

Definition and Distribution of Sample Units

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Introduction

Objectives

We assume that a land manager may wish to conduct detection surveys for one of two reasons. The first is to determine the distribution of each species within a management or administrative area (Regional Surveys). For example, a biologist may want to know whether wolverines occupy any of the watersheds in the northern half of a ranger district or whether marten occur throughout the true fir (*Abies* spp.) forest types on the district. The second reason to conduct detection surveys is to determine whether any of the target species occur in an area where some management activity is proposed (Project Surveys). We will present general sampling schemes that address both needs.

Background

The theoretically “ideal” survey is to place only one detection device (a camera or track plate) or a short snow-transect in a frequently used portion of each potential home range for only as long as it takes to detect the resident. However, this manner of sampling is unrealistic for several reasons. First, we will never have *a priori* knowledge of the home ranges of target individuals. Second, even if we knew the locations of home ranges, we do not understand enough about home range use to know exactly where to place our station or snow transect so that we could detect the resident in a reasonable period of time. Although a single detection device or transect would not maximize the possibility of detecting a resident, dozens of stations (or many kilometers of snow transects) per home range would probably be more than necessary; the optimum of this trade-off lies somewhere between.

Detection surveys should be designed to maximize the probability of detecting target species while simultaneously minimizing multiple detections of the same individuals. A single detection is all that is necessary to document the presence of a species in a survey area. Multiple detections, especially when individuals cannot be distinguished, provide no new information in this regard. However, with animals as rare as those considered here we believe that survey effort must be somewhat redundant; the density of detection devices and snow transects within the sample unit should exceed some minimum effort. Likewise, the distance between sample units should minimize the possibility of overlooking an occupied area within the region. This approach will probably result in some situations where the same individual is detected at more than one device or on more than one sample unit (especially with wolverines and lynx). We prefer this potential redundancy because it reduces the chance that occupied areas will be overlooked.

We explain the characteristics of survey protocols (e.g., duration of survey, frequency of visits to sample units) for cameras, track plates, and snow tracking in Chapters 3, 4, and 5, respectively. This chapter provides suggestions for allocating effort to the sample

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unit and for distributing sample units. We have modeled our approach on the American Breeding Bird Atlas (Smith 1990) and the Atlas of Mammals of the British Isles (Arnold 1978). These surveys provide a “snapshot” of the distribution of target taxa by recommending minimum survey effort within cells created by a grid overlaid on the geographic area of interest. The resulting distribution of cells with and without evidence of occurrence is a database of distribution. Here, we suggest a sample unit size (analogous to the grid cells in atlas methods) and recommend minimum effort to detect MFLW. This is an unprecedented survey approach for these species; we solicit alternative ideas if they can be demonstrated to be more useful or efficient.

The Sample Unit

The sample unit is the smallest division of a detection survey. It is the same size regardless of the target species, and is scaled to be large enough to include the entire home-range size of the smallest species, American marten. The sample unit we propose is a 4-mi² area that is aligned with section boundaries (figs. 1-3) and is the basis for all detection methods (camera, track plate, and snow tracking). This standard unit is recommended for simplicity, comparability, and ease of application using available maps. In those locations in the western United States where township and range designations are not used (e.g., National Parks), sampling units will need to be identified using the Universal Transverse Mercator (UTM) projection. In these locations, create sample units that are 3.2 km (3200 m) on a side.

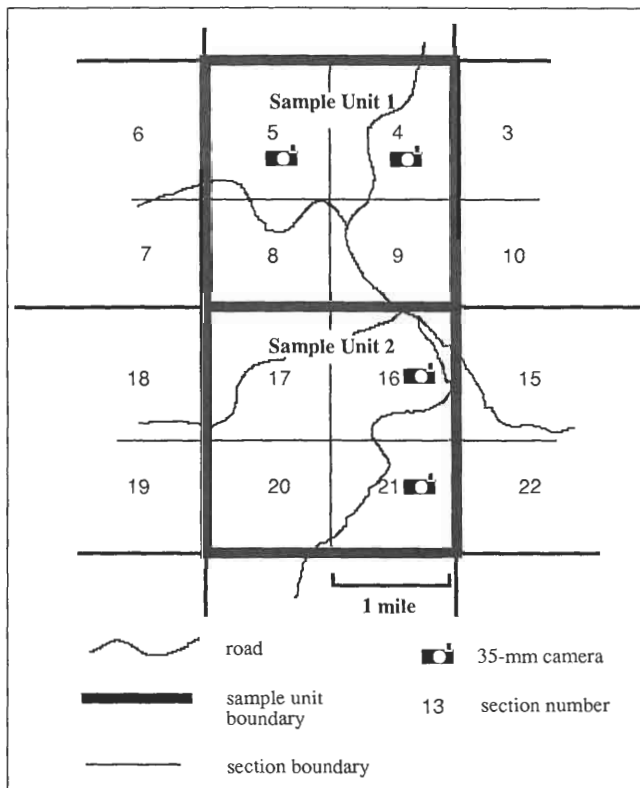


Figure 1—Schematic representation of two adjacent sample units surveyed using 35-mm cameras. The cameras are located one mile apart. The location of the cameras within each sample unit is assumed to coincide with either the most appropriate habitat or a site of an unconfirmed observation (Sections 4 and 5 of Sample Unit 1 and Sections 16 and 21 of Sample Unit 2).

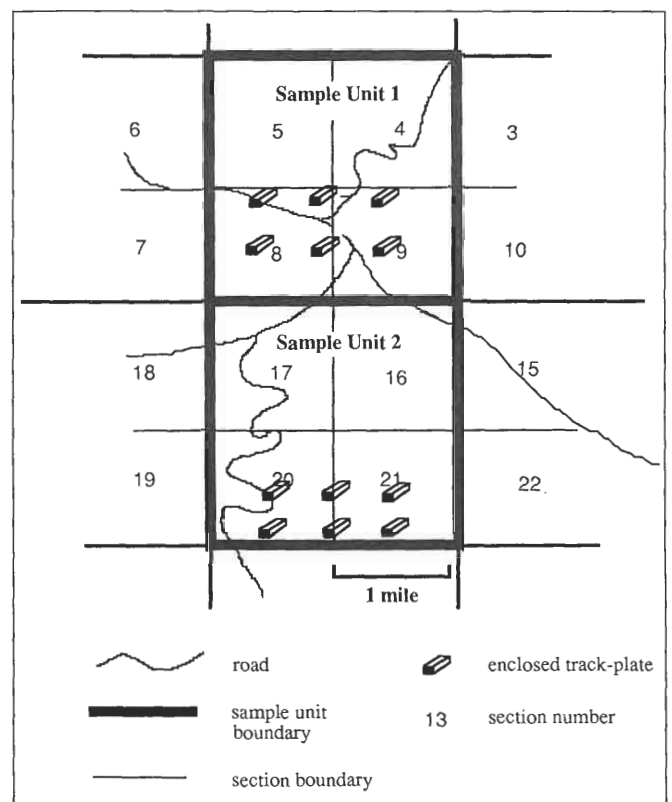


Figure 2—Schematic representation of two adjacent sample units surveyed using a grid of track-plate stations or line-triggered cameras with the objective of detecting marten or fisher. The stations are located 0.5 mile apart. The location of the grid within each sample unit is assumed to coincide with either the most appropriate habitat or a site of an unconfirmed observation (central portion of Sample Unit 1 and southern portion of Sample Unit 2).

The fact that the sample-unit size is *not* scaled to the density of particular target species, but is relatively small and invariant, assures that the rarer species with the largest home ranges (i.e., wolverine and lynx) will have the least chance of being overlooked in a survey area. However, if wolverine is the sole species of interest, larger sample units could be considered given that a detection in one 4-mi² area would guarantee that large adjacent areas are probably used as well. In this case, sampling immediately adjacent 4-mi² units for wolverines may not be the most cost effective. We encourage the use of 4-mi² sample units so that as data accumulate throughout the west they can be mapped using the same scale. Should one wish to create a distribution map with larger scale units at some later date, the information from the 4-mi² units can readily be aggregated.

Use of Detection Devices: Cameras and Track Plates

We describe camera and track-plate procedures in detail in Chapters 3 and 4; here we describe the number and distribution of the devices in general. The minimum number of devices per sample unit differs with the type of device. If 35-mm cameras are used, there should be *at least* two per 4-mi² sample unit, spaced 1.0 mile apart (*fig. 1*). However, if track plates (either enclosed or open) or line-triggered cameras are used, we recommend a *minimum* of six devices per sample unit (*fig. 2*). Because 35-mm cameras may be checked less frequently and larger, more attractive baits can be used

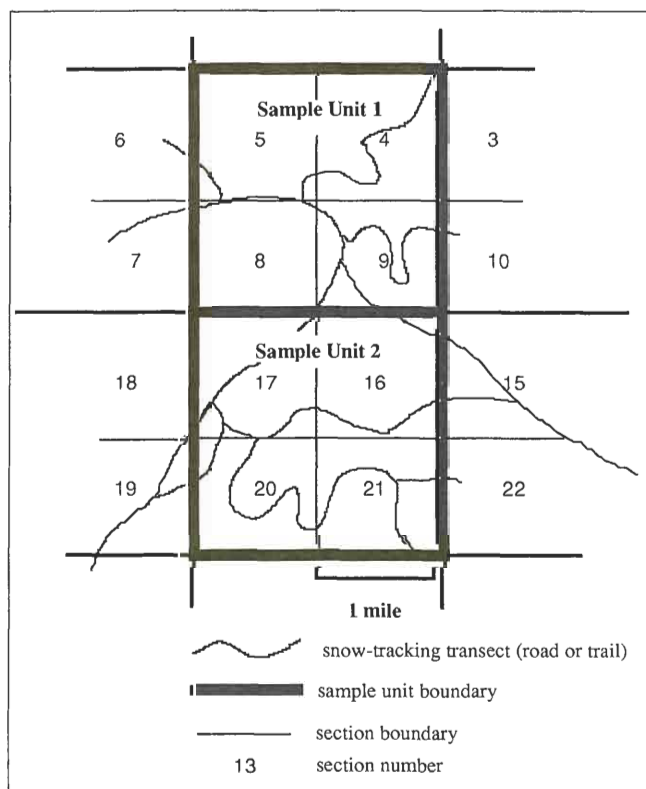


Figure 3—Schematic representation of two adjacent sample units surveyed using snow-tracking transects. Transects follow every road and trail. The route should begin at the access point to the sample unit that is nearest the most appropriate habitat for the target species, or nearest the site of an unconfirmed observation.

with them, fewer cameras are needed per sample unit. Fewer 35-mm cameras per sample unit may also be a financial necessity as they are considerably more expensive than the other devices.

Using more than one device is essential for several reasons. First, the distances from which target species are attracted to baits or lures at the devices are unknown, and a single station has a lower probability of being within the detection distance of a target species than two devices. Second, devices can be rendered ineffective from vandalism (by humans and bears) and mechanical failure. Therefore, it is better to have more than one detection device when their failure is influenced by unpredictable events.

Placement of Detection Stations

Place the array of devices (at least two 35-mm cameras or at least six track-plate boxes or line-triggered cameras) in the sample unit at a site where detections are most likely. This will be either where the habitat suitability appears highest (see Ruggiero and others 1994 for habitat descriptions) or where unconfirmed sightings are concentrated. This method approximates the “expert sampling” approach (Kish 1965) where professional judgment is used to select sample strata from a heterogeneous population. If habitat appears equally suitable throughout the sample unit, choose an area closest to the center of the sample unit with acceptable access.

Snow-Tracking Methods

We describe snow-tracking protocols in detail in Chapter 5; here we describe the essence of the procedures. We assume that snow tracking is conducted on foot using skis or snowshoes, or from a snowmobile; we expect that aerial surveys (e.g., Golden and others 1992, Stephenson 1986) will be difficult in the forested areas that comprise most of the habitat of MFLW in the conterminous western United States.

We discuss two methods for detecting the presence of the target species: “Searching for Tracks” and “Tracking at Bait Stations.” The former and historically more common method involves traversing trails and roads in an area in search for tracks. The latter method involves the detection of tracks in the snow at bait stations.

When conducting a survey by searching for tracks, all roads and trails within the 4-mi² sample unit comprise the population of routes to be surveyed (*fig. 3*). An attempt should be made to travel all routes in the sample unit during the course of one day. If that is not possible, at least 10 km of trail should be traversed. If there are no roads, cover the area on skis as thoroughly as possible. Start the survey at the portion of the sample unit with the most likely habitat for the target species or where there have been unconfirmed sightings. If on skis, cover the sample unit proceeding from the most suitable to least suitable habitat and conclude the search after one day, regardless of distance traveled provided it exceeds 10 km. Traveling all roads in the sample unit in one day should not be difficult if snowmobile(s) are used. When tracking at bait stations is the chosen method, a protocol similar to that for 35-mm cameras should be used. A minimum of two bait sites, at least 1.0 mile apart, should be chosen per 4-mi² square sample unit.

Survey Duration

Searching for rare carnivores is expensive. While some duplication of effort is necessary to minimize the possibility of overlooking an occupied area, detection surveys should be designed to reduce the costs of collecting more information than is necessary. To minimize these costs we advocate that surveys be conducted in each sample unit until either the target species is detected *or* a reasonable amount of effort is expended (see

Chapters 3, 4, and 5 for minimum survey durations). The survey of a sample unit is terminated when the intended target species is (are) detected. Although multiple detections can be of value in some circumstances (e.g., when detection sites are used to assess habitat use), they are of little use when individuals cannot be reliably identified and when the objective is to determine the distribution of a species within an administrative area.

Regional Surveys

Regional Surveys are designed to determine the distribution of MFLW within an administrative area and are not motivated by the need to verify the presence of a species on a project area. For this reason, the objectives of the survey are determined by the information needs of the land manager. The region within which information on the distribution of target species is desired should be delineated and divided into 4-mi² sample units. All sample units should eventually be surveyed, and the number that can be surveyed each year will depend on funding and the detection method chosen. Many different schedules can be envisioned; we suggest one of the three following options (*fig. 4a-c*):

(1) *Stratify by expectation of success.* Use the same logic for determining where to allocate survey effort within the region that is applied to the sample unit: choose the areas to survey first where the expectation of success is greatest (northeast and southwest regions in *fig. 4a*).

(2) *Proceed in a single direction.* Proceed across the administrative area in a consistent pattern or direction, surveying as many sample units as possible each year.

(3) *Systematic surveys.* Each year, distribute the number of sample units for which you have funding or personnel to survey evenly across the administrative area. Survey the same number of new sample units each successive year until all the sample units have been surveyed.

Hypothetical results of surveys conducted in any one of these ways is presented in *fig. 5*.

Project Surveys

A Project Survey is conducted prior to a proposed management activity (e.g., timber harvest, recreational development). Projects vary in size, but are typically small relative to the size of the home ranges of the species considered here (with the possible exception of marten). With small projects, surveys conducted only within the boundaries of the project have a poorer chance of detecting a member of a resident population than surveys in larger areas. If a target species is not detected during a survey, that should not be interpreted to mean that the species does not use the area at some other time or that it does not occur immediately adjacent to the project. As good as our detection methods appear, their efficiencies have not been adequately tested. This uncertainty demands a conservative approach. It is important to determine use on adjacent areas because this should be considered in evaluating a project's indirect and cumulative effects on habitat suitability. For these reasons we recommend that every project be centered on a *minimum* survey area equivalent to the size of a township (36 mi²) (e.g., *fig. 6*).

The 36-mi² area should be delineated and divided into nine, 4-mi² sample units. Each 4-mi² sample unit should be surveyed as described above for Regional Surveys until either the maximum effort recommended for the method has been expended or the target species has been detected. It is important to emphasize, however, that a detection

Sample Unit Distribution

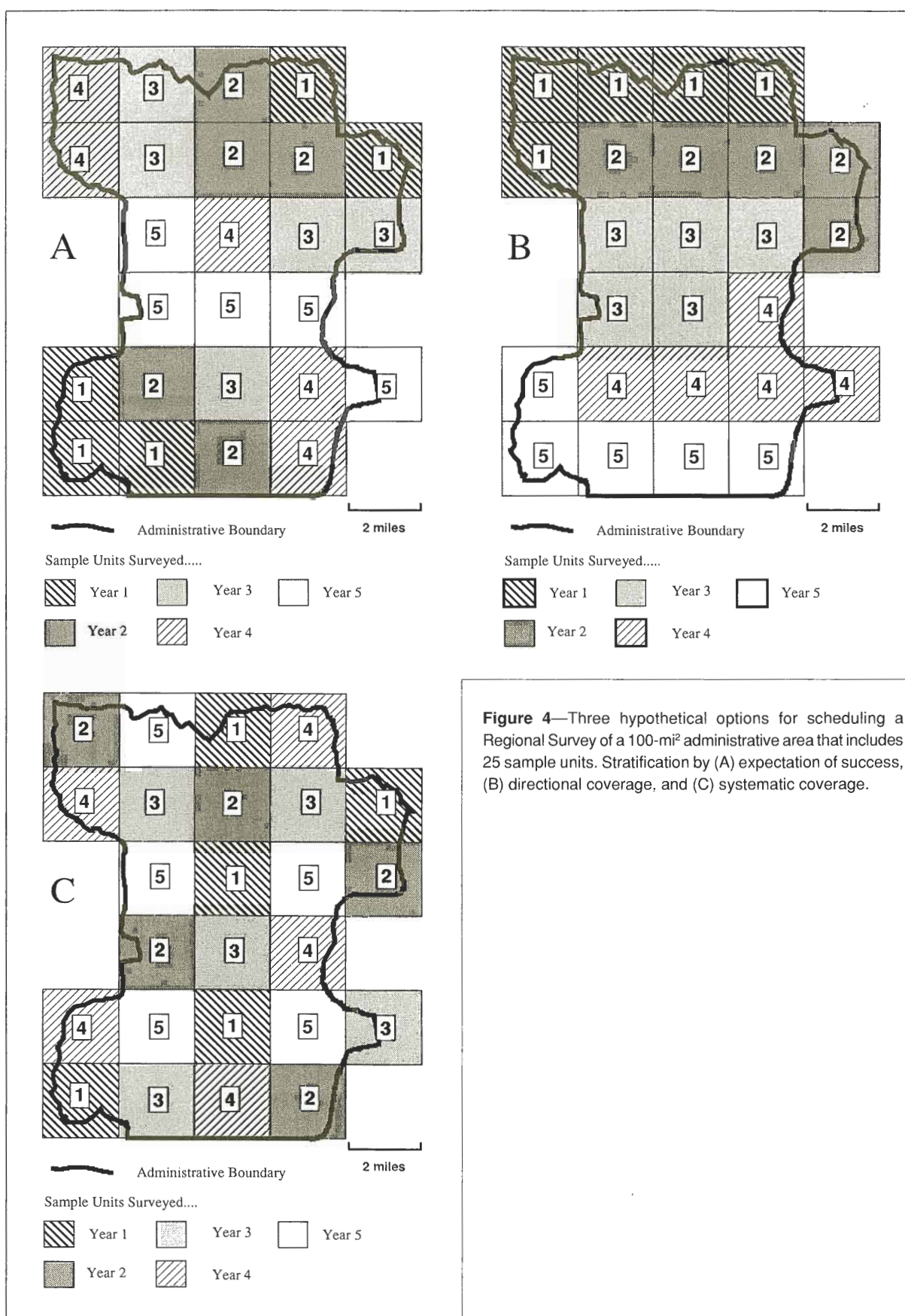


Figure 4—Three hypothetical options for scheduling a Regional Survey of a 100-mi² administrative area that includes 25 sample units. Stratification by (A) expectation of success, (B) directional coverage, and (C) systematic coverage.

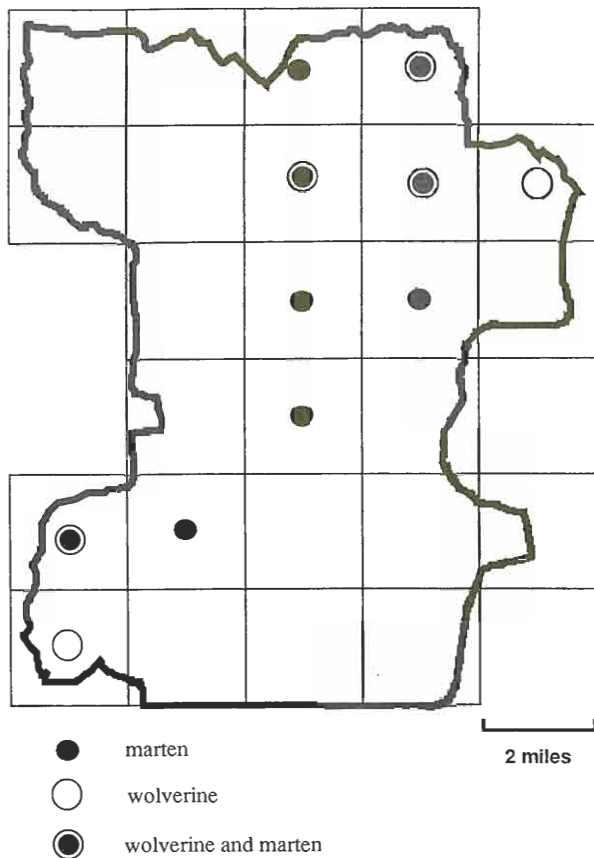


Figure 5—Hypothetical results of the completed surveys on a 100-mi² study area. Each sample unit is reported as either occupied or not occupied after the survey is complete, regardless of the number of detections that have occurred.

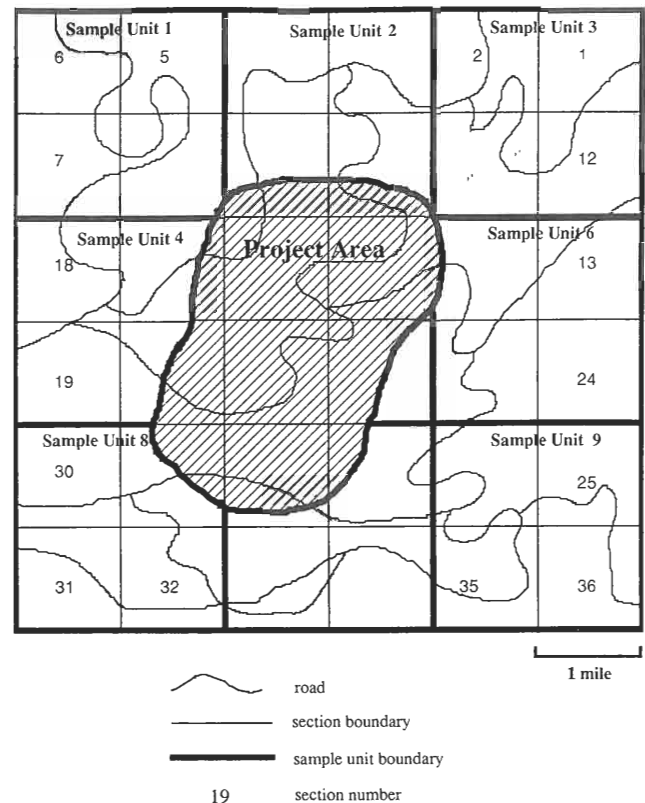


Figure 6—Schematic representation of a simulated survey area for a proposed project (e.g., timber sale, recreational development). The approximately 4,000-acre project area is centered on a township-sized (36-mi²) area that is composed of nine, 4-mi² sample units (see also *figs. 1-3*).

in one of the nine sample units should not trigger the termination of survey efforts on all nine sample units. Each of the nine sample units should be surveyed until either a species is detected or the maximum effort is expended.

Several options for survey schedules exist, but we suggest that the sample units that include the project area be surveyed first and, based on resources available, the sampling sequence thereafter proceed from sample units nearest the project to those furthest from the project boundary.

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