Spring Creek Valley Ecological Assessment
Annotated Bibliography

I. Population Viability in Small Forest Fragments

Shaffer ML. 1981. Minimum population sizes for species conservation. Bioscience 31: 131–134.

> Species become extremely vulnerable to extinction below a certain population size, even when the habitat quality of the fragment where they reside is optimal. This paper proposes criteria for successful preservation of populations, discusses the various methodS available for determining the population sizes and their area requirements to meet these criteria, and relates both to overall conservation strategy.

Tilman D., May R.M., Lehman C.L., Nowak M.A. "Habitat destruction and the extinction debt." *Nature* (371): 65–66. 1994.

> This paper describes the concept of "extinction debt," where populations will persist for some amount of time even after habitat fragmentation and alteration have eliminated the possibility of new immigration and damaged long-term population viability. Populations may persist because of individual longevity, or because there were initially large numbers and some degree of reproduction continues: but if habitat is not suitable the population will slowly decline and become extinct.

Other resources:

- Brown JH, Kodrick-Brown A. 1977. Turnover rates in insular biogeography: effect of immigration on extinction. Ecology 58: 445–449.
- Hanski I. 1999. Metapopulation Ecology. Oxford, UK: Oxford University Press.

A.) Population Viability - Insects

Tscharntke T, Steffan-Dewenter I, Kruess A, Thies C. Characteristics of insect populations on habitat fragments: A mini review. Ecological Research Volume 17 Issue 2 Page 229 - March 2002.

> There is tremendous variability within the insect taxa, and consequently tremendous variability in the response of different insects to fragmenting habitats. This paper addresses groups of insects and their probable responses to habitat fragmentations. The group of plant-eating insects is likely to decline in diversity and numbers as forest fragment size gets smaller, because small fragments have lower species diversity and higher prevalence of invasive species, and 90% of plant-eating insects are highly specific to particular plant species.

B.) Population Viability - Plants

Honnay, Olivier, Hans Jacquemyn, Beatrijs Bossuyt and Martin Hermy. "Forest fragmentation effects on patch occupancy and population viability of herbaceous plant species." *New Phytologist* (166) 723. 2005.

This paper summarizes research that has been done to elucidate the potential survival of herbaceous plant populations in small forest fragments. The genetic composition of populations in small fragments is altered due to genetic drift and increased inbreeding. The availability of pollinators, necessary for sexual reproduction and seed production in many plant species, is generally reduced greatly in small forests, which can doom the plant population to eventual extinction. Edge effects (altered environmental conditions at forest edges, increased competition with exotic species, decreased pollinator availability) can cause plant species to decline in areas that are not interior forest. However, many herbaceous plant species of temperate forests are very long lived and have clonal growth forms. Thus, it is likely that many plant populations in small forest fragments represent "extinction debt"; habitat changes have created many of the above detrimental impacts such that populations are not actually viable, but they have not gone extinct yet due to the longevity of the individuals. If habitat improves, detrimental effects may be reversed and the populations may persist; if not, they will eventually become extinct.

C.) Population Viability – Birds

The following studies document various negative impacts of edge conditions on the breeding success of native bird species that require interior forest habitat. In summary: if interior area is not large enough, these species are extremely unlikely to breed successfully, and the forest effectively serves as a "trap," luring individuals to reside in an area where they cannot reproduce and causing decline in the regional population.

Wilcove, D. S. "Nest predation in forest tracts and the decline of migratory songbirds." *Ecology* (66):1211-1214. 1985.

American robins nesting in exotic honeysuckle and buckthorn shrubs experienced higher nest predation than nests in comparable native shrubs. These results suggest that restoring native plant communities may benefit the surrounding avian community.

Peter W. C. Paton. The Effect of Edge on Avian Nest Success: How Strong Is the Evidence? Conservation Biology, Vol. 8, No. 1 (Mar., 1994), pp. 17-26.

A review of available studies about whether nest predation of songbirds increases at forest edges reveals that most studies show increased predation within 50 m.

Brittingham, Margaret C. and Stanley A. Temple. "Have Cowbirds Caused Forest Songbirds to Decline?" *BioScience* (33) 31-35. 1983.

This study documents the regional decline of songbird populations due to brown-headed cowbirds. The cowbirds lay eggs in the nests of native species, displacing eggs and outcompeting native hatchlings such that the native parent often does not succeed in raising any of their own young. Cowbirds' habitats are open areas, and thus they by forest fragmentation and high prevalence of edges, where forest attracts native species they are parasitic upon.

Temple, S. A., and J. R. Cary. 1988. Modeling dynamics of habitat-interior bird populations in fragmented landscapes. Conservation Biology (2):340-347.

Keyser, Amber J., Geoffrey E. Hill, and Eric C. Soehren. "Effects of Forest Fragment Size, Nest Density, and Proximity to Edge on the Risk of Predation to Ground-Nesting Passerine Birds." *Conservation Biology* (12) 986-994.1998.

Flaspohler, David J.; Stanley A. Temple, and Robert N. Rosenfield. "Species-Specific Edge Effects on Nest Success and Breeding Bird Density in a Forested Landscape." *Ecological Applications* (11) 32-46. 2001.

D.) Pollinators in Small Forest Fragments

A number of studies document changes in pollinator abundance and behavior in small forest fragments, as compared to large forested areas. Some pollinators are much more erratic in visiting plants, resulting in lower rates of seed set. There is a lower diversity of pollinator species in small versus large forest fragments. Some pollinators avoid forest edges. Together, these studies suggest that pollination, a process vital to the successful reproduction of many plant species, is gravely disrupted in small forest fragments. Pollination also enables sexual reproduction, which is the mechanism by which species adapt to changing conditions. Disruption of pollination systems may leave some plant species without the ability to adapt.

- Kearns CA, Inouye DW, Waser NM. 1998. Endangered mutualisms: the conservation of plant–pollinator interactions. Annual Review of Ecology and Systematics 29: 83–112.
- Steffan-Dewenter I, Tscharntke T. 1999. Effects of habitat isolation on pollinator communities and seed set. Oecologia 121: 432–440
- Didham RK, Ghazoul J, Stork NE, Davis AJ. 1996. Insects in fragmented forests: a functional approach. Trends in Ecology and Evolution 11: 255–260.
- Kunin WE. 1997. Population size and density effects on pollination: pollinator foraging and plant reproductive success in experimental arrays of Brassica kaber. Journal of Ecology 85: 225–234.
- Bond WJ. 1994. Do mutualisms matter? Assessing the impact of pollinator and disperser disruption on plant extinction. Philosophical Transactions of the Royal Society of London B 344: 83–90.
- Waser NM, Chittka L, Price MV, Williams NM, Ollerton J. 1996. Generalization on pollination systems, and why it matters. Ecology 77: 1043–1060.
- Sih A, Baltus MS. 1987. Patch size, pollinator behavior, and pollinator behavior in catnip. Ecology 68: 1679–1690
- Aizen MA, Ashworth L, Galetto L. 2002. Reproductive success in fragmented habitats: do compatibility systems and pollination specialization matter? Journal of Vegetation Science 13: 885–892
- Murcia C. 1996. Forest fragmentation and the pollination of neotropical plants. In: J Schelhas, R Greenberg, eds. Forest Patches in Tropical Landscapes. Washington, DC, USA: Island Press, 19–36.
- Aizen MA, Feinsinger P. 1994a. Habitat fragmentation, native insect pollinators, and feral honey bees in Argentine 'Chaco Serrano'. Ecological Applications 4: 378–392.
- Rathcke, B. J., and E. S. Jules. "Habitat fragmentation and plant-pollinator interactions." *Current Science* (65) 273-277. 1993.

I. Edge effects

A.) Direct Impact on Native Species

Jules ES. 1998. Habitat fragmentation and demographic change for a common plant: Trillium in old growth forest. Ecology 79: 1645–1656.

Jules ES, Rathcke BJ. 1999. Mechanisms of reduced Trillium recruitment along edges of old-growth forest fragments. Conservation Biology 13: 784–793.

These studies document a case where reproduction of a native forest herb, *Trillium ovatum*, declined dramatically within 100 m of a newly created edge with a clearcut in an old-growth forest. The reasons for its inability to reproduce were lack of pollinators and altered microclimatic conditions near the edge.

B.) Edges Favor Invasive Species

Yates, E.D., D.F. Levia Jr., and C.L. Williams. "Recruitment of three non-native invasive plants into a fragmented forest in southern Illinois." *Forest Ecology and Management* (190) 119–130. 2004.

This study addresses the reproduction of three non-native shrubs, one of which, multiflora rose (*Rosa multiflora*), is very common in the Spring Creek Valley. The study finds multiflora rose grows faster and reproduces more successfully better near edges.

Meekins, J.F; McCarthy, BC . "Effect of environmental variation on the invasive success of a nonindigenous forest herb." *Ecological Applications* (11) 1336-1348. 2001.

Garlic mustard establishes better and grows more vigorously in higher light environments; in areas with adequate soil moisture; in lowlands rather than uplands. These patterns appear to be present at Spring Creek Valley, where the soil is generally circumneutral, and garlic mustard is especially dense in areas of high moisture (road ditches, some riparian areas), along edges. Minimizing canopy gaps and edges will create conditions more favorable to native species and may help to slow the growth of this invasive species.

Ellsworth, JW; Harrington, RA*; Fownes, JH. "Seedling emergence, growth, and allocation of Oriental bittersweet: effects of seed input, seed bank, and forest floor litter." *Forest Ecology and Management* (190) 255-264. 2004.

Oriental bittersweet appears to germinate from seed rain, and not to remain viable in the seed bank. Leaf litter density does not affect seedling germination or success. Since the seeds do not remain viable in the seed bank, it may be an effective control strategy to remove the existing plants.

Silveri, Ann, Peter W. Dunwiddie, and Helen J. Michaels. "Logging and Edaphic Factors in the Invasion of an Asian Woody Vine in a Mesic North American Forest." *Biological Invasions* (3) 379-389. 2001.

Oriental bittersweet grows better with high light availability and circumneutral pH soil. The most extensively invaded areas at study sites had these characteristics. Also provides an introduction to the destructive potential of this vine, which can grow up to 3 m in a season and overwhelm a tree in 3-4 seasons.

Collier, Matthew H. and John L Vankat. "Diminished plant richness and abundance below Lonicera maackii, an invasive shrub." *The American Midland Naturalist*. (147) 60-72. 2002.

Deering, Ryan H. and John L. Vankat. "Forest Colonization and Developmental Growth of the Invasive Shrub Lonicera maackii." *The American Midland Naturalist* (141): 43-50. 1999.

A case study of the invasion of Amur honeysuckle (*Lonicera maackii*) in an Ohio deciduous forest. The population spread from several initial colonizing individuals, and after a few years increased dramatically in number once the initial colonizers had reached sufficient maturity to set seed. Monitoring relatively uninvaded areas to detect and remove initial colonizers before they reach reproductive maturity may be an effective way to prevent invasive species from attaining dominance in forests.

Luken, James O., Linda M. Kuddes, Tim C. Tholemeier, and David M. Haller. "Comparative responses of Lonicera maackii (Amur honeysuckle) and Lindera benzoin (spicebush) to increased light." *The American Midland Naturalist*. (138): 331-344.

This study finds that Amur honeysuckle (*Lonicera maackii*) increases is growth rate greatly in increased light, peaking in high light, while the native shrub spicebush (*Lindera benzoin*) does not increase its growth rate in response to increased light, and peaks in relatively shaded conditions. This shows that Amur honeysuckle is able to take advantage of light gaps or high light conditions at edges, while the native spicebush is adapted for growth in the shade of the forest canopy and cannot respond similarly, thus making it vulnerable to being out-competed in high light conditions.

Luken, James O., Tim C. Tholemeier, Linda M. Kuddes, and B.A. Kunkel. "Performance, plasticity, and acclimation of the nonindigenous shrub Lonicera maackii (Caprifoliaceae) in contrasting light environments." *Canadian Journal of Botany/Revue Canadienne de Botanique* (73) 1953-1961. 1995.

These growth-response studies show that Amur honeysucke (*Lonicera maackii*) is definitely shade-intolerant and plants perform best in full light. Thus, maximizing the condition of full canopy cover in forests—by minimizing edges and gaps—will best position native species to compete with the exotic honeysuckle.

Luken, James O. and Norbert Goessling. "Seedling distribution and potential persistence of the exotic shrub Lonicera maackii in fragmented forests." *American Midland Naturalist* (133)124-130. 1995.

This study shows Amur honeysuckle also germinates worse in poor light than in high light conditions.

III. Impacts of residential development

Friesen, Lyle E. Paul F. J. Eagles, and R. J. Mackay. "Effects of Residential Development on Forest-Dwelling Neotropical Migrant Songbirds." *Conservation Biology* (9) 1408-1414. 1995.

This study examined the effect of housing development on neotropical migrant bird species diversity and abundance. Neotropical migrants consistently decreased in diversity and abundance as the level of adjacent development increased, regardless of the size of the forest study site. The number of species of neotropical migrants in sites with high development (25 houses or more adjacent to the forest) was less than half the number at sites with no adjacent development. At sites with low (1-3 adjacent houses) or moderate development (8 to 15 adjacent houses), the diversity delined less, but the numbers of individuals present were lower. Of the common neotropical migrant species, those exhibiting a marked aversion to forests with nearby development were: the Eastern Wood Pee-wee, Wood Thrush, Rose-breasted Grosbeak, Northern Oriole, and Scarlet Tanager. The Red-eyed Vireo and Great Crested Flycatcher appeared to tolerate development.

IV. Case Studies in Ecological Management

Smith, Robert J. The Kern River Preserve. Competitive Enterprise Institute/Center for Private Conservation.

This case study describes management of a private preserve in California. The preserve is a river valley that contains a uniquely intact example of riparian forest community, which has been largely eliminated in California. This community is habitat for two globally rare bird species; based on scientific evaluation of the type of habitat and the areas needed to sustain viable populations, goals were set to restore degraded areas to forest in order to expand the overall amount of habitat available. Within several years the populations of both species expanded, utiziling the restored habitat, to a level very close to the estimated numbers needed for a viable population. The river valley habitat is also vulnerable to invasion by exotic species, some of which were already present; an aggressive management program was put in place to eliminate these species.

Additional Resources:

- Viable Populations, Reserve Size, and Federal Lands Management: A Critique. RE Grumbine - Conservation Biology, 1990.
- Slocombe, DS . Implementing ecosystem-based management. Development of theory, practice, and research for planning and managing a region. Bioscience. Vol. 43, no. 9, pp. 612-622. 1993.