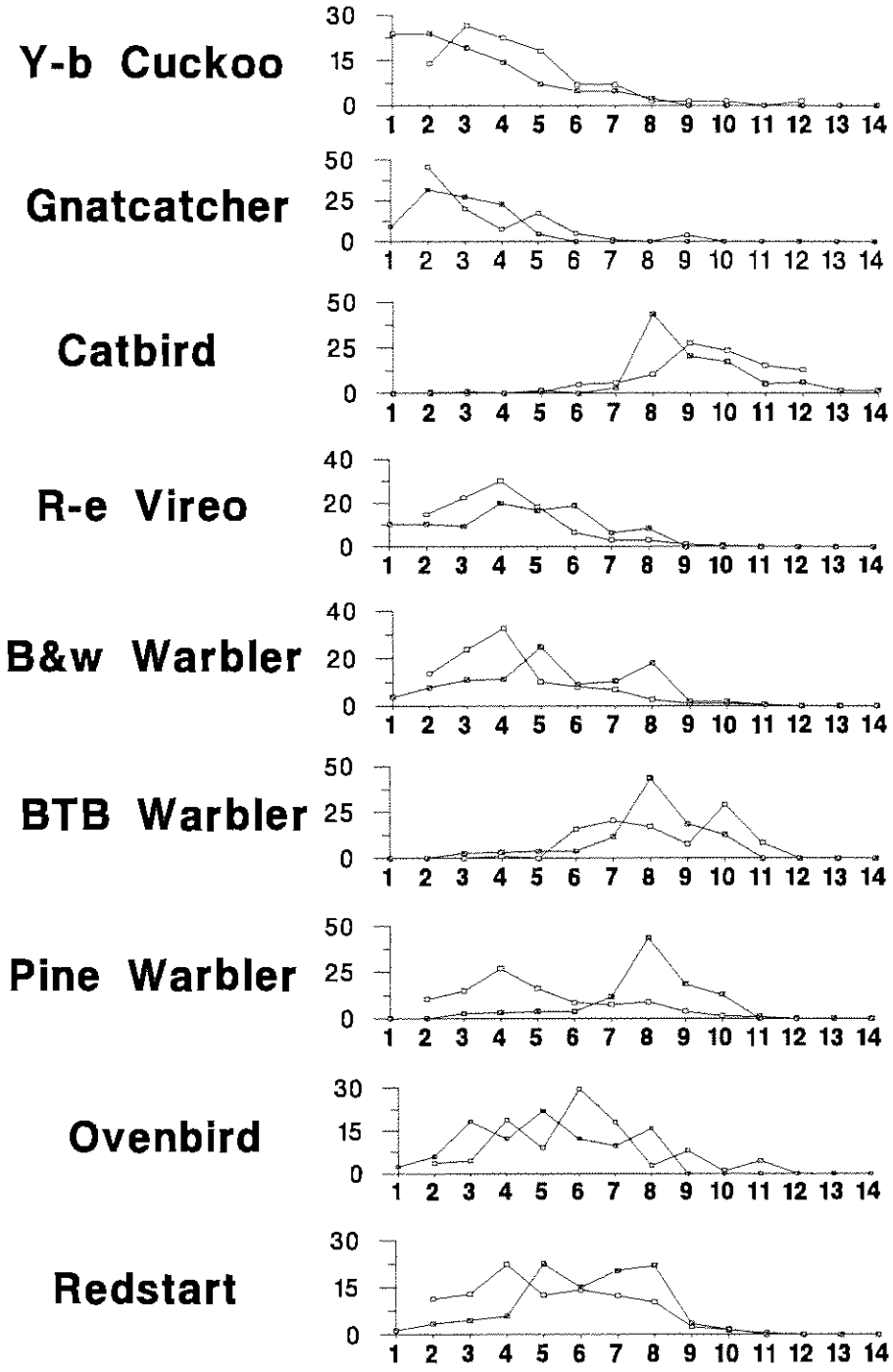
Cardinal



Seasonal Patterns in Detection Frequency
For Selected Short-distance Migrants



Seasonal Patterns in Detection Frequency For Selected Long-distance Migrants



Appendix 8: Weekly summaries of species detected throughout the study. **Table A**. presents data collected in 1992. Numbers indicate the total number of individuals detected (standardized number detected). Numbers were standardized to compensate for effects of surveys missed due to bad weather as follows: (total individuals detected/total survey routes completed)x10. **Table B**. presents data from the main study (point counts), 1993 and **Table C.** presents data from the Bayside transects, 1993.

Table A. Weekly summary of species detected. Numbers indicate total number of individuals detected (standardized number detected). Numbers were standardized as follows: (Total individuals detected/Total survey routes completed) X 10.

SPECIES	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	TOTAL
Green-backed Heron							1 (0.07)					1
American Woodcock										4 (0.26)	11 (0.63)	15
Common Bobwhite	1 (0.06)	5 (0.28)	1 (0.06)		3 (0.17)				2 (0.12)			12
Sharp-shinned Hawk					4 (0.23)	1 (0.06)	1 (0.07)	5 (0.45)	4 (0.23)	2 (0.13)	5 (0.28)	22
Cooper's Hawk					1 (0.06)			2 (0.18)		1 (0.07)	1 (0.06)	5
Red-tailed Hawk			2 (0.11)	3 (0.17)		3 (0.19)			2 (0.12)	2 (0.13)	3 (0.17)	15
Broad-winged Hawk		1 (0.06)				1 (0.06)			1 (0.06)		1 (0.06)	4
Bald Eagle											1 (0.06)	1
Osprey		1 (0.06)										1
Turkey Vulture			2 (0.11)	1 (0.06)						1 (0.07)	4 (0.23)	8
Black Vulture	1 (0.06)											1
American Kestrel					1 (0.06)				1 (0.06)		2 (0.11)	4
Merlin											2 (0.11)	2
Northern Harrier						1 (0.06)						1
Great-horned Owl	2 (0.11)	3 (.017)		1 (0.06)	4 (0.23)	1 (0.06)	1 (0.07)	1 (0.09)		1 (0.07)		14
Mourning Dove	6 (0.34)	18 (1.02)	20 (1.14)	25 (1.42)	9 (0.51)	15 (0.96)	11 (0.73)	11 (0.98)	23 (1.34)	56 (3.68)	20 (1.14)	214
Yellow-billed Cuckoo	10 (0.57)	19 (1.08)	16 (0.91)	13 (0.74)	5 (0.28)	5 (0.32)	1 (0.07)	1 (0.09)	1 (0.06)		1 (0.06)	72
Black-billed Cuckoo		1 (0.06)	1 (0.06)									2
Chuck-will's Widow	2 (0.11)		2 (0.11)	4 (0.23)		1 (0.06)			3 (0.17)			12
Ruby-throated Hummingbird	13 (0.74)	13 (0.74)	8 (0.45)	6 (0.34)	1 (0.06)	1 (0.06)						42
Belted Kingfisher									1 (0.06)			1
Red-headed Woodpecker	14 (0.80)	11 (0.63)	18 (1.02)	28 (1.59)	8 (0.45)	8 (0.51)	4 (0.26)	3 (0.27)	4 (0.23)	7 (0.46)	18 (1.02)	123
Red-bellied Woodpecker	12 (0.68)	35 (1.99)	28 (1.59)	37 (2.10)	27 (1.53)	43 (2.76)	45 (2.98)	73 (6.52)	134 (7.79)	104 (6.84)	142 (8.07)	680
Yellow-bellied Sapsucker					1 (0.06)			5 (0.45)	9 (0.52)	1 (0.07)	6 (0.34)	22
Downy Woodpecker	50 (2.84)	43 (2.44)	57 (3.24)	59 (3.35)	42 (2.39)	20 (1.28)	13 (0.86)	15 (1.34)	34 (1.98)	13 (0.86)	24 (1.36)	370
Hairy Woodpecker	2 (0.11)	3 (0.17)	6 (0.34)	1 (0.06)	5 (0.28)	3 (0.19)	3 (0.20)	4 (0.36)	2 (0.12)	3 (0.20)	3 (0.17)	35
Pileated Woodpecker	5 (0.28)		1 (0.06)	1 (0.06)	11 (0.63)	2 (0.13)	7 (0.46)	5 (0.45)	4 (0.23)	1 (0.07)	1 (0.07)	38
Northern Flicker	11 (0.63)	32 (1.82)	7 (0.40)	26 (1.48)	24 (1.36)	66 (4.23)	78 (5.17)	138 (12.32)	119 (6.92)	81 (5.33)	95 (5.40)	677
Eastern Wood Pewee	7 (0.40)	9 (0.51)	2 (0.11)	3 (0.17)		1 (0.06)	2 (0.13)	5 (0.45)			6 (0.35)	35
Acadian Flycatcher	2 (0.11)	3 (0.17)		3 (0.17)								8
Great-crested Flycatcher	2 (0.11)	5 (0.28)	3 (0.17)	7 (0.40)	4 (0.23)			2 (0.18)	1 (0.06)			24
Least Flycatcher								1 (0.09)	1 (0.06)			2
Yellow-bellied Flycatcher				3 (0.17)					6 (0.35)			9
Eastern Phoebe	1 (0.06)	3 (0.17)	1 (0.06)	1 (0.06)		1 (0.06)	7 (0.46)	12 (1.07)	6 (0.35)	18 (1.18)	13 (0.74)	63
Eastern Kingbird		18 (1.02)	4 (0.23)	1 (1.06)	1 (0.06)							24
Tree Swallow	1 (0.06)						2 (0.13)					3
Blue Jay	9 (0.51)	40 (2.27)	17 (0.97)	33 (1.88)	35 (1.99)	19 (1.22)	28 (1.85)	414 (36.96)	523 (30.41)	301 (19.80)	428 (24.32)	1847
American Crow	24 (1.36)	76 (4.32)	25 (1.42)	52 (2.95)	54 (3.07)	60 (3.85)	43 (2.85)	22 (1.96)	51 (2.97)	40 (2.63)	67 (3.81)	514
Fish Crow	26 (1.48)	30 (1.70)	82 (4.66)	102 (5.80)	39 (2.22)	18 (1.15)	18 (1.19)	1 (0.09)	1 (0.06)	7 (0.46)	12 (0.68)	336
Carolina Chickadee	289 (16.42)	344 (19.55)	280 (15.91)	250 (14.20)	178 (10.11)	145 (9.29)	145 (9.60)	114 (0.18)	180 (10.47)	153 (10.07)	205 (11.65)	2283
Brown Creeper							6 (0.40)	4 (0.36)	7 (0.41)	15 (0.99)	25 (1.42)	57
Tufted Titmouse	28 (1.59)	25 (1.42)	28 (1.59)	41 (2.33)	22 (1.25)	33 (2.12)	13 (0.06)	13 (1.16)	45 (2.68)	5 (0.33)	15 (0.85)	268
White-breasted Nuthatch	1 (0.06)	1 (0.06)										2
Red-breasted Nuthatch								1 (0.09)	1 (0.06)	2 (0.13)		4
Brown-headed Nuthatch		1 (0.06)										1

SPECIES	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	TOTAL
House Wren				1 (0.06)	10 (0.57)	7 (0.45)	10 (0.66)	3 (0.27)	4 (0.23)	3 (0.20)	11 (0.63)	49
Winter Wren								11 (0.98)	8 (0.47)	32 (2.11)	30 (1.70)	81
Carolina Wren	342 (19.43)	470 (26.70)	391 (22.22)	399 (22.67)	277 (15.74)	177 (11.35)	152 (10.07)	174 (15.54)	229 (13.31)	160 (10.53)	256 (14.55)	3027
Ruby-crowned Kinglet								20 (1.79)	25 (1.45)	78 (5.13)	18 (1.02)	141
Golden-crowned Kinglet							3 (0.20)	143 (12.77)	128 (7.44)	256 (16.84)	810 (46.02)	1340
Blue-gray Gnatcatcher	37 (2.10)	16 (0.91)	6 (0.34)	14 (0.80)	4 (0.23)	1 (0.06)		3 (0.27)				81
Eastern Bluebird		1 (0.06)		5 (0.28)								6
Wood Thrush		2 (0.11)	1 (0.06)		1 (0.06)			4 (0.36)	6 (0.35)	2 (0.13)		16
Swainson's Thrush			3 (0.17)	1 (0.06)		7 (0.45)	1 (0.07)		5 (0.29)	2 (0.13)	1 (0.06)	20
Gray-cheeked Thrush			1 (0.06)	1 (0.06)		1 (0.06)	1 (0.07)	5 (0.45)	8 (0.47)	3 (0.20)	1 (0.06)	21
Hermit Thrush								1 (0.09)		23 (1.51)	108 (6.14)	132
Veery	1 (0.06)	1 (0.06)	8 (0.45)		19 (1.08)	4 (0.26)		1 (0.09)	1 (0.06)	2 (0.13)		37
American Robin	16 (0.91)	36 (2.05)	9 (0.51)	5 (0.28)	8 (0.45)	4 (0.26)	1 (0.07)		10 (0.58)	120 (7.89)	1177 (66.88)	1386
Gray Catbird	1 (0.06)			2 (0.11)	12 (0.68)	14 (0.90)	26 (1.72)	69 (6.16)	59 (3.43)	38 (2.50)	32 (1.82)	253
Mockingbird	4 (0.23)	3 (0.17)		3 (0.17)	2 (0.11)	1 (0.06)	1 (0.07)	2 (0.18)	1 (0.06)		3 (0.17)	20
Brown Thrasher		3 (0.17)			7 (0.40)	10 (0.64)	2 (0.13)	15 (1.34)	7 (0.41)	2 (0.13)	1 (0.06)	47
Cedar Waxwing	6 (0.34)	2 (0.11)	3 (0.17)		3 (0.17)	1 (0.06)	4 (0.26)		9 (0.52)	8 (0.53)		36
Eastern Meadowlark											1 (0.06)	1
European Starling	66 (3.75)	88 (5.00)	60 (3.41)	93 (5.28)	3 (0.17)	26 (1.67)	17 (1.13)		39 (2.27)	35 (2.30)	45 (2.56)	472
White-eyed Vireo	4 (0.23)	5 (0.28)	4 (0.23)	5 (0.28)	2 (0.11)							20
Solitary Vireo	1 (0.06)							2 (0.18)	8 (0.47)	10 (0.66)	4 (0.23)	25
Red-eyed Vireo	29 (1.65)	44 (2.50)	59 (3.35)	36 (2.05)	13 (0.74)	6 (0.38)	6 (0.40)	2 (0.18)	1 (0.06)			196
Warbling Vireo		1 (0.06)										1
Philadelphia Vireo		8 (0.45)	1 (0.06)	2 (0.06)	2 (0.11)		4 (0.26)		3 (0.17)			20
Blue-winged Warbler	1 (0.06)	3 (0.17)	6 (0.34)	2 (0.11)								12
Golden-winged Warbler		1 (0.06)			2 (0.11)							3
Tennessee Warbler							2 (0.13)	4 (0.36)				6
Nashville Warbler						1 (0.06)						1
Northern Parula					3 (0.17)	13 (0.83)	6 (0.40)	4 (0.36)	6 (0.35)			32
Black-and-white Warbler	58 (3.30)	102 (5.80)	140 (7.95)	43 (2.44)	34 (1.93)	29 (1.86)	11 (0.73)	4 (0.36)	4 (0.23)	2 (0.13)		427
Black-throated Blue Warbler			2 (0.11)		25 (1.42)	32 (2.05)	27 (1.79)	12 (1.07)	46 (2.67)	13 (0.86)		157
Cerulean Warbler			3 (0.17)									3
Blackburnian Warbler		2 (0.11)	1 (0.06)						1 (0.06)			4
Chestnut-sided Warbler						1 (0.06)	1 (0.07)					2
Cape May Warbler						1 (0.06)	1 (0.07)					2
Magnolia Warbler		1 (0.06)	4 (0.23)		2 (0.11)	8 (0.51)	2 (0.13)		6 (0.35)			23
Yellow-rumped Warbler								12 (1.07)	594 (34.53)	619 (40.72)	547 (31.08)	1772
Black-throated Green Warbler		1 (0.06)	1 (0.06)	1 (0.06)	1 (0.06)		3 (0.20)	1 (0.09)	5 (0.29)			13
Yellow-throated Warbler		3 (0.17)	3 (0.17)		3 (0.17)	1 (0.06)			1 (0.06)			11
Prairie Warbler				2 (0.11)	1 (0.06)	1 (0.06						4
Bay-breasted Warbler						3 (0.19)		2 (0.18)		1 (0.07)		6
Pine Warbler	44 (2.50)	63 (3.58)	114 (6.48)	68 (3.86)	36 (2.05)	32 (2.05)	38 (2.52)	15 (1.34)	6 (0.35)	4 (0.26)		420
Palm Warbler									10 (0.58)	3 (0.20)	2 (0.11)	15
Mourning Warbler				1 (0.06)								1
Connecticut Warbler		1 (0.06)							1 (0.06)			2
Kentucky Warbler	1 (0.06)	1 (0.06)										2

SPECIES	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	TOTAL
Canada Warbler	2 (0.11)		5 (0.28)	1 (0.06)								8
Wilson's Warbler			1 (0.06)		1 (0.06)							2
Worm-eating Warbler	8 (0.45)	2 (0.11)	4 (0.23)		1 (0.06)							15
Ovenbird	4 (0.23)	5 (0.28)	21 (1.19)	10 (0.57)	33 (1.88)	20 (1.28)	3 (0.20)	9 (0.80)	1 (0.06)	5 (0.33)		111
Louisiana Waterthrush	7 (0.40)	1 (0.06)	1 (0.06)			1 (0.06)						10
Northern Waterthrush	6 (0.34)	3 (0.17)	9 (0.51)	1 (0.06)	4 (0.23)		1 (0.07)					24
Common Yellowthroat	2 (0.11)	4 (0.23)	5 (0.28)	4 (0.23)	9 (0.51)	6 (0.38)	4 (0.26)	3 (0.27)	5 (0.29)	3 (0.20)		45
American Redstart	91 (5.17)	104 (5.91)	180 (10.23)	101 (5.74)	115 (6.53)	99 (6.35)	84 (5.56)	19 (1.70)	11 (0.64)	4 (0.26)		808
Blue Grosbeak	2 (0.11)	4 (0.23)	7 (0.40)					48 (1.2)				13
Rose-breasted Grosbeak		2 (0.11)				2 (0.13)						4
Northern Cardinal	162 (9.20)	161 (9.15)	135 (7.67)	115 (6.53)	102 (5.80)	71 (4.55)	64 (4.24)	48 (1.29)	82 (4.77)	51 (3.36)	57 (3.24)	1048
Indigo Bunting	11 (0.63)	17 (0.97)	1 (0.06)		1 (0.06)							30
Rufous-sided Towhee			1 (0.06)					48 (4.29)	9 (0.52)	34 (2.24)	26 (1.48)	118
Song Sparrow									1 (0.06)	10 (0.66)	48 (2.73)	59
Field Sparrow											12 (0.68)	12
Chipping Sparrow								1 (0.09)				1
White-throated Sparrow							1 (0.07)	8 (0.71)		43 (2.83)	128 (7.27)	180
White-crowned Sparrow										1 (0.07)	2 (0.11)	3
Swamp Sparrow									1 (0.06)	4 (0.26)	29 (1.65)	34
Savannah Sparrow									1 (0.06)			1
Dark-eyed Junco								2 (0.18)		2 (0.13)	29 (1.65)	33
Red-winged Blackbird	2 (0.11)			30 (1.70)							12 (0.68)	44
Brown-headed Cowbird	1 (0.06)		20 (1.14)	1 (0.06)							1 (0.06)	23
Common Grackle	263 (14.94)	42 (2.39)	123 (6.99)	191 (10.85)	220 (12.50)	20 (1.28)	203 (13.44)	93 (8.30)	16 (0.93)	7 (0.46)	68 (3.86)	1246
Northern Oriole		3 (0.17)	22 (1.25)	8 (0.45)				2 (0.18)				35
Scarlet Tanager			1 (1.06)	5 (0.28)	1 (0.06)							7
Summer Tanager	7 (0.40)	14 (0.80)	19 (1.08)	25 (1.42)	2 (0.11)							67
American Goldfinch		1 (0.06)		1 (0.06)								2
UID Flycatcher		1 (0.06)	3 (0.17)	2 (0.11)	2 (0.11)	5 (0.32)	8 (0.53)	7 (0.63)	1 (0.06)	3 (0.20)		32
UID Crow			9 (0.51)	1 (0.06)		1 (0.06)	13 (0.86)	5 (0.45)	3 (0.17)	5 (0.33)	1 (0.06)	38
UID Thrush	1 (0.06)	1 (0.06)	1 (0.06)	1 (0.06)	5 (0.28)	10 (0.64)	1 (0.07)		12 (0.70)	9 (0.59)	5 (0.28)	46
UID Vireo	1 (0.06)		2 (0.11)	1 (0.06)	1 (0.06)		1 (0.07)					6
UID Warbler	4 (0.23)	6 (0.34)	15 (0.85)	3 (0.17)	13 (0.74)	45 (2.88)	44 (2.91)	4 (0.36)	44 (2.56)	15 (0.99)	1 (0.06)	194
UID Sparrow							3 (0.20)	5 (0.45)		3 (0.20)	9 (0.51)	20
UID Tanager	2 (0.11)											2
UID Bird	12 (0.68)	6 (0.34)	5 (0.28)	10 (0.57)	11 (0.63)	13 (0.83)	50 (3.31)	7 (0.63)	17 (0.99)	15 (0.99)	22 (1.25)	168
UID Hawk					5 (0.28)	7 (0.45)	1 (0.07)		4 (0.23)		1 (0.06)	18
UID Kinglet								9 (0.80)			10 (0.57)	19
UID Owl				2 (0.11)			1 (0.07)		2 (0.12)			5
UID Accipiter					1 (0.06)							1
UID Woodpecker	1 (0.06)	1 (0.06)		2 (0.11)	1 (0.06)	3 (0.19)			1 (0.06)			9
UID Waterthrush	1 (0.06)	1 (0.06)										2

Table B. Weekly summaries, main study 1993

SPECIES	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	WK13	WK14	TOTAL
Green-backed Heron	0	2	1	0	0	0	0	1	0	0	0	0	0	0	4
Great Blue Heron	0	0	3	0	0	0	0	2	0	0	0	0	0	1	6
American Woodcock	0	0	0	0	0	0	0	0	0	0	0	0	6	3	9
Common Bobwhite	13	0	16	0	3	20	3	0	0	0	0	0	1	0	56
Sharp-shinned Hawk	0	0	0	0	0	0	1	2	3	5	2	1	2	1	17
Red-tailed Hawk	0	0	0	0	1	0	0	0	1	0	1	0	1	0	4
Broad-winged Hawk	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
Red-shouldered Hawk	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Bald Eagle	0	0	0	0	0	1	0	0	0	0	0	1	0	0	2
American Kestrel	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Merlin	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Great-horned Owl	1	1	0	1	0	4	1	0	0	2	0	1	1	0	12
Screech Owl	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Mourning Dove	7	5	9	14	4	7	10	5	1	17	2	0	0	18	99
Yellow-billed Cuckoo	10	10	8	6	3	2	2	1	0	0	0	0	0	0	42
Black-billed Cuckoo	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
Chuck-will's Widow	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Ruby-throated Hummingbird	4	3	1	1	0	2	0	0	0	0	0	0	0	0	11
Red-headed Woodpecker	0	6	5	1	13	3	3	2	0	0	0	0	2	0	35
Red-bellied Woodpecker	11	15	18	10	11	12	20	22	14	15	7	17	12	17	201
Yellow-bellied Sapsucker	0	0	0	0	0	0	0	0	3	2	1	1	2	3	12
Downey Woodpecker	20	22	14	13	16	9	18	20	10	13	6	12	4	14	191
Hairy Woodpecker	3	1	1	4	0	3	0	2	2	1	0	1	4	4	26
Pileated Woodpecker	0	0	1	0	0	0	0	0	1	1	0	0	0	1	4
Norther Flicker	2	14	5	4	12	21	27	67	55	30	36	52	26	30	381
Eastern Wood Pewee	3	6	2	0	0	2	1	5	1	1	0	0	0	0	21
Acadian Flycatcher	0	0	0	0	2	0	0	1	0	0	0	0	0	0	3

SPECIES	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	WK13	WK14	TOTAL
Great-crested Flycatcher	5	2	1	3	6	3	0	1	0	0	0	0	0	0	21
Least Flycatcher	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Eastern Phoebe	0	0	0	0	0	0	0	5	8	6	1	0	1	11	32
Eastern Kingbird	0	0	2	1	6	0	0	0	0	0	0	0	0	0	9
Blue Jay	12	21	9	8	13	20	27	71	67	54	15	49	12	17	385
American Crow	4	19	1	6	9	18	12	7	1	14	6	0	6	4	107
Fish Crow	2	5	5	26	9	3	0	0	0	1	0	0	0	1	52
Carolina Chickadee	109	113	103	93	63	85	85	126	83	150	92	68	72	83	1325
Brown Creeper	0	0	0	0	0	0	0	2	2	16	7	8	6	17	58
Tufted Titmouse	5	16	18	6	16	20	20	14	18	27	19	32	27	27	265
White-breasted Nuthatch	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2
Red-breasted Nuthatch	0	0	0	0	0	0	10	31	25	13	11	46	7	10	153
Brown-headed Nuthatch	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
House Wren	0	0	0	0	0	1	0	5	3	1	0	0	0	0	10
Winter Wren	0	0	0	0	0	0	0	2	8	12	1	11	17	28	79
Carolina Wren	184	202	142	100	153	129	143	121	106	87	63	85	90	126	1732
Ruby-crowned Kinglet	0	0	0	0	0	0	0	2	5	12	22	25	30	11	107
Golden-crowned Kinglet	0	0	0	0	0	0	0	1	5	65	85	168	213	122	659
Blue-gray Gnatcatcher	2	7	6	5	1	0	0	1	0	0	0	0	0	0	22
Eastern Bluebird	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2
Wood Thrush	0	0	0	0	0	1	0	6	2	0	0	1	0	0	10
Swainson's Thrush	0	0	0	0	1	1	0	5	0	0	0	0	0	0	7
Gray-cheeked Thrush	0	0	0	0	0	0	0	2	5	1	0	0	0	0	8
Hermit Thrush	0	0	0	0	0	0	0	0	1	3	17	28	28	49	126
Veery	0	0	0	3	25	7	5	3	0	0	0	0	0	0	43
American Robin	0	22	111	7	1	22	5	2	16	1	7	141	2639	191	3165
Gray Catbird	0	0	1	0	2	0	4	58	27	23	7	8	2	2	134

SPECIES	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	WK13	WK14	TOTAL
Mockingbird	2	1	3	0	7	5	1	3	2	1	1	1	0	0	27
Brown Thrasher	0	0	0	0	0	1	4	20	7	0	0	1	0	0	33
Cedar Waxwing	0	0	0	0	0	1	0	17	0	6	0	6	47	2	79
European Starling	0	22	51	36	29	34	16	5	2	41	28	3	90	1	358
White-eyed Vireo	2	5	4	3	1	0	0	0	0	0	0	0	0	0	15
Solitary Vireo	0	0	0	0	0	0	1	0	0	2	0	1	1	0	5
Red-eyed Vireo	10	10	19	9	16	18	6	8	0	0	0	0	0	0	96
Warbling Vireo	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Blue-winged Warbler	1	0	2	1	0	0	0	0	0	0	0	0	0	0	4
Tennessee Warbler	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
Nashville Warbler	0	0	0	0	0	0	2	1	0	1	0	0	0	0	4
Northern Parula	0	0	0	0	0	0	11	58	9	5	0	0	0	0	83
Black-and-white Warbler	8	17	24	25	55	20	23	40	4	4	1	0	0	0	221
Black-throated Blue Warbler	0	0	5	6	7	7	22	82	35	24	0	0	0	0	188
Blackburnian Warbler	0	0	0	0	0	1	0	4	0	0	0	0	0	0	5
Chestnut-sided Warbler	0	0	2	4	0	1	3	0	0	0	1	0	0	0	11
Cape May Warbler	0	0	0	0	0	0	0	1	11	1	2	0	0	0	15
Magnolia Warbler	0	0	1	1	0	1	5	20	2	0	0	0	0	0	30
Yellow-rumped Warbler	0	0	0	0	0	0	0	5	56	138	212	167	186	177	941
Black-throated Green Warbler	0	0	0	0	0	0	6	6	5	2	2	0	0	0	21
Yellow-throated Warbler	0	2	1	0	2	1	1	1	0	0	0	0	0	0	8
Prairie Warbler	0	1	0	1	0	0	1	0	0	0	0	0	0	0	3
Bay-breasted Warbler	0	0	0	0	0	0	1	0	2	0	0	0	0	1	4
Blackpoll Warbler	0	0	0	0	0	0	0	3	6	3	1	2	0	0	15
Pine Warbler	12	35	42	28	19	45	57	18	8	8	2	2	0	1	277
Palm Warbler	0	0	0	0	0	0	0	9	6	14	2	0	2	1	34
Connecticut Warbler	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1

SPECIES	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	WK13	WK14	TOTAL
Hooded Warbler	0	3	0	0	1	0	0	1	0	0	0	0	0	0	5
Canada Warbler	0	0	2	1	0	0	1	0	0	0	0	0	0	0	4
Worm-eating Warbler	2	4	6	6	0	0	0	0	0	0	0	0	0	0	18
Ovenbird	2	6	15	10	18	10	8	13	0	0	0	0	1	0	83
Louisiana Waterthrush	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Northern Waterthrush	2	0	1	0	1	1	0	2	0	0	0	0	0	0	7
Common Yellowthroat	0	0	0	1	0	0	0	6	2	1	1	0	1	0	12
American Redstart	13	36	45	59	226	151	207	221	35	17	0	1	0	0	1011
Prothonotary Warbler	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Blue Grosbeak	2	1	1	0	0	1	0	0	0	0	3	0	0	0	8
Rose-breasted Grosbeak	0	0	0	0	0	0	2	10	0	0	0	0	0	0	12
Evening Grosbeak	0	0	0	0	0	0	0	0	0	0	5	0	3	0	8
Northern Cardinal	114	138	113	90	83	70	71	82	59	59	27	31	15	29	991
Indigo Bunting	9	0	0	0	0	1	0	2	8	1	1	0	0	0	22
Rufous-sided Towhee	0	0	0	0	0	0	0	3	5	8	3	10	5	5	39
Fox Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
Song Sparrow	0	0	0	0	0	0	0	0	0	0	0	3	3	7	13
Field Sparrow	0	0	0	3	0	0	0	0	0	4	0	2	0	0	9
Chipping Sparrow	0	0	0	0	0	0	0	0	1	2	7	0	6	6	22
White-throated Sparrow	0	0	0	0	0	0	0	1	2	3	11	55	80	100	262
Swamp Sparrow	0	0	0	0	0	0	0	0	0	0	0	2	0	5	7
Dark-eyed Junco	0	0	0	0	0	0	0	0	0	1	1	1	9	36	48
Red-winged Blackbird	0	0	1	0	0	0	0	0	0	0	0	0	1	0	2
Rusty Blackbird	0	0	0	0	0	0	0	0	0	0	0	0	51	4	55
Brown-headed Cowbird	2	0	0	0	1	0	0	0	0	0	0	0	0	0	3
Common Grackle	138	189	298	50	77	120	15	1	207	3	50	3	463	1	1615
Boat-tailed Grackle	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1

SPECIES	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	WK13	WK14	TOTAL
Northern Oriole	0	0	4	2	22	46	5	4	0	0	0	0	0	0	83
Scarlet Tanager	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
Summer Tanager	5	7	6	1	2	4	4	1	0	1	0	0	0	0	31
Purple Finch	0	0	0	0	0	0	0	0	2	2	1	2	14	3	24
House Finch	2	0	0	0	0	0	0	0	4	1	1	0	0	0	8
Pine Siskin	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
American Goldfinch	1	1	0	0	0	0	0	8	0	4	0	3	1	9	27
UID Flycatcher	0	0	0	1	4	0	2	2	0	0	0	1	0	0	10
UID Crow	0	2	0	2	3	0	0	0	0	0	0	0	0	0	7
UID Thrush	0	0	0	0	2	0	0	2	0	0	0	0	0	0	4
UID Vireo	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
UID Warbler	5	7	4	3	6	3	13	20	24	7	10	0	0	0	102
UID Sparrow	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1
UID Hawk	0	1	0	0	0	1	0	0	0	0	0	0	0	3	5
UID Kinglet	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
UID Woodpecker	0	1	1	1	1	1	1	2	1	2	0	0	0	0	11
UID Bird	3	3	4	7	2	8	5	3	6	10	2	2	0	2	57
Total	734	987	1139	667	956	952	892	1290	978	951	782	1063	4202	1197	14729

Table C. Weekly summaries, bayside transects 1993

SPECIES	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	WK13	WK14	TOTAL
Great Blue Heron	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
American Woodcock	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
Sharp-shinned Hawk	0	0	0	0	0	1	2	0	1	6	5	0	2	3	20
Cooper's Hawk	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Red-tailed Hawk	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Broad-winged Hawk	0	0	0	0	0	1	0	0-	0	0	0	0	0	0	1
Bald Eagle	0	0	0	0	1	1	2	0	0	0	0	0	0	0	4
Osprey	1	0	0	1	1	0	0	0	0	0	1	0	0	0	4
Merlin	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Peregrine Falcon	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Great-horned Owl	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1
Barred Owl	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Mourning Dove	13	10	9	1	5	2	2	1	0	6	9	2	0	0	60
Yellow-billed Cuckoo	4	3	0	0	2	1	1	0	0	0	0	0	0	0	11
Black-billed Cuckoo	1	0	0	0	0	0	0	1	0	0	0	0	0	0	2
Chuck-will's Widow	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Ruby-throated Hummingbird	5	2	11	0	1	0	0	0	0	0	0	0	0	0	19
Red-headed Woodpecker	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2
Red-bellied Woodpecker	4	5	4	2	2	3	2	5	1	0	1	6	3	4	42
Yellow-bellied Sapsucker	0	0	0	0	0	0	0	0	0	1	2	0	0	0	3
Downey Woodpecker	6	1	5	2	5	6	1	2	1	4	1	4	4	0	42
Hairy Woodpecker	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
Pileated Woodpecker	0	0	1	2	0	0	0	2	0	0	0	0	0	0	5
Norther Flicker	2	6	3	6	0	3	8	12	26	6	8	9	5	5	99
Eastern Wood Pewee	0	1	0	0	3	0	3	1	0	0	1	0	0	0	9
Acadian Flycatcher	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2
reat-crested Flycatcher	0	0	1	0	4	0	0	0	0	0	0	0	0	0	5

SPECIES	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	WK13	WK14	TOTAL
Willow Flycatcher	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2
Yellow-bellied Flycatcher	0	0	0	0	1	1	0	0	0	0	0	0	0	-	2
Eastern Phoebe	0	0	0	0	0	0	0	2	1	0	0	0	0	0	3
Eastern Kingbird	0	11	201	57	20	16	0	0	0	0	0	0	0	0	305
Barn Swallow	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Blue Jay	1	5	2	3	3	8	12	33	40	10	29	11	21	7	185
American Crow	0	0	0	0	0	10	0	0	0	0	0	0	0	0	10
Fish Crow	4	0	0	1	33	0	0	0	0	1	0	0	0	0	39
Carolina Chickadee	82	54	44	14	30	26	8	36	31	30	35	41	39	25	495
Brown Creeper	0	0	0	0	0	0	0	0	2	6	4	5	3	0	20
Tufted Titmouse	1	2	2	4	1	4	1	6	3	3	11	20	11	58	127
White-breasted Nuthatch	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Red-breasted Nuthatch	0	0	0	0	0	6	9	25	48	18	27	20	50	17	220
House Wren	0	0	0	0	0	0	1	0	0	1	0	0	1	0	3
Winter Wren	0	0	0	0	0	0	0	0	2	3	14	0	18	4	40
Carolina Wren	103	84	70	28	25	30	34	27	25	13	30	22	31	23	545
Ruby-crowned Kinglet	0	0	0	0	0	0	0	0	10	9	48	14	104	11	196
Golden-crowned Kinglet	0	0	0	0	0	0	0	0	8	17	44	58	323	49	499
Blue-gray Gnatcatcher	45	5	21	4	6	11	0	0	0	0	0	0	0	0	92
Wood Thrush	0	0	0	0	0	1	0	0	2	1	1	0	0	0	5
Swainson's Thrush	0	0	0	0	1	0	0	0	0	0	1	0	0	0	2
Gray-cheeked Thrush	0	0	0	0	0	0	1	1	1	1	1	0	0	0	5
Hermit Thrush	0	0	0	0	0	0	0	0	0	2	27	16	41	20	106
Veery	0	0	2	0	12	15	2	0	1	0	0	0	0	0	32
American Robin	9	0	1	2	8	1	0	0	2	0	2	30	116	15	186
Gray Catbird	0	0	0	0	0	1	0	15	14	6	8	0	2	0	46
Mockingbird	3	0	0	0	4	0	1	0	0	0	0	0	0	1	9

SPECIES	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	WK13	WK14	TOTAL
Brown Thrasher	0	0	0	0	0	0	3	4	2	0	0	1	0	1	11
European Starling	0	0	0	0	0	0	0	0	0	0	0	50	0	0	50
White-eyed Vireo	14	4	16	9	18	4	0	0	0	0	0	0	0	0	65
Red-eyed Vireo	5	7	10	3	31	4	1	5	0	0	0	0	0	0	66
Blue-winged Warbler	0	1	4	0	0	0	0	0	0	0	0	0	0	0	5
Lawrence's Warbler	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Northern Parula	0	0	0	0	0	2	2	21	1	0	0	0	0	0	26
Yellow Warbler	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Black-and-white Warbler	7	11	12	7	77	15	1	19	3	1	0	0	0	0	154
Black-throated Blue Warbler	0	0	0	2	2	5	2	32	11	7	3	0	0	0	64
Blackburnian Warbler	0	0	0	0	1	0	0	2	0	0	0	0	0	0	3
Chestnut-sided Warbler	0	0	1	0	0	1	1	0	0	0	0	0	0	0	3
Cape May Warbler	0	0	0	0	0	0	2	18	5	2	1	1	0	0	29
Magnolia Warbler	0	0	0	0	1	7	1	4	2	0	0	0	0	0	15
Yellow-rumped Warbler	0	0	0	0	0	0	0	1	35	50	569	217	219	91	1182
Black-throated Green Warbler	0	0	0	0	0	2	1	7	1	0	3	3	0	0	17
Yellow-throated Warbler	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Prairie Warbler	10	1	3	3	2	7	0	5	0	0	0	0	0	0	31
Blackpoll Warbler	0	0	0	0	0	0	5	3	9	2	3	3	0	0	25
Pine Warbler	26	25	17	6	57	3	3	6	6	0	0	2	0	0	151
Palm Warbler	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
Mourning Warbler	0	0	0	0	0	5	0	0	0	0	0	0	0	0	5
Kentucky Warbler	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Hooded Warbler	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Canada Warbler	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Wilson's Warbler	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Worm-eating Warbler	0	0	5	0	0	0	0	0	0	0	0	0	0	0	5

SPECIES	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	WK13	WK14	TOTAL
Ovenbird	0	2	2	3	3	4	0	1	1	0	0	0	0	0	16
Northern Waterthrush	0	1	0	1	0	0	0	2	0	0	0	0	0	0	4
Common Yellowthroat	0	0	2	1	4	6	0	3	1	0	1	0	0	0	18
American Redstart	7	23	9	19	74	202	10	55	8	5	0	0	0	0	412
Prothonotary Warbler	0	2	0	1	0	0	0	0	0	0	0	0	0	0	3
Blue Grosbeak	0	0	3	1	0	1	0	0	0	0	0	0	0	0	5
Rose-breasted Grosbeak	0	0	2	0	1	0	1	0	0	0	0	0	0	0	4
Northern Cardinal	41	33	22	22	19	12	25	30	18	13	9	11	12	14	281
Indigo Bunting	1	0	0	0	0	1	0	8	1	0	0	0	0	0	11
Rufous-sided Towhee	0	0	0	0	0	0	0	0	1	1	17	0	8	3	30
Fox Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
Song Sparrow	0	0	0	0	0	0	0	0	0	0	2	0	5	0	7
Field Sparrow	1	3	1	1	0	0	0	0	0	0	0	3	0	3	12
Chipping Sparrow	0	0	0	0	0	0	1	0	0	0	2	1	0	0	4
White-throated Sparrow	0	0	0	0	0	0	0	0	0	0	13	3	24	19	59
Swamp Sparrow	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Dark-eyed Junco	0	0	0	0	0	0	0	0	0	1	8	2	20	27	58
Brown-headed Cowbird	1	0	2	0	0	0	0	0	0	0	0	0	0	0	3
Common Grackle	1	0	0	0	0	0	0	0	0	0	150	0	0	0	151
Boat-tailed Grackle	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Northern Oriole	0	0	0	0	9	0	0	2	0	0	0	0	0	0	11
Orchard Oriole	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2
Scarlet Tanager	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Summer Tanager	3	2	2	1	4	1	0	0	0	0	0	0	0	0	13
Purple Finch	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
House Finch	0	0	1	0	0	0	0	0	0	0	0	2	0	0	3
Pine Siskin	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1

SPECIES	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	WK13	WK14	TOTAL
American Goldfinch	0	0	0	0	0	0	0	2	0	0	0	2	5	1	10
UID Flycatcher	1	0	0	0	0	3	1	0	0	0	0	0	0	0	5
UID Thrush	0	0	0	0	0	1	1	1	0	0	0	0	0	0	3
UID Warbler	2	2	2	6	13	19	3	24	10	6	3	3	3	0	80
UID Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
UID Hawk	0	0	0	1	0	0	0	0	0	0	0	0	0	1	2
UID Woodpecker	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
UID Bird	2	0	1	1	3	2	2	3	1	5	4	0	0	0	24
Total	409	310	493	218	501	450	157	429	333	236	1152	515	1073	407	6686

APPENDIX 9: DRAFT VEGETATION STANDARDS

Draft proposed vegetation protection and installation standards for Northampton County revised zoning ordinance. Proposed standards are based in part on this study's finding of a strong relationship between migrant abundance and dense understory and subcanopy vegetation. The standards emphasize maintaining natural vegetation at new development sites.

E. Vegetation Protection and Installation Performance Standard.

1. Purpose. This section was adopted to protect existing vegetation and to provide for the installation of new vegetation in order to specifically:

a. provide for the protection of the natural environment;

b. provide for the protection of surface and ground water quality;

b. provide for the protection against flooding;

c. encourage economic development.; and

d. facilitate the creation of a convenient, atractive and harmonious community

2. Authority.

a. 15.1-489 as ammended.

b. 15.1-490 as ammended.

3. Jurisdiction and Exemptions.

a. This section shall apply to all development and redevelopment within the Northampton County. No department or board shall issue any permit, zoning clearance, special use permit, rezoning approval, variance approval, waiver approval, exception approval, subdivision approval or site plan review approval without compliance with the vegetation protection and installation requirements of this section. **Check definition of development and redevelopment.

b. If the provisions of this section conflict with other ordinances or regulations, the more stringent limitations or requirements shall govern or prevail to the extent of the conflict.

c. Nothing in this section is intended to prohibit agriculture, silvaculture activity, horticulture or nursery operations within the County.

d. Emergency Provisions: In the case of hurricanes or other natural disasters, the provisions of this section shall be waived by the County Administrator to the extent necessary to ensure the safety of life and property.

e. The regulations set forth herein shall apply to all real property within the County limits, subject to the following exemptions:

(1). **Individual single and two-family residential lots** whitch are zoned RV-RR, RV-R, CD-RR, CD-R1 and CD-RM shall only comply with any section dealing with the protection and replacement of special vegetation and will be exempt from all other provisions of this section.

(2). All bone fide silvaculture activities as defined herein shall be exempt from both vegetation protection and installation performance standards. "silivicultural activity" means any forest management activity, including but not limited to the harvesting of timber, the construction of roads and trails for the forest management purposes, and the preparation of property for reforestation.

(3). Wetlands mitigation plans shall be exempt from vegetation protection and installation preformance standards provided that such plan has been approved by the Northampton County Wetlands Board.

(4). Commercial nursery operations shall be exempt from vegetation protection performance standards but not the installation preformance standards as it applys to land use not operations as set forth in section xxx.

(5). Bona fide agricultural operations shall be exempt from the vegetation protection and installation performance standards. Agricultural operations are defined as tilling, planting, or harvesting of agricultural, horticultural, or forest crops, or livestock feedlot operations; including engineering operations as follows: constructsion of terraces, terrace outlets, check dams, desilting basins, dikes, ponds, ditches, strip cropping, lister furrowing, contour cultivating, contour furrowing, land drainage and land irrigation; however, this shall not include the harvesting of forest crops unless the area on which harvesting occurs is reforested artificially or naturally in accordance with the provisions the Code of Virginia, Chapter 11 Section 10.1-1100 or is converted to bona fide agricultural or improved pasture use as described in the Code of Virginia, Section 10.1163, Subsection B. In addition agricultural operations do not include the construction of roads, structures and buildings.

(6). Individual and public utilities and Utility Companies shall be exempt from vegetation protection and installation preformance standards for the purpose of maintaining or creating easements to provide safe clearance for the utility provided that a Memorandum of Understanding (MOU) with Northampton County has been executed. Such MOUs shall at a minimum:

(a). recognize the need to minimize the cutting or pruning of special vegetation which does not frustrate or substantially interfere with the intended purpose of construction or maintenance;

(b). establishes, to the extent feasible, design guidelines for construction and maintenance which identifies the saving of special vegetation as a factor to be considered in the design process;

(c). allows for a consultation process with the County prior to the commencement of major construction or maintenance or the removal of special vegetation;

(d). provides that a breach of such Understanding constitutes a violation of this ordinance and a loss of exemption from the requirements of this Ordinance.

(7). State Agencies shall be exempt from the vegetation protection and installation performance standards but shall be encouraged to follow guidance set forth herein.

(8). Federal Agencies shall be exempt from vegetation protection and installation preformance standards but shall be encouraged to follow guidance set forth herein.

(9). County Agencies shall be exempt from the vegetation protection and installation preformance standards to the extent necessary to provide services to citizens and provide for their health, safety, and welfare.

4. **Definitions.**

Berm -

Brush pile -

Buffers -

Caliper -

Canopy trees - Any and all trees in the highest strata of vegetation; trees that define the upper height limit of a forest or vegetated area.

Construction footprint - standard definition plus it shall mean the same as limits of work, limits of clearing and grading or limits of land disturbance

Critical root area -

Contiguous Cover -

Crown - The leafy/branched area of a tree.
Deciduous - Any perennial plant that annually sheds all of its leaves.

Density - The number of individuals per unit area; individuals may refer to trees, vegetation, people, or structures.

Development -

Diameter Breast Height (dbh) - The width (diameter) of a plant stem as measured at 4.5 feet above the ground surface.[1]

Drip line -

Dominant species - For each stratum of vegetation, dominant species are those that represent 50% or more of the total vegetation.

Ecosystem -

Evergreen - Any perennial plant that retains its leaves beyond the growing season and usually through the winter.

Existing tree -

Fence -

Ground cover - The lowest vegetation stratum; generally all vegetation less than 3 feet in height and comprised primarily of herbaceous plants.

hedge - proposed planting of shrub materials xxxxxx size and xxxxx height xxxx spacing to fulfill the required installation requirements

Hedgerow -

Herbaceous plants - Nonwoody plants including graminoids (grass and grasslike plants), forbs, ferns, fern allies, and nonwoody vines; (also here to include seedlings of woody plants less than three feet in height?)[1]

Indigenous plants - Any plant species believed to be present in the region prior to Columbian settlement or that has naturally migrated or migrates into the area.

Interior, landscaping -

Irrigation system -

Landscaping -

Mitigation -

Mulch -

Natural resource -

Opaque buffer -

Passive tree protection -

Perennial plant - Living for many years.[1]

Perimeter, installation -

Planting Plan or vegetation protection and installation plan -

Project envelope -

Proposed tree - tree planted to fulfill the installation requirement xxxxx size, xxxxx height?

Protected vegetation -(1) Hardwood and softwood trees 6 inches DBH, (2) Understory trees and or shrubs providing contiguous cover of 400 square feet or greater.

Protection and installation Plan or vegetation protection and installation plan-

Pruning standards -

Roadway, installation -

Replacement vegetation - (point of this definition is to clarify that replacement vegetation can not be used to fulfill the installation requirements

Row of parking spaces -

Semi-opaque buffer -

Shade tree -

Shrub - Woody vegetation usually greater than 3 feet but less than 20 feet tall, including multi-stemmed, bushy shrubs and small trees and saplings.[1]

Silviculture -
Special vegetation resource - (1) Hardwood canopy trees 24" DBH, (2)

Softwood trees 30" DBH, (3) Hardwood understory trees 6" DBH, (4) hedgerows 30 feet or greater in length and more than 15 years in age, (5) Nontidal wetland vegetation,(6) vegetation belonging to any of the following rare natural communities: a. forest communities characteristic by xxxx , b. shrub-scrub communities characteristic by xxxx and c. dune communities characteristic by xxxxxxxx

Tree protection barricade -

Tree - A woody plant 6 inches or greater in diameter at breast height and 20 feet or taller; or any plant species that has the documented ability to attain these characteristics.[1]

Tree spade -

Town -
Unincorporated
Incorporated

Understory tree -

Utility clearance -

Vegetation, native -

Village - must establish these boundaries

Vision clearance -

Wall -

Wildlife Habitat -

5. **Prohibited Vegetation Removal.**

a. Special vegetation shall not be removed from any location except for situations that meet the criteria in section 6b, 6c and 6d.

b. Protected vegetation shall not be removed:

(1). outside the construction foot print except for situations that meet the criteria in section 6.

(2). on existing slopes greater than 15% grade shall not be removed except for situations that meet the criteria in section 6.

(3). within the construction footprint if it is the only existing vegetation connected/adjacent to vegetation on a neighboring lot shall not be removed in excess of 40% of its original area unless replacement vegetation (see replacement schedule) is planted such that it connects existing vegetation on the lot in question and a neighboring lot.

(4). adjacent to and within 20 feet of existing drainage ways, swales, and ditches shall not be removed except for situations that meet the criteria in

section 6.

c. Any vegetation that will fulfill the vegetation installation requirements shall not be removed except for situations that meet the criteria in section 6.

d. Any vegetation protected by any other ordinance or regulation that applies to the site shall not be removed such as tidal wetlands, nontidal wetlands, 100 year flood plain, Chesapeake Bay/Atlantic Ocean preservation 100' buffer, coastal primary sand dunes, beaches and highly erodible soils.

6. Allowable vegetation removal.

a. Protected vegetation:

(1). within the approved construction footprint may be removed when it falls in the location of proposed buildings, stormwater facilities, roadway, parking area, loading area or sidewalk. Replacement of vegetation removed shall be required when vegetation counts for the entire lot or parcel of land drops below 20 canopy trees per acre, 30 under story trees per acre and 30 shrubs per acre. Replacement shall be based on each canopy tree, understory tree or shrub removed below these limits as specified in the replacement schedule. Development and redevelopment shall be designed to reduce vegetation removal to the greatest extent possible.

(2). outside the construction footprint may be removed for personal uses such as firewood or construction of small accessary structures under 150 square feet provided no special vegetation resources are removed and 20 canopy trees per acre, 30 understory trees per acre and 30 shrubs per acre is maintained. Replacement shall be based on each canopy tree, understory tree or shrub removed below these limits as specified in the replacement schedule.

b. Canopy trees of species with the documented ability to achieve heights of more than 20 feet that are located within 20 feet of a permanent structure may be removed, provided that for each tree removed, replacement vegetation is planted as specified in the replacement schedule.

c. Understory trees and or shrubs within or outside the construction footprint to create a view shed a maximum length of 50% of the length of the longest side of the primary structure on a lot or parcel of land provided that a continuous tree canopy is maintained. A corner lot may designate one side as a primary view shed a maximum length of 50% of the length of the longest side of the primary structure and a secondary view shed a maximum of 25% of the length of the longest side of the primary structure on a lot or parcel of land provided that a continuous tree canopy is maintained. The view shed length can be contiguous or broken into sections, but is limited to the percentage stated above. Each understory tree and or shrub remove shall be replaced base on the replacement schedule. Replacement vegetation shall be located such that it connects separate patches of existing vegetation or is added to the edge of existing vegetation. Understory trees and shrubs remove outside the construction footprint shall be done by hand or with light equipment with rubber tires (not tracts). Removal of vegetation within the 100 foot buffer shall comply fully with the Chesapeake Bay/ Atlantic Ocean Preservation Overlay District.

d. When determined by the Zoning Administrator, trees or shrubs infected by

deadly or contagious fungi, insects, or parasites and trees or shrubs severely damaged by natural forces including wind, fire, and lightening that are a hazard to life and property may be removed provided that, in recognition of the wildlife value of dead and dying trees or shrubs, a brush pile be established within the area of protected vegetation. Condition must be documented before removal. Professional verification of the condition can be requested by the Zoning Administrator, when he/she determines the vegetation does not meet the above criteria. The Zoning Administrator may use the services and technical assistance provided by the Virginia Department Forestry and the Northampton County Extension Service when determining the health of vegetation. If professional verification can not be provided, a variance must be granted by the Board of Zoning Appeals to remove the vegetation.

7. Replacement Schedule.

a. Replacement vegetation required by standards set forth in this section shall be planted such that:

(1). ratios of removed trees or shrubs to replacement trees or shrubs follows the schedule below.

(2). replacement vegetation shall be native to the area and preferably drawn from the list provided in Appendix A of this section and of the same species as the removed vegetation when possible. If this is not possible the replacement vegetation shall be of similar characteristics to the removed vegetation.

(3). plantings enhance connectivity with existing vegetation.

(4). plantings are not placed in locations proposed for future additions or expansion or in the way of vision clearance.

(5). replacement vegetation that is projected to reach a height of 20 feet or more shall not be planted under power lines.

(6). replacement vegetation shall not fulfill the vegetation installation requirements; replacement vegetation may be required above and beyond the number of plants required to meet the vegetation installation requirements.

(7). replacement vegetation must be planted on the same property from which vegetation was originally removed.

(8). replacement schedule chart.

REPLACEMENT SCHEDULE

REMOVED VEGETATION		REPLACEMENT VEGETATION	
TYPE	SIZE	TYPE	SIZE
Softwood Canopy Tree	12 - 24" DBH	1A	A ≥ 1" Dia. & 4' in height
	24 - 30" DBH	1A + 1B or 1A + 1C	A ≥ 1" Dia. & 4' in height B ≥ 1" Dia. & 2' in height C ≥ 8" GCW & 1' in height
	> 30" DBH	2A or 1A + 2B or 1A + 2B or 1A + 2C	A ≥ 2" Dia. & 6' in height B ≥ 1" Dia. & 2' in height C ≥ 8" GCW & 1' in height
Hardwood Canopy Tree	6 - 12" DBH	1A	A ≥ 1" Dia. & 4' in height
	12 - 24" DBH	1A + 1B or 1A + 1C	A ≥ 1" Dia. & 4' in height B ≥ 1" Dia. & 2' in height C ≥ 8" GCW & 1' in height
	> 24" DBH	2A or 1A + 2B or 1A + 2C	A ≥ 2" Dia. & 6' in height B ≥ 1" Dia. & 2' in height C ≥ 8" GCW & 1' in height
Understory Tree	3 - 6" DBH	1B	B ≥ 1" Dia. & 2' in height
	> 6" DBH	2B or 1B + 1C	B ≥ 2" Dia. & 4' in height C ≥ 8" GCW & 1' in height
Shrub	1 - 2' GCW	1C	C ≥ 8" GCW & 1' in height
	> 2' GCW	2C	C ≥ 1' GCW & 18" in height
Dying/Sick Tree/Shrub	All	Brushpile	min. 3' w x 4' l x 2' h

A = Canopy Tree, B = Understory Tree and C = Shrub
DBH = Diameter Breast Height - 4.5' from existing grade
GCW = Greatest Crown Width or shrub crown at widest point
Dia. = Diameter of a proposed tree measured 6" from the proposed grade.

8. Vegetation Protection Standards.

a. Protective barricades are required. Protective barricades shall be placed around all protective vegetation located in a development or redevelopment areas, and designated to be saved on the approved Site Plan. Prior to the commencement of site work, protective barricades shall be installed by the constractor and inspected by the Northampton County Planning Department. This inspection can co-incide with the intial Erosion and Sediment Control Inspection and can continue as a part of the following Erosion and Sediment Control inspection throughout the project. The protective barricades shall remain in place until all site work inspected for completeness. The area within the protective barricade shall remain free of all building materials, dirt or other construction debris, vehicle and development activities. Protective barricades shall be erected according to the following standards:

(1). 5 feet outside the dripline of protected vegetation.

(2) 15 feet outside the dripline of special vegetation.

b. Construction within protective barricades. Changes in grade, construction of harden surfaces (pervious or impervious) or utilities within ther required protective barricade shall be permitted subject to the following standards:

(1). Changes in grade and construction of utilities shall comply the specification described in *The Virginia Erosion and Sediment Control Handbook* (as amended) - Chapter III, Standard and Specifications 3.37 & 3.38.

(2) Construction of hardened surfaces shall not be permitted within 5 feet of the base of protected vegetation or within 15 feet of the base of special vegetation, uless special construction methods, including but not limited to root feeders and pouous paving materials, are used and certified as acceptable by a reputable arborist or qualified organizaiton.

(3). All roots outside the protective barricade to be removed during construction shall be servered clean (root pruned) and a 2 inch layer of mulch shall be applied over the surface of the exposed roots.

(4) All pruning of protected and special vegetation shall be done in accordance with pruning standard adopted by the National Arborist Association.

9. Vegetation installation requirements. **General, where required.**

a. No new site development, redevelopment, building, structure or vehicular use area (parking lot, internal / external access ways, driveways ect...) shall hereafter occur, be erected, constructed or used, nor shall any existing building, structure or vehicular use area be expanded, unless the minimum vegetation installation is provided as required in the provisions below.

b. Existing vegetation can be used to satisfy vegetation installation requirements.

c. Replacement vegetation can not be used to satisfy vegetation installation requirements.

d. Vegetation installations can be placed within building setbacks and the CBPA 100 foot buffers.

10. Types of Installation. In order to accomplish the purpose of this Article, the following

regulations shall be utilized.

a. Roadway frontage installation requirements.

b. Parking lot periphearl / interior installation requirements.

c. Perimeter screening installation requirements.

d. Refuse collection facilities installation requirements.

e. Subdivision street trees.

f. 100 foot buffer.

11. Roadway Frontage Installation Requirements. On the site of a building or structure or open lot use providing an off-street parking, loading or other vehicular use area, where such area will ont be entirely screened visually form all adjacent public rights-of-way by an intervening building or structure, vegetation shall be required along any property boundary that abuts the public right-of-way of a public street, road or highway.

a. A planting area at least five feet (5') in depth shall be located between the abutting right-of-way and any off-street parking, loading or other vehicular use area, except where permitted driveway openings and pedestrian ways are to be provided.

The planting area shall be planted in accordance with the following standards.

(1). One (1) canopy tree shall be planted for each forty linear feet (40') of the planting area; or

(2). One (1) canopy tree grouped with one (1) understory tree shall be planted each seventy linear feet (70'); or

(3). A hedge of at least three feet (3') in height at maturity shall be planted within the planting area so as to provide a continuous element; or

(4). A combination of trees and hedge or approved wall, fence or earthberm may be utilized to form the continuous element; and

(5). All portions of the planting area not planted with hedge and trees or covered by wall or fence shall be planted in grass and/or ground cover.

b. If the roadway which the development or redevelopment fronts is included in the Street Tree Master Plan and Program, the planting area shall reflect participation in the program.

12. Parking Lot Peripheral / Interior Installation Requirements. Peripheral planting shall be provided along any side of an off-street parking, loading or other vehicular use area that abuts adjoining property and not a right-of-way of a public street, road or highway. Such planting shall be provided as follows:

a. Peripheral Parking Lot installation Requirements. A planting area at least five feet (5') in depth shall be located between the abutting property lines and the parking, loading or other vehicular use area, except where permitted driveway openings are to be provided. Where drainage or other utility easements exist along property lines, the planting area shall be located between the parking, loading or other vehicular use area and the utility or drainage

easements.

The planting area shall be planted in accordance with the following standards:

(1). One (1) canopy tree shall be planted for each fifty lineal feet (40') of the planting area; or

(2). One (1) canopy tree grouped with one (1) understory tree shall be planted each seventy linear feet (70'); or

(3). A hedge of at least three feet (3') in height shall be planted within the planting area so as to provide a continuous element; or

(4). A combination of trees and hedge, or approved wall, fence or earthberm may be utilized to form the continuous element;

(5). All portions of the planting area not planted with hedge and trees or covered by wall or fence shall be planted in grass and/or ground cover; and

(6). Parked vehicles may overhang a planting area no more than two and one-half feet (2.5'), provided curbing or other wheel stops are to be installed to insure no greater overhang or penetration of the planted areas. Plantings, walls, fences and earthberms shall be so located as to prevent their damage and/or destruction by overhanging vehicles.

b. The provisions of subsection a. shall not be applicable in the following situations:

(1). Where any off-street parking, loading or other vehicular use area will be entirely screened visually from any point of view by an intervening building or structure from abutting property; or

(2). Where planting and/or walls or fences are required to satisfy Section 13 perimeter screening standards between different land uses.

c. Interior Parking lot planting requirements. Section XI. Roadway/Street Frontage Installation Requirements and Section XII. A. Peripheral Parking Lot Installation Requirements shall not used to satisfy the interior parking lot requirements. These requirements are as follows:

(1). Planting islands.

(a). Single row planting islands - No more than ten (10) parking spaces shall be permitted in a continuous row without being interrupted by a single planting island a minimum of nine feet (9') in width and eighteen feet (18') in length. Such planting islands shall be planted with one (1) canopy tree.

(b). Two single row planting islands - In situation where a parking row has single row planting islands that can be group together, it is encouraged for design flexibility and increased root growth area to connect them into two single row planting island. No more than fifteen (15) parking spaces shall be permitted in a continuous row without being interrupted by two single row planting island a minimum of eighteen feet (18') in width and eighteen feet (18') in length. Such planting islands shall be planted with one (1) canopy tree and one (1) understory tree; or one (1) canopy tree and two (2) shrubs.

(c). Double row planting islands - In situation where adjacent parking rows have single planting islands close together, it is encouraged for design flexibility and increased root growth area to connect them into a double row planting island. No more than fifteen (15) parking spaces shall be permitted in a continuous row without being interrupted by a double row planting island a minimum of nine feet (9') in width and thirty-six feet (36') in length. Such planting islands shall be planted with one (1) canopy tree and one (1) understory tree; or one (1) canopy tree and two (2) shrubs.

(d). Two double row planting islands - In situation where adjacent parking rows have double planting islands close together, it is encouraged for design flexibility and increased row growth area to connect them into two double row planting island. No more than twenty (20) parking spaces shall be permitted in a continuous row without being interrupted by a two double row planting island a minimum of eighteen feet (18'') in width and thirty-six feet (36') in length. Such planting islands shall be planted with one (1) canopy tree and one (2) understory trees; or one (1) canopy tree and four (4) shrubs.

(2). Every fourth row of parking shall be separated by a median strip for planting purposes of not less than ten feet (10') in depth. Such median strips shall be planted with at least one (1) canopy tree per median strip except that one (1) canopy tree for every fifty feet (50') or fraction thereof shall be planted in the median strips that exceed fifty feet (50') in length. For purposes of Section XII double-backed parking areas shall be considered two rows;

(3). Each parking row shall terminate in a single row planting island a minimum of nine feet (9') in width and eighteen feet (18') in length. Such planting islands shall be planted with one (1) canopy tree or one (1) canopy tree.

(4). Parked vehicles may overhang a planting area no more than two and one-half feet (2.5'), provided curbing or other wheel stops are to be installed to insure no greater overhang or penetration of the planted areas. Plantings, walls, fences and earthberms shall be so located as to prevent their damage and/or destruction by overhanging vehicles.

13. **Perimeter Screening.** Perimeter screening shall be required to separate a proposed use from different land uses, zoning designation or roadway.

a. Perimeter screening, generally.

Perimeter screening shall vary in depth and in planting requirements according to the existing use or zoning district of the adjoining property or the classification of the adjacent road. (See attached road classification chart.)

Perimeter screening shall be located along the perimeter of a lot or parcel and shall extend to the boundary line of the lot or parcel. Perimeter screening shall not be located on any portion of an existing public or private street right-of-way. Where utility rights-of-way or drainage easements exist along property lines, the perimeter screening shall be located adjacent to the utility right-of-way or drainage easement.

Required perimeter screening shall be designated as part of platted lots and/or on an approved site plan. The following notation shall be lettered on the face of both the preliminary and final subdivision plats and/or site plans:

PERIMETER SCREENING: The use and maintenance of the perimeter screening and the building of structures thereon is restricted pursuant Article VII, Section E. of the Northampton County Zoning Ordinance.

b. Schedule of Required Perimeter Screening.

The types of buffers as specified below shall be used as the basis for the schedule of required buffer.

An opaque perimeter screening is intended to create a strong impression of spatial separation and to preclude visual contact. A semi-opaque perimeter screen is intended to maintain a sense of spatial separation and to partially block visual contact.

Compliance of planted perimeter screening will be evaluated on the basis of average height and density of plant material upon maturity. Compliance of existing vegetation to fulfill the requirements of planted perimeter screening shall be judged on the basis of field observation.

c. Perimeter Screening Types.

(1). "A" Perimeter Screening type A shall maintain a depth of fifteen feet (15') and shall be semi-opaque. Upon maturity, the perimeter screening shall not contain any completely unobstructed opening more than ten feet (10') in width.

(2). "B" Perimeter Screening type B shall maintain a depth of twenty-five feet (25') and shall be semi-opaque in all seasons of the Upon maturity, the screening shall not contain any unobstructed openings more than ten feet (10') in width.

(3). "C" Perimeter Screening type C shall maintain a depth of fifty feet (50') and shall be opaque in all seasons of the year.

(4). "D" Perimeter Screening type D shall maintain a depth of fifty feet (50') and shall be semi-opaque in all seasons of the year. Upon maturity, the buffer shall not contain any unobstructed openings more than ten feet (10') in width.

d. Road Classifications.

(1). Class I.
U. S. Route 13 - Lankford Highway

(2). Class II.
State Route 600 - Seaside Road
xxxxxxx - Bayside Road

(3). Class III.
Main Roads and Cross Roads within Rural Villages. (must be designated and mapped)
Main Roads and Cross Roads approaching and within a Community Development Areas. (must be designated and mapped)

(4). Class IV.
Neck Roads. (must be designated and mapped)

(5). Class V.
New Subdivision Roads.

(6). Class VI.
All other Roads.

e. **Chart.**

Schedule of required screening

Existing or Proposed Principle Use(s)	Adjacent Existing Land Uses or Undeveloped Land Zoning or Road Classification*											
	conservation/ agriculture/ silviculture	residential single-family	residential multi-family	office/ service/ institutional	commercial	industrial/ warehouse/ distribution manufacturing	Class 1 Roads	Class 2 Roads	Class 3 Roads	Class 4 Roads	Class 5 Roads	Class 6 Roads
residential multi-family	C	B	none required	none required	A	B						
office/ service/ institutional	C	B	A	none required	none required	none required						
commercial	C	B	B	none required	none required	none required						
industrial/ warehouse/ distribution/ manufacturing	C	C	C	B	A	none required						

* Existing land use supercedes zone district. Where more than one use occurs on the property, the most intensive use determines the standard. Road classifications are listed on the preceding page.

14. Refuse Collection. Refuse collection facilities shall be screened from view by an opaque enclosure composed of evergreen vegetation, fence, wall or a combination of the same, except as follows:

a. Where screened from view by and intervening building or structure; and

b. Excluding views from adjacent properties zoned or used for industrial purposes.

15. **Subdivision Street Trees**

16. **100 Foot Buffer.**

17. **Safety.** Pedestrain and vehicular safety in and around parking lots shall be considered when reviewing the installation plan for compliance with the requirment of this Article VII, Section E.

a. Roadway frontage and parking lot installation shall be designed to provide ready visibility into the parking facility from adjacent public sidewalks and public right-of-ways and shall not create blind or hidden areas with the facility.

b. Roadway frontage and parkinglot installation shall be designed to provide visibility to pedestrians and vehicles circulating within, entering or leaving the parking facility.

18. **Location, Species, Quality and Size of required plant material.**

19. **Inspection and Maintenance.**

20. **Submission of a vegetation protection and installation plan.**

a. Application for permits and or zoning approval.

(1). Prior to any development, redevelopment, and or land disturbing activity that disturbs or alters any [natural vegetation] and or issuance of building or other relevant permits, a landowner shall provide a scaled vegetation survey locating all existing natural vegetation and special vegetation. The site drawing shall also represent the proposed construction footprint and vegetation protection measures. (needs to be coordinated with other regulations such as site plan review requirement and CBPA requirement. also I think commercial, subdivision and residential should be different commercial - actual survey, subdivision - ??????, individual residential - plot plan verified by staff????) Vegetation protection must be shown on drawing.

(2). Review standards of vegetation survey The construction footprint will be reviewed, approved or disapproved by the Northampton County Planning and Zoning Staff based on the following criteria:

a. 60%
b. includes
c. designed to protect existing vegetation

(3). A site visit by Northampton County Planning and Zoning Staff may be necessary before approval construction footprint and commencement of any land disturbing activity if ... (Note: Should this be required before plans are drawn?)

(4). Review and approval.

(5). Implementation and inspections.

(6) Violations.

b. Application for subdivision approval.

(1). Land proposed for a subdivision can not be timber. Land which has been timbered can not be subdivided for 5 years.

(2). Requirements of plan.

(3). Review and Approval.

(4) Implementation and inspections.

(5) Violations.

Appendix A.

Suggested Vegetation Replacement Material: Trees, Shrubs, and Ground Cover Native to Northampton County, Virginia.

The following list is intended to provide guidance to landowners who must fulfill the vegetation protection standards by replacing removed vegetation or landowners who must install new vegetation as required. This list does not represent a comprehensive list of all plants native to Northampton County, rather it includes those that are both native and likely to be commercially available.

NATIVE VEGETATION RECOMMENDED FOR REPLACEMENT

CANOPY TREES			
PLANT NAME	**FOLIAGE**	**HEIGHT**	**FEATURES**
Loblolly Pine Pinus teada	Evergreen	45 ft	
Red Maple Acer rubrum	Deciduous	75 ft	
Shagbark Hickory Carya ovata	Deciduous	60-80 ft	
Pignut Hickory Carya glabra	Deciduous	50-75 ft	
Sweet Gum Liquidambar styraciflua	Deciduous	50 ft	
Tulip Poplar; Tulip Tree Liriodendron tulipifera	Deciduous	80-120 ft	
White Oak Quercus alba	Deciduous	60-90 ft	
Post Oak Quercus stellata	Deciduous	40-60 ft	
Water Oak Quercus nigra	Deciduous	60-70 ft	
Black Oak Quercus velutina	Deciduous	50-70 ft	
Willow Oak Quercus phellos	Deciduous	80-100 ft	
Black Cherry Prunus serotina	Deciduous	50-60 ft	
American Beech Fagus grandifolia	Deciduous	80 ft	
Blackgum; Tupelo Nyssa sylvatica	Deciduous	70-80 ft	
Hackberry Celtis occidentalis; C. xenaifolia	Deciduous	30-50 ft	

UNDERSTORY TREES			
PLANT NAME	**FOLIAGE**	**HEIGHT**	**FEATURES**
American Holly Ilex opaca	Evergreen	40-50 ft	
Eastern Redcedar Juniperus virginiana	Evergreen	40-50 ft	
Sweet Bay Magnolia virginiana	Evergreen	10-30 ft	
Persimmon Diospyros virginiana	Deciduous	10-50 ft	
Sassafras Sassafras albicum	Deciduous	20-40 ft	
Shad Blow Tree Amelanchier aborea	Deciduous	10-40 ft	
Downy Serviceberry Amelanchier canadensis	Deciduous	10-40 ft	
Flowering Dogwood Cornus florida	Deciduous	15-40 ft	
SHRUBS			
Inkberry Ilex glabra	Evergreen	10 ft	
Juniper Juniperus communis	Evergreen	20 ft	
Mountain Laurel Kalmia latifolia	Evergreen	15 ft	
Bayberry Myrica pensylvanica	Evergreen	10-40 ft	
Wax Myrtle Myrica cerifera	Evergreen	10-40 ft	
Red Chokeberry Aronia arbutifolia	Deciduous		
SHRUBS CONTINUED			

PLANT NAME	FOLIAGE	HEIGHT	FEATURES
Black Chokeberry Aronia melanocarpa	Deciduous		
Winterberry Ilex verticillata	Deciduous	15 ft	
Roseshell; Early Honeysuckle Azalea Rhododendron roseum	Deciduous	10 ft	
Blackberry Rubus occidentalis	Deciduous	6 ft	
Paw Paw Asimina triloba	Deciduous	6-20 ft	
Caroline Rose Rosa carolina	Deciduous		
Pink Pinxter Azalea Rhododendron nudiflorum; R. periclymenoides	Deciduous	10 ft	
Clammy Swamp Azalea Rhododendron viscosum	Deciduous	10-20 ft	
Shining Sumac; Winged Sumac Rhus copallina	Deciduous	4-10 ft	
Staghorn Sumac Rhus typhina	Deciduous	4-15 ft	
Elderberry Sambucus canadensis	Deciduous	3-15 ft	
Coralberry; Indian Currant Symphoricarpos orbiculatus	Deciduous	6 ft	
Highbush Blueberry Vaccinium corymbosum	Deciduous	12 ft	
Lowbush Blueberry Vaccinium pallidum	Deciduous	2 ft	
Arrowwood Virburnum dentatum	Deciduous	10 ft	

SHRUBS CONTINUED

PLANT NAME	FOLIAGE	HEIGHT	FEATURES
Black Haw Viburnum prunifolium	Deciduous	10-25 ft	
HARDY GROUND COVER			
Grass-leaved Blazing Star Liatrus graminifolia	Deciduous	1-3 ft	
Wild Strawberry Fragaria virginiana	Deciduous		
Virginia Rye Elymus virginicus	Deciduous		
Switch Grass Panicum virgatum	Deciduous	5 ft	
Virginia Broom Andropogon virginicus	Deciduous		
Little Blue Star Andropogon scoparius	Deciduous		
Indian Grass Sorghasum nutans	Deciduous		
Wild Rice Zizania aquatica	Deciduous		
FLOWERING PERENNIALS			
Butterfly Weed Asclepias tuberosa	Deciduous	2-3 ft	
Bushy Aster Aster dumosus	Deciduous		
New York Aster Aster novibelgii	Deciduous		
Threadleaf Coreopsis Coreopsis verticillata	Deciduous	1-2 ft	

FLOWERING PERENNIALS CONTINUED			
PLANT NAME	**FOLIAGE**	**HEIGHT**	**FEATURES**
Black-eyed Susan Rudbeckia hirta	Deciduous	1-3 ft	
Seaside Goldenrod Solidago sempervirens	Deciduous	8 ft	
Wand Goldenrod Solidago nemoralis	Deciduous		
Silverrod Solidago bicolor	Deciduous		
Meadow Beauty Rhexia mariana	Deciduous		
Marsh Mallow Hibiscus moscheutos	Deciduous	10 ft	
Prickly Pear Cactus Oprentia	Deciduous	1-2 ft	
Kostelzkya virginica	Deciduous		