Expansions of Mockingbird and multiflora rose in the northeastern United States and Canada

An imaginative analysis of Mockingbird sightings on Christmas Bird Counts confirms a suspected correlation.

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INTRODUCTION

IT IS WELL ESTABLISHED that the Mockingbird (*Mimus polyglottos*) has shown a dramatic extension in its wintering range and increase in numbers in the northeastern United States during the last 30 years (Beddall, 1963; Bull, 1964; Leck, 1972; Temple and Temple, 1976; Kastner, 1979). This paper has two objectives. The first is to present an analysis of the Christmas Bird Counts (hereafter, CBCs) of Mockingbirds in the northeastern United States from 1947-1980. The second is to establish a link between the range expansion of the Mockingbird and the increase of the multiflora rose (*Rosa multiflora* Thunb.). The association of Mockingbirds and multiflora rose is also recognized. Kastner (1979) quotes Roger T. Peterson as saying "people have been planting multiflora rose everywhere and the Mockingbird feeds on its berries all winter. A good place to look for it is in shopping plazas where a lot of multifloras are planted." Bull (1964) notes breeding Mockingbirds associating with multiflora rose. The importance of multiflora rose as a winter food source for the Mockingbird needs to be examined further, as an example of a range expansion of a native bird species influenced by the introduction of a new food resource.

METHODS AND MATERIALS

MOCKINGBIRD numbers and total party-hours were tabulated from the CBCs for all counts from Maryland, Delaware, Washington, D.C., Pennsylvania, New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, Vermont, Maine, Ontario, Quebec, New Brunswick, Nova Scotia, and Prince Edward Island, from 1947-1980 (*Audubon Field Notes*, volumes 1-25; *American Birds*, volumes 26-34). Coordinates were determined of all counts and count data tabulated for every 2 × 2 degree block from 38° N to 48° N and 60° W to 84° W using only the data from the included states and provinces.

A total of 7077 separate counts taken 1947-1980 was examined. Of these, 3641 counts recorded at least one Mockingbird. Observers spent a total of 436,706 party-hours and observed 161,254 Mockingbirds.

Use of the CBC information has advantages and disadvantages, and care must be used in the interpretation of results. The number of observers and the ability of the observers varies from year to year on the same counts. Changes in the extent of the coverage of the count circles and the varying ability of the observers may alter the birds observed per unit of time. In all calculations birds/party-hour have been used to attempt to equalize the large differences in party-hours from count to count and year to year. This is a good indicator of relative abundance of Mockingbirds when numbers are high but when only a few Mockingbirds are present, differences in total party-hours greatly influence the relative numbers of Mockingbirds. Also, CBCs are not random samplings of rare birds; rare birds are often searched for and "staked out" in advance. This elevation of the probability of finding rare birds has advantages for the purpose of this study as early stages of the range extension are well documented.

Data on multiflora rose use by Mockingbirds was obtained by 2105 minutes of observation of one individual on 5 separate days (Feb. 2, 3, 9, 23, and Mar. 2, 1979) in Piscataway, N.J., and 834 minutes of observation of another individual over 7 days in February and March of the same year. All activities were recorded during this period for the first bird, but only information on the food items eaten were recorded for the second. Seeds from 40 Mockingbird fecal pellets from a third Mockingbird were collected in East Millstone, N.J., during December, 1978.

Caloric values of pericarp were determined using a microbomb calorimeter, and seed:pericarp ratios were determined as part of a larger study exploring fruit nutrient values in the eastern deciduous forest (White and Stiles, unpub.).

RESULTS

Mockingbird increase

MOCKINGBIRDS observed/party hour on CBCs have increased dramatically in the Northeast between 1947 and 1980 (Table 1). The increase in the southern states reached a plateau earlier than in the North with Maryland and Delaware reaching a relatively constant population density by 1958, and New Jersey by 1966. Massachusetts, New Hampshire and Vermont, however, are still showing substantial increases, while some of the Canadian provinces have not shown any increases (Fig. 1). All counts were also recorded lying within 2 × 2 degree blocks of latitude and longitude (Fig. 2). The increase in numbers of wintering Mockingbirds

Table 1. Mockingbirds per 100 party hours for states and provinces in the Northeast from 1947-1980.

Year	Nova Scotia	Prince Edward Island	New Brunswick	Quebec	Ontario	Maine	New Hampshire	Vermont	Mass.
1947				0	0	0		0	.003
1948				0	0	0	0	0	0
1949	0		0	0	0	0	0	0	.003
1950			0	0	0	0	0	0	.005
1951				0	0	0	0	0	.003
1952				0	0	0	0	0	.002
1953	0			0	0	0	0	0	.002
1954	0			0	0	.001	0	0	.008
1955	0			0	.001	.007	0	0	.003
1956	0			0	.002	.011	0	0	.006
1957	0			0	.001	.011	.014	0	.010
1958	0			0	.004	0	0	0	.006
1959	.013		0	0	0	0	0	0	.004
1960	.021		0	0	.005	.018	0	.011	.015
1961	.013		0.8	0	0	0	.013	0	.012
1962	.021		0.6	0	.001	.012	.028	.006	.023
1963	.021		0	0	.002	0	.007	0	.016
1964	.016		0	0	.001	.030	.008	0	.049
1965	.016		0	0	.001	.005	.008	0	.071
1966	.018			.003	.003	.029	.021	0	.068
1967	.058		0.6	.004	.001	.020	.029	.011	.135
1968	.009			.005	.003	.009	.030	0	.129
1969	.013		0	.005	.007	.014	.018	0	.200
1970	.003		0	0	.010	.011	.033	.007	.209
1971	.014		0	0	.010	.033	.033	.004	.248
1972	.004	0	0	0	.010	.034	.025	.003	.270
1973	0	0	0	0	.012	.033	.138	.011	.266
1974	.014	0	0	0	.011	.022	.063	.005	.281
1975	.004	0	0	.004	.007	.035	.067	.004	.470
1976	.005	0	0	.003	.010	.041	.108	.011	.542
1977	.010	0	0	.005	.005	.045	.186	.019	.719
1978	.006	0	0	.004	.003	.036	.145	.028	.601
1979	.009	.013	0	.007	.003	.050	.197	.017	.543
1980	.005	0	0.9	.009	.005	.035	.179	.024	.573

Year	Rhode Island	Connecticut	New York	New Jersey	Pennsylvania	Delaware	Maryland	Wash. D.C.
1947	0	0	0	.007	.006	.173	.257	.638
1948	0	0	0	.004	.002	.295	.150	1.013
1949	0	0	0	.008	.002	.156	.250	.538
1950	0	0	0	.013	.014	.262	.218	.667
1951	.013	0	.001	.008	.013	.286	.477	1.000
1952	0	.006	.003	.016	.014	.129	.480	—
1953	.009	.007	.003	.028	.030	.077	.487	1.373
1954	.048	.002	.003	.066	.041	.198	.654	1.135
1955	0	0	.002	.083	.053	.420	.546	1.581
1956	0	0	.002	.064	.119	.623	.956	1.299
1957	.059	.007	.001	.070	.077	.424	.764	.921
1958	.037	.006	.006	.229	.246	1.43	1.15	1.582
1959	.022	.007	.005	.181	.225	.657	.818	1.860
1960	.074	.001	.007	.385	.324	.885	1.053	1.579
1961	.014	.008	.008	.417	.380	.783	1.106	2.092
1962	.031	.007	.008	.353	.280	.919	1.074	1.431
1963	.031	.009	.016	.428	.427	1.161	1.280	1.927
1964	.133	.025	.024	.564	.558	1.468	1.400	2.082
1965	.197	.032	.037	.524	.522	.946	1.205	2.864
1966	.250	.035	.057	.750	.714	1.044	1.478	2.250
1967	.200	.076	.087	1.053	.775	1.402	2.520	2.114
1968	.179	.065	.110	.711	.510	1.173	1.536	1.830
1969	.326	.078	.129	.792	.506	.431	1.769	2.349
1970	.410	.139	.154	.740	.685	1.000	1.622	1.363
1971	.580	.199	.189	.783	.530	1.034	1.472	2.252
1972	.705	.244	.245	.890	.540	1.037	1.150	1.705
1973	.557	.244	.213	.681	.329	.691	.869	1.335
1974	.762	.343	.260	.721	.473	1.063	1.157	2.122
1975	.973	.484	.287	.943	.570	1.050	1.235	2.063
1976	.806	.462	.332	.899	.503	.830	1.233	1.594
1977	1.050	.653	.349	1.001	.651	1.268	1.426	1.404
1978	.930	.554	.314	.909	.605	.806	1.019	1.766
1979	1.146	.662	.299	.584	.411	.572	.746	1.399
1980	.892	.660	.338	.776	.521	.761	.950	1.845

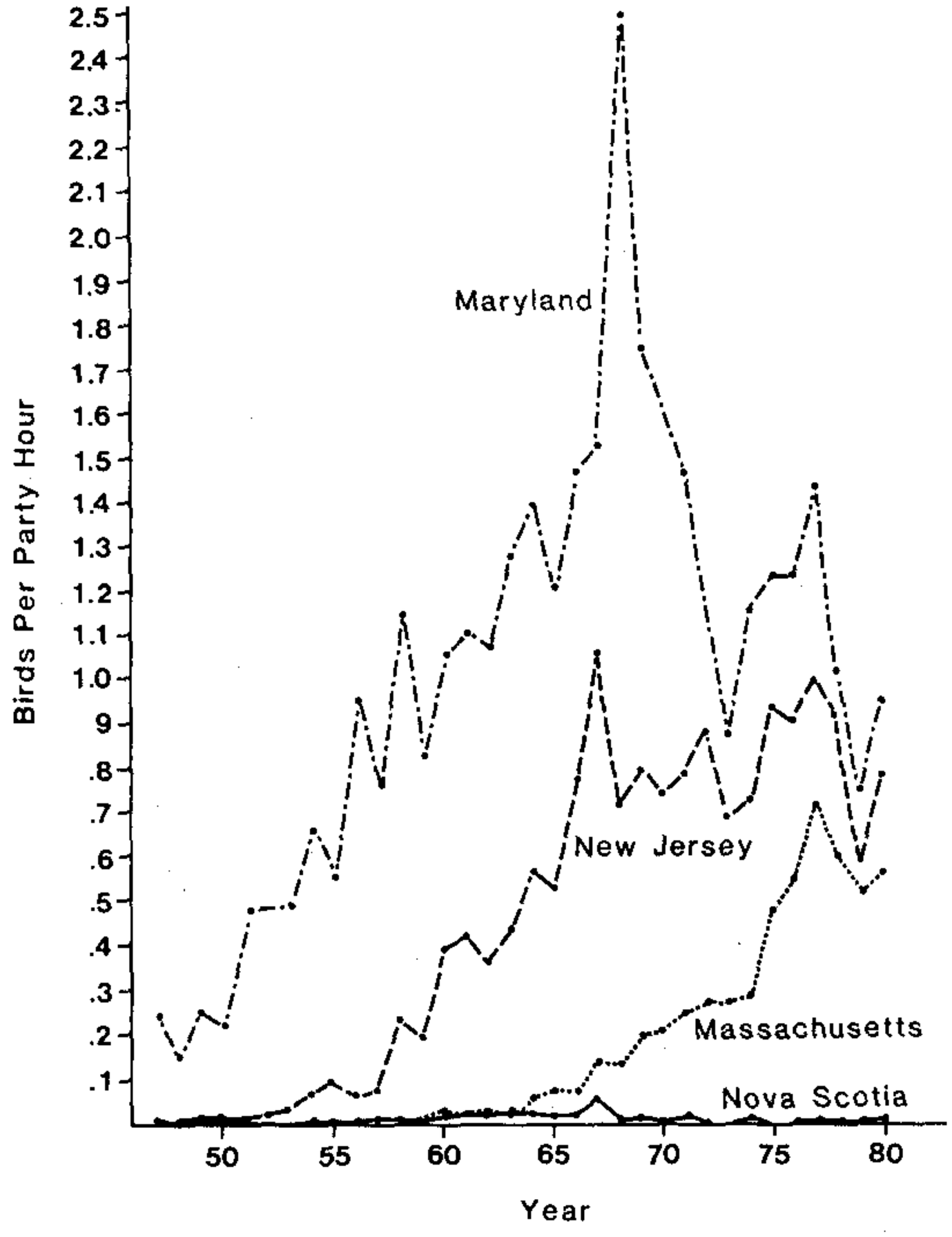

Figure 1. *Mockingbirds per party-hour for representative states and provinces on the eastern seaboard.*

showed a regular northward progression during this period. Counts between 38° N and 40 ° N reached an asymtote of Mockingbird occurrence on counts by 1958 (Fig. 3) whereas counts between 40° N and 42° N plateaued about 1970 with 90% of the counts recording Mockingbirds. Counts north of 42° N were still showing increases, although in a less regular fashion, in 1980. Increases in Mockingbirds in the western sections of the latitudes considered, showed increases later than in the coastal regions (Fig. 4). Many of these counts are in the Appalachian and Allegheny Mountain regions where winter temperatures at a given latitude are colder. Farmland constitutes a lower proportion of the landscape and the introduction and expansion of the multiflora rose may have been slower.

The increase in Mockingbirds can be seen not only on a regional basis but also in individual, long-running counts

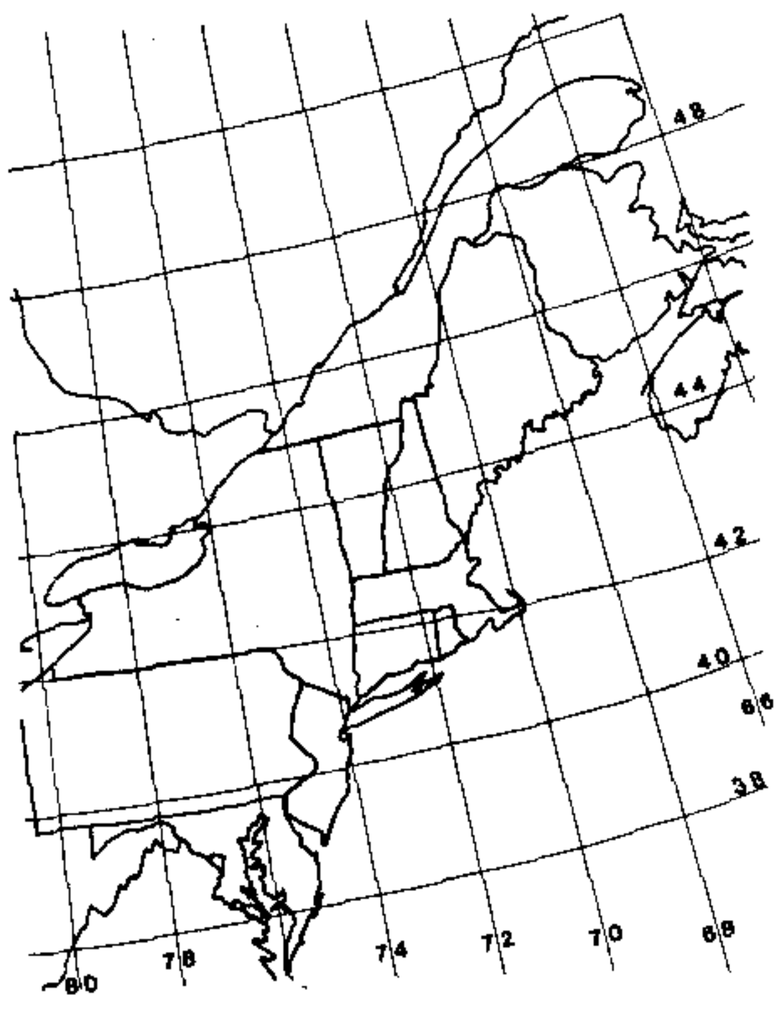

Figure 2. *Two by two degree blocks of latitude and longitude for the Northeast. Counts with centers lying within these blocks were considered together.*

(Table 2). The counts from Princeton, N.J., South Kingston, R.I., and Hartford, Conn., showed large increases in Mockingbirds 1958-1975 (Fig. 5). I analyzed the counts recorded for the Song Sparrow *(Melospiza melodia)* for the same period for these three counts (Fig. 6). Song Sparrows reside in similar habitats to those used by Mockingbirds, feeding in old fields and residential areas. They rarely feed on fruits (Martin *et al.*, 1951). Song Sparrows showed substantial variation in numbers of individuals recorded during this period but showed no trend of increase approximating that found for Mockingbird.

Multiflora rose increase

INCREASE IN THE multiflora rose in the Northeast is not easy to document quantitatively. Multiflora rose is native to Japan and Korea and was introduced from Japan to England in the late 18th century. It was subsequently introduced to America in about 1870 (Edminster and May, 1951).

The spread of multiflora rose in the Northeast began in the late 1930s. It was highly recommended by the Soil Conservation Service for wildlife cover and soil erosion control starting in 1938 (Edminster and May, 1951). It was recommended so strongly that Allen (1949) wrote "Charles A. Dambach—suggests that perhaps we are going too rapidly with this plant". By 1951 multiflora rose was "used more than any other shrub in conservation plantings" in the Northeast (Edminster and May, 1951). Studies in 1952 and 1953 were still quite positive but expressed slight concern about invasion of "unmanaged" areas. This resulted in studies on possible means for control of multiflora rose (Lloyd and Eley, 1955). By 1965, however, multiflora rose was recognized as a distinct problem in much of the area of introduction (Scott, 1965). The area of introduction included most of the Northeast and Midwest (Fig. 7) but quantitative information on its spread away from plantings is difficult to obtain. At the Patuxent Wildlife Research Center, spread of multiflora rose could be traced to the original introduced stands 15 years after the original introduction, but the number of plots containing plants had tripled in 15 years under ordinary farming practices (Scott, 1965).

Bard (1951) studying secondary succession on the New Jersey Piedmont

Table 2. Mockingbirds per party hour for selected long-running counts.

Year	Coastal N.H. 42-70	South Kingston R.I. 41-71	Bronx-Westchester N.Y. 40-73	Hartford Conn. 41-72	Princeton N.J. 40-74	Washington D.C. 38-77
1947		0	0	0	0	.638
1948		0	0	0	0	1.013
1949		0	0	0	0	.583
1950		0	0	0	.015	.667
1951	0	0	0	0	0	1.000
1952	0	0	0	.011	0	—
1953	0	0	0	.008	0	1.369
1954	0	.095	0	.008	.023	1.135
1955	0	0	0	0	.020	1.582
1956	0	0	0	0	.023	1.296
1957	.037	.021	0	.010	.100	.921
1958	0	.049	.011	.009	.105	1.582
1959	0	0	0	.008	.024	1.860
1960	0	.024	.008	.008	.179	1.579
1961	.028	.023	.008	.017	.468	2.092
1962	.023	.024	.013	.022	.203	1.431
1963	.026	.024	.008	.011	.746	1.927
1964	.030	.079	.031	.023	.882	2.082
1965	.019	.163	.008	.028	.700	2.864
1966	.042	.239	.027	.079	1.080	2.250
1967	.060	.100	.044	.169	1.025	2.114
1968	.081	.156	.071	.136	.837	1.830
1969	.058	.300	.048	.130	.937	2.349
1970	.104	.378	.198	.213	.737	1.363
1971	.099	.578	.288	.312	.857	2.252
1972	.064	.905	.737	.214	.828	1.705
1973	.324	.711	1.035	.337	.468	1.335
1974	.171	.611	.817	.416	.662	2.122
1975	.149	.982	.592	.515	1.364	2.063
1976	.294	1.048	1.270	.371	.886	1.594
1977	.329	.919	.614	.676	1.411	1.402
1978	.408	.753	.902	.718	1.009	1.763
1979	.524	1.338	.692	.835	.231	1.396
1980	.312	.722	1.214	.488	.658	1.842

found multiflora rose at only a maximum of 4.7% coverage in 1949, but she also found that multiflora rose was present in five of six fields aged greater than 4 years since last cultivation. At the Hutcheson Memorial Forest in East Millstone, N.J., also on the Piedmont of New Jersey, long-term studies have been conducted on abandoned old-fields (Buell *et al.* 1971). Replicate fields were plowed and then left fallow every 2 years starting in 1958. Forty-eight 1 m permanent quadrats have been studied in each field every year since 1958 (Table 4). Multiflora rose is found in all fields although none is found in the permanent quadrats in the fields abandoned in 1958. By 1976 all fields had multiflora rose with as high as 14% coverage in one field, greater than 3 times the maximum found by Bard in 1949.

Mockingbird winter food habits

ALL THREE MOCKINGBIRDS studied ate a considerable number of multiflora rose fruits. During 2105 minutes of observation, the individual under most intensive study ate 1847 food items, all fruit, of which 31.5% were multiflora rose (Table 4). The numbers of fruits consumed included 65.6% sumacs (*Rhus glabra* L. and *Rhus copallina* L.), 2.4% Japanese honeysuckle (*Lonicera japonica* Thunb.), 0.4% blackhaw (*Viburnum prunifolium* L.), and 0.1% eastern red cedar (*Juniperus virginiana* L.). The available pulp in the different fruits is very different, however, and if one measures consumption of fruit by dry weight of the pericarp, this Mockingbird consumed 72.9% multiflora rose and 19.8% sumac, or if the same values are measured in calories the Mockingbird obtained 66.6% from multiflora rose and 26.3% from sumac.

The second bird, under less intensive observation, ate 76.4% multiflora rose fruits and received 86.7% of its calories from multiflora rose. It was also observed eating sumac, Japanese honeysuckle, and pecking at crabapple (*Pyrus* sp.).

Forty fecal pellets from the third Mockingbird contained 547 seeds of

Table 3. Increase in multiflora rosè *(Rosa multiflora)* in abandoned agricultural fields in New Jersey. Pairs of 1 ha fields abandoned at 2 year intervals beginning in 1958. Percent cover calculated from 48—1 meter square permanent quadats in each field.

	% Cover of *Rosa multiflora* in indicated fields									
Year	1	2	3	4	5	6	7	8	9	10
1958	0	0								
1959	0	0								
1960	0	0	0	0						
1961	0	0	0	0						
1962	0	0	0	0	0	0				
1963	0	0	0	0	0	0				
1964	0	0	0	0	0	0	0	0		
1965	0	0	.83	0	0	0	0	0		
1966	0	0	.52	0	0	0	0	0	0	0
1967	0	0	.21	0	.42	.08	0	0	.02	0
1968	0	0	1.04	0	.63	.19	0	0	.44	0
1969	0	0	1.44	2.08	1.15	1.29	0	0	1.35	.10
1970	0	0	2.88	0	1.81	2.81	0	0	2.81	.46
1971	0	0	4.17	.002	2.09	4.90	.01	.63	3.46	.63
1972	0	0	7.21	.05	2.38	6.38	1.27	1.60	4.27	1.90
1973	0	0	8.25	.13	2.98	7.23	1.25	4.50	4.79	1.50
1974	0	0	11.29	.38	2.84	9.67	2.59	4.63	4.69	2.84
1975	0	0	11.58	1.30	5.48	10.86	4.81	9.69	4.86	3.69
1976	0	0	14.63	4.59	7.61	13.72	4.83	13.04	6.11	7.10

multiflora rose. 65 seeds of Japanese honeysuckle and 2 seeds of eastern red cedar; 89.1% multiflora rose.

Mockingbird energetics

ESTIMATES FOR Mockingbird daily energy expenditure and for energy gain were made using the continuous observations of Mockingbird activity during February and March.

Calculations of energy expenditure were made using Utter's (1970) estimates of Mockingbird energy expenditure. Mean weight of the 14 birds studied by Utter was 48.9 grams. Using Lasiewski and Dawson's (1967) calculations for standard metabolic rate (SMR = resting metabolism at thermoneutral conditions (30° C))

$$\log (SMR) = \log 129 + .724 \log (\text{weight})$$

Mockingbird SMR is 14.5 kcal/day. Utter found that Mockingbirds were generally active from 0.5 hour before sunrise to 0.5 hour after sunset so total active period for purposes of my calculations was based on total day length plus 60 minutes. Energy expenditure while sleeping was calculated as the proportion of the day inactive multiplied by the SMR. Energy expenditure while active, but not flying ranged from 2-4 times SMR and energy expenditure while in flight ranged from 12-15 times SMR. To calculate Mockingbird energy expenditure I used 3 times SMR for non-flight activity and 15 times SMR for flight. The Mockingbird spent very little time in flight (range = 1.5% to 2.4% of the active period). This is substantially less than the percentages of time in flight recorded by Utter (5.77% to 10.14%) during the breeding season.

The influence of low ambient temperatures on increasing metabolic expenditure is dependent on the nature of the insulation of the bird and a variety of behavioral factors. Kendeigh (1944) estimated 5.79 kcal/day as the energy expenditure of House Sparrows *(Passer domesticus)* in direct response to overcoming cold. This figure will vary with the severity of the weather conditions and a conservative value of 5 kcal/day was added to Mockingbird daily energy expenditure to compensate for energy expenditure directly related to cold weather. Estimates for the 5 days of observation are around 35 kcal/day (Table 5). These estimates compare favorably with those found by Utter (1970) during the breeding season (25.3 to 35.2 kcal/day).

Estimates for energy gain are made from the analyses of caloric value of fruits eaten by the Mockingbird (White and Stiles, unpub.; Graber and Powers,

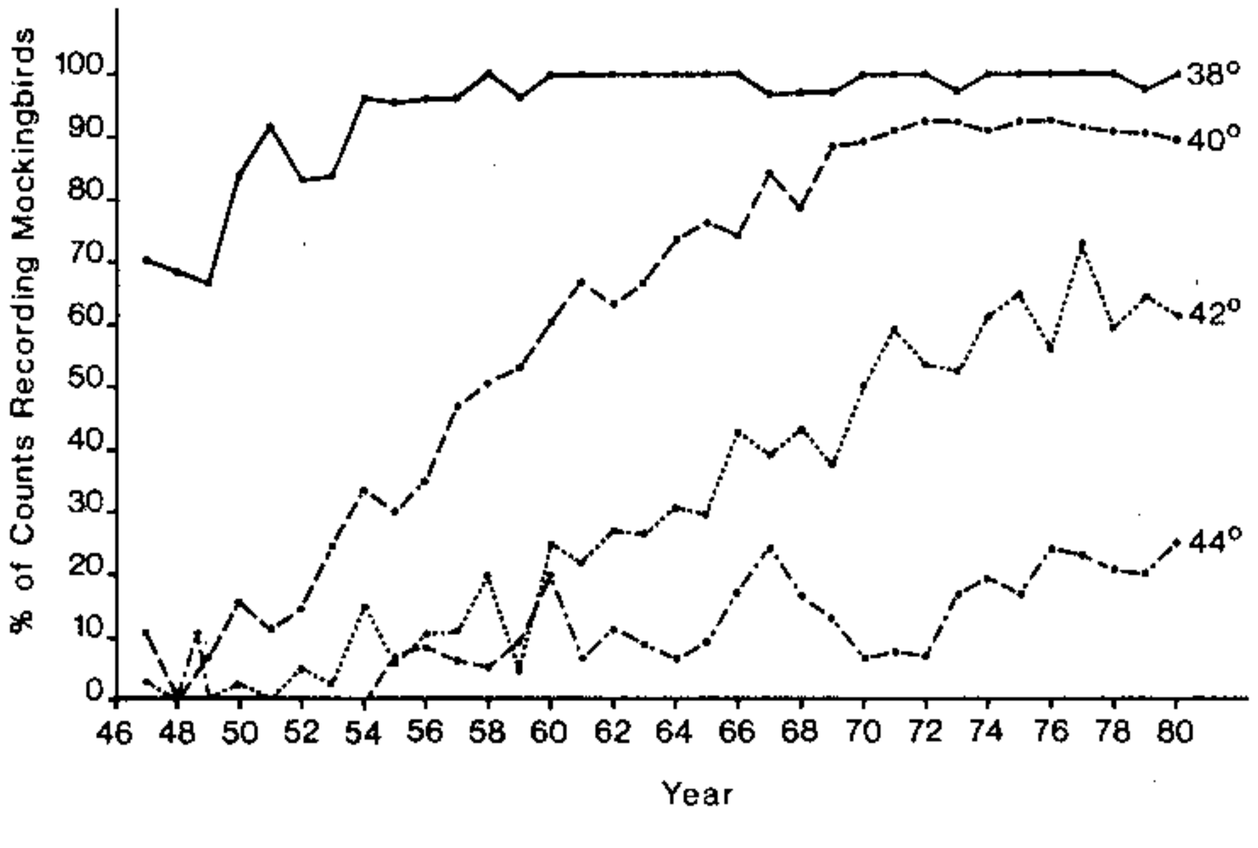

Figure 3. *Percent of counts recording at least one Mockingbird for all counts within each latitude.*

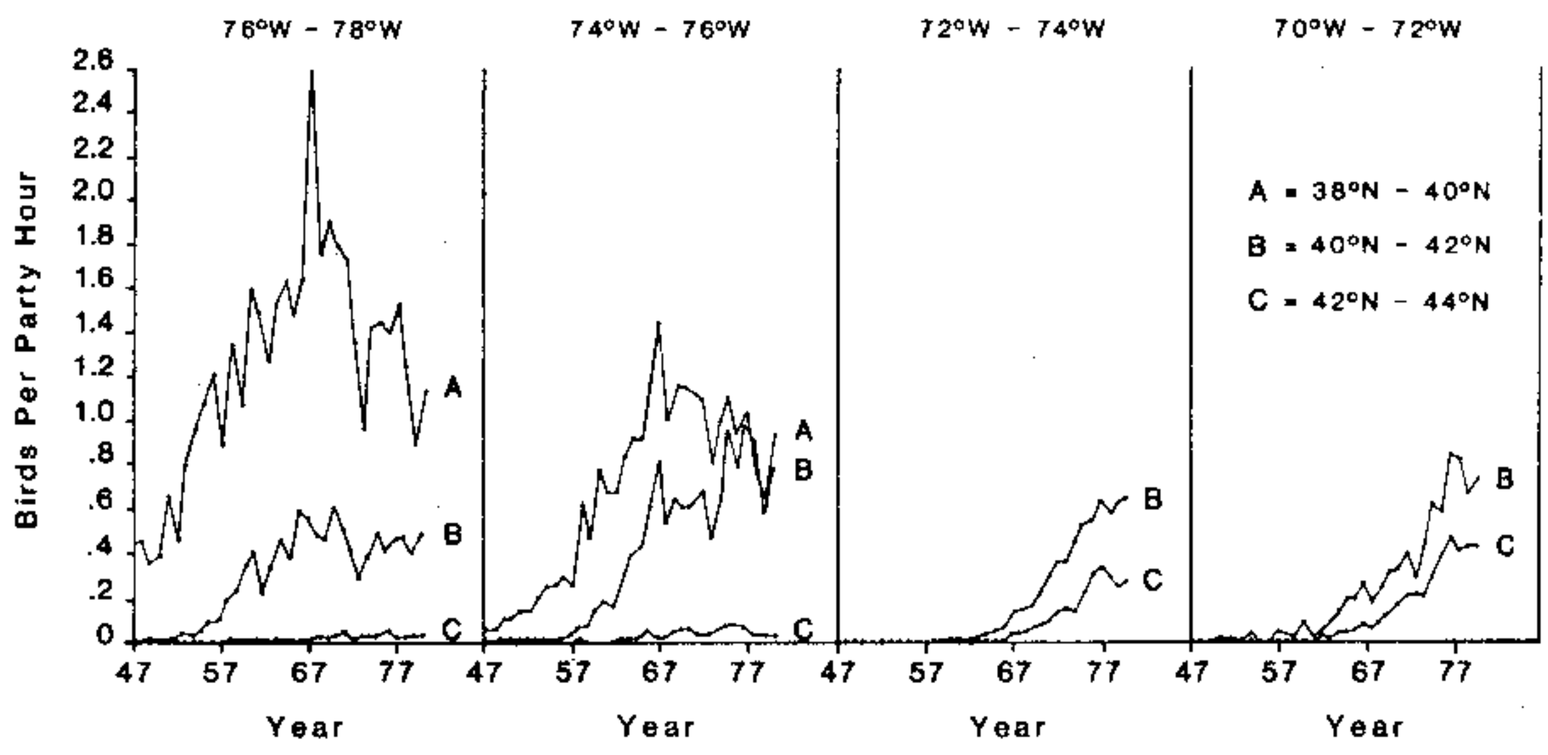

Figure 4. *Average Mockingbirds per party-hour for each 2 x 2 degree block from 38°N to 44°N.*

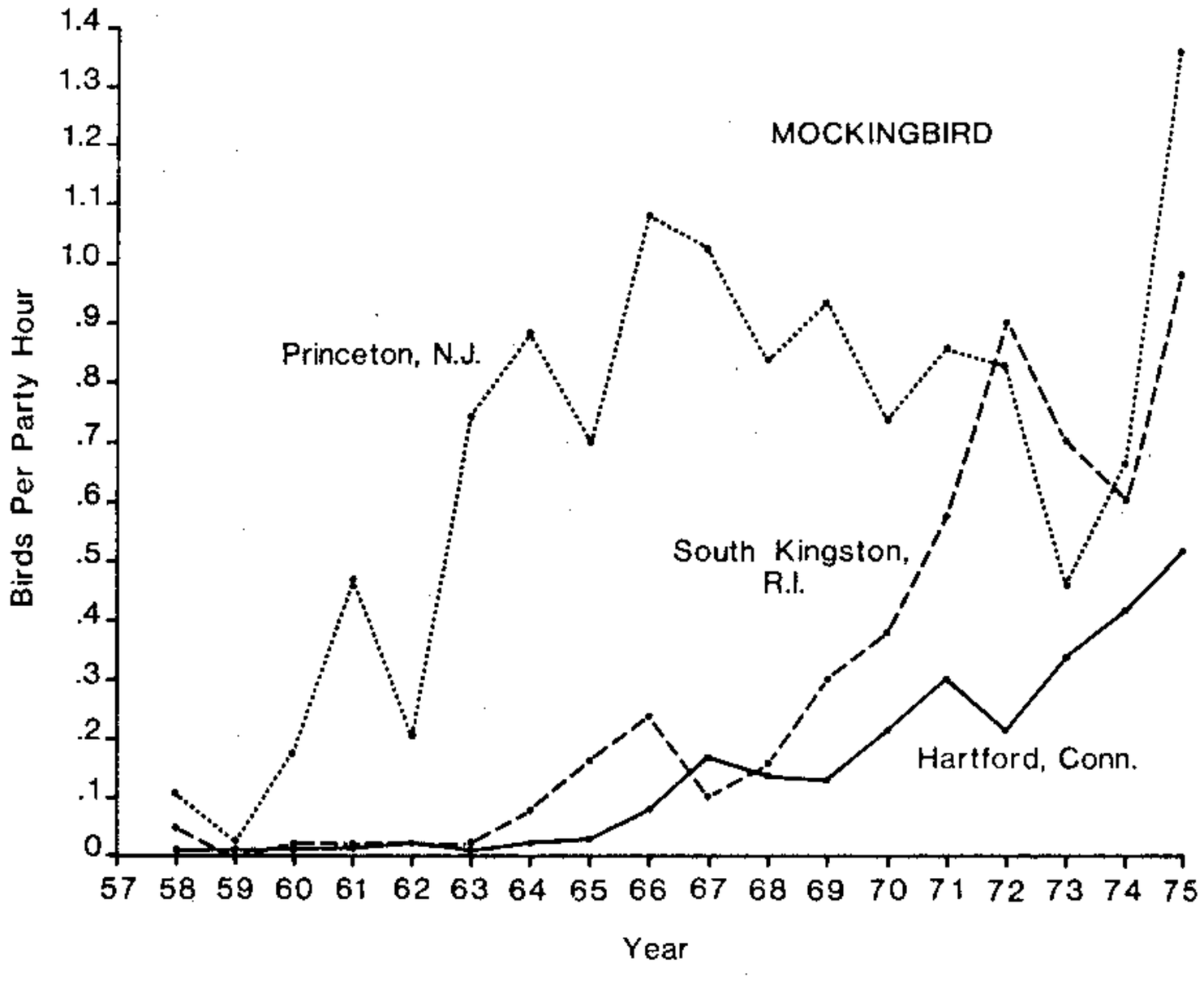

Figure 5. *Mockingbirds per party-hour for Princeton, N.J., South Kingston, R.I., and Hartford, Conn., from 1958 to 1975 during a period of Mockingbird expansion.*

Table 4. Times of observation and food eaten by one Mockingbird in Piscataway, N.J. Total food items per day are extrapolated from the observed proportions.

	Feb. 2	*Feb. 3*	*Feb. 9*	*Feb. 23*	*Mar. 2*
Daylength + 60 min.	676	676	687	724	727
Minutes Observed	170.1	553.9	492.8	328.5	359.8
Percent of Day	25.2	81.9	71.7	45.4	49.5
#*Rosa* eaten	37	146	162	130	107
#*Rhus* eaten	120	293	375	212	211
#*Lonicera* eaten	0	21	4	16	3
#*Other* eaten	0	0	2	8	0
#*Rosa* (whole day)	146	178	226	286	216
#*Rhus* (whole day)	476	358	523	467	426
#*Lonicera* (whole day)	0	26	6	35	6
#*Other*	0	0	3	17	0

1981). Working with House Sparrows, Kendeigh (1969) found a metabolic coefficient (metabolized energy per gram of energy intake) that averaged 77.4% at temperatures between 0° C and 10° C. A conservative figure of 70% assimilation efficiency was adopted by Utter (1970) for Mockingbirds and has been used here as an estimate for assimilation of fruit calories by Mockingbirds (Table 5). Energy excess ranged from −4.11 kcal/day to +19.57 kcal/day. On February 3 and 9 the Mockingbird was observed for 81.9% and 71.7% of the potential active time respectively, yielding the best estimate for energy expenditure and gain. The small positive energy balance on each of these days is indicative of the problems the Mockingbird may have in procuring food. To maintain a positive energy balance eating sumac alone a Mockingbird would need to consume over 1400 fruits each day.

DISCUSSION

WINTERING MOCKINGBIRDS have increased dramatically during the last 30 years in the Northeast. There has been a steady northward progression during this period and locations above 40° N are still experiencing increases in numbers of wintering birds. Although the increases are evident and substantial, the factors which have contributed to the increase are less clear. One of the factors contributing to the Mockingbirds' winter survival has been the increasing availability of winter food in the form of multiflora rose fruits. The association of Mockingbirds and multiflora rose has been recognized anecdotally and the quantitative feeding data presented here support the important contribution of multiflora rose to winter survival of Mockingbirds. Safina *(pers. comm.)* studying Mockingbirds in New York State also found that multiflora rose was by far the most important food.

Foraging observations and energy analysis of multiflora rose and other fruits indicate that Mockingbirds maintain a slight positive energy balance when feeding on multiflora rose. The magnitude of the energy excess may be lower than calculated, however, as multiflora rose has a fibrous pericarp and 70% assimilation of the measured calories may be a high estimate. Without the available fruit in the winter it is doubtful that the Mockingbird could maintain a positive energy balance. Although multiflora rose appears to be a major component of Mockingbird diet in the winter, it is certainly not the only fruit species contributing to the Mockingbird's winter survival. Concurrent with the expansion of the multiflora rose during the past 3 decades there has been a great increase in the extent of ornamental plantings, the fruits of which are fed upon by Mockingbirds. In addition, other introduced species have escaped and are widely distributed. These are also available for Mockingbirds including barberry (*Berberis thunbergii* DC.) from Japan which is a frequent escape and fed on by Mockingbirds (Safina MS), Japanese honeysuckle from eastern Asia which is abundant in many areas of the Mockingbird expansion and privet (*Ligustrum vulgare* L.) from Europe.

The Mockingbird is not the only species to show dramatic population increases in the Northeast during this period. Both the Tufted Titmouse *(Parus bicolor)* (Beddall, 1963; Bull, 1964; Temple and Temple, 1976; Kricher, 1981) and the Cardinal *(Cardinalis cardinalis)* have shown substantial gains in this region (Beddall, 1963). These species, however, are primarily seed-eaters during the winter and the in-

Table 5. Estimates of energy expenditure and gain based on Mockingbird activity and feeding.

	Feb. 2	*Feb. 3*	*Feb. 9*	*Feb. 23*	*Mar. 2*
Temperature max/min °C	−2.2/−6.7	0.6/−7.2	−0.6/−11.1	9.4/−1.7	12.2/0.5
Energy Expenditure (Kcal/day)	35.09	34.62	34.98	36.21	35.44
Energy Gain (Kcal/day)	30.98	35.32	43.80	55.78	39.82
Energy Excess (Kcal/day)	−4.11	+0.7	+8.82	+19.57	+4.44

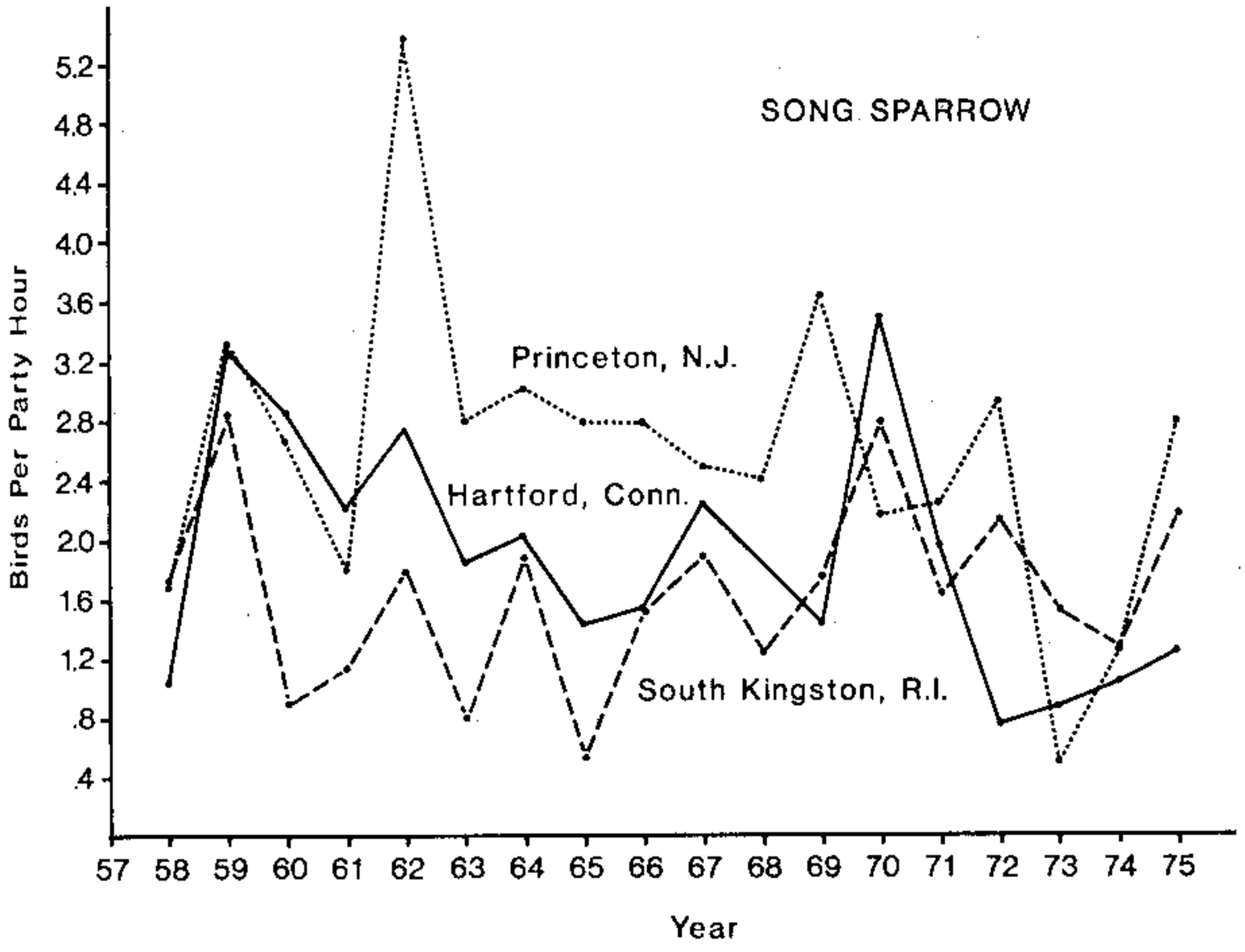

Figure 6. *Song sparrows per party-hour for Princeton, N.J., South Kingston, R.I., and Hartford, Conn., from 1958 to 1975 during a period of Mockingbird expansion.*

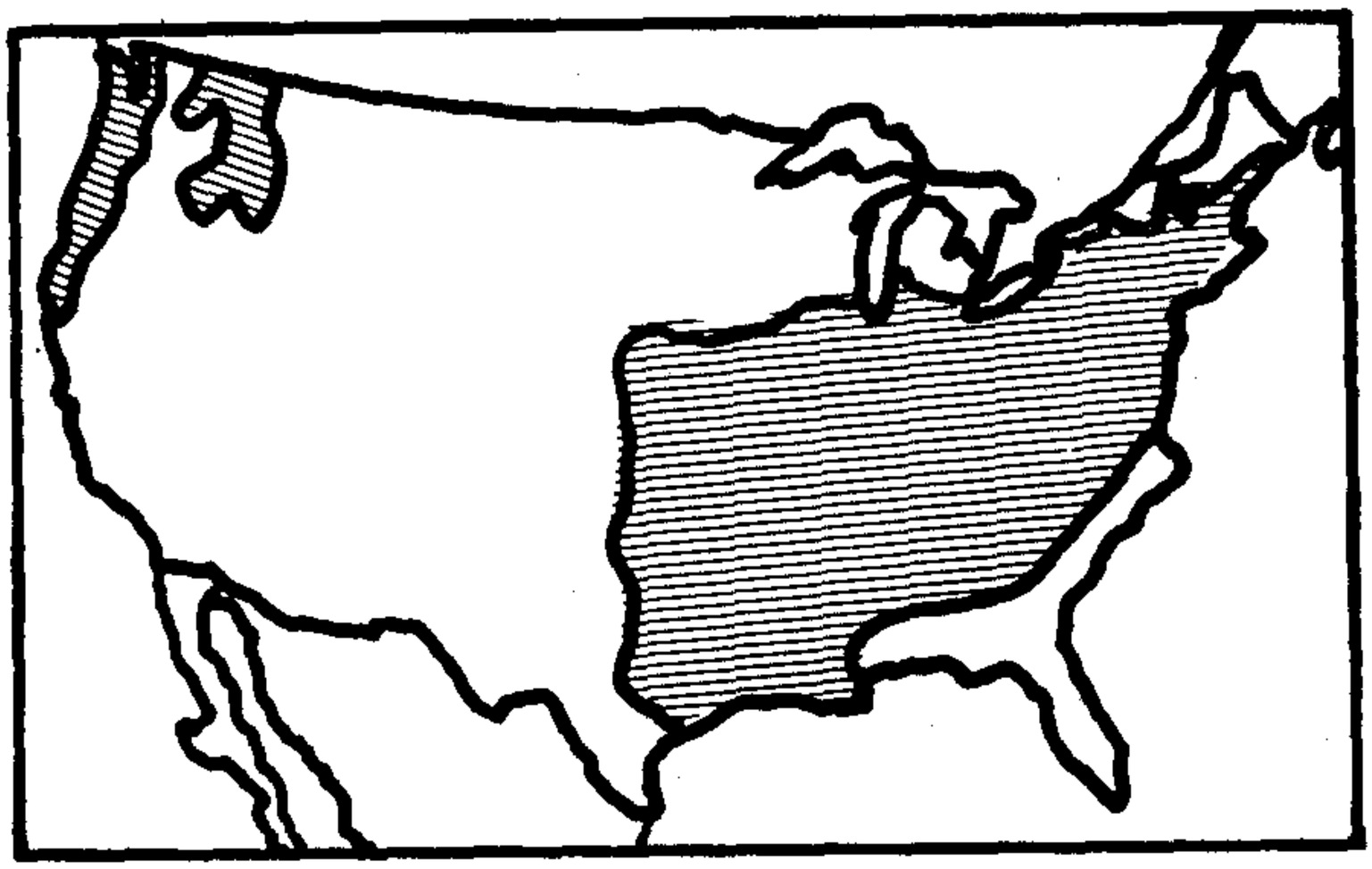

Figure 7. *Area where multiflora rose will grow successfully.*

crease in the numbers of feeding stations has been hypothesized as a major factor influencing their expansion (Bull, 1964: Kricher, 1981). Although the Mockingbird does frequent feeding stations for apples or raisins, these items are rarer commodities at feeders, and the Mockingbird increase has probably been affected only peripherally by feeding stations.

Beddall (1963) felt that climatic change was a major factor influencing the expansion of the Mockingbird and other species. While this may be a contributing factor, the Mockingbird expansion has proceeded northward much more rapidly than changes in the mean monthly winter temperatures. Food availability must be a major consideration even if climate is ameliorating.

In addition to providing winter food for the Mockingbird, multiflora rose also provides excellent nesting locations (Bull, 1964). This enables Mockingbirds to associate with multiflora rose on a year round basis. There is evidence that Mockingbirds move away from residential areas without multiflora rose during mid-winter (C. Leck, *pers. comm.*). Mockingbirds are primarily insectivorous during the breeding season (Martin *et al.*, 1951), and nest sites and insect food have probably not been limiting in the northward expansion. Rather, the energy supply in the fruits of multiflora rose has been an important factor. Multiflora rose ripens later than most native temperate species, ripening in mid- to late October. This reduces the availability for the bulk of temperate migrant frugivores thereby increasing the availability for wintering frugivores like the Mockingbird.

The ability of the Mockingbird to survive in the winter in the Northeast is a complicated relationship among physiology, behavior, morphology and environment. Fruits which remain available on plants during the winter in the Northeast are generally poor in nutrient availability (Stiles, 1980). It is a distinct possibility that the expansion of the multiflora rose has added enough available food in the non-forest habitats to permit the winter survival of the frugivorous Mockingbird.

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