

## American Robin *Turdus migratorius*

**Preferred breeding habitat:** Forest, woodland and other shrub/tree patches (nesting habitat) adjoining grassland, pasture, lawns and other short-grass areas (foraging habitat).

**Nest placement:** Saddled on a firm support and usually sheltered from the rain, from ground level to the top of a tree.

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

- Clutch size 3.49 ( $\pm$ 0.65)
- Brood size 2.70 ( $\pm$ 0.91)

**Number of broods per season:** Two, occasionally three

**Annual adult survival rates:** Male and female 57.1%

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

- Fledge at least 3.0 young per female per year

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

- Daily nest predation rate increases as the percent cropland cover in the local landscape (within a 1 km radius) increases, after controlling for a positive relationship between nest predation rate and distance from the nearest developed edge
- At two western study sites, however, daily nest predation rate declines as the percent cropland cover in the local landscape declines

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

- Local landscape-scale (within a 1 km radius) effects of forest fragmentation appear to overwhelm patch-level effects, such as distance from forest edge, on daily nest predation rates

**General conclusions:**

- Daily nest predation rate is influenced primarily by the degree of forest fragmentation at the local-landscape scale (within a 1 km radius), increasing with increasing fragmentation across BBIRD sites generally, but declining with increasing fragmentation at two western sites
- Lambda exhibits a strong negative relationship with the degree of forest fragmentation (primarily with percent cropland cover) at local-landscape scales (within 1-10 km radii)

**Management guidelines:** The American Robin is widely distributed, has generally benefited from the process of forest fragmentation and suburban development across much of North America, and exhibits stable to increasing population trends (Sallabanks & James 1999), despite apparently poor breeding productivity in highly fragmented landscapes. Given that it is not a species of conservation concern, and that management prescriptions for improving the availability of breeding habitat in forested areas would generally degrade habitat quality for forest-interior birds, management guidelines are considered unnecessary.

### DETAILED and BACKGROUND INFORMATION

#### *Distribution and habitat preference*

The breeding range of the American Robin extends throughout most of North America. It is absent only from the extreme northern reaches of Canada and Alaska, and it vacates some

wintering quarters in southeastern California, southwestern Arizona, southern New Mexico, southern Texas, southern Mississippi and the Florida panhandle during the breeding season (Sallabanks & James 1999). During the winter, non-breeding season, many American Robins migrate to lower elevations and latitudes, vacating breeding grounds over most of Canada, northern North Dakota, northern Minnesota and northern Michigan. However, not all robin populations are migratory, some spending the winter months close to their breeding grounds (Sallabanks & James 1999).

During the breeding season, it frequents forest, woodland, and residential areas, breeding primarily where grassland, pasture, lawns and other short-grass areas (foraging habitat) are interspersed with or adjoin shrubs and trees (nesting habitat). In general, it prefers residential areas, riparian areas, and early-successional forest after cutting or fire, but prefers partially logged stands (commercial thins) over clear-cuts and old growth forest (Sallabanks & James 1999, Artman et al. 2001). In general, the process of forest fragmentation, urbanization, and agricultural intensification have increased, rather than decreased, the amount of available breeding habitat for the American Robin (Sallabanks & James 1999). Breeding densities are positively associated with the extent of forest edge (Hawrot & Niemi 1996), decline with increasing distance from the forest edge (i.e. are lower in forest interior than at forest edges: Brand & George 2001)

Breeding territory size varies inversely with population density: 0.11-0.21 ha in New York (n = 33 pairs: Howell 1942); 0.04-0.24 ha in Wisconsin (n = 34 pairs: Young 1951); and 0.12-0.84 in Tennessee (n = 62 pairs: Pitts 1984).

### *Nest site characteristics*

The nest may be placed from ground level to the top of a tree, but it is usually saddled on a firm support and sheltered from rain, often just below a vegetation layer with the largest volume of foliage. First nests in a season are likely to be low in a protected evergreen tree, later nests higher in a deciduous tree (Sallabanks & James 1999).

## **BREEDING PRODUCTIVITY**

### *Laying seasons*

Earliest and latest American Robin nests in the BBIRD database were initiated on 14 April and 18 July respectively. Both the timing and length of the laying season were similar across all latitudes, although the peak in laying occurred a week later at latitudes 40-50°N than at latitudes 30-40°N (Figure 1). Most nest initiation occurred during an 8-9 week period between 30 April and 1 July, with the average length of the laying season estimated at 69 days.

### *Assumptions in calculations of breeding productivity*

Eggs are laid at daily intervals (Sallabanks & James 1999). BBIRD data indicate a mean clutch size of 3.49 (SD = 0.65, n = 489). The mean incubation period has been reported as 13.0 days in Arizona (Clark & Martin in review), and the nestling period as 14.7 days in Arizona (Clark & Martin in review). BBIRD data indicate a mean incubation period of 12.0 days (range 9-14 days; n = 28) and a mean nestling period of 13.7 days (range 11-15 days; n = 29). Re-nesting intervals

are reported as approximately 7 days after successful fledging (Howell 1942). First nests of the season take 5-7 days to build (Sallabanks & James 1999), but later nests can be built in 1 day, and the first egg is generally laid 3-4 days after nest completion. Females are usually double-brooded, but can raise up to three broods in a season, particularly in the south of the range (Howell 1942; Young 1955). To calculate breeding productivity, we used a 69-day laying season, 29-day nesting period (2-day laying, 13-day incubation, 14-day nestling), and re-nesting intervals of 6 days and 7 days following nest loss and successful fledging respectively.

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

Annual adult survival (both sexes together) of a color-banded population in northern Arizona was estimated at 70.0% (SE = 21.1%) over six years (Clark & Martin in review). Using the proportions of individuals >1 year old in museum collections, Ricklefs (1997) estimated the adult survival rates for eight American Robin populations (grouped by subspecies and geographic location). These estimates ranged from 46.0% for *T. m. migratorius* from central North America to 74.3% for *T. m. confinus*. Including the estimate of (Clark & Martin in review), the average of nine adult survival estimates is 57.1%. Banding returns, which generally underestimate survival, have suggested a 48% annual survival rate in all age classes after age 6-months (Farner 1949). We assume a 57.1% annual adult female survival rate. We further assume a juvenile survival rate estimate of 28.6% (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), although Young (1955) estimated the survival of young from fledging to 1 November to be only 25%.

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

No effect. American Robins are rarely parasitized, but they recognize and reject the eggs of Brown-headed Cowbirds by puncturing them and throwing them out of the nest. Only a single known case of a pair of robins raising cowbird young (reviewed in Sallabanks & James 1999).

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

Not applicable.

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

Among all plots, daily nest predation rate was not significantly correlated with any single index of fragmentation at any spatial scale (Table 2), although a positive relationship between nest predation and percent cropland cover within a 1 km radius approached significance ( $r = 0.21$ ,  $P = 0.066$ ). A multiple regression entering distance to nearest developed edge and percent cropland cover within a 1 km radius as two independent variables was, however, significant ( $F = 3.17$ ,  $P = 0.048$ ), with a significant positive relationship between nest predation and percent cropland cover within a 1 km radius ( $r_p = 0.27$ ,  $P = 0.02$ ), after controlling for a positive relationship between nest predation and distance from the nearest developed edge ( $r_p = 0.19$ ,  $P = 0.1$ ).

At each of the three sites for which there were sufficient plot data, all in the western United States, daily nest predation rate was significantly related to indices of forest fragmentation

at the 1-km radius scale (Table 3, Figure 3). At both the Bitterroot Valley and Snake River BBIRD sites, whose plots were situated within or bordering agricultural croplands, daily nest predation rate declined as the cropland cover within a 1 km radius increased. Tewksbury et al. (1998), the source of the Bitterroot Valley BBIRD data, noted that daily nest mortality, mostly from predation, was higher in forested landscapes (2.82%) than in nearby fragmented, agricultural landscapes (1.30%) in the Bitterroot Valley (Tewksbury et al. 1998). They attributed this pattern to the importance of forest predators in this study area: Red Squirrels (*Tamiasciurus hudsonicus*) were much more abundant in forested landscapes and declined quickly with decreasing forest cover, whereas predators that typically increase in fragmented landscapes in the Midwest (such as corvids) increased only at very high levels of fragmentation (Tewksbury et al. 1998). The pattern was opposite at the Coconino National Forest site, with daily nest predation increasing as percent grassland cover within a 1 km radius increased. At this latter site, the well-forested landscape is fragmented naturally by grassy meadows.

Among sites, daily nest predation rate was not significantly correlated with any single index of fragmentation at any spatial scale (Tables 2).





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

Site	No. of nests	Clutch size <sup>1</sup>	DPR (%) <sup>2</sup>	Nest success (%) <sup>3</sup>	Fledglings/ Nest <sup>4</sup>	Annual Fecundity <sup>5</sup>	Lambda
Wayne Natl Forest, OH	12	3.25	7.12	11.75			
Priest Lake, ID	16		3.22	38.74			
Northern Ohio	88	3.42	4.81	21.43	2.41	1.67	0.81
Snake River, ID	445	3.47	4.87	22.29	2.43	1.73	0.82
Payette Natl Forest, ID	8		2.26	18.52	3.00	1.86	0.84
NW Monongahela Natl Forest, WV	27	3.44	4.37	24.91	2.56	1.97	0.85
Coconino Natl Forest, AZ	449	3.36	3.70	32.18	2.57	2.38	0.91
Sierra Natl Forest, CA	10	3.29	2.89	42.72	2.50	2.81	0.97
Nicolet Natl Forest, WI	25	3.74	4.42	26.93	3.44	2.81	0.97
Upper Mississippi, MN, WI, IL	156	3.43	2.50	40.61	2.76	2.99	1.00
Colfax County, NM	41	3.66	3.23	33.32	3.18	3.01	1.00
Bitterroot, MT	305	3.65	2.60	44.33	2.72	3.13	1.02
San Bernadino Natl Forest, CA	23	3.30	2.77	40.34	2.93	3.16	1.02
Western New York	15	3.00	1.53	47.27	2.67	3.20	1.03

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

<sup>2</sup> Percentage of nests lost to predators per day

<sup>3</sup> Percentage of nests that produced at least 1 fledgling

<sup>4</sup> Number of young fledged per successful nest

<sup>5</sup> Average number of 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 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. Independent variables included: forest patch size; forest patch core area; average distance between plot centers and nearest forest edge; percent cropland cover; percent grassland; % forest cover; Shannon-Weaver diversity index; and average forest patch size. 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. R <sup>2</sup>	Slope	Dependent variables	Adj. R <sup>2</sup>	Slope
Patch	Predation	Patch size	-0.01		Core forest area	-0.07	
	Lambda	Patch size	0.05		Core forest area	0.07	
1 km	Predation	% cropland	0.03		% cropland	-0.06	
	Lambda	% cropland	0.19**	-0.3	% cropland	0.43*	-0.34
5 km	Predation	% cropland	0.02		Shannon-Weaver diversity	-0.01	
	Lambda	% cropland	0.18**	-0.24	% cropland	0.30*	-0.22
10 km	Predation	% grassland	0.02		Shannon-Weaver diversity	0.01	
	Lambda	% cropland	0.02		% cropland	0.28*	-0.21
50 km	Predation				Avg. forest patch size	-0.02	
	Lambda				% cropland	0.22	
100 km	Predation				Avg. forest patch size	0.02	
	Lambda				% cropland	0.07	

**Table 3.** Adjusted  $R^2$  and slope ( $b$  - if significant) of the relationship between daily nest predation rate and various fragmentation indices at the spatial scale of the forest patch within which the plot is embedded, or within radii of 1-10 km of the plot centers at each of three sites.

Site		Patch	1km	5km	10km
Bitterroot Valley, MT	$R^2$	-0.01 <sup>a</sup>	0.28* <sup>c</sup>	0.04 <sup>f</sup>	-0.01 <sup>f</sup>
	$b$		-0.068		
Snake River, ID	$R^2$	0.08 <sup>a</sup>	0.38* <sup>d</sup>	0.41* <sup>c</sup>	0.34* <sup>c</sup>
	$b$		0.19	-0.19	-0.15
Coconino Natl Forest, AZ	$R^2$	-0.02 <sup>b</sup>	0.15* <sup>e</sup>	0.04 <sup>g</sup>	0.19* <sup>h</sup>
	$b$		0.043		0.13

Independent variables: <sup>a</sup>distance to nearest developed edge; <sup>b</sup> distance to nearest edge; <sup>c</sup>percent cropland cover; <sup>d</sup>Shannon-Weaver diversity index; <sup>e</sup>percent grassland cover; <sup>f</sup> Aggregation index; <sup>g</sup>forest edge density; <sup>h</sup>percent forest cover. \* $P < 0.05$ ; \*\* $P < 0.01$ .

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

Among all plots, lambda was significantly negatively related to percent cropland cover at local landscape scales within 1-5 km radii (Table 2, Figure 4). Among sites, lambda was significantly negatively related to percent cropland cover within 1-10 km radii (Table 2, Figure 5). Lambda was generally substantially below unity at sites where the average distance between plot centers and the nearest forest edge was less than 30 m, which were also sites with less than 60% forest cover within a 1 km radius (Figure 5).

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

No published data on effects on nest success. Breeding densities are generally greater in early-successional forest after logging, but prefers partially logged stands (commercial thins) over clear-cuts and old growth forest (Sallabanks & James 1999).

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

No data on effects of burning on nest success. Breeding densities were higher in early-successional forest habitats post-fire than in unburned, mature forest (Raphael et al. 1987), and increased with repeated prescribed burning that reduced shrub and sapling density (Artman et al. 2001).

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

No data.

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

BBIRD data suggest that American Robin breeding productivity (and hence lambda) generally declines with increasing cropland cover (an index of the extent of forest fragmentation) within the local landscape (within 1-5 km radius). This reduced breeding productivity in more fragmented landscapes appears to be as a consequence of a positive relationship between daily nest predation rate and percent cropland cover (an index of forest fragmentation) within a 1-5 km radius. These fragmentation effects at the local landscape scale appear to overwhelm the apparent positive relationship between daily nest predation rate and distance from the nearest developed edge, given the positive relationship between lambda and distance from the nearest forest edge, and strongly negative relationship between daily nest predation rate and lambda.

These results contrast with the within-site analyses for the Bitterroot Valley (see also Tewksbury et al. 1998) and Snake River study sites, where the daily nest predation rate declines as the proportion of cropland agriculture within the local landscape (within a 1 km radius) increases (Table 4, Figure 3). Despite these contrasting results, BBIRD data do not support the suggestion (e.g. Tewksbury et al. (1998)) that the relationship between nest predation and landscape structure may differ between regions (see Figure 4). However the relationships evident in the BBIRD data are strongly influenced by data from the three sites with the greatest degree of

landscape-level fragmentation. Further investigation of possible regional differences in the relationship between nest predation and landscape structure is required to address this issue.

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

The relationships between lambda and landscape structure at various spatial scales is insufficiently resolved to permit reliable mapping of predicted source and sink habitat.

## **MANAGEMENT GUIDELINES**

The American Robin is widely distributed, has generally benefited from the process of forest fragmentation and suburban development across much of North America, and exhibits stable to increasing population trends (Sallabanks & James 1999), despite apparently poor breeding productivity in highly fragmented landscapes. Given that it is not a species of conservation concern, and that management prescriptions for improving the availability of breeding habitat in forested areas would generally degrade habitat quality for forest-interior birds, management guidelines are considered unnecessary.

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

The suggestion that the relationship between American Robin nest predation and degree of forest fragmentation may differ between the western United States on the one hand (predation declining with increasing agricultural fragmentation), and the Midwest and eastern United States on the other hand (predation increasing with increasing agricultural fragmentation), requires more rigorous testing from a number of sites in each region. Nesting success data should be gathered from at least five plots (each separated by at least 5 km from the others) spanning a range of forest fragmentation within each site. Given that the relationships may differ between naturally-fragmented forests and agriculturally-fragmented forests in the western United States, sites should be selected from both landscape types.

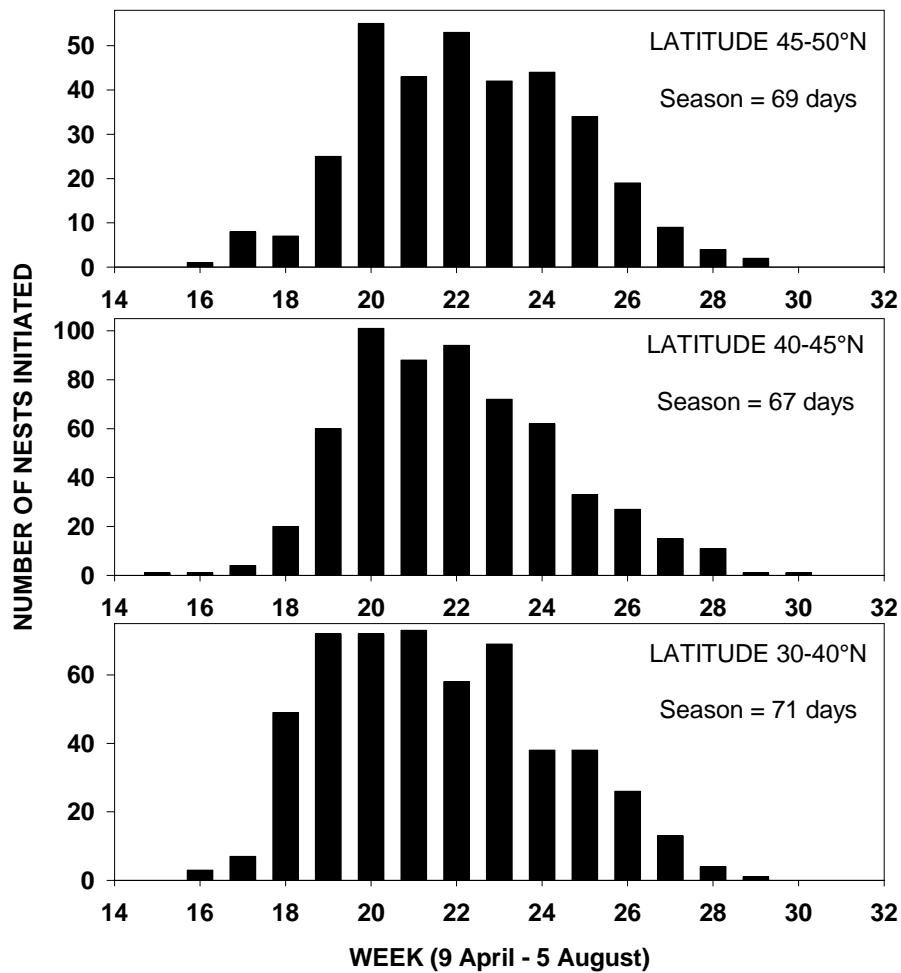
Good estimates of re-nesting intervals following both nest failure and successful fledging are important for any model estimating seasonal productivity. Our estimate of the re-nesting interval following failure is based on a small sample, and no field measurements of the re-nesting interval after successful fledging among double-brooded females have been made. It would therefore be useful to gather additional data by monitoring color-banded individuals throughout a breeding season.

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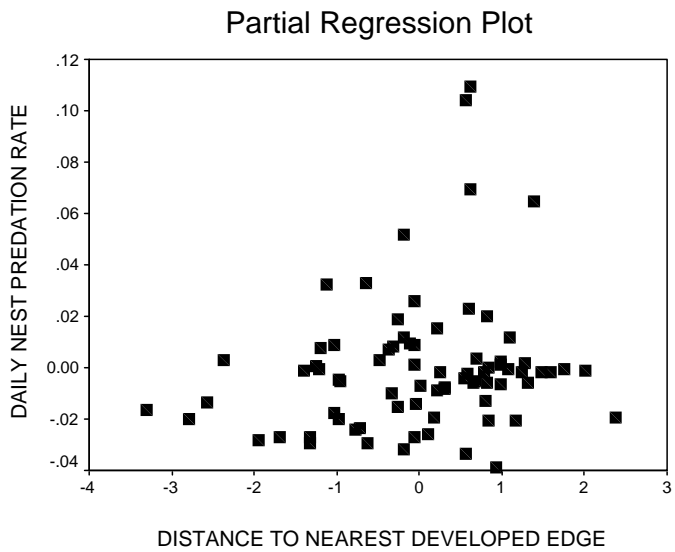
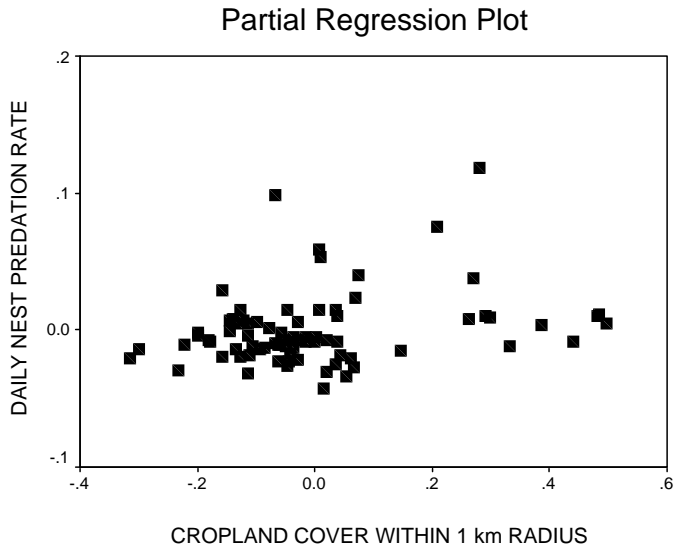
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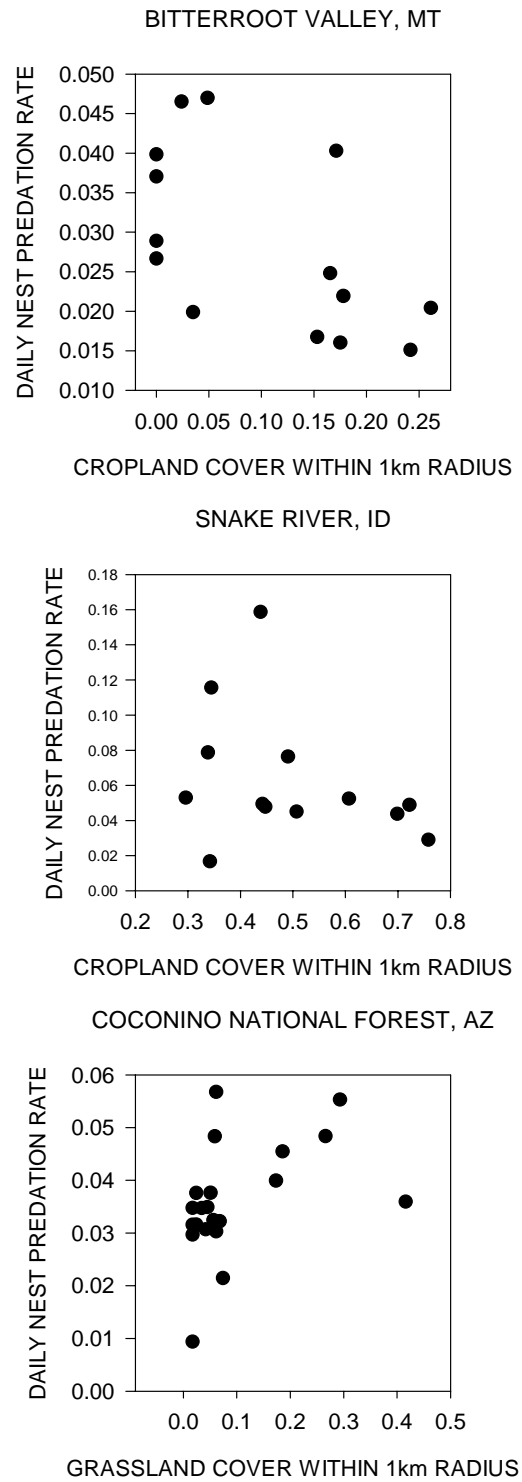
**Figure 1.** American Robin laying season (number of new nests initiated each week) in relation to latitude. Laying season length estimated using the MacArthur index (Ricklefs 1966).



**Figure 2.** In a multiple regression entering distance to nearest developed edge and percent cropland cover within a 1 km radius of plots as two independent variables ( $F = 3.17, P = 0.048$ ), daily nest predation rate among plots increases with an increase in percent cropland cover within a 1 km radius ( $r_p = 0.27, P = 0.02$ ), after controlling for a positive relationship between nest predation and distance from the nearest developed edge ( $r_p = 0.19, P = 0.1$ ).



**Figure 3.** Relationship between daily nest predation rate on American Robin nests and percent cropland or grassland cover within a 1 km radius (arcsine-transformed) of the plots of three different sites in the western United States.



**Figure 4.** Relationship between lambda and each of the area of the forest patch within which the plot is embedded (ln-transformed), and percent cropland cover (arcsine-transformed) within 1-10 km radii, for all plots with  $\geq 5$  nests.

