

## ***Veery Catharus fuscescens***

**Preferred breeding habitat:** Early-successional, damp, deciduous forests, often associated with riparian thickets or swamps.

**Nest placement:** On or within 1.5 m of the ground, usually in or at the base of shrubs or small deciduous trees.

**Mean clutch size and fledging brood size ( $\pm$ SD):**

- Non-parasitized nests: clutch  $3.43 \pm 0.72$ ; brood  $3.10 \pm 0.93$
- Cowbird parasitized nests: clutch  $2.96 \pm 1.00$ ; brood  $1.74 \pm 1.52$

**Number of broods per season:** One, or perhaps up to two.

**Annual adult survival rates:** Assumed male and female: 70%

**Requirements for population stability ( $\lambda \geq 1$ ):**

- Fledge at least 1.8 young per female per year
- Among BBIRD sites on average, fledge  $\geq 2.6$  own young per successful nest if single brooded, or  $\geq 2.2$  own young per successful nest if double brooded
- Assuming zero parasitism, daily nest mortality  $\leq 6.4\%$  ( $\geq 20\%$  nest success) if double brooded, or  $\leq 5.2\%$  ( $\geq 28\%$  nest success) if single brooded
- Assuming 20% parasitism, daily nest mortality  $\leq 5.7\%$  ( $\geq 24\%$  nest success) if double brooded, or  $\leq 4.6\%$  ( $\geq 32\%$  nest success) if single brooded
- Assuming 40% parasitism, daily nest mortality  $\leq 4.8\%$  ( $\geq 31\%$  nest success) if double brooded, or  $\leq 3.5\%$  ( $\geq 43\%$  nest success) if single brooded
- Generally  $\leq 15\%$  nest parasitism across BBIRD sites
- Generally  $\leq 2-5\%$  nest predation rate across BBIRD site
- Percent forest cover approximately  $\geq 70\%$  within a 5 km radius

**Nest mortality and parasitism rates in relation to landscape context:**

- Nest predation increases as the distance to the nearest forest edge, particularly developed land cover edge, is reduced
- Once edge effects are controlled for, nest predation may increase as the degree of local landscape-level forest fragmentation is reduced
- Nest parasitism rate is most significantly positively related to the degree of forest fragmentation within a 5-10 km radius

**The importance of spatial scale to the relationship between nesting success and landscape context:**

- Nest parasitism rate appears to be determined primarily by the degree of forest fragmentation at the local-landscape scale (within a 5-10 km radius)
- Daily nest predation rate appears to be determined primarily by distance from the nearest developed edge, increasing as distance to edge is reduced. After controlling for the negative effect on nesting success of this fragmentation edge effect, forest fragmentation at the local-landscape scale may enhance nesting success through a reduction in nest predation rate, although this is offset by the negative effects of an increase in nest parasitism at this scale.

**General conclusions:**

- Nest parasitism has a severe effect on Veery breeding productivity, reducing host fledging success by 44% among parasitized nests.

- Nest parasitism rate is most strongly determined by the degree of forest fragmentation at spatial scales of 5-10 km radii.
- Nest predation rate is most strongly determined by distance to the nearest forest/developed land cover edge.
- Lambda is strongly negatively correlated with the degree of forest fragmentation across all spatial scales.

**Management guidelines:**

- Given the severe effect of cowbird parasitism on Veery breeding productivity, any management efforts that reduce cowbird abundance both locally and in the broader landscape (within up to a 15 km radius) will benefit vireo populations. A primary objective, therefore, is to minimize the availability of cowbird feeding habitat within at least a 10 km radius of Veery breeding habitat by minimizing (1) the extent of agriculture and development (particularly human dwellings) within or adjoining forests (not always feasible); (2) the extent of short grass openings, such as along road verges, utility corridors and around human dwellings; and (3) the presence of livestock within or adjoining forests.
- Given that nest predation rates may be elevated close to forest edges, particularly adjoining grassland, agricultural lands and other human-developed land cover, the extent of forest/developed edges within preferred Veery breeding habitat should be minimized where possible.
- Given this species' area sensitivity, and the strong effect of forest fragmentation at landscape scales on population lambda, a primary regional management focus should be to maintain a representative network of large, unfragmented forests to serve as source populations across the breeding range of the Veery. These forests should ideally be greater than 10,000 ha in area, and incorporate the damp, deciduous forest habitats preferred by this species.
- In regions where the Veery is a conservation concern, a broad-scale planning objective should be to maintain or improve the integrity (by minimizing the amount of agricultural land, particularly livestock grazing lands, within forested areas) of the larger forest tracts within the region, to ensure that percent forest cover within a 5 km radius of focal forest tracts is maintained above 70%.
- Because small canopy openings promote the development of a dense understory preferred by the Veery, silvicultural practices that include group selection logging, small or narrow clearcuts, thinning to remove overmature trees, cutting trees larger than a specified diameter limit, could be expected to generally benefit Veery populations, although this still needs to be confirmed. Large clear-cuts reduce Veery populations in the short term (up to at least eight years post harvest).

**DETAILED and BACKGROUND INFORMATION**

*Distribution and habitat preference*

A long-distance Neotropical migrant, the Veery is a widely-distributed breeder within latitudes 40-50°N of North America, and overwinters in northern South America. The

breeding range stretches from southeastern British Columbia and central Alberta, east across southern Canada to southwestern Newfoundland, south along the Atlantic seaboard to northern New Jersey, and east through southern Pennsylvania, the northeastern and northwestern extremes of Ohio, northern Indiana, central Minnesota, and North Dakota. It also breeds in the eastern United States at higher elevations of the Appalachians from western Maryland south to northern Georgia. In the western United States, the breeding range stretches from central and western Montana, east to eastern and northern Washington, and south through northeastern Oregon and Idaho (except extreme southwest), to northern Utah, southern Wyoming and central Colorado. More isolated breeding populations occur in the Black Hills of South Dakota, and the Little Colorado River in east-central Arizona (Moskoff 1995).

The Veery generally inhabits damp, deciduous forests, with a strong preference for riparian habitats. It prefers areas with a dense shrub cover (Moskoff 1995). It is reported to prefer disturbed or early-successional forests, probably because of a denser understory that is not as prevalent in undisturbed mature forests (Kendeigh 1945, Dilger 1956). In northern hardwood forests, Veery bred in 77% of disturbed and early-successional habitats available, but in only 18% of mature, undisturbed habitats available (Noon et al. 1979 in Moskoff 1995). In New Jersey, it much prefers areas cleared 40-60 years ago to areas cleared 10-20 years ago (Suthers 1987-1988 in Moskoff 1995). However, when a combination of Dutch elm disease, drought and windstorms changed a mature, closed-canopy forest in northern Minnesota to a more open habitat with a dense undergrowth, breeding densities were reduced by an average of 78%, from 2.1-5.5 territories/10 ha to 0-1.4 territories/10 ha (Canterbury & Blockstein 1997). Habitat selection can also depend on the extent of competitive interactions with other thrush species (reviewed in Moskoff 1995). There are no data to suggest that the habitat requirements of juveniles or post-breeding adults on the breeding range differ from those of breeding adults.

Breeding territories range in size from 0.1 ha to a few hectares (Moskoff 1995), with an average territory size of 0.25 ha (n = 61) in Ontario (Martin 1960).

The Veery is an area-sensitive species. In southern Wisconsin, it occurred in only 29% of forest patches <100 ha in size, but in 88% of patches >100 ha (Temple 1986). Similarly, the Veery rarely breeds in forests <100 ha in size in Illinois (Blake 1991, Herkert 1995). In the mid-Atlantic states, the Veery is most likely to occur in forests of 3,000 ha or greater in size (Robbins et al. 1989), and may require at least 100 ha of contiguous forest to sustain a viable breeding population (Robbins 1980).

### *Nest site characteristics*

The open cup nest is typically sited on or near the ground, usually in or at the base of shrubs or small deciduous trees. Most of the elevated nests are placed within 1.5 m of the ground.

## **BREEDING PRODUCTIVITY**

### *Laying seasons*

Earliest and latest Veery nests in the BBIRD database were initiated on 11 May and 16 July respectively. Nearly all laying took place during an 8-week period 14 May to 8 July, yielding an estimated laying season length of 57 days (Figure 1). This is in general agreement with published data (Moskoff 1995).

### ***Assumptions in calculations of breeding productivity***

No information on egg-laying intervals, but eggs are assumed to be laid at daily intervals. BBIRD data indicate a mean clutch size in unparasitised nests of 3.43 (SD = 0.72, n = 131). The incubation period has been described as 10-14 days (Moskoff 1995), but the mean incubation period from BBIRD data is 10.8 days (range 10-12 days; n = 10). There is no published information on the nestling period, but BBIRD data indicate a mean nestling period of 10.7 days (range 9-13 days; n = 14). There is no published information on re-nesting intervals. Although there is some suggestion of two broods per season (Moskoff 1995), no breeding females studied in southern Ontario over a 4-year period attempted to raise two broods (Burke & Nol 2000). To calculate breeding productivity, we used a 57-day laying season, 24-day nesting period (2-day laying, 11-day incubation, 11-day nestling), 7-day re-nesting interval following clutch loss (as for Wood Thrush), and 15-day re-nesting interval following successful fledging (as for Wood Thrush).

### ***Assumptions in calculations of finite rate of population increase ( $\lambda$ )***

There are no published adult survival rate data for the Veery. Intensive spot-mapping of color-banded populations of the related Swainson's Thrush (*Catharus ustulatus*) estimated adult survival rates of 57% (n = 149 adult male and females combined) over 11 years in an extensive, undisturbed forest in New Hampshire (Nichols et al. 1981), and 77% for adult males (n = 206) over five years in central Idaho (Hovis et al. 1997, cited in Mack & Yong (2000)). Adult survival in a color-banded population of the related Hermit Thrush (*C. guttatus*) in northern Arizona was estimated at 66.7% (SE = 26.4%) over six years (Clark & Martin, in review). We used the average of these three published estimates, giving an assumed annual adult female survival rate of 70%. We further assume a juvenile survival rate estimate of 35% (50% of the adult survival rate estimate, following the hypothesis of Greenberg (1980) and Temple & Cary (1988) that juvenile survival is approximately 50% of adult survival among small, north-temperate passerines).

### ***Effects of Brown-headed Cowbird nest parasitism on host reproductive success***

BBIRD data indicate that the mean clutch size in parasitized nests (2.96, SD = 1.00, n = 26) was 14% lower than that of non-parasitized nests (3.43, SD = 0.72, n = 131). Mean fledging success was 44% lower from successful parasitized nests (1.74, SD = 1.52, n = 19) than from non-parasitized nests (3.10, SD = 0.93, n = 81). The mean number of Brown-headed Cowbird eggs laid per parasitized Veery nest increases non-significantly ( $F = 5.49$ ;  $P = 0.079$ ), and the mean number of host young fledged per successful nest decreases significantly ( $F = 22.4$ ;  $P = 0.002$ ) as the site-specific parasitism rate increases (Figure 2).



**Table 1.** Summary of Veery breeding productivity and estimated finite rate of population increase ( $\lambda$ ) across BBIRD sites.

Site	No. of nests	Clutch size <sup>1</sup>	Parasitism rate (%) <sup>2</sup>	DPR (%) <sup>3</sup>	Nest success (%) <sup>4</sup>	Fledglings/ nest <sup>5</sup>	Annual fecundity <sup>6</sup>	Annual fecundity <sup>6</sup>	Lambda Single brd	Lambda Dbl brd
Western New York	4		25.00	5.41	13.14					
Chequamegon Natl Forest, WI	6	3.40	0	8.11	13.14					
Nicolet Natl Forest, WI	4	3.25	0	6.35	20.71					
Bitterroot, MT	15	3.60	46.67	3.78	20.00	2.00	0.89	1.09	0.86	0.89
Snake River, ID	23	3.73	21.74	5.56	22.75	2.33	1.14	1.39	0.9	0.94
Northern Ohio	89	3.40	19.10	5.00	27.82	2.38	1.33	1.63	0.93	0.98
Western Maryland	7		85.71	2.41	55.69	1.60	1.36	1.70	0.94	1.00
Nantahala National Forest, NC	11	3.55	0	4.96	23.93	3.50	1.77	2.16	1.01	1.08
NW Monongahela Natl Forest, WV	73	3.23	1.37	4.56	30.59	3.31	1.99	2.42	1.05	1.12
Chippewa Natl Forest, MN	9	3.80	0	2.62	52.88	3.00	2.49	3.09	1.14	1.24
Upper Mississippi, MN, WI, IL	5		20.00	1.55	68.69					

<sup>1</sup>Number of host eggs incubated in non-parasitized nests

<sup>2</sup>Percentage of nests that received 1 or more cowbird eggs

<sup>3</sup>Percentage of nests lost to predators per day

<sup>4</sup>Percentage of nests that produced at least 1 host fledgling or cowbird

<sup>5</sup>Number of host young fledged per successful nest

<sup>6</sup>Average number of host young fledged per female per year

**Table 2.** Summary of the best predictor variables (fragmentation indices) for the relationship between each of nest parasitism rate and lambda (assuming double-brooded) across plots (all plots with  $\geq 5$  nests) and sites (plot averages for scales of patch and 1-10 km radii) using multiple regression analysis. Spatial scales included: the patch of forest within which the study plot was embedded; 1-10 km radii of study plot centers; and 50-100 km radii of study site centers. Non-significant results included for comparison across scales. \* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ .

Scale	Plots				Sites		
	Independent variables	Dependent variables	Adj. R2	Slope	Dependent variables	Adj. R2	Slope
Patch	Parasitism	Patch core area	0.12		Patch edge density	0.30*	0.51
	Predation	Forest patch area	0.03		Patch core area	-0.06	
	Lambda	Patch edge density	0.28		To developed edge	0.87**	0.11
1 km	Parasitism	% developed	0.36**	0.94	% developed	0.51**	1.13
	Predation	% cropland	0.08		Fractal dimension	0.13	
	Lambda	% developed	0.2		% grassland	0.79**	-0.49
5 km	Parasitism	% developed	0.68***	1.17	% developed	0.66**	0.99
	Predation	% cropland	0.03		Angular second moment	0.19	
	Lambda	% developed	0.3		% grassland	0.82**	-0.49
10 km	Parasitism	% developed	0.71***	1.25	Avg patch size	0.68**	-0.2
	Predation	% cropland	0.03		Shannon-Weaver diversity	0.17	
	Lambda	% developed	0.47*	-0.48	Fractal dimension	0.84**	-2.29
50 km	Parasitism				Avg patch size	0.47*	-0.23
	Predation				Contagion	0.12	
	Lambda				Fractal dimension	0.77**	-2.9
100 km	Parasitism				% grassland	0.49**	1.99
	Predation				% grassland	0.19	
	Lambda				Fractal dimension	0.71*	-3.01



**Table 3.** Correlations ( $r$ ) between site means for landscape variables and each of nest parasitism rate, daily nest predation rate, and finite rate of population increase ( $\lambda$ ) among sites. Landscape variables include average distance between plot centers and the nearest developed edge at the patch scale, and percent cover of grassland (planted pasture/hay and semi-natural grassland/herbaceous), forest, and cropland (row crops, small grains, fallow and orchards/vineyards) at 1-100 km radii.

	Parasitism rate vs			Daily predation rate vs			Lambda
	Grass	Forest	Crop	Grass	Forest	Crop	Forest
	$r$	$r$	$r$	$r$	$r$	$r$	$r$
Patch		-0.60			-0.17		0.94**
1 km	0.60	-0.59	0.32	-0.17	0.30	0.00	0.73
5 km	0.70*	-0.76**	0.34	-0.29	0.40	-0.04	0.75
10 km	0.68*	-0.78**	0.33	-0.30	0.39	-0.05	0.73
50 km	0.56	-0.63*	0.24	-0.40	0.37	-0.14	0.54
100 km	0.74**	-0.61*	0.25	-0.52	0.42	-0.34	0.52
150 km		-0.56			0.46		0.50

\*  $P < 0.05$ ; \*\*  $P < 0.01$ ; \*\*\*  $P < 0.001$

#### ***Effects of landscape-level habitat variables on nest parasitism***

Among both plots and sites, nest parasitism rate was most significantly positively related to the degree of forest fragmentation within 5-10 km radii of plot centers (Tables 2-3, Figures 3-4). Including distance from the nearest developed edge as a patch-scale variable in a multiple regression did not improve either model. These patterns suggest that the effects of forest fragmentation within the local landscape overwhelm any patch-scale edge effects on nest parasitism rate.

There are no published data on the relationship between landscape structure and Veery nest parasitism.

#### ***Effects of landscape-level habitat variables on nest predation rate***

Among both plots and sites, there were no significant relationships between nest predation rate and any index of fragmentation at any spatial scale (Tables 2-3). Although the among-site individual correlations between nest predation rate and each of distance to nearest developed edge and average patch size within a 5 km radius were non-significant ( $r = -0.16$ ,  $P = 0.63$  and  $r = 0.47$ ,  $P = 0.15$  respectively), a regression entering these two independent variables together is significant ( $F = 8.3$ ,  $P = 0.011$ , adjusted  $R^2 = 0.59$ ), with significant partial correlations (see Figure 5) between nest predation rate and each of distance to nearest developed edge ( $r_p = -0.76$ ,  $P = 0.01$ ) and average forest patch size within a 5 km radius ( $r_p = 0.82$ ,  $P = 0.004$ ). This suggests that landscape structure at both the patch scale and local landscape scale are important determinants of nest predation rate, with nest predation increasing as the distance to the nearest forest edge is reduced

(i.e. illustrating a negative effect of edge on nest success), but increasing as the degree of landscape-level forest fragmentation is reduced (suggesting a positive effect of forest fragmentation on nest success), as indicated by the positive relationship between nest predation rate and average forest patch size within a 5 km radius once edge effects are controlled for.

Published data on the relationship between landscape structure and Veery nest predation are limited. Burke & Nol (2000) found a non-significant trend of increased nest predation with reduced distance to forest edge in southern Ontario.

### ***Effects of landscape-level habitat variables on the finite rate of population increase***

Among plots, lambda was most significantly negatively related ( $F = 7.2$ ,  $P = 0.037$ , adjusted  $R^2 = 0.47$ ) to percent developed land cover within a 10 km radius of plot centers (Table 2, Figure 6), due largely to the negative influence of nest parasitism rate at this spatial scale. Including distance to nearest developed edge accounted for a greater proportion of the variance in the relationship between lambda and landscape structure ( $F = 6.7$ ,  $P = 0.039$ , adjusted  $R^2 = 0.62$ : see Figure 7). Among sites, lambda was strongly negatively related to indices of forest fragmentation across all spatial scales, and was particularly positively related to the average distance from the nearest developed edge (Tables 2-3, Figure 8).

Published data on the relationship between landscape structure and Veery breeding productivity or lambda are limited. Burke & Nol (2000) found that the breeding productivity of the Veery did not differ between large forest fragments and contiguous forest, but was significantly lower in small forest fragments in southern Ontario.

### ***Effects of silviculture on nest predation and nest parasitism***

No data on effects of silviculture on nesting success. Breeding density was significantly lower both within and adjoining clearcut plots 15 years after harvest (0.03 and 0.04 individuals/50-m radius point count respectively) than within or adjoining 15-year-old, two-age harvested plots (1.4 and 0.5 individuals/count) or unharvested forest (0.9 individuals/count) in West Virginia (Duguay et al. 2001). The Veery was largely absent from regenerating clearcut areas in Nova Scotia for the first 5-7 years post harvest, but occurred in plots of age 8-74 years (Morgan & Freedman 1986).

### ***Effects of burning on nest success***

No data.

### ***Effects of grazing/browsing on nest success***

No data.

### ***Overview of landscape-level habitat effects on breeding productivity and population growth rate***

Among both plots and sites, nest parasitism rate was most significantly positively related to the degree of forest fragmentation within 5-10 km radii of plot centers, suggesting that fragmentation at the local landscape scale is the most important determinant of nest parasitism rate. The risk of parasitism, and the distance to which Brown-headed Cowbirds will penetrate forest interiors are correlated with the local population size of cowbirds in suitable habitat surrounding the forest (Donovan et al. 1997). The local abundance of cowbirds is, to a large extent, limited by the availability of suitable feeding areas, an area effect. Thus, local cowbird abundance increases as the relative area of human-transformed, usually agricultural habitats surrounding or perforating the forest increases. In turn, edge effects at the patch scale are expected to be strongly constrained by variation in local cowbird abundance associated with these area effects at local landscape scales within as much as a 10 km radius (Thompson et al. 2002, Lloyd et al. in review).

There was a significant edge effect on daily nest predation rate, with predation declining with increasing distance from the nearest developed edge, only once a negative effect on nest predation rate of the degree of forest fragmentation at the local landscape scale of within a 5 km radius had been controlled for, and vice versa. A decline in nest predation rate with increasing distance from a developed edge is to be expected if edge-adapted predators that are subsidized by resources in human-developed landscapes are more abundant within forest edge habitats. The suggestion that, after controlling for distance from the nearest developed edge, nest predation is lower in more fragmented landscapes is unusual, unless forest-interior predators are less abundant in fragmented landscapes. However, this potential benefit to nest success from a fragmentation-induced reduction in nest predation is overwhelmed by edge effects on nest predation and landscape-level effects on nest parasitism, given that breeding productivity was strongly negatively correlated with the degree of forest fragmentation across all spatial scales.

### ***Mapping predicted source and sink habitat***

Mapping predicted source and sink habitat is problematic due to uncertainty regarding the degree of double-broodedness, which affects breeding productivity estimates, and insufficient resolution in the relationship between  $\lambda$  and landscape metrics of forest fragmentation across BBIRD sites.

### **MANAGEMENT GUIDELINES**

Given the severe effect of cowbird parasitism on Veery breeding productivity, any management efforts that reduce cowbird abundance both locally and in the broader landscape (within up to a 15 km radius) will benefit Veery populations. A primary objective, therefore, is to minimize the availability of cowbird feeding habitat within at least a 10 km radius of Veery breeding habitat by minimizing (1) the extent of agriculture and development (particularly human dwellings) within or adjoining forests (not always feasible); (2) the extent of short grass openings, such as along road verges, utility corridors and around human dwellings; and (3) the presence of livestock within or adjoining forests.

Given that nest predation rates are elevated close to forest edges, particularly adjoining grassland, agricultural lands and other human-developed land cover, the extent of forest/developed edges within preferred Veery breeding habitat should be minimized where possible.

Given this species' area sensitivity, and the strong effect of forest fragmentation at landscape scales on population lambda, a primary regional management focus should be to maintain a representative network of large, unfragmented forests to serve as source populations across the breeding range of the Veery. These forests should ideally be greater than 10,000 ha in area, and incorporate the damp, deciduous forest habitats preferred by this species.

In regions where the Veery is a conservation concern, a broad-scale planning objective should be to maintain or improve the integrity (by minimizing the amount of agricultural land, particularly livestock grazing lands, within forested areas) of the larger forest tracts within the region, to ensure that percent forest cover within a 5 km radius of focal forest tracts is maintained above 70%.

Because small canopy openings promote the development of a dense understory preferred by the Veery, silvicultural practices that include group selection logging, small or narrow clearcuts, thinning to remove overmature trees, cutting trees larger than a specified diameter limit, could be expected to generally benefit Veery populations, although this still needs to be confirmed. Large clear-cuts reduce Veery populations in the short term (up to at least eight years post harvest).

## **FILLING THE GAPS – FUTURE RESEARCH AND MONITORING NEEDS**

Because small canopy openings promote the development of a dense understory preferred by the Veery, silvicultural practices that include group selection logging, small or narrow clearcuts, thinning to remove overmature trees, and cutting trees larger than a specified diameter limit, could be expected to generally benefit Veery populations. However the effects of selective logging, and other silvicultural practices, on Veery breeding density and nesting success have not been investigated. Although daily nest predation is strongly negatively correlated with distance from the nearest developed land cover forest edge, it is not known whether clearcut edges will have a similar negative effect on nest success.

An accurate estimate of annual adult female survival rate is critical for the estimation of lambda, but is currently lacking for the Veery. This should be determined with intensive monitoring, over a period of at least five years, of a color-banded population occupying the interior of a large forest tract where reproductive success is high, given that poor reproductive success may result in higher levels of breeding dispersal (e.g. Porneluzi & Faaborg 1999, Bayne & Hobson 2002).

Good estimates of re-nesting intervals following both nest failure and successful fledging are important for any model estimating seasonal productivity. Our estimates of re-nesting intervals are based on estimates for a related species. It would therefore be useful to gather additional data by monitoring color-banded individuals throughout a breeding season.

The extent of double-brooding by the Veery is largely unknown. Since this is an influential parameter to any model that estimates seasonal productivity, it would be useful

to investigate the extent of double-brooding by color-banded females, particularly from the southern extent of their range, given that one study has been done in southern Ontario.

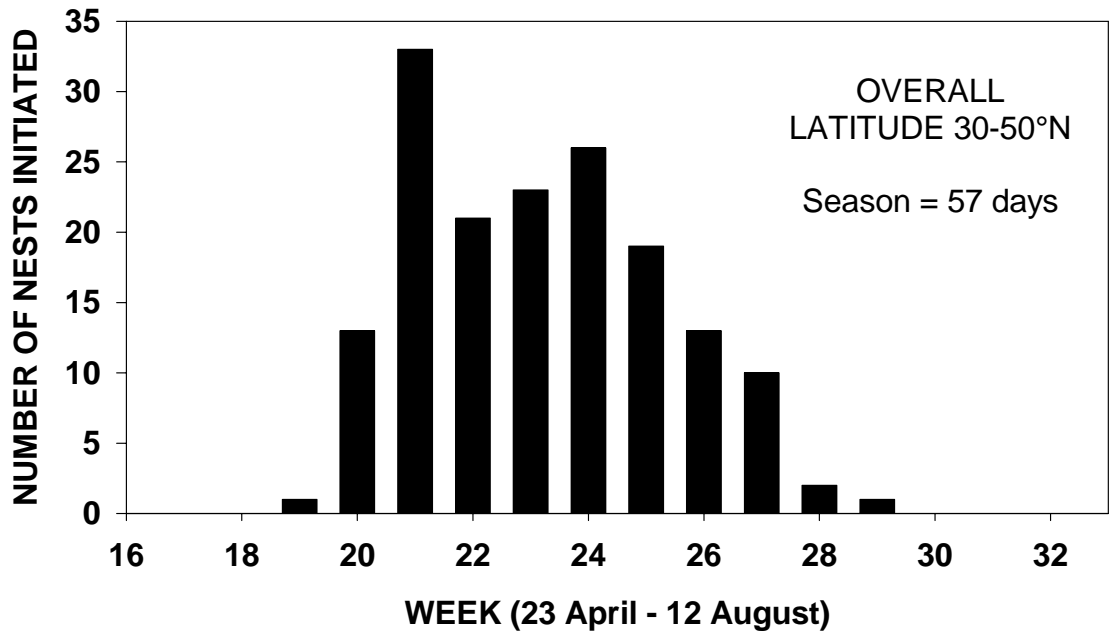
Further data on nesting success in both small and large forest patches in landscapes with differing extents of forest fragmentation at broad scales in different regions within the breeding range of the Veery would be useful for improving resolution in our understanding of the influence of landscape structure on breeding productivity, and thus on the patterns of sources and sinks in the landscape. These data are not difficult to collect, requiring a sample of ideally at least 25 nests (to give a sample of at least 10 successful nests for a reliable estimate of mean number of host young fledged per successful nest) that are monitored frequently enough to accurately determine their fate, and collected from a plot, up to 50 ha in size, of homogenous habitat whose center can be geo-referenced with a precision of approximately 30 meters (to allow plot-specific landscape features to be characterized from a digital land cover map). If any nests are located within 100 m of a habitat edge, measurements of the distance between that nest and the nearest edge would be useful for investigating patch-scale edge effects.

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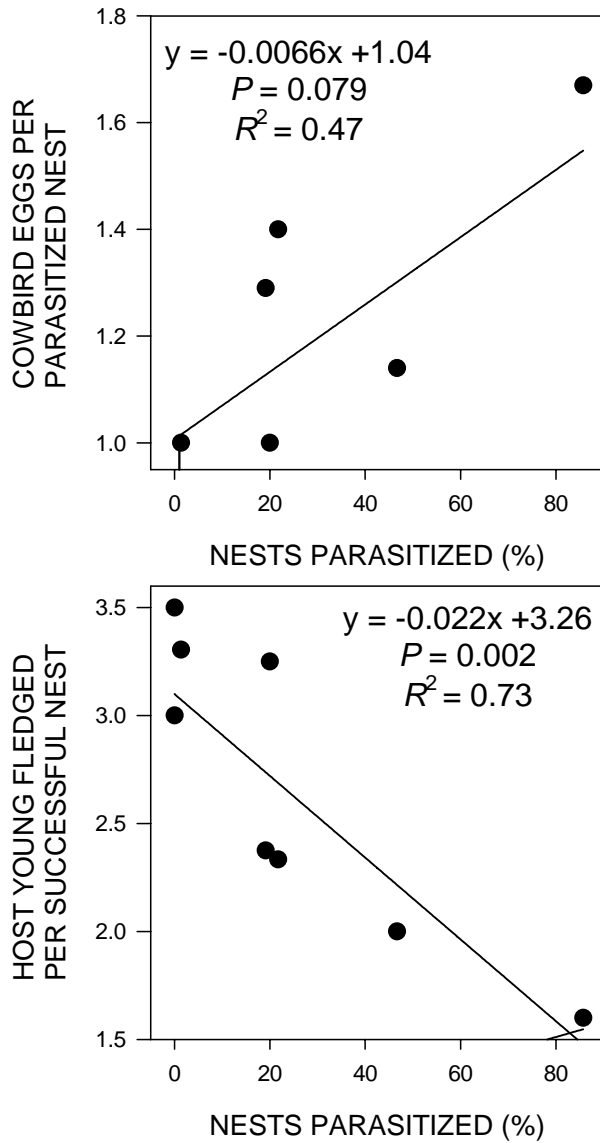
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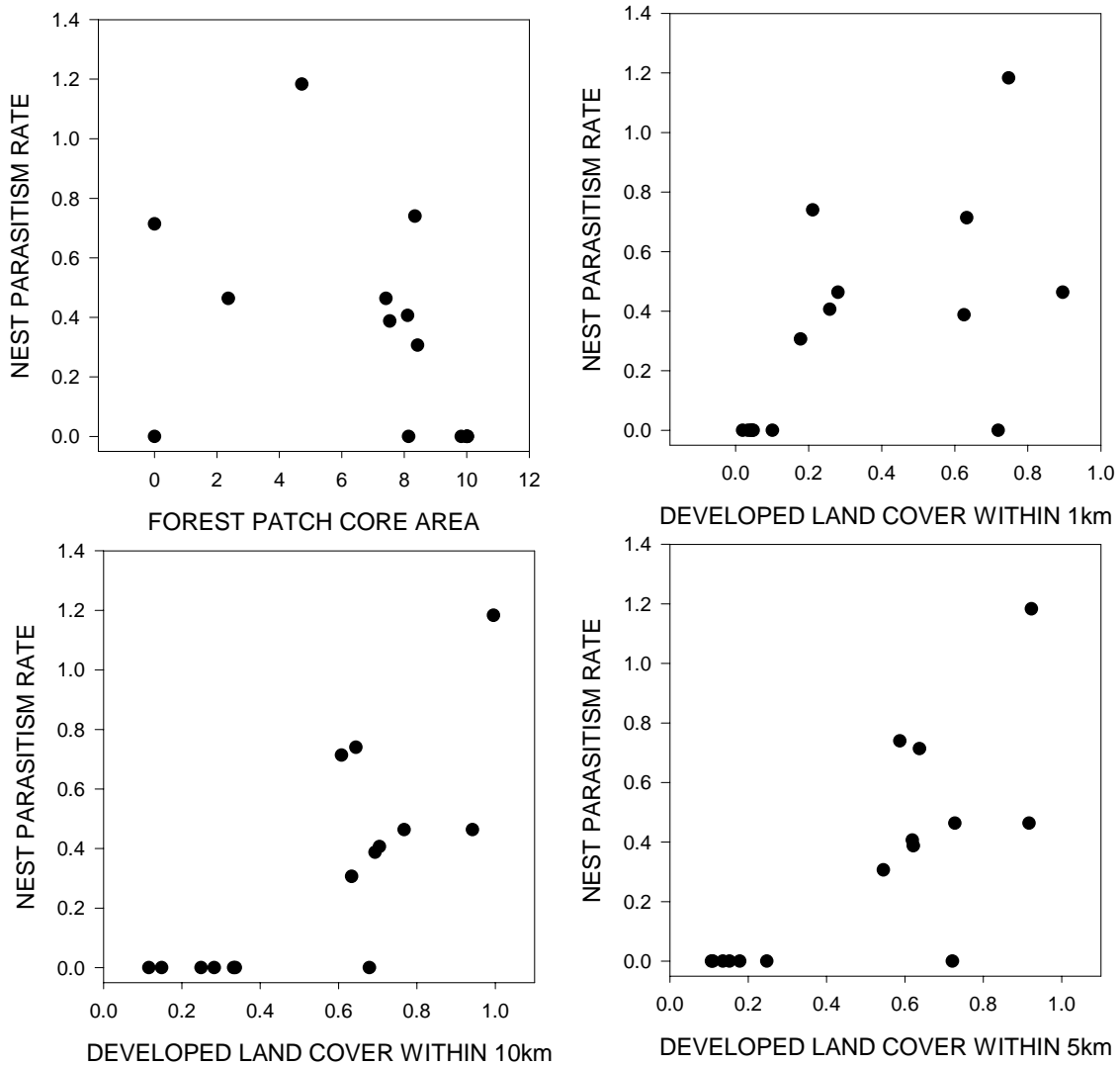
**Figure 1.** Veery laying season (number of new nests initiated each week) using BBIRD data over the latitudinal range 30-50°N. Laying season length estimated using the MacArthur index (Ricklefs 1966).



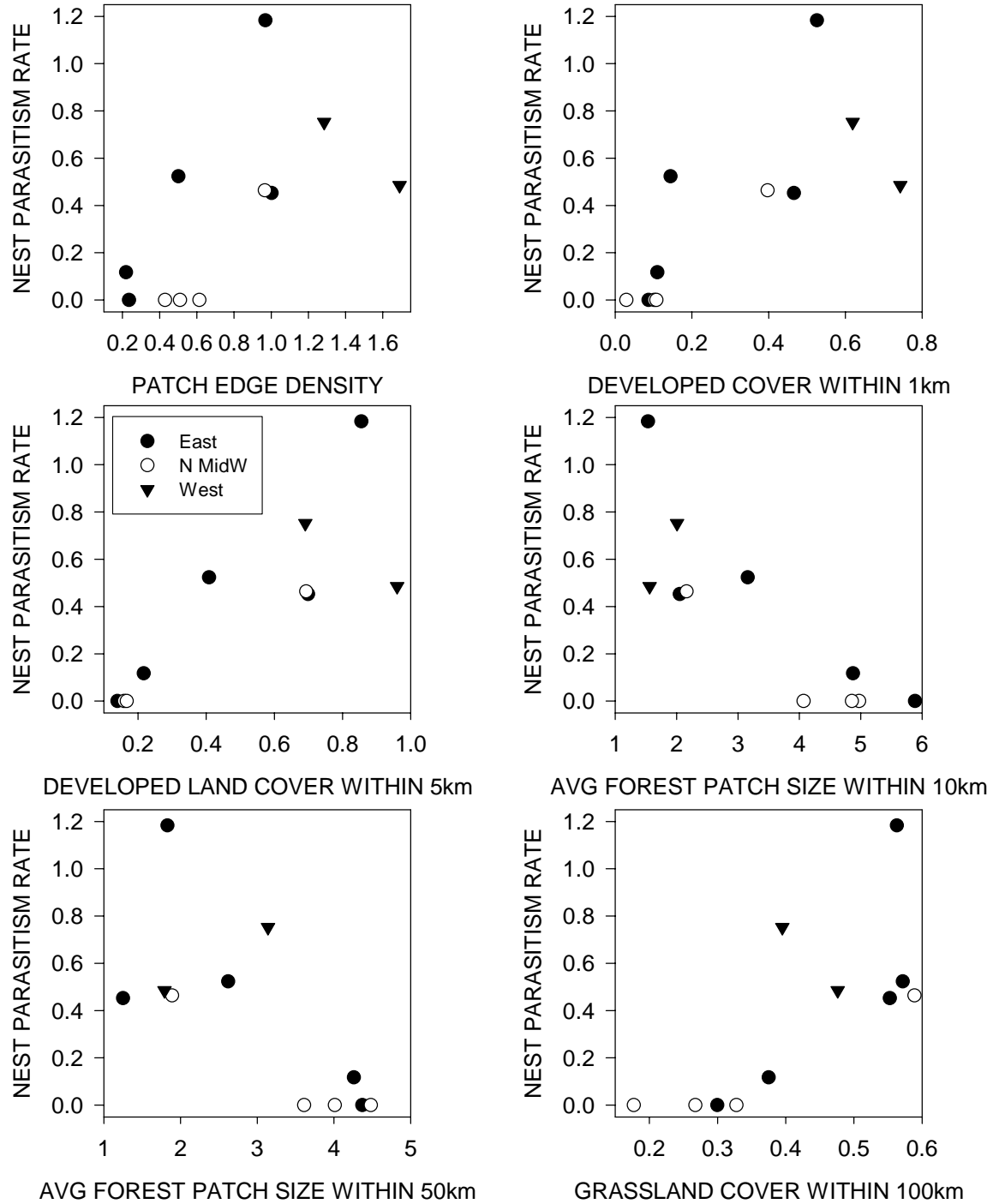
**Figure 2.** The mean number of Brown-headed Cowbird eggs laid per parasitized Veery nest (top) increases non-significantly ( $F = 5.49$ ;  $P = 0.079$ ), and the mean number of host young fledged per successful nest (bottom) decreases significantly ( $F = 19.0$ ;  $P = 0.005$ ) as the site-specific parasitism rate increases.



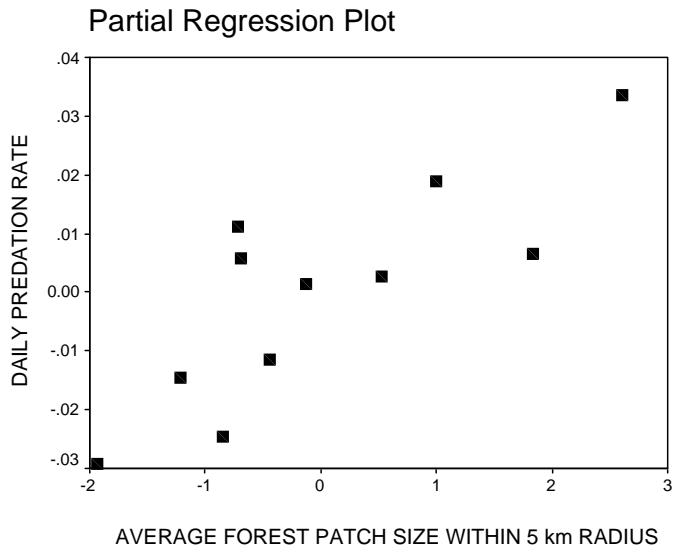
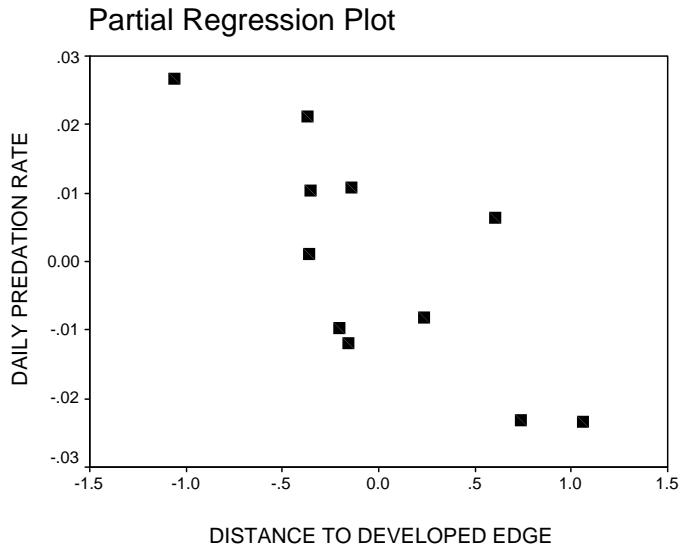
**Figure 3.** Relationship between nest parasitism rate (arcsine transformed) and each of forest patch core area (ln-transformed) and percent developed land cover (arcsine transformed) within radii of 1-10 km of plot centers, for all plots with  $\geq 5$  nests.



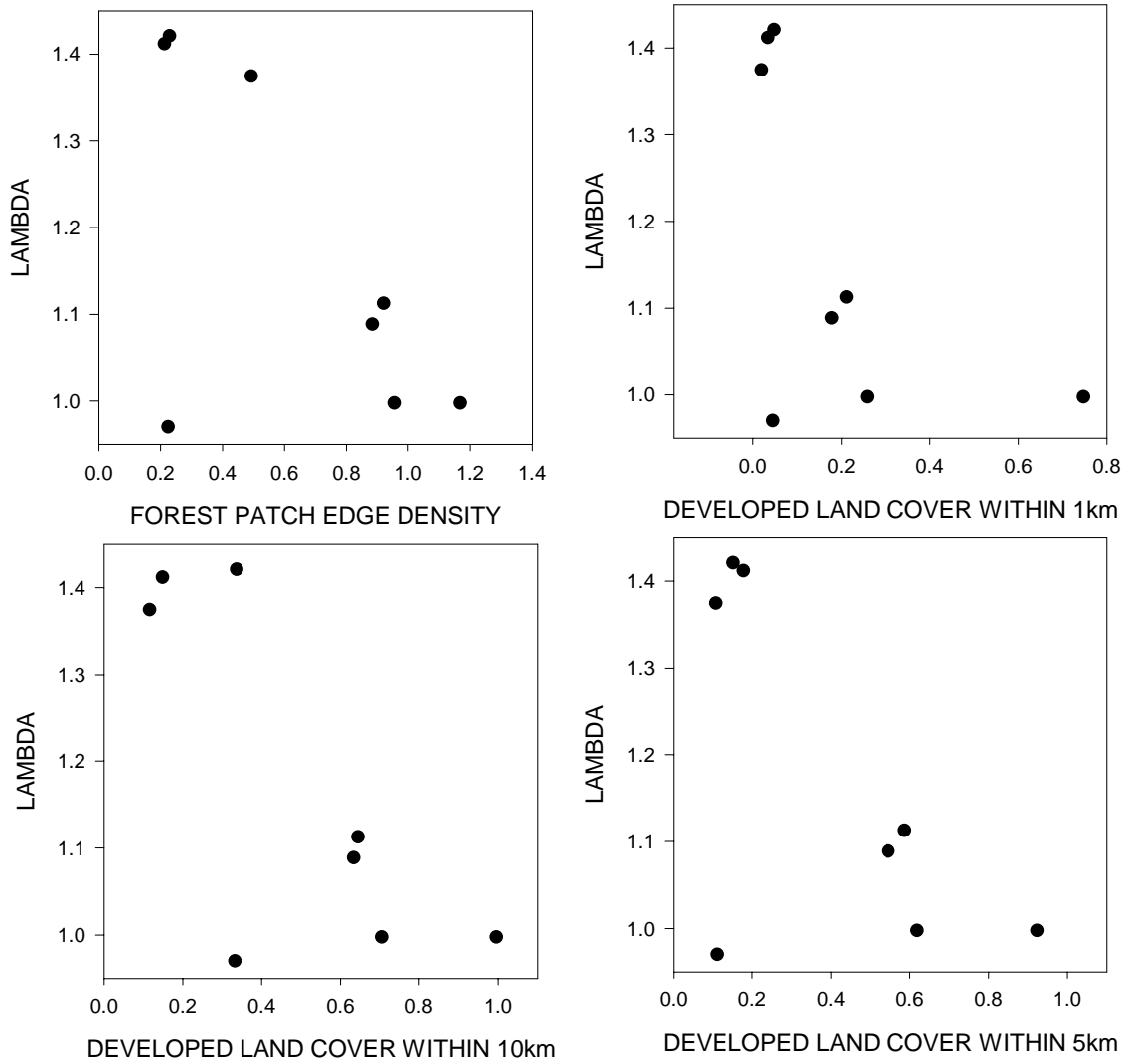
**Figure 4.** Relationship between nest parasitism rate (arcsine transformed) and various indices of forest fragmentation at spatial scales of the forest patch, within radii of 1-10 km of plot centers (site averages), and within radii of 50-100 km of site centers. Sites are classified according to region: East; Northern MidWest; and West.



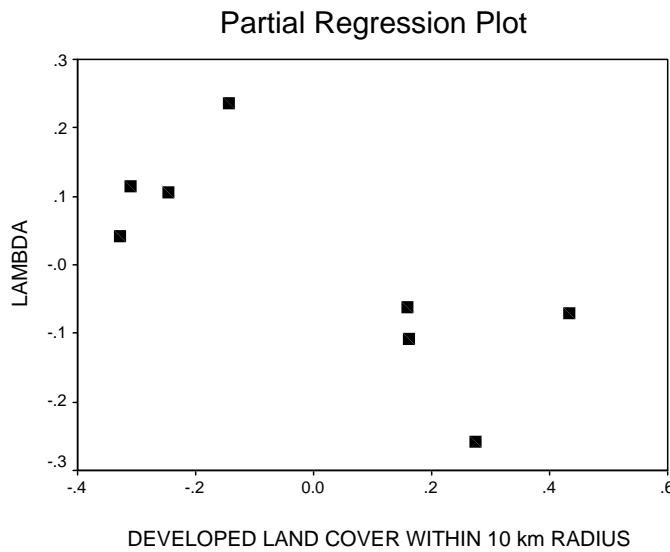
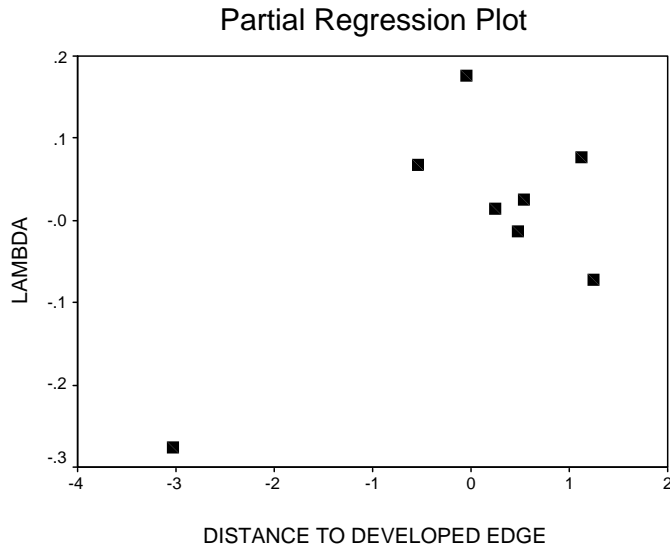
**Figure 5.** In a multiple regression entering two independent variables, Veery daily nest predation rate among BBIRD sites decreases with increasing distance from the nearest developed edge ( $r_p = -0.76$ ,  $P = 0.01$ ), and increases with increasing average forest patch size within a 5 km radius ( $r_p = 0.82$ ,  $P = 0.004$ ).



**Figure 6.** Relationship between lambda and each of patch-scale forest edge density and percent developed land cover (agriculture, grassland, other developed: arcsine-transformed) within radii of 1-10 km of plot centers.



**Figure 7.** Entering distance to developed edge as a second independent variable with percent developed land cover within a 10 km radius in a multiple regression accounted for a greater proportion of the variance in the relationship between lambda and landscape structure (regression  $F = 6.7$ ,  $P = 0.039$ ,  $R^2 = 0.62$ ).



**Figure 8.** Relationship between lambda and various indices of forest fragmentation at spatial scales of the forest patch, within radii of 1-10 km of plot centers (site averages), and within radii of 50-100 km of site centers.

