Connecting Landscapes for Biodiversity

Habitat Conservation On and Around DoD Lands

by Aaron Moody

Habitat fragmentation due to land-use changes near military bases poses major challenges for wildlife conservation on Department of Defense (DoD) lands. Fragmentation isolates species populations, thereby increasing their exposure to risks from demographic, genetic, and environmental factors (Gilpin and Soule 1986). This potentially undermines the wildlife recovery efforts on installations by DoD land managers.

Fort Bragg, situated in the Sandhills ecoregion of North Carolina, is emblematic of this situation. One of the largest and most active U.S. military bases, Ft. Bragg is an island of nearly intact forest surrounded by agriculture and development. As a result of fire management that mimics natural processes, Fort Bragg contains some of the most extensive high-quality long-leaf pine habitat for the endangered red-cockaded woodpecker (*Picoides borealis*). It fully encompasses the known range of an endangered butterfly, the Saint Francis' satyr (*Neonympha mitchellii francisci*). Fort Bragg also is home to three other endangered species and approximately 70 species of concern. Our research team is working on behalf of DoD's Strategic Environmental Research and Development Program to determine how to conserve habitat connectivity between on- and off-base habitats where multiple species must be managed simultaneously, while also accommodating the base's military readiness mission.

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The Saint Francis' satyr survives only on Fort Bragg.

One approach to offsetting the isolating effects of fragmentation is to preserve connections among protected habitats (Beier & Noss 1998, Tewksbury et al. 2002). The DoD has accelerated land acquisition around some bases to enhance connectivity among existing habitats for rare species (Herring 2004). However, identifying the best lands to preserve is challenging, especially for multiple species that vary in their abilities to disperse through different natural, managed, or developed habitats (Ricketts 2001).

Historically, lands have been selected using expert opinion on a species-by-species basis (Beier et al. 2009). More recently, computational approaches have been developed to reduce subjectivity and automate the process of quantifying the value of land for habitat connectivity (Calabrese and Fagan 2005). For most species, these approaches are limited by a lack of information about how landscape features affect movement behavior and by the persistence of a single-species focus for connectivity assessment.

Study species include not only the red-cockaded woodpecker and Saint Francis' satyr but also two amphibian species, the eastern tiger salamander (*Ambystoma tigrinum tigrinum*) and Carolina gopher frog (*Rana capito capito*), both of which are listed by North Carolina as threatened at the state level. The team collected detailed data on movement behavior for these species using multiple methods, including radio-telemetry, *in-situ* (on site) observations, experimental releases of captive-bred animals and translocated animals into different landscape types and at landscape boundaries, tracking movement paths using fluorescent dye powder, and pit-trapping for amphibians near breeding ponds. The team is linking these data with detailed environmental maps derived from field data, satellite remote sensing, and aircraft-based light detection and range (LiDAR), which uses a laser pulse return to map the 3-D structure of the land surface, to understand how different landscape features affect animal movement and dispersal and to map habitat connectivity. The goal is to provide information on the habitat connectivity value of each land parcel that might be acquired for conservation.

The team developed statistical models of habitat connectivity for the red-cockaded woodpecker by using radio-telemetry data from dispersing juvenile females as they searched for breeding sites. Dispersing birds avoided open and developed areas and preferred to disperse through forested landscapes, including forest types that are not used for nesting. The research team used the data to measure the relative resistance of the landscape to dispersal and to map those lands that promote dispersal.

For the Saint Francis' satyr, models of habitat connectivity are based on the simulated dispersal of butterflies through a virtual representation of Fort Bragg and surrounding landscapes. The simulation is based on movement behaviors observed from butterflies in their natural habitats and butterflies experimentally translocated and released into different types of natural and developed habitats. To map habitat connectivity, the team recorded the frequency with which simulated butterflies passed through each grid cell in the virtual landscape. Interestingly, butterflies make longer, straighter movements in upland forests, suggesting that this may be important dispersal habitat. Butterfly behavior at riparian forest edges indicated that these lands also function as dispersal corridors. In contrast, because butterflies rarely enter large open areas, these habitats may serve as dispersal barriers.

To streamline the process of developing and integrating connectivity models, the team developed a user-friendly software package called "CONNECT" that operates seamlessly with mainstream geographic information software (ESRI ArcGIS 9.3). CONNECT combines habitat data and resistance surfaces (maps that depict how difficult it is for animals to move through the landscape) to generate likely dispersal corridors and habitat networks. CONNECT also allows combining connectivity models for multiple species to identify the highest value locations for multi-species connectivity. CONNECT makes it easy for users to incorporate animal movement models into larger work flows and to explore the affects of alternate land management, conservation, and restoration scenarios on regional-scale habitat connectivity for wildlife conservation.

Our research team is using data, models, and CONNECT to address questions relevant to wildlife conservation on and around DoD installations. The Sandhills Conservation Partnership, a multiple-stakeholder group that coordinates conservation activities in the Sandhills ecoregion, can use the information and methods developed through this project to set land acquisition priorities in order to benefit both the base and the fauna and flora of the region.

References:

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