Nutrient Deposition in Cattail Stands by Communally Roosting Blackbirds and Starlings

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ABSTRACT: Nutrient additions to five cattail (*Typha* spp.) stands in central New York State from droppings of roosting red-winged blackbirds (*Agelaius phoeniceus*), common grackles (*Quiscalus quiscula*), brown-headed cowbirds (*Molothrus ater*) and European starlings (*Sturnus vulgaris*) are reported. Bird numbers were estimated by counting birds as they left their roosts in the morning. Red-winged blackbirds were mistnetted as they entered a roost and were held until morning in cages lined with aluminum foil of known mass to determine the quantity of droppings excreted per bird-night. These data were used to develop a regression model to predict, from existence energy, the quantity of excreta input per bird per night. The amounts of nitrogen (N), phosphorus (P) and potassium (K) in the excreta were measured for red-winged blackbirds fed a simulated August diet and a simulated October diet. Red-winged blackbird droppings averaged 9.2% N, 1.41% P and 1.35% K. Nightly excretions of N, P and K averaged 59, 9.0 and 8.7 mg for a 39.0-g female and 75, 12 and 11 mg for a 56.0-g male. Nutrient loadings from blackbirds and starlings to the most densely populated roosts ranged up to 28, 4.3 and 4.1 kg•ha^{-1}•year^{-1} of N, P and K, respectively. These nutrient loadings are greater than those coming into the stands via precipitation and may be of similar magnitude to runoff loadings in some systems.

INTRODUCTION

Little is known about the role birds play in nutrient cycling (Sturges *et al.*, 1974; Wiens and Dyer, 1977). Wiens (1973) suggested three possible roles for birds in ecosystems: (1) they may directly affect an ecosystem through a major influence on the flow of energy or nutrients; (2) they may act as controlling factors helping to maintain stability in the system without playing a major role in energy or nutrient cycling, or (3) they may be "frills" in the ecosystem living off its excess production and having no influence on the system. Population bioenergetics has been the primary means of assessing the role of birds in ecosystems. In general, this approach has shown that birds act only as "frills," or at most play only a minor role in energy cycling (Holmes and Sturges, 1973; Wiens, 1973; Weiner and Glowacinski, 1975). Because of the necessary link between energy and nutrient cycling in birds, one might conclude that birds play at most a minor role in nutrient cycling. We present evidence to the contrary.

Few rigorous studies have directly examined the role of birds in nutrient cycling. Bedard *et al.* (1980) found that nutrient importation by seabirds to an area of the St. Lawrence estuary was negligible relative to nutrients already present in the water or nutrients flowing into the estuary from the Mitis River. Likewise, Sturges *et al.* (1974) reported that birds played only a minor role in the nutrient budget of a northern hardwoods ecosystem. These studies support the idea that birds are of little consequence in nutrient cycling, but studies by Manny *et al.* (1975) and McColl and Burger (1976) came to different conclusions. Manny *et al.* (1975) suggested that inputs of N (12.9 kg•ha^{-1}•year-1) and P (3.9 kg•ha^{-1}•year^{-1}) from migrant Canada geese (*Branta canadensis*) were the principal cause of hypereutrophic conditions in Wintergreen Lake, Michigan. McColl and Burger (1976) found that Franklin's gulls (*Larus pipixcan*) contributed 36% of the total annual P inputs to a cattail (*Typha* spp.) pool in Minnesota. These studies indicated that birds were potentially important nutrient cyclers.

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We examined the role of an abundant colonially roosting species, the red-winged blackbird (*Agelaius phoeniceus*), and three associated species, common grackles (*Quiscalus quiscula*), brown-headed cowbirds (*Molothrus ater*) and European starlings (*Sturnus vulgaris*), in the nutrient cycling of cattail stands. During the summer and autumn, these birds roost in dense aggregations in cattail stands in central New York State. They are among the most conspicuous and abundant birds using the cattail stands, and peak biomass of roosting birds probably exceeds 250 kg/ha. The birds feed outside of the marshes during the day and return at night (Bent, 1965), excreting some fraction of their daily food consumption and metabolic wastes into the cattail stands.

This study reports N, P and K inputs from roosting blackbirds and starlings to cattail stands in five marshes in central New York State.

Study Area

The five marshes we studied, Canoga, Cayuga, Montezuma National Wildlife Refuge (hereafter, Montezuma NWR), Union Springs and Watkins Glen, are located in the Finger Lakes Region of Central New York State. Except at Montezuma NWR, virtually the entire surface area of each marsh was dominated by cattails (*Typha glauca*), and there was little or no open water. Montezuma NWR contained large areas of open water and a variety of vegetation types other than cattails. We studied a part of the cattail stand in each marsh. At Montezuma NWR, part of the stand we studied was dominated by the alien purple loosestrife (*Lythrum salicaria*).

Methods and Materials

Three types of data were collected to calculate the nutrient inputs of the birds: (1) the number of birds using each cattail stand during the roosting season; (2) the quantity excreted per bird per night, and (3) the composition of the excreta. The total number of bird-nights (*i.e.*, one bird roosting 1 night) spent in a stand was multiplied by the amount excreted per bird and by the percent of each nutrient in the excreta, to calculate the quantity of nutrients added to each site by the birds.

Population estimates. — From July to December 1980, the populations of five blackbird and starling roost sites in central New York State were estimated at approximately 10-day intervals by block-counting birds (Meanley, 1965; White, 1980) as they left their roosts in the morning (Fig. 1). Species composition was usually recorded. Otherwise, it was estimated by interpolation from subsequent and prior counts. Because brown-headed cowbirds are difficult to distinguish from red-winged blackbirds in flight and their numbers were small, these species were treated as one group.

Quantity excreted per night. — The quantity of excreta deposited into a roost per bird-night was measured for red-winged blackbirds using birds caught at two roosts. Sixty-eight red-winged blackbirds (58 females and 10 males) were mistnetted as they entered the roost on the evenings of 14 August, 30 September, 17 October and 22 October 1981. Birds were removed as quickly as possible from the mistnet, placed in wire mesh cages (0.46 m on a side, with a 1.3-cm mesh on the top and sides and a 2.5-cm mesh on the bottom), and held outdoors overnight. The 68 birds were held in 16 cages, several birds to a cage. We measured amount excreted in each of the 16 cages. A cardboard box lined with aluminum foil of known mass was placed below each cage. The following morning the birds were weighed to ± 0.5 g on a 100 g Pesola balance and released at their normal departure time. The aluminum foil with droppings on it was dried to constant mass at 80 C and reweighed to ± 0.0001 g.

Digestive wastes pass through birds very rapidly, and the bulk of their excreta is exogenous waste from the digestive tract (Kontogiannis, 1967). Thus, even if birds exhibit a "fright response," their digestive tracts should clear by morning, and the amount excreted overnight should not be substantially affected.

To estimate the dry matter excreted per night for species other than red-winged blackbirds, we developed a regression model based on existence energy (Fig. 2). Ex-

istence energy is the energy a bird needs to maintain its body mass in a cage (Kendeigh
et al., 1977). It is basically a function of a bird's body mass and the ambient
temperature. The regression was based on the following rationale. The amount ex-
creted by a bird is roughly a function of the amount of food it consumes and the
metabolizable energy coefficient (MEC = metabolizable energy/gross energy) of that
particular food for that bird. Food consumption is related to energy requirements,
which can be predicted for a bird with a known body mass at a known environmental
temperature; therefore, if MECs do not vary substantially, there should be a relation-
ship between existence energy and the amount excreted. MECs do vary among species
and for different diets. Kendeigh *et al.* (1977) reported the known range of MECs
among passerines was ca. 60-90%. Unless the species we studied fell at different ex-
tremes of this range, this model should provide a reasonable approximation of the
amount excreted. In any case the strong and highly significant relationship we found
between existence energy and amount excreted per bird-night (Fig. 2) validated the
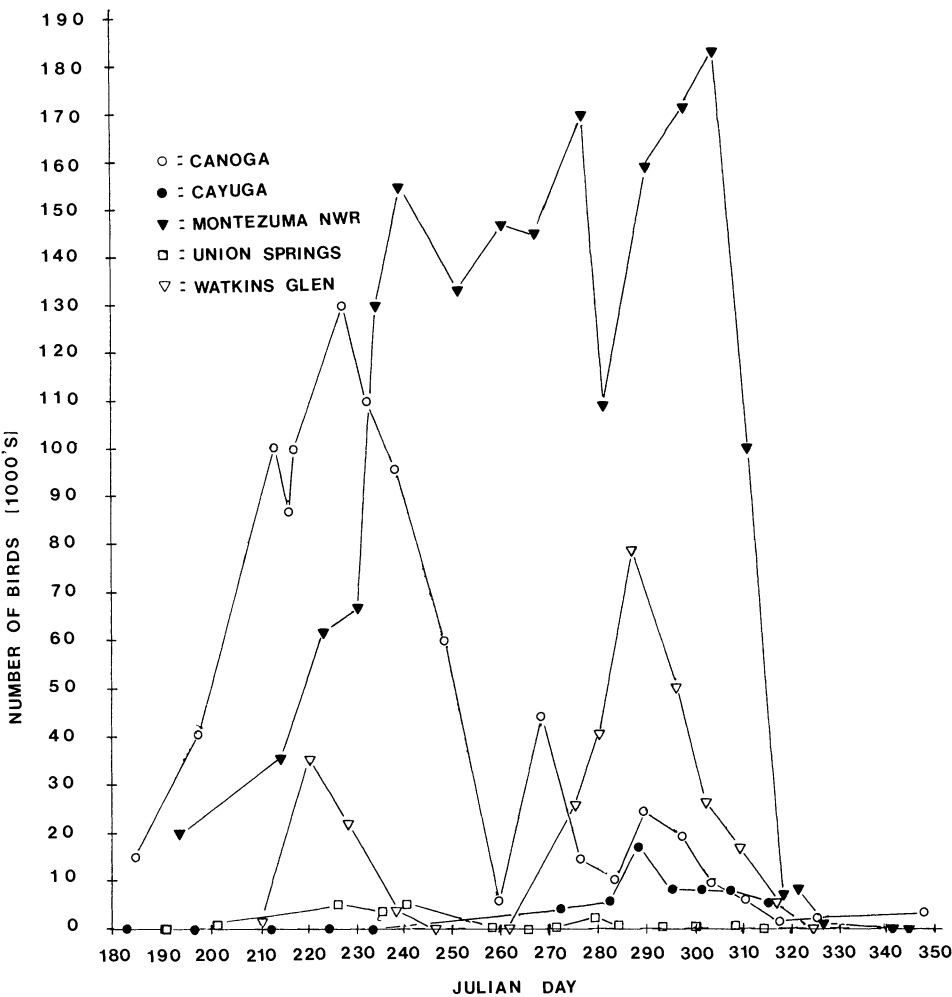regression model empirically. Furthermore, because red-winged blackbirds were by far

Fig. 1.—Roosting populations at the five marsh study sites during 1980

the most numerous species at each of the roosts, and because this model was used only to estimate the amount excreted for the other species, the nutrient loadings we calculated should be relatively insensitive to errors in the model.

The model is a regression of amount excreted per bird-night with the calculated existence energy. Amount excreted per bird-night was what we measured with the mistnetted red-winged blackbirds. We also incorporated into the model data from Stewart (1973) on the amount excreted per bird-night by red-winged blackbirds, common grackles, brown-headed cowbirds and European starlings that he captured. His data were on air-dried excreta, while ours were on oven-dried excreta. We corrected

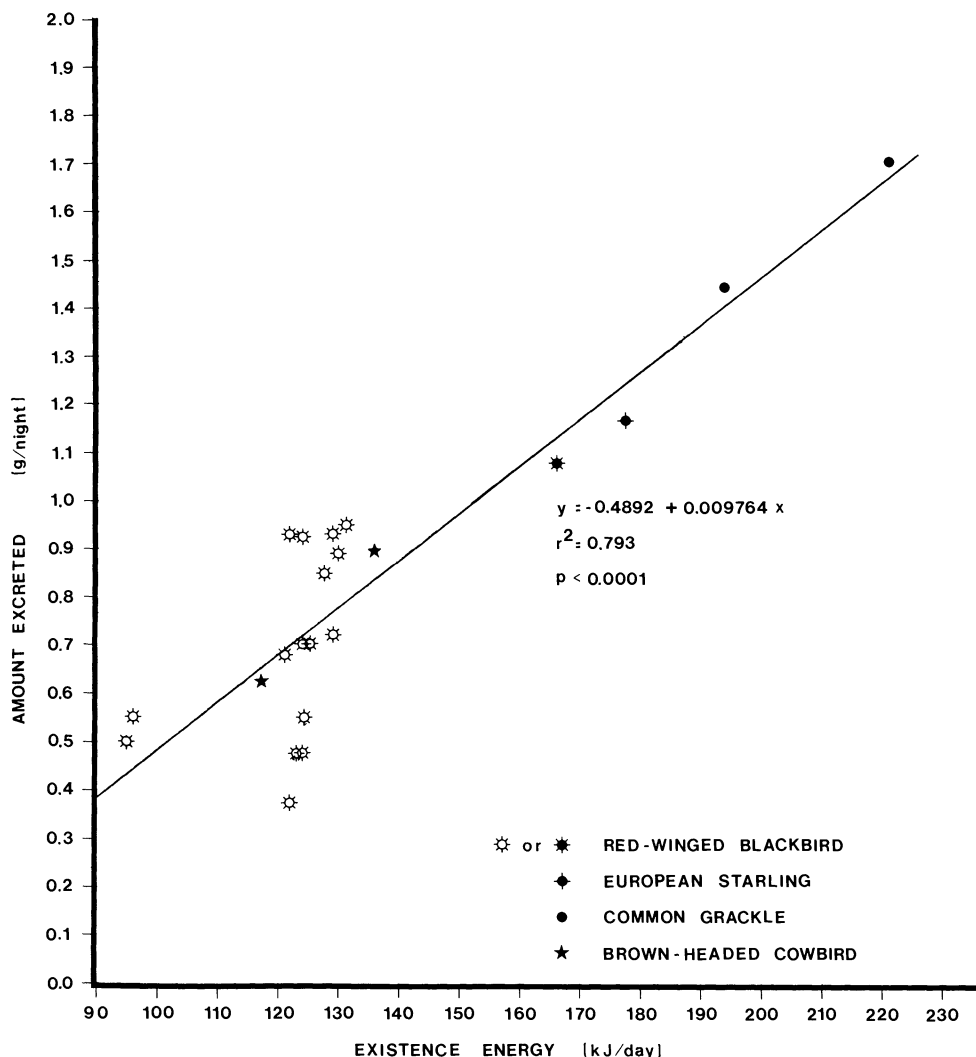Fig. 2. — Amount excreted per bird per night vs. calculated existence energy. Solid symbols are based on data from Stewart (1973) and Dolbeer *et al.* (1978) and the authors' calculations. Each solid symbol is the mean value per bird for 5-10 birds. Open symbols represent data collected in this study. Each open symbol is the mean value per bird for each cage for which we measured amount excreted

for these moisture differences by multiplying his data on air-dried excreta by 0.9, because we found that oven-dried excreta was about 0.9 times the mass of air-dried excreta.

Existence energy is calculated based on the body mass of the birds and the ambient temperature. For the birds we captured we used the regression equation for passerines during the breeding-molting season given in Kendeigh et al. (1977). The calculations used the average body mass of the birds in each cage and the average daily temperature (National Oceanic and Atmospheric Administration, 1981) at Ithaca, New York, for the day the birds were mistnetted. Existence energies for Stewart's birds were calculated with the regression for passerines during the nonbreeding-migration season (Kendeigh et al., 1977) by using the body masses for those species given by Dolbeer et al. (1978) and the mean daily temperature (National Oceanic and Atmospheric Administration, 1972) at Lewiston, North Carolina, for the day Stewart mistnetted the birds. Amount excreted per bird-night was significantly correlated (P < 0.0001, r^2 = .793) with existence energy (Fig. 2).

The model was then used to estimate the amount excreted per bird-night by European starlings and common grackles. First, existence energy was calculated with Kendeigh et al.'s (1977) equation for breeding-molting passerines, using average body masses of 81 g for European starlings (Stevenson, 1933; Stegeman, 1955), and 111 g for common grackles ($\bar{x}$ for six birds caught in the study area) and a temperature of 15 C. Then, existence energy was inserted into the model to estimate amount excreted per bird-night.

Nutrient excretion trials. — Red-winged blackbirds were mistnetted and decoy-trapped from autumn 1980 to spring 1981 for use in cage studies of nutrient excretion. The birds were held in outdoor aviaries supplied with grit and water. They were fed poultry grower pellets (Agway Inc., Ithaca, New York) and cracked corn ad lib. In spring 1981 they were moved indoors and given at least 4 weeks to acclimate to room temperature (ca. 23 C) and a 12-hr photoperiod.

We conducted two nutrient excretion trials, using simulated wild diets of the red-winged blackbird during August and October (Table 1). The simulated diets were based on the food habits studies of earlier investigators, especially Allen (1914), Hintz and Dyer (1977) and Bridgeland (1980). To prevent birds from preferentially selecting particular ingredients, the diets were ground with a variety of mills to pass an approximately 850 μm opening, and then thoroughly mixed with a Hobart mixer. The temperatures for the August and October trials were 20 C and 11 C, the respective 20-year mean temperatures for Ithaca, New York, for those months (National Oceanic and Atmospheric Administration, 1981).

The weed seed parts fed to the birds were the involucre and achene of *Ambrosia artemisiifolia,* and the kernel and calyx of *Polygonum convulvulus.* Red-winged blackbirds eat only the kernel of *Polygonum. convulvulus* and probably only the achene of *Ambrosia artemisiifolia,* but we had no means of separating those plant parts. Both the caryopsis

TABLE 1. — Ingredients of simulated August and October diets

Ingredient	Percent dry mass	
	August	October
Corn (*Zea mays*)	58.14	69.61
Setaria glauca	12.28	27.05
Ambrosia artemisiifolia	1.89	1.94
Polygonum convulvulus	0.74	0.78
Tenebrio molitor larvae	23.65	–
Musca domesticus adults	2.61	–
Calcium carbonate	0.41	0.28
Sodium chloride	0.28	0.25

and the glumes of *Setaria glauca* were fed in the August diet, but only the caryopsis was fed in the October diet, since we found that red-winged blackbirds husk the seeds of *Setaria glauca.* Caryopses were separated from the glumes by cracking the seeds in a hammer mill in which the blades had been replaced with rubber strips and then using a seed blower in conjunction with a variety of sieves. Mealworm (*Tenebrio molitor*) larvae and house fly (*Musca domesticus*) adults comprised the insect fraction of the August diet. The mealworms were lyophilized, and the house flies were dried in an oven at 40 C, so that they could be ground easily. Based on Scott's (1978) recommendations for nongrowing, nonbreeding birds, the simulated diets were supplemented with low levels of NaCl and CaCO₃ (Table 1) to prevent deficiencies of sodium and calcium. It was assumed that birds in the wild would obtain these elements from grit.

The birds were weighed at the start and end of each trial. The August diet trial was 4 days in length; the October diet trial, 3 days. Seven groups of four birds and one group of three birds in a cage were used for each trial. Each cage had four feeders and three watering devices. The birds were acclimated to the trial temperature for at least 5 days and to the experimental diet for at least 3 days before a trial began. Droppings and spilled feed were collected on a vinyl sheet beneath each cage. A barrier lined with aluminum foil of known mass surrounded each cage to catch droppings forcibly excreted to the sides. After each trial, the droppings and spilled feed were dried at room temperature for 1 day, then were separated by screening, sieving and hand-picking with forceps. Droppings from each cage were dried to constant weight at 80-85 C and analyzed for total N, P and K by the Forage Testing Laboratory of the New York Dairy Herd Improvement Cooperative, Ithaca, New York.

Calculation of nutrient loadings. — Calculation of nutrient loadings from birds required four basic steps. The first was to calculate the number of bird-nights spent in each roost by each species. This was obtained by multiplying the average of two successive population estimates by the number of days between the estimates. The calculation was repeated for all the population estimates for each roost for each species. The numbers of bird-nights for all intervals for each roost were then summed to give the total number of bird-nights spent at the roost site by each species. The numbers of bird-nights before 15 September and after 15 September were tabulated separately.

The second step in the calculation was multiplying the number of bird-nights spent in the roost by each species, by the amount it excreted per bird-night. This equaled total dry matter excreted into the roost. Because we did not collect data on the amount excreted per bird-night for common grackles and European starlings, we used the amounts estimated by the existence energy model. For red-winged blackbirds we performed the calculation twice. The first time we assumed that all the red-winged blackbirds were females and the second time that they were all males. The amount excreted per bird-night was that determined with the mistnetted birds. Summing the totals for red-winged blackbirds, common grackles and European starlings gave the total dry excreta inputs to each roost.

Next, to determine the amount of each nutrient (N, P and K) added to each roost, we multiplied the total dry excreta mass by the concentration of the nutrient in the excreta, as measured with the simulated, August and October diets. The total dry matter added prior to 15 September was multiplied by the concentrations of N, P and K measured in the August diet trial. Inputs on or after 15 September were multiplied by the concentrations in the October diet. These were added to give the total inputs for the roosting season. This calculation assumed that the percentages of N, P and K for all the species were the same as for the red-winged blackbird. We expect there would be some difference in the excreta composition of the species given that the diets of the species differ (*e.g., see* Dolbeer *et al.,* 1978), but because inputs by red-winged blackbirds are much greater than for any of the other species, the calculated inputs should be reasonable. Furthermore, both the red-winged blackbird and the common grackle are granivorous species, so the elemental composition of their diets is probably not suffi-

ciently different to produce substantial differences in the composition of their excreta.

The last step in calculating nutrient loadings was to divide the inputs by the area of the study for which the bird populations were estimated. Areas were determined using aerial photographs in conjunction with topographic maps. Thus, a range of nutrient loadings was calculated for each cattail stand. The lower loading was that obtained assuming that all the red-winged blackbirds were females, the higher loading was that obtained assuming they were all males.

Results

Red-winged blackbirds were by far the dominant species at all five sites (Table 2). The Cayuga site received virtually no bird use until late September (Fig. 1), although observations of other parts of the whole Cayuga roost showed that it had large numbers of birds starting in July. The population at the Canoga site declined markedly in September (Fig. 1) when the birds shifted outside the study site to another area of the roost. Montezuma NWR and Canoga received the highest intensities of bird use.

The dry matter excreted per night by the mistnetted red-winged blackbirds was 0.6410 g for females (average body mass of 39.0 g) and 0.8134 g for males (average body mass of 56.0 g). The regression model predicted the following amounts of excreta at 15 C: 1.12 g for an 81.0 g European starling and 1.44 g for a 111.0 g common grackle (Table 3).

The concentration of N in red-winged blackbird droppings (Table 4) differed significantly (t = 2.473, df = 14, p < 0.05) between the August and October excretion trials. The same was true of P (t = 4.508, df = 14, p < 0.0001), but not of K (t = 0.076, df = 14, p > 0.05).

Based on the average of the excreta composition for the August and October trials, nightly excretions of N, P and K averaged 59, 9.0 and 8.7 mg for a 39-g female and 75, 12, and 11 mg for a 56-g male. The range of calculated nutrient loadings varied by about 20%, depending on whether the red-winged blackbirds were assumed to be males or females (Table 5). Montezuma NWR and Canoga received the greatest amount of nutrients/area from birds (Table 5).

Discussion

A critical factor in assessing the significance of N, P and K from birds is defining the system of interest. At all our sites, we defined our system as specific cattail stands rather than the entire flooded marsh area. At the sites that had little or no open water (Canoga, Cayuga, Union Springs and Watkins Glen), this distinction is inconsequential because the cattail stands and the flooded areas are essentially coextensive. This is not the case at Montezuma NWR, where the inclusion of large areas of open water and other habitats would have substantially reduced the loadings we calculated from birds. Conversely, because birds tended to concentrate in pockets within stands, our calculations will underestimate the local effects in areas used most heavily by birds.

The importance of nutrient inputs by birds is inversely related to the magnitude of additions from other nutrient sources. Birds are more likely to play a significant role in stands where other inputs are comparatively small than in stands where they are large (*e.g.,* systems receiving sewage effluent or small stands with an extensive and fertile catchment basin). Runoff, groundwater, gaseous flux, precipitation and flood transport are other potential nutrient influxes. These influxes may vary considerably among wetland ecosystems, but few data on nutrient budgets for wetlands are available. Consequently, we restrict our comparisons to external inputs via precipitation and runoff.

The range of N inputs by the birds overlaps N inputs from precipitation reported for the area (Likens, 1974a). At Watkins Glen, a sparsely populated roost, the N added by the birds was only ca. 15% of that expected from precipitation (Table 5). Densely populated roosts (Canoga and Montezuma NWR) received about 2.5 times as much N

TABLE 2. — Total bird-nights, and species composition before and after 15 September and areas of five marsh sites

	Canoga		Cayuga		Montezuma NWR		Union Springs		Watkins Glen	
	before	after	before	after	before	after	before	after	before	after
Bird-nights (1000/roosting season)	5302	1184	49	373	5182	8561	194	37	555	1817
Red-winged blackbirds plus brown-headed cowbirds (%)	75.0	77.3	87.6	94.6	69.5	83.9	100	100	70.0	82.0
Common grackles (%)	17.3	14.9	0.6	1.7	21.7	4.1	–	–	15.8	1.8
European starlings (%)	7.7	7.8	11.8	3.7	8.9	12.0	–	–	14.2	16.2
Area (ha)	20.3		6.4		41.6		2.3		114.2	

from birds as expected from precipitation. Phosphorus from birds at all the sites exceeded that expected from precipitation and was roughly 20 times more at Montezuma NWR and Canoga study areas. Birds added as much or more K as expected from precipitation at Montezuma NWR, Canoga and Union Springs and less at the other two sites. Precipitation is likely to be only a minor component of the nutrient fluxes of wetlands with appreciable surface inputs (Prentki et al., 1978). Therefore, unless the transport of nutrients by birds exceeds that of precipitation, the impact of the birds would probably also be minor. Because nutrient inputs by birds at the more densely populated roosts exceeded those expected via precipitation, we conclude the birds were a more important nutrient source than precipitation at these sites. For more sparsely populated sites, nutrient input by birds was apparently minor.

Our comparison with runoff is less clear. At the densely populated roosts (Canoga and Montezuma NWR), birds added quantities of N and P similar to the influent inputs of 23.7 and 4.3 kg•ha^{-1}•year^{-1} of N and P that Davis et al. (1981) reported for a partially cattail-dominated marsh with a predominantly agricultural watershed in Iowa. In contrast, at Canoga and Montezuma NWR birds added much more than the 0.875 kg•ha^{-1}•year^{-1} of P that McColl and Burger (1976) reported for a cattail pool in Agassiz National Wildlife Refuge, Minnesota. Nutrient flux in runoff is affected by catchment area, wetland size, land use and soil characteristics within the watershed, and variation in these features makes comparisons with literature values difficult. Because we did not measure runoff into our stands and comparisons with other systems are tenuous, we calculated runoff for Canoga and Montezuma NWR based on a runoff study conducted within the Cayuga Lake basin (Likens, 1974b). According to that study the average annual inputs of N (NH$^+$ and NO$_3^-$), P and K to Cayuga Lake from the Canoga Creek drainage basin were 10.8, 0.906 and 37.3 kg/ha, respectively. To obtain runoff estimates, we multiplied these values for runoff (for both Canoga and Montezuma NWR), by the area of the drainage basin and divided by the area of the wetland. Canoga's drainage basin is 829 ha (Likens, 1974b) and Montezuma NWR's is ca. 7000 ha (Have, 1973). The marsh at Canoga is about 45 ha. At Montezuma NWR, the flooded marsh and swamp is ca. 2060 ha. Based on these calculations, N, P and K in runoff at Canoga are 200, 16.7 and 695 kg•ha^{-1}•year^{-1}, respectively, while at

TABLE 3.—Calculated existence energies and amounts excreted per bird-night for male and female red-winged blackbirds, European starlings and common grackles

Species	Calculated existence energy (kJ/day)	Amount excreted per bird-night (g dry mass)
Red-winged blackbird		
(females)	119	0.641*
(males)	124	0.813*
European starling	165	1.12**
Common grackle	197	1.44**

* = Measured with mistnetted birds
** = Estimated with the regression model

TABLE 4.—N, P and K in red-winged blackbird droppings. Number of samples equals eight for each diet and each element

	% dry mass ± 1 SD		
Diet	Nitrogen*	Phosphorus*	Potassium
August	9.6 ± 0.40	1.31 ± 0.066	1.35 ± 0.075
October	8.8 ± 0.78	1.52 ± 0.108	1.35 ± 0.117

* = Excreta composition from August and October diets was significantly different (t-test, df = 14, p < 0.05) for this element

TABLE 5. – Estimated annual nutrient loadings by blackbirds and starlings at study sites compared with nutrients in peak standing crop of vegetation and from precipitation. The lower values for the range of loadings assumed that all red-winged blackbirds were females, the upper value assumed that they were all males

| Nutrient | Study location | | | | | Peak standing crop | Precipitation |
	Canoga	Cayuga	Montezuma NWR	Union Springs	Watkins Glen		
			kg•ha^{-1}•year^{-1}				
Nitrogen	24-28	4.1-5.0	23-28	6.0-7.6	1.4-1.7	442[a]	10.3[b]
Phosphorus	3.5-4.1	0.67-0.83	3.7-4.3	0.86-1.1	0.23-0.27	44[a]	0.18[b]
Potassium	3.5-4.1	0.61-0.75	3.5-4.1	0.86-1.1	0.21-0.25	218[a]	1.1[b]

[a]Bernard and Fitz, 1979
[b]Likens, 1974

Montezuma NWR they are 36.9, 3.08 and 128 kg•ha^{-1}•year^{-1}, respectively. At Canoga, these estimates are almost certainly too high because most of the runoff there passes through the marsh in a discrete channel. Clearly, these are rough approximations; nevertheless, they are useful. They suggest that birds added an amount equivalent to 13-73% of the N, 23-140% of the P, and 0.5-3.1% of the K contained in runoff at these two sites. This indicates that, relative to runoff, birds are probably not important K contributors, but they may be significant sources of N and P.

Bird inputs of N, P and K were small, relative to the quantities of those elements present in the peak aboveground biomass of a cattail stand near Ithaca, New York (Bernard and Fitz, 1979). However, at Canoga and Montezuma NWR, birds added ca. 6% of the N, and almost 9% of the P contained in peak aboveground biomass of the stand that Bernard and Fitz (1979) studied. Prentki *et al.* (1978) found that *Typha latifolia* annually lost 81% (25 kg/ha) of the P in its aboveground biomass through leaching and litter fall, so recycling of nutrients probably overshadows N, P and K transport by birds.

In conclusion, this study has shown that roosting blackbirds and starlings can transport large quantities of N and P into cattail stands. Future attempts to measure wetland nutrient budgets should consider the potential impact of the avian community, especially in areas of high bird density. The role of birds in some ecological systems may be greater than previous research has suggested.

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