The Use of Core Areas in Comprehensive Mitigation Strategies

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Buchanan et al. (this issue) express two main concerns regarding our recent paper on mitigation of habitat "take" (Bingham & Noon 1997). First, they state that we failed to adequately discuss the appropriate use of core areas as part of an overall mitigation strategy. Specifically, they were concerned that implementation of the core area concept would lead to insufficient amounts of habitat for the conservation of Spotted Owls (*Strix occidentalis caurina* and *S. o. occidentalis).* Second, they believe that our method of calculating core areas-rules for excluding some birds from the data set-may not provide adequate representation of the habitat-area needs for a sizable proportion of the species' population.

These concerns, when considered in the context of our entire paper and not in isolation, can be easily addressed. Our incentive for revisiting the core area concept was not to propose a comprehensive mitigation strategy, as suggested by Buchanan et al. Rather, our goal was to offer, in the context of habitat conservation plans (HCPs), a "defensible, repeatable, and empirical" method of estimating mitigation areas that would be a clear improvement over current, ad hoc approaches. We emphasized the biological significance of core areas, proposed an objective method for their estimation, and highlighted their potential for use in partially mitigating against the loss of habitat.

In response to the concerns raised by Buchanan et al., we point out that we purposely avoided detailed discussion of the applications of the method to the mitigation of habitat take for the Spotted Owl; our paper was not meant to be an inclusive conservation strategy for this species. A comprehensive conservation strategy for the Spotted Owl, or any other species, would need to account for many additional factors (Thomas et al. 1990; Murphy & Noon 1992). Our goal was simple: to offer the core area approach as an improvement over current methods of estimating the areal requirements of terrestrial species for whom the concept of a home range or territory is meaningful. We presented the details of computation and interpretation in this empirically based approach so that our methods and rationale were clear. The Spotted Owl was used as an example because of its status as "threatened" under the U.S. Endangered Species Act and the availability of appropriate data. We encourage the use of core area estimates as a critical component of a more comprehensive strategy, as necessary but not sufficient by themselves.

Buchanan et al. state that the "[i]dentification and protection of Spotted Owl core areas alone would not adequately mitigate for impacts in areas of importance for demographic support because the core area approach does not address the annual resource needs of this species." We agree with this point; we did not argue that core areas "alone" were a sufficient mitigation strategy. Our assertion was that HCPs for Spotted Owls and many other species typically include the protection of some area during the breeding season as part of a conservation strategy (Simpson Timber Company 1991; other examples in Beatley 1994). But the logic and data used to estimate areas are usually not stated. The core area method as we described it provides an empirical and logical basis for estimating the area to be protected during the breeding season.

Buchanan et al. note that Spotted Owl home ranges can be very large and that core areas may include only a small proportion of the breeding season home ranges. (Our method can be applied to estimating year-round as well as breeding season core areas.) This is somewhat misleading. The breeding season home ranges of Spotted Owls, as calculated from the 95% adaptive kernel isopleth (or any number of algorithms), typically show an area of overlap among individual members of pairs (Bingham & Noon, unpublished data). In this sense, they are redundant estimates of areal requirements. We found, however, that the core areas we calculated also included discrete, non-overlapping areas of space use. Collectively, the unique and overlapping areas of space use often included 60-70% of the owl pair's breeding

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season activity. Core areas based on year-round patterns of space use could also be estimated from our methods, and unique and overlapping area of use could be clearly identified.

Presumably making indirect reference to the lack of known fitness relationships in our core area estimates, Buchanan et al. state that "We don't understand the value of using a scientific process to develop a strategy that only partially addresses this species' habitat requirements." Obviously, the availability of demographic data, related to areal measures of habitat, would enhance confidence in any conservation strategy. But if we set as a standard for management the complete understanding of a species' ecology, then few species will have conservation strategies. In the interim, we must make proposals based on sparse data and an incomplete understanding of how nature works.

Buchanan et al. correctly point out that we failed to address some issues critical to a comprehensive conservation strategy. For example, "[i]f additional mitigation beyond core areas is needed, what should it be and how should it be determined?" And, "[i]f core areas are to be included as part of a mitigation strategy, should they be managed or treated as reserves?" Given that we were publishing a research paper, not a monograph, this and many other relevant issues were not addressed. We assumed that individuals developing mitigation strategies would consider factors in addition to core area estimates when developing comprehensive plans. We did, however, emphasize the important responsibility of the biologist in proposing science-based (i.e., repeatable and defensible) methods of mitigation that increase the likelihood of species' persistence while also addressing the intent of environmental laws.

Buchanan et al. state that our assumptions in developing the core area calculations ". . . may introduce subjecttivity and potentially influence the repeatability of the approach." We disagree. We restricted our home-range calculations to birds that exhibited nonrandom utilization, an objective assumption of site fidelity that is basic to the home-range concept (Spencer et al. 1990). Buchanan et al. suggest that we subjectively omitted "(1) pairs that abandoned their nest for some reason, but not their home range and (2) territorial single owls." If a pair had abandoned their nest but maintained their home range, then both members of the pair should have exhibited nonrandom movement patterns; these birds would have passed the site-fidelity test and been included in our analyses of space-use patterns. Likewise for a single bird that exhibited territorial behavior.

Our analyses were restricted in two ways: we only used owl relocation data obtained from 1 March through 31 July, and we required an asymptotic estimate of the utilization distribution. Buchanan et al. suggest that we made these decisions arbitrarily, but our paper clearly describes our methodology and the logic behind our decisions. For example, breeding season period (1 March through 31 August) was based on our own observations and on previously published studies of the breeding chronology and habitat use of Spotted Owls (Carey et al. 1990; Solis & Gutierrez 1990; Thomas et al. 1990). The requirement for an asymptotic estimate of home range is standard in home-range studies (e.g., Wray et al. 1992). Non-asymptotic movement patterns are characteristic of transient adults, dispersing subadults, and individuals that have been sampled inadequately (Harris et al. 1990). In our data set, all birds that reached asymptotes exhibited them prior to 1 August, and no birds exhibited an asymptote at sample sizes of less than 30 relocations. As suggested by Harris et al. (1990) and Wray et al. (1992), we used both daytime and nighttime relocations to examine the effects of sample size and time interval on estimates of home-range size during breeding season.

The statement by Buchanan et al. that we excluded some birds based on their space-use patterns is correct. We excluded birds for which a home range could not be reliably estimated. But the statement by Buchanan et al. that "As a result of these two sampling screens [failing to exhibit site fidelity or to reach an asymptote], their strategy was based on 24 of 55 birds equipped with radios" suggests an inappropriate filtering of our data. In our final sample, 24 of the 55 birds met our criteria of site fidelity (16 owls failed Spencer's site-fidelity test; Bingham & Noon 1997:130), minimum number of radio days (> 100 days with a functional transmitter), and stability in home-range size and core area estimates (asymptotic estimate) (Gingham & Noon 1997:132). The fact that birds with less than 30 relocations were excluded was because these birds failed to show an asymptotic estimate of home-range size. Our focus was on resident individuals and breeding pairs of animals-that is, those showing site fidelity. We chose to exclude suspected transients, birds whose transmitters failed, and those with unreliable home-range size estimates. Obviously, other investigators could argue that such individuals should be included in the estimates.

Buchanan et al. conclude by agreeing that there is a need to improve the scientific basis of mitigation strategies. Further, they believe that the core-area method (as we presented it) does not adequately address the habitat requirements of the Spotted Owl and cannot be applied without additional mitigation measures. We agree: developing a comprehensive mitigation strategy for the Spotted Owl or any other species will require additional information beyond estimates of core-area size. Buchanan et al. believe that our "assumptions" may find limited use in other applications because of our "narrow focus." We disagree. Buchanan et al. miss the main point of our paper. Our motive was to encourage the use of a biologically based, empirical method of estimating core areas as a useful adjunct to a more comprehensive mitigation strategy. Our focus on resident animals was ap-

propriate to our goal of reliably estimating core areas for pairs and individuals that exhibit nonrandom habitat-use patterns during the breeding season. Our method is easily extended to include year-round core area estimates for individuals or pairs, or to resident nonbreeding or nonreproductive individuals. HCPs are planning tools that allow private land owners to contribute to the conservation of threatened or endangered species (Endangered Species Act 1973) while still allowing exploitation of their land. As such, HCPs were never intended to be stand-alone conservation strategies providing, by themselves, for species recovery. Rather, HCPs are part of an overall strategy including federal agencies and private landowners, with the greater conservation burden falling on federal lands (see Section 7 of the Endangered Species Act). It is in this context that we proposed a science-based method of partially mitigating against the "take" of habitat in order to enhance the contribution of private landowners to the conservation of our nation's resources.

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