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***Adaptive Sampling Methods for Surveying and Mapping Nonindigenous Invasive Plant Species***

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Nonnative invasive plant species (NIS) pose a significant threat to native biological diversity. Their management and control is of great conservation concern and has been mandated on all federal lands, including Army training lands, in the United States by Executive Order 13112. Currently, approximately 275,000 acres of Army training land currently have restrictions on use related to invasive species. However, the true magnitude of the problem is difficult to estimate due to a lack of information about NIS distributions on most Army installations.

Accurate information about NIS distributions is a key component of any NIS management strategy. Such information is usually obtained by implementing survey or sampling methods, because installations are too large to inventory completely. Efficient sampling is crucial because early detection rapid response management strategies rely on effective detection of small, newly established patches of NIS that are rare across the landscape. Alternatives to conventional sampling methods that capitalize on the spatial clustering exhibited by many biological populations, known as adaptive sampling, have been introduced, however they are still rarely implemented and their application to NIS has yet to be thoroughly explored.

We evaluated and compared fifteen different sampling methods – three conventional and twelve adaptive - in terms of their ability to effectively and efficiently detect NIS patches, document the area infested, and characterize the spatial distribution of NIS across the landscape. Efficiency, measured in time units, was evaluated in a relative sense by comparing the various methods to the more established methods of stratified random transects and biased roadside sampling. Using simulation, we virtually surveyed four separate NIS differing in their reproductive and dispersal mechanisms, as well spatial distributions and clustering patterns across an actual landscape. Preliminary results suggest, with the exception of the adaptive cluster methods, the adaptive methods, for all species, were equally or more efficient than stratified random transect sampling at detecting NIS presence, but not number of NIS

patches. Adaptive cluster methods were efficient in both metrics. For all but the most rare and most abundant NIS, the majority of adaptive sampling methods were more efficient than biased roadside sampling at detecting both NIS presence and number of NIS patches. The results of this study suggest choice of sampling method can be very important in determining the accuracy and cost of NIS survey efforts.