When is an Acre "Infested"?

Using the FNAI implementation of NAWMA standards to describe invasive plant occurrences

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When mapping invasive plants, what counts as an "infestation"? And when should an area be described as "infested"? These questions are the topic of recurring discussions in invasive plant mapping circles so it was no surprise that they recently came up on the Florida Exotic Pest Plant Council (FLEPPC) listserv in mid-February. What was surprising was the excellent multi-agency dialog that the questions stimulated.

The original post phrased the questions:

> ***"Can anyone direct me to a good source for a definition of 'acres infested'?"***
> ***&***
> ***"Is one acre containing one exotic plant considered 'infested'?"***

For the purposes of clarity, and consistency with established mapping standards, the term "infested acres" will be used in place of "acres infested" in this article.

Answering the questions above is essential if estimates of infested acres are to be compared from site to site, from agency to agency or from year to year. A total of 17 answers were received on the FLEPPC list. The respondents represented all levels of government, academic institutions, non-profit organizations and industry and thus offered interesting insight into the current state of invasive plant mapping methods in Florida.

The responses can be roughly classified into three categories. About one third of respondents felt that "infested acres" is an ambiguous term that is defined in many ways, about a third felt that "infested acres" is a useful measure but that a percent cover value must be specified, and the remaining third explicitly stated that they follow North American Weed Management Association (NAWMA) Standards in defining "infested acres." NAWMA Standards have been adopted by numerous state and federal agencies, and invasive plant mapping systems including The Florida Natural Areas Inventory (FNAI) Florida Invasive Plants Geodatabase (FLInv) project, The Nature Conservancy's Weed Information Management System (WIMS), the University of Georgia's Early Detection and Distribution Mapping System (EDDMapS) and, most recently, the cooperative iMapInvasives effort. However, the listserv responses indicate that there is still widespread uncertainty about how the NAWMA Standards can be used to produce repeated, comparable estimates of infested acres.

Many respondents qualified their responses by recognizing that the suitable description of infestations depends on the goal of the user. Site managers often just want to know where invasives are located so they can treat them as efficiently as possible or evaluate how well previous treatments worked. Higher level managers generally want to assess levels of, or changes in, infestation from an agency-wide or statewide perspective. While a census of all invasive plants in the state would meet the needs of all users, it would be too expensive and time consuming. Agency or state level assessments could be served by a systematic statistical sampling design, but this wouldn't give site level managers the information they need to direct or evaluate treatments. For an invasives assessment system to be widely used it must demand a minimum in terms of agency time or resources, it must provide information to land managers on where they need to direct treatment efforts, it must capture the effects of treatments, and it must be able to provide data for large scale evaluations.

The FNAI FLInv Mapping System

The methods developed for the FNAI FLInv project provide an example of how NAWMA standards can be used to estimate infested acres with minimal expense to managing agencies. FNAI has been contracted by the Invasive Plant Management Section of the Florida Fish and Wildlife Conservation Commission to establish a baseline record of invasive plant occurrences on public conservation lands in Florida (the FLInv Geodatabase) and provide a tool for monitoring these occurrences (the FLInv Mapping System). This system can be used by policy makers and land managers to assess the status of invasive plants and set priorities for control efforts. While FNAI conducts invasive plant surveys of public lands where agencies do not have complete data, the goal of the project is to provide a data collection system that managers can use to map invasive plant occurrences themselves. The mapping system consists of a suite of standards, methods and tools designed to facilitate collection and storage of invasive plant data in a standardized format. Land managing agencies often do not have the time or funding available to conduct extensive additional fieldwork so the methods take advantage of existing staff knowledge whenever possible. Depending on the surveyor's goals and technical capabilities, data collection using the FLInv system can range from simple paper maps with large occurrences circled, to detailed surveys in which every patch is mapped using a GPS data logger. At any scale the methods yield information useful at the site level while providing data for statewide or agency-wide evaluations.

Using the FLInv system, users record occurrences of FLEPPC listed Category I and II species using polygons, lines with specified width, or points (for extremely small occurrences) and an associated set of descriptive attributes. Recording occurrences using polygons and lines avoids potential error associated with visually estimating the acreage of large occurrences recorded as points. The descriptive attributes are classified into three tiers. Tier 1 data, the minimum required for a record to be included in the FLInv geodatabase, consists of just a species, a date and a spatial feature which provides location. Tier 2 provides the name of the surveyor who recorded the occurrence and attributes that characterize the spatial characteristics of the occurrence. Tier 3 data includes supplementary but useful information about plant maturity, site access, natural community, disturbance and treatment. The surveying agency and the type and extent of the survey are also recorded.

Defining infested acres following NAWMA standards using the FLInv system

The FLInv data collection system is based on NAWMA standards with a few changes due to the scale of the project and use of GIS. The NAWMA Standards contain two fields describing acreage: Infested Area and Gross Area. They are defined by NAWMA as follows:

GROSS AREA: This field is intended to show general location and population information. Like Infested Area it is the area of land occupied by a weed species. Unlike Infested Area, the area is defined by drawing a line around the general perimeter of the infestation, not the canopy cover of the plants. The gross area may contain significant parcels of land that are not occupied by weeds. Gross area is used in describing large infestations. When a value is entered for gross area, the assumption is that the area within the perimeter of the weed population (area perimeter) is an estimate or the product of calculating the area within a described perimeter. If a value for Gross Area is entered, a value for Infested Area must still be entered. The value for Infested Area is derived by estimating the percentage of land occupied by weed plants.

Why is it Useful? It is useful in describing large infestations or discontinuous infestations on the landscape. For larger weed populations it is very time consuming to plot the actual perimeter of the weed population. The increase in accuracy of plotting individual plants may not be enough to compensate for the increase in cost or manpower. An estimate of land area may be sufficient to meet the inventory and treatment requirements.

INFESTED AREA: Area of land containing one weed species. An infested area of land is defined by drawing a line around the actual perimeter of the infestation as defined by the canopy cover of the plants, excluding areas not infested. Areas containing only occasional weed plants per acre do not equal one acre infested.

Why is it Useful? An area of weeds can be defined in many ways and there is little consistency between individuals, counties, states and countries. Is an acre of weeds one weed plant

Figure 1. FNAI's implementation of NAWMA guidelines can be used to delineate invasive plant infestations at a variety of scales. The use of Percent Cover classes (equivalent of NAWMA Canopy Cover) allows relatively consistent calculation of infested acres even if Gross Area of an infestation is coarsely delineated.

A field in central Florida with Cogon Grass (*Imperata cylindrica*) near the center and along the southwest edge (2004).

At the lowest level of detail, the infestation can be delineated using one large rectangle (in blue).

Gross Acres *(NAWMA Gross Area)*	24.9
Percent Cover *(NAWMA Canopy Cover)*	5-25%
Infested Acres *(calculated using midpoint of Percent Cover class)*	3.7

At a moderate level of detail, the infestation can be delineated using two separate polygons (in green).

Gross Acres	4.6 total
Percent Cover	26-50%
	51-75%
Infested Acres	2.1

At the highest level of detail, the infestation can be delineated using seven separate polygons (in yellow).

Gross Acres	—
Percent Cover	>75% for all
Infested Acres *(actual)*	3.0

in an acre, an acre covered with weeds or all the lands threatened with invasion from an existing infestation? This definition provides a consistent and common method of describing weed populations. This is the data field that will be used to sum and report weed acres across all ownerships.

Infested Area is a required field in the NAWMA Standards while Gross Area is an optional field. Gross Area can also be thought of as the "area to be worked for treatment" and Infested Area as the "area to be treated." The NAWMA Standards also require the associated field, Canopy Cover, described below.

CANOPY COVER: Canopy cover will be estimated as a percent of the ground covered by foliage of a particular weed species. Cover will be recorded as a numeric value. If inventory procedures include the use of cover classes, such as Daubenmire codes, then the midpoint of the cover class will be entered as the cover value.

Why is it Useful? Canopy cover is a way to estimate the amount or severity of a weed infestation. Area tells you the extent of the population across the landscape. Canopy cover tells how that weed dominates the vegetation within that area. The greater the canopy cover, the more weeds there are.

FNAI incorporates these NAWMA definitions into the FLInv system in the following way:

- Gross Area is stored as acres in a FLInv database field called GrossAcres.
- Canopy Cover is referred to as Percent Cover and is recorded as one of five cover classes in a FLInv database field called PctCover.
- Infested Area can be calculated as the product of Gross Acres and the midpoint of the Percent Cover class.

Figure 1 provides an example of how area delineations at three different levels of detail still provide comparable estimates of infested acres. The accuracy of the infested acres is dependent upon an accurate choice of percent cover. In this example, in comparison with the finest level of assessment, the coarsest level slightly overestimates infested acres and the moderate level underestimates it. However, these differences are likely relatively small from a management perspective compared to the size of the area surveyed.

The FLInv system of delineating infested acreage also offers other benefits. In describing occurrences using Percent Cover, the system simplifies the evaluation of treatment efforts which do not appreciably change the Gross Acres of the occurrence, but do change the Infested Acres. When it is not possible to completely eradicate a species, agencies can assign a Percent Cover range that constitutes maintenance level control. The system also eliminates the need for use of a separation distance to separate areas of occurrence into discrete units that can be tracked over time. Rather than delineating and evaluating change in individual occurrences, managers can evaluate change in an entire area of interest even if occurrences are defined at different times using different levels of detail. When managers are not interested in the area infested with a particular species, but instead with the area containing any listed invasive species, data can be aggregated using GIS to provide this type of estimate. Together, these capabilities allow users of the FLInv system to quickly assess the status of invasive plants in an area and produce estimates of infested acres that suit the needs of a wide array of users at minimal expense.

For more detail on FNAI's implementation of the NAWMA standards please see our invasives webpage at: http://www.fnai.org/invasivespecies.cfm

Please Note: FNAI shares invasive plant data with the Florida Exotic Pest Plant Council (FLEPPC) EDDMapS; if you send data to FNAI, you need not send it to FLEPPC and vice versa. FNAI is available to train staff in invasive plant identification and FLInv data collection methods and to assist with invasive plant surveys on public conservation lands where no invasives data has been collected.

Comments, questions and suggestions are welcome. Please contact FNAI invasives project manager, Frank Price at fprice@fnai.org or (850) 224-8207 ext 210.

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References:

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