

## What a small bird taught us about habitat selection

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Understanding why animals choose the habitats that they do is important for the successful management of wildlife populations. A major assumption in habitat selection theory has been that animals should prefer habitats where they are most successful in terms of reproduction and/or survival. However, many studies have shown neutral or even negative relationships between preferred habitats and indices of fitness across a wide variety of taxa, including insects, mammals, reptiles, and birds. Such results have been especially prevalent in studies of nesting success in birds, which is surprising considering that where parents place nests can have critical consequences to offspring survival. Nest sites, for example, can influence whether nests are discovered by enemies such as predators or parasites. Such intriguing results pose a potential paradox: why should we ever see mismatches between habitat preferences and reproductive performance?

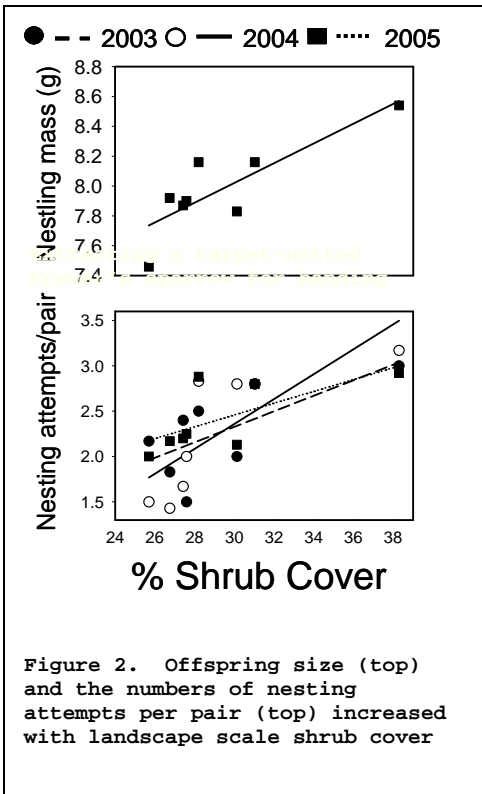
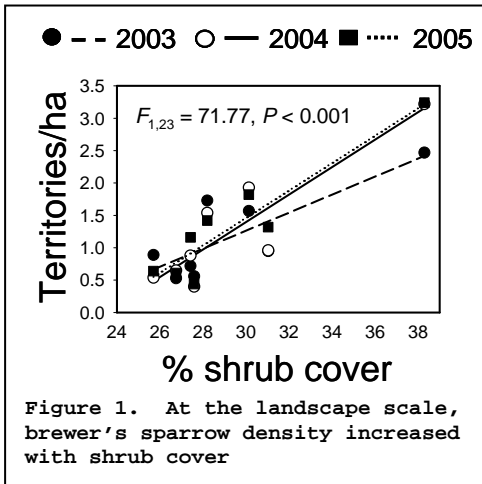


One of the eight shrubsteppe study sites in Carbon County, MT



A very patriotically color-banded Brewer's Sparrow male

Habitat preferences may indeed in some cases be maladaptive, especially in human-altered environments where habitat cues have become decoupled from their historic quality to wildlife. However, even in pristine environments, habitat selection and the subsequent fitness consequences of habitat use are likely a product of a complex suite of factors including multiple spatial scales, availability and acquisition of important resources (such as food and refugia from predators), and different fitness components. Yet studies rarely tease apart the relative importance of these various factors or examine the interactions between them. We wanted to take an integrated and conceptually-thorough approach to examining habitat selection in order to better understand the relationship between habitat preferences and reproductive performance.



We focused on a shrubsteppe songbird, the Brewer's sparrow (*Spizella breweri*) on Bureau of Land Management lands in Carbon County, Montana, during the breeding seasons of 2003-2005. Brewer's sparrows, like all migratory breeding birds, choose habitats at multiple spatial scales, including the overall landscape in which they settle, territory locations, and finally nest patches for each individual nest attempt. Nest predation is the main cause of reproductive failure in this species, and food (insect) availability is also important in terms of the energy that parents have available to invest in offspring. We examined habitat selection and multiple fitness components (reproductive success, clutch size, offspring size, and numbers of nesting attempts) of Brewer's sparrows across eight 30-ha study sites that varied in habitat structure. We focused on three habitat variables relevant to the ecology of Brewer's sparrows: shrub cover, shrub density, and the density of potential nest shrubs. A sub-set of Brewer's sparrow pairs were captured and individually marked with colored leg bands at each site within each year to calculate actual seasonal reproductive success.

We found that habitat preferences were specific to particular spatial scales, and that not all fitness components were positively correlated to preferences within scales. At the landscape scale (as assayed by territory densities and nesting chronology), birds preferentially settled in areas with higher shrub cover during all three years of the study (Figure 1). Yet, nesting success (the primary fitness component typically assessed in avian studies) was not higher in such landscapes. Rather, we observed a positive relationship between landscape preferences and two other important fitness components known to be highly influenced by food availability: offspring size and the numbers of nesting attempts that parents were able to put forth within a season (Figure 2). Offspring size can positively influence future survival prospects of young, and the ability of parents to attempt many

nests is critical in terms of maximizing reproductive output in situations where nest predation may be particularly high and/or variable as they are at our sites.

Brewer's sparrows placed territories non-randomly with respect to all three habitat variables, yet only the density of potential nest shrubs was positively associated with seasonal reproductive success (Figure 3). Potential nest shrub density is rarely measured in avian breeding studies. Yet, if we had not identified it as a potentially important habitat attribute in our study, we would have failed to identify (as many previous studies have) any positive relationships between territory preferences and reproductive consequences.

Finally, at the nest patch scale, Brewer's sparrows placed nests in areas with greater shrub density and greater potential nest shrub density, and nest success was higher in patches with higher potential nest shrub densities (Figure 4). Because overall shrub density and potential nest shrub density are correlated in this system, however, we conducted a microhabitat manipulation experiment to more conclusively determine which was most important in terms of nest predation rates. Only the reduction of potential nest shrubs within patches elevated rates of nest predation (Figure 5). These results suggest that nest predators are not simply physically impeded by greater vegetative density or complexity, but rather may abandon search efforts sooner in areas where a greater number of potential prey sites must be searched prior to locating actual sites. The ubiquity of this relationship should be determined via examination in other nesting species.

Therefore, individuals in our system appear to be maximizing

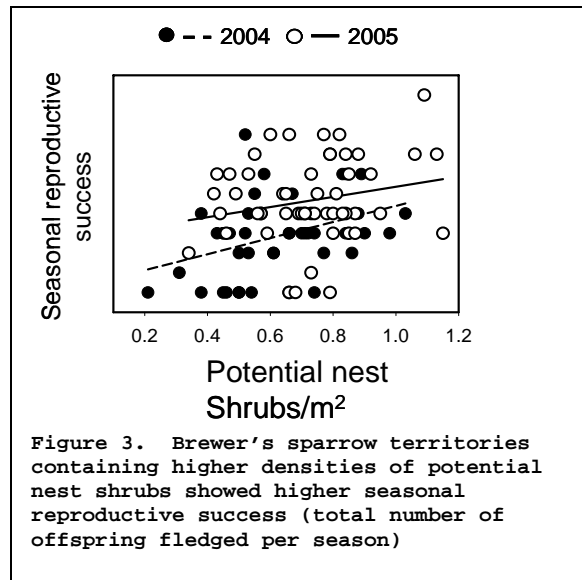


Figure 3. Brewer's sparrow territories containing higher densities of potential nest shrubs showed higher seasonal reproductive success (total number of offspring fledged per season)

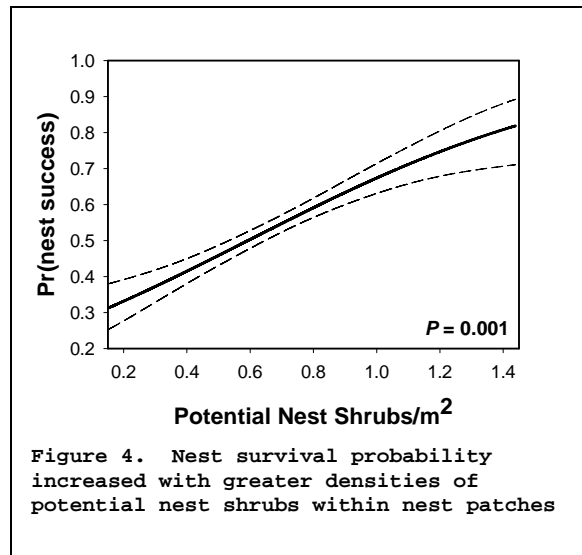


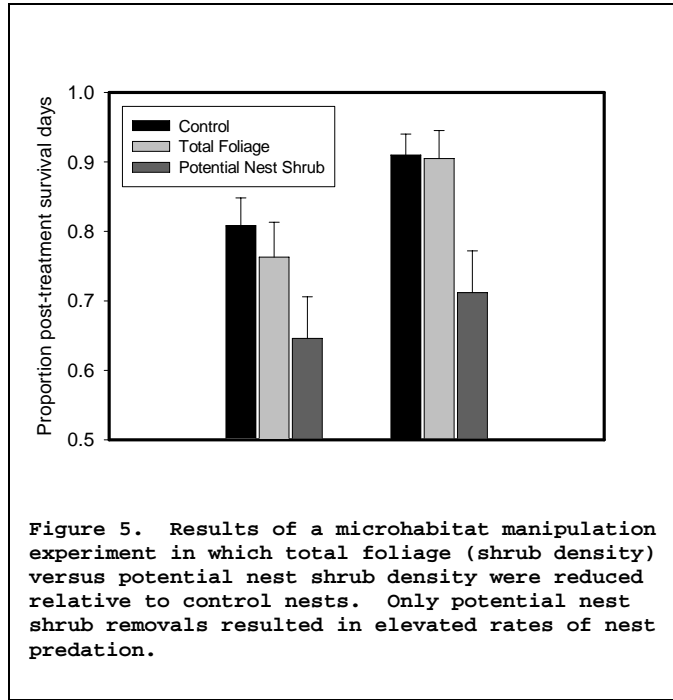
Figure 4. Nest survival probability increased with greater densities of potential nest shrubs within nest patches



Brewer's sparrow nestlings stretching for food

access to food resources at larger spatial scales, and numbers of potential nesting sites at smaller spatial scales. In the aggregate, our results suggest that the ecological processes influencing habitat choice and fitness vary in importance across spatial scales, and affect different fitness components in different ways. Therefore, research

focused on single spatial scales and/or fitness components may fail to identify adaptive habitat selection strategies.



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**Figure 5. Results of a microhabitat manipulation experiment in which total foliage (shrub density) versus potential nest shrub density were reduced relative to control nests. Only potential nest shrub removals resulted in elevated rates of nest predation.**