Field Guide

Invasive Plant Inventory, Monitoring and Mapping Protocol

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General Description

This protocol is for the inventory monitoring and mapping of invasive plant populations. The Forest Service has adopted the International Data Standards for the Inventory, Mapping and, Monitoring Invasive Plants[1]. This protocol incorporates these standards. The International Data Standards were designed to be compatible with existing inventory protocols such as the Montana Mapping Strategy[2] and the mapping system described in the Guidelines for the Coordinated Management of Noxious Weeds[3]. This method records information about the distribution and relative abundance of invasive plant species. Treatment of invasive species is recorded using a separate protocol called Treatment of Invasive Plants, which can be viewed at .

Invasive plant infestations cross-jurisdictional boundaries and are seldom managed in isolation. A cornerstone of noxious weed or invasive plant management is cooperation and coordination with adjacent land ownerships and jurisdictions. This cooperation requires that information on the location and distribution of invasive species be shared. The protocol standardizes information gathering and mapping procedures, facilitates information sharing between cooperators, aids in the early detection of new invasive plant populations and meets Forest Service reporting requirements. Some of the data elements required by this method may not be essential for Forest Service use, but will facilitate data sharing with other entities.

This protocol is derived from a single species inventory where the single species has been identified as an invasive plant. A single species inventory is most commonly used to describe rare plant population such as sensitive or endangered plants. The single species protocol has been modified to accommodate the ecological characteristics of invasive plants.

The invasive species protocol includes parameters such as location, population size, and habitat information. The protocol focuses on presence, location, extent, and abundance of an invasive species population. Monitoring invasive species populations occurs through repeated observations, noting relative changes in location, extent, and density of the plant population over time. If more detailed information is needed on either the weed or the plant community in which it is found other methodologies such as line intercept, point intercept and rooted nested frequency should be used. These methodologies are described in detail at the following web site.

Areas of Use

This protocol is applicable to both aquatic and terrestrial invasive plant species and across all vegetation types. This protocol may be applied to any invasive plant species and within all ecosystems. The information gathered using this protocol will be the

[1] International Data Standards for Inventory, Monitoring and Mapping Standards of Invasive Plants. 2001.NAWMA
[2] Cooksey, D.; R.Sheley. 1998. Mapping Noxious Weeds in Montana. Montana State University, extension. Bozeman, Montana
[3] Guidelines to Coordinated Management of Noxious Weeds - Development of Weed Management Areas", formerly The Guidelines for Coordinated Management of Noxious Weeds in the Greater Yellowstone Area. 1999.

source of information for noxious weed (invasive plant) inventories, planning, analysis, monitoring, treatment, reporting and budget allocations. The information gathered will be stored in the Terra module of NRIS (National Resource Information Systems). The protocol can be applied to both Forest Service and other land ownerships. The database will accept information for both public and private lands, inventories taken on National Forest and other land ownerships.

Advantages and Limitations

The invasive plant protocol can be used on a wide variety of plants, in a wide variety of habitats. It is relatively easy methodology and can be used by individuals with a wide range of expertise in plant ecology and plant identification.

Equipment

No specialized equipment is needed for this protocol. GPS (Global Position System) can be helpful in determining locating and relocating sites. A camera and a photo of the general setting and location may be helpful but is also not required. Field data recorders and hand held computers can facilitate data gathering and data entry. Programs for these devices will be available in the fall of 2002.

Training

Examiners must be knowledgeable in invasive plant identification.

Using the Protocol

Introduction

This Invasive Plant Protocol will require the use of both the General and the Invasive Plant Forms. Use the General Form to record information on the location, site, and ecological setting, of the infestation. Directions for completing this form are located in the section of the handbook titled “Rangeland General Form Field Guide”, on the Terra Web site and the Forest and Rangeland web site. Capturing detailed information on soils, existing and potential vegetation, aspect, and elevation is recommended. This information will be useful in stratifying areas for treatment or planning and will aid in predicting the spread of weeds to other areas and other habitats. Ecological site information can be used to determine what areas may or may not be subject to future invasions.

Project Name

The General Form offers many avenues to group and sort information, ranger district, forest, allotment, state and counties to name a few. The project name allows the user to group based on an activity. The Weed Management Area (WMA) is a logical project name for invasive species. Choosing the WMA as the project name will quickly allow information about a WMA to be sorted and consolidated for sharing with partners within the WMA.

Mapping Invasive Plants

The first step is to locate and outline the weed infestation on a map. Maps of weed populations can be created by a number of methods, hand drawing on maps and aerial photos, using GPS (Global Positioning Systems) and through computerized mapping system, Geographic Information System (GIS). Whatever method you use to delineate an infestation in the field, it is highly recommended that maps be converted and stored in an electronic format, GIS.

To ensure consistency the scale for hand drawn weed populations on maps should be 1:24000. 1:24,000 is the scale of United States Geological Service (USGS) 7.5-minute Quadrangle (Quad) maps. The 1:24,000 scale is also the standard for invasive plant mapping as recommended by the International Mapping Standards for Invasive Plants. Aerial photos, ortho quads and other remote sensing can also be useful formats for delineating weed populations. Using photography at 1:24000 scales will aid in the conversion to electronic computerized format.

There is no minimum size for an infestation (polygon). Terra currently accommodates values to $1/100^{th}$ (.01) of an acre. The next update of Terra, will allow for increased accuracy, values of $1/1000^{th}$ of acre may be recorded. This increase in accuracy will allow very small, single plant infestations to be accurately depicted and located. It will also facilitate monitoring small changes in population size.

To facilitate consistency and information sharing in GIS, all invasive plant infestations will be mapped and stored as polygons. Line and point data (layers) will not be supported. This conforms to the International Data Standards (NAWMA) and agreements with states and other federal agencies on sharing invasive plant information. Infestations that could be displayed as “Points”, such as a single plant or small infestations, will still be mapped as a polygon. You may enter the actual area occupied by the infestation or use the standard conversion factor. The standard conversion is $1/10^{th}$ of an acre and its equivalent in hectares[4]. The conversion factor may be useful when converting paper maps or GIS point layers to polygons. It can also be useful when the exact size of an infestation is not known (historical data), an infestation is rapidly growing or $1/10^{th}$ acre is accurate enough. Infestations that could be mapped as “lines” such as, infestations along roads and streams, will also be converted to long thin polygons, with the area corresponding the actual area in the polygon or the standard $1/10^{th}$ acre conversion factor.

Assign a unique identity, (*Site_ID*) to each polygon or map unit. The *Site_ID* can be any combination of letters and number up to 30 characters in length. It is strongly encouraged and highly recommended that the combination of Region, Forest and District numbers form the first six digits of the *Site_ID.* Each weed will be mapped separately so that each *Site_ID*, polygon, will contain a single species. The result will be polygons of different species can and will be overlapping. While this convention may seem cumbersome it

[4] International Data Standards for the Inventory, Monitoring and Mapping of Invasive Plants. 2001. NAWMA.

will greatly facilitates tracking the growth and changes in weed infestations over time and across the landscape.

The location of an infestation (polygon) must be entered in one of the location data fields (see General Form), even if the infestation is spatially located in GIS. The data based location information will assist in the transfer of information between cooperating agencies and allows the easy compilation of data. The location will correspond to the center of the infestation (polygon) or the population perimeter. The next release of Terra scheduled for fall of 2002, will allow users to enter this information automatically from GIS.

There will be two standard, default GIS map displays for invasive plants in NRIS. The first will be a map of the current infestations for all species. This map will be result of displaying the most recent information for each infestation (*Site_ID).* Not all sites may be visited each year, in this case the most recent information may be several years old. The query will search for the last update and then display that information. The second map will show the historical changes for each weed species. In this case every re-measurement including the most recent will be displayed. This map will readily show the change in a weed population over time. Each of these maps will be archived at the end of each year (January).

Plant Information

Complete definitions and explanations for all data fields can be found on page 16 in the following section called *Data Fields*. Record the invasive plant species using the species code from the NRCS, PLANTS. If appropriate enter the code for the subspecies or variety. The common name, complete genus, species, subspecies, variety and accompanying authority will be displayed automatically. Only one invasive plant species may be entered on each form or for each polygon. If you cannot identify the plant to species you can enter the code for the genus or family. Other generic codes for grasses and forbs are also available. In some instances there may be no PLANT code for the species you have identified. Enter NO-XWALK in the plant code field and then select the Unidentified/New Plant tab. Instructions for the Unidentified/New Plant screen can be found on page 27 of this guide. Use the NO-XWALK only for plants you can identify and no PLANTS code exists, this code is not for plants you cannot identify.

If more than one invasive plant is found at a given site a new form/record, a new polygon with a unique *Site_ID* must be drawn. This convention was agreed upon because of the difficulty of monitoring several species within a GIS polygon.

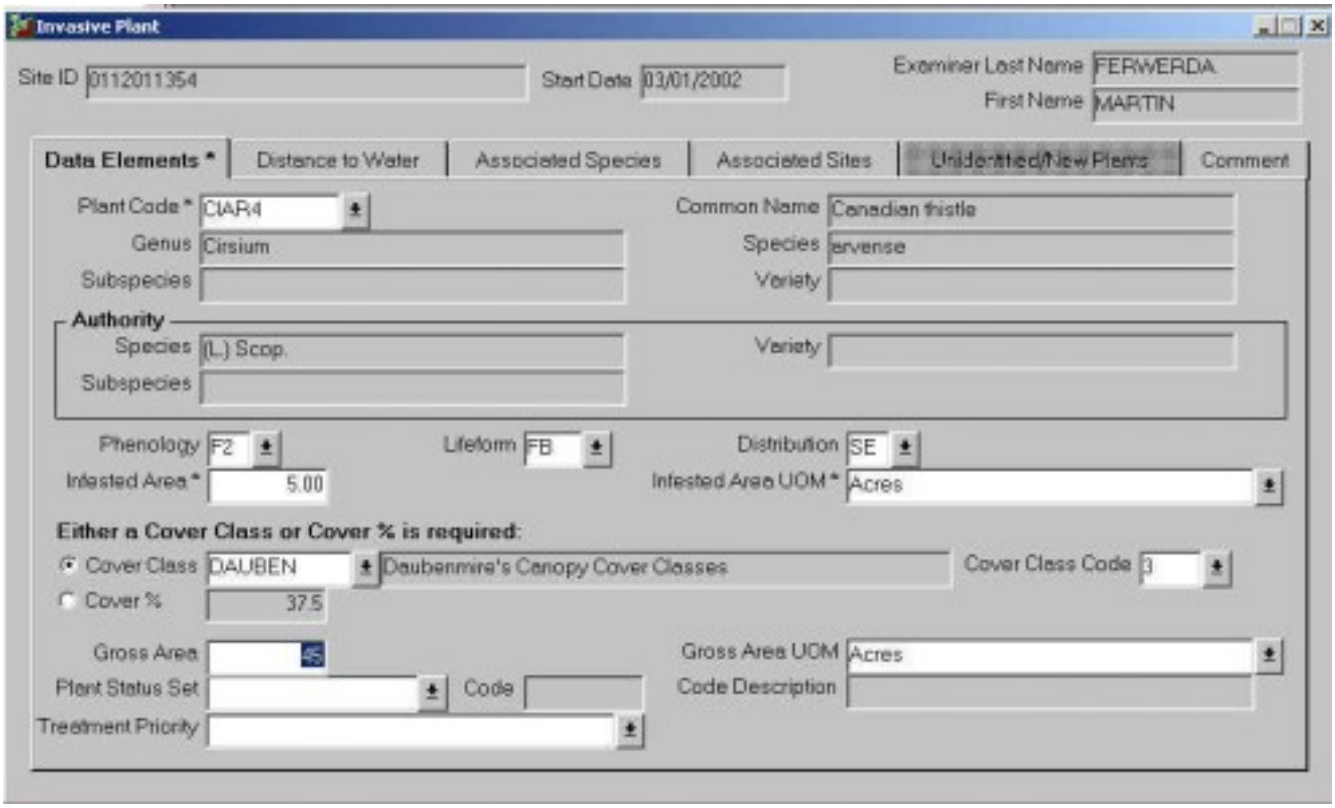


Figure 1: NRIS Terra Invasive Plant Data Entry Screen

The extent or size of the infestation is recorded in the *Infested_Area* field. This field is a critical component of this methodology and will be used to monitor changes in infestation size, report acres of invasive plants in national and regional reports and share information on invasive plants with cooperators, Weed Management Areas, counties, states, federal agencies and other entities.

> The *Infested_Area* is defined as the: "Area of land containing a single 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. Generally, the smallest area of infestation mapped will be 1/10th (.10) of an acre or 0.04 hectares."

Some infestations are very large or discontinuous and it is difficult or not useful to map these larger infestations based on the canopy cover of the plants. The increase in accuracy gained by plotting individual plants may not compensate for the increase in cost or manpower. The general location on the landscape and an estimate of land area may be sufficient to meet inventory and treatment requirements. For these larger infestations draw a line around the outer perimeter of the area occupied by the plant population, this is the *Gross_Area. Gross_Area* is intended to show general location and population information and is defined as:

> " 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."

If a value for *Gross_Area* is entered a value for Infested_Area must also still be entered. The *Infested_Area* field will be used to sum and correlate data. When the question is asked "How many acres of spotted knapweed are there on the Mark Twain National Forest?", that number will come from summing all the *Infested_Area* fields for records *(Site_IDs)* where spotted knapweed is found. The value for *Infested_Area* is derived from estimating the actual land area or the percentage of land occupied by weed plants and then multiplying this estimate by the *Gross_Area*.

> For example: A large spotted knapweed infestation is located in the West Fork drainage. By driving around the area and looking at aerial photos the weed population is an approximate *Gross_Area* of 600 acres. There are significant portion of the area that are not infested. It is estimated that approximately 40% of the area is actually occupied, or an estimated 240 acres infested (600 x .40 = 240). The value entered in *Gross_Area* is 600 and value entered in *Infested_Area* is 240. In this case there was no added value or utility in mapping the smaller infestations within the gross area. Treatment options would be the same for all the individual infestation or the gross area. Only the values recorded in infested area will be used for upward reporting.

Measure or estimate the canopy cover for each species recorded. The estimate of canopy cover is made on and refers to the *Infested_Area*, the portion of the site, which is actually occupied by the weed species. Canopy cover can be estimated using any of the following three types of cover classes: Daubenmire, 10-point Classes or the Greater Yellowstone Guidelines. The numeric midpoint of these cover classes will be the number actually shared with cooperating entities. Canopy cover can also be recorded as the actual percent canopy cover observed or measured. On sites with a *Gross_Area*, canopy cover is estimated on the *infested* and not the *Gross_Area*. In the example above, the average canopy cover was estimated to be 20% on the 240 acres actually infested.

Canopy cover can change rapidly in a population of invasive plants. A few scattered plants will grow to several acres and a dense canopy in a short time, one to two years. Often surveys taken at the beginning of the season will be not accurately reflect the nature of the infestation at the end of the season. Nor will the canopy cover be uniform throughout the infestation. For this reason it is impractical and often inappropriate to spend much time measuring canopy cover, therefore canopy cover will almost always be an estimate. Only significant differences in canopy cover should be mapped as separate polygons. As a general rule, until differences are equal to one or more cover classes listed in should infestation be mapped as separate polygons.

The protocol allows further description of the infestaion such as the phenology of the weed at the time the site was visited, the lifeform of the weed and the distribution pattern of the weeds across the landscape. The protocol also offers space to hold information on mangement of the plants *Treatment_Priority* and *Plant_Status.*

The distance to water may be recorded for each species. This information is often valuable for environmental analysis or planning treatments. It allows the categorization of treatment options

and potential effects around water. For example, infestations that are greater than 100' horizontally or vertically from water have a low probability of herbicides or effects from other treatments entering water.

Aquatic Plants

This methodology can be used both on terrestrial and aquatic invasive plants. Aquatic species tend to mutiply and move rapidly creating challenges to mapping. In lakes and ponds it may be appropriate to apply the concepts of *Infested_Area* and *Gross_Area*. The *Infested_Area* would be the area that is currently occupied by the weed species. Since aquatic species mutilply rapidly and often are moved with readily with currents it is likely that other areas will be quickly infested. In this instance the *Gross_Area* could be the entire pond or a bay in larger lakes. In streams, rivers and irrigation canals aquatic species are easily transported with the currents. To facilitate and display the areas that are infested the methodogy requires that the Hydrologic Unit Code (HUC) also be included for aqauatic species. The HUC code is located on the General Form.

MONITORING INVASIVE PLANTS

An essential element of invasive plant management is observing changes in weed populations over time, monitoring. This method monitors weeds at the population and infestation level through characteristics such as expansion or contraction of a given infestation. Each observation will require the completion of a new form and creation of a new record in the database. The site or polygon identifier (*Site_ID*) will allow changes in the infestation to be traced and connected from one observation to another. Individual observation can be identified and differentiated by the date. In Terra monitoring, subsequent visits to a site, will be referred to as a re-measurement. All the site and setting information, from the General Form, and the weed information, from the Invasive Plant Form, can be automatically transferred to the new record. You can then modify the information based on the current site visit, see Figure 2.

Weed infestations can change dramatically over time. Weed populations can expand exponentially, spreading along roads and trails. Conversely, infestations can be reduced through treatment. Separate infestations can grow together to form a single, large infestation. An infestation can split forming two separate populations where one previously existed. Changes in size and shape of an infestation can be traced over time through subsequent site visits, differentaited by the *Date.* The *Site_ID* will remain with a particular infestation (polygon) unless it splits or is combined with other polygons. The Re-Measurement Wizard and the Associated Sites utility in Terra will help you track these changes through time and record display the history of any given site.

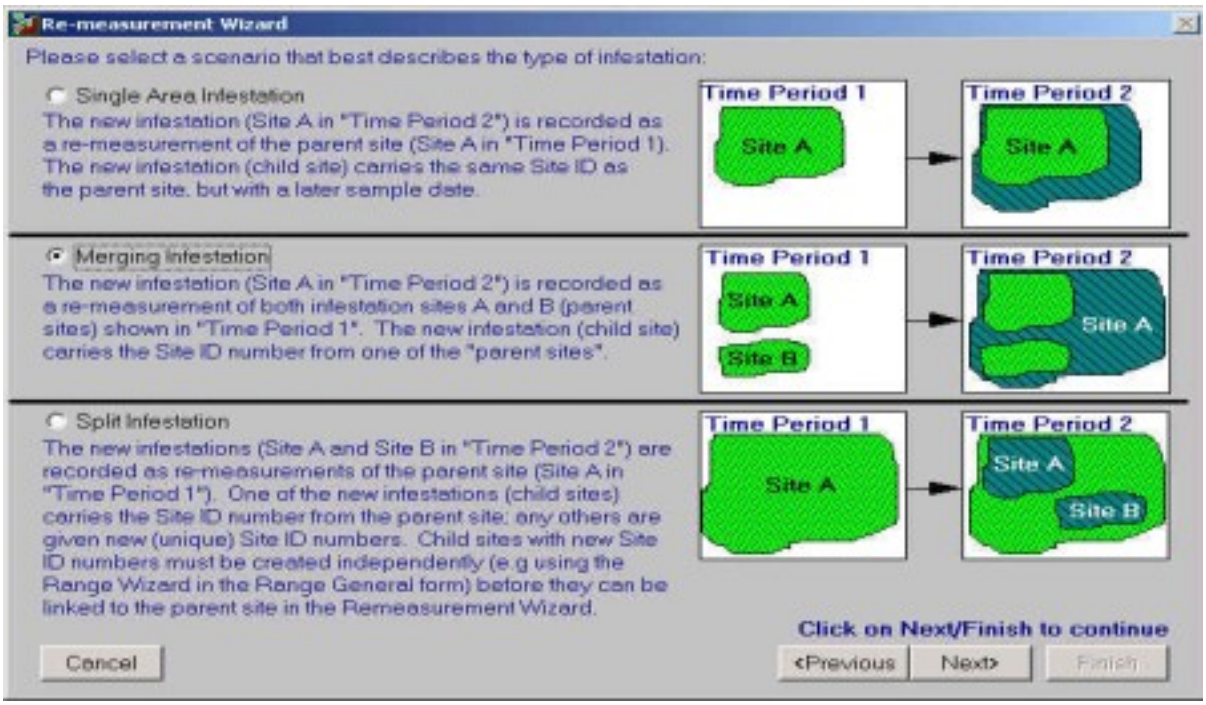


Figure 2: NRIS TERRA - Monitoring or Re-measuring a site

Monitoring/Re-measuring a Single Site

An individual infestation can expand, contract or even move across the landscape. All observations are tied together by the *Site_ID* and differentiated from each other by the date of the observation. For each observation make any needed adjustments to the information contained in the General Form, site and setting or to the invasive plant community on the Invasive Plant

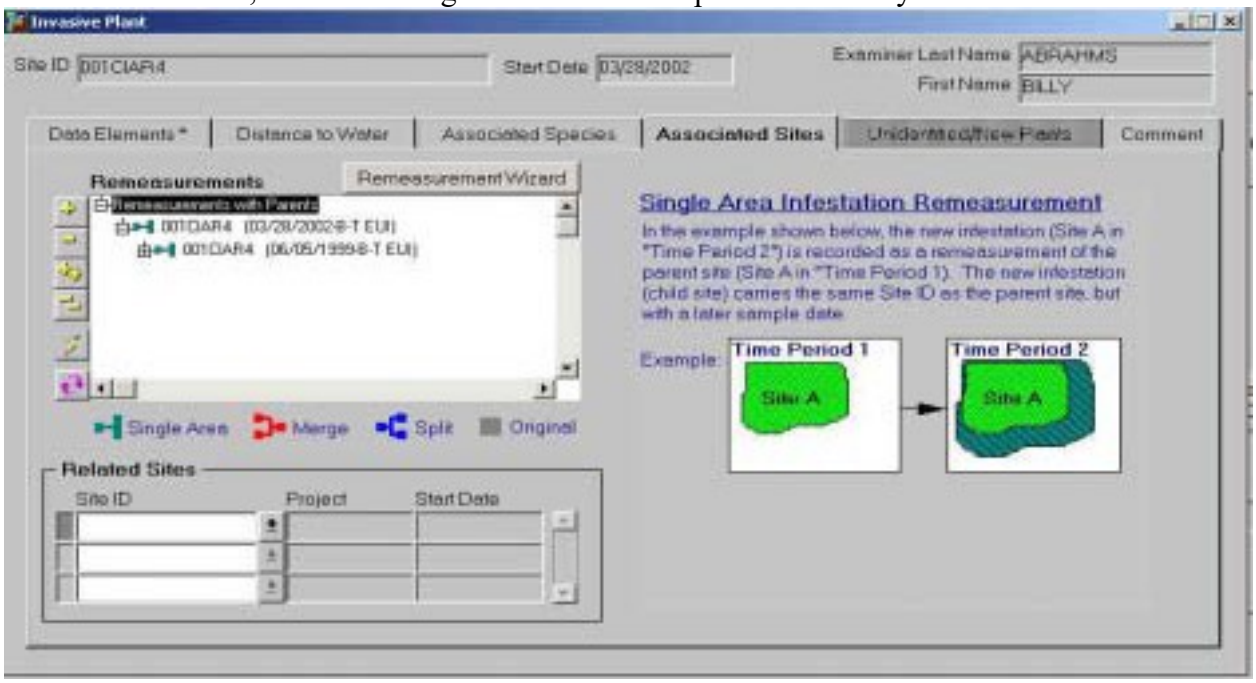


Figure 3: NRIS TERRA Re-measurement of a single site

Form. It is important to enter all observations even if there is no change in the invasive plant community. An observation of no change is an important observation. There is no limit to the number of re-measurements. Terra will display all the recorded observations to a site (Figure 3).

Merging Infestations

Weed populations can grow and expand overtime, merging into a single infestation. Two geographically separate populations can also merge. It is important to monitor and be able to recreate the weed expansion over the landscape. The Re-measurement Split Infestation Wizard, Figures 4 & 5 will assist in tracking these changes. The two "parent" sites with their *Site_ID*s will merge into a single site with one *Site_ID*. This new site is called the "child" and will retain the *Site_ID* from one of the "parents". All the previous sites and their relationships will be maintained. While there is no limit to the number of merges, the number of merged sites can be minimized by carefully drawing infestation boundaries. If sites are relatively close and will soon grow together, consider mapping these adjacent sites as a single site, using the *Gross_Area* concept. Encouraging the grouping of small infestations when it is likely that they will merge overtime will minimize the dilemma described in this section.

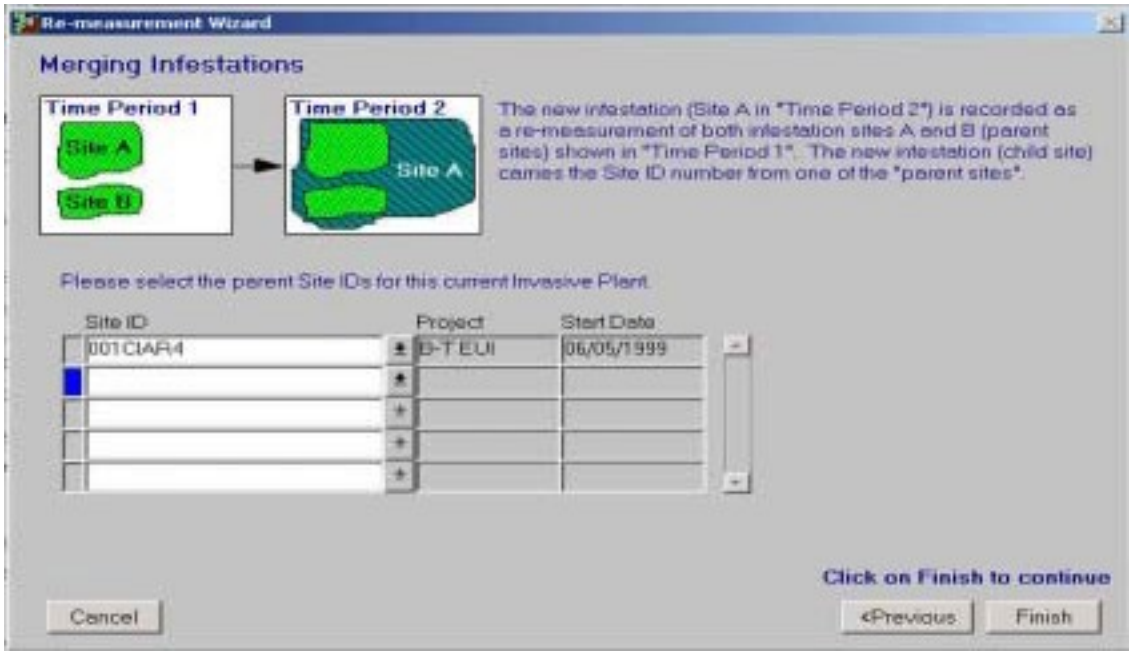


Figure 4: Merging Infestations

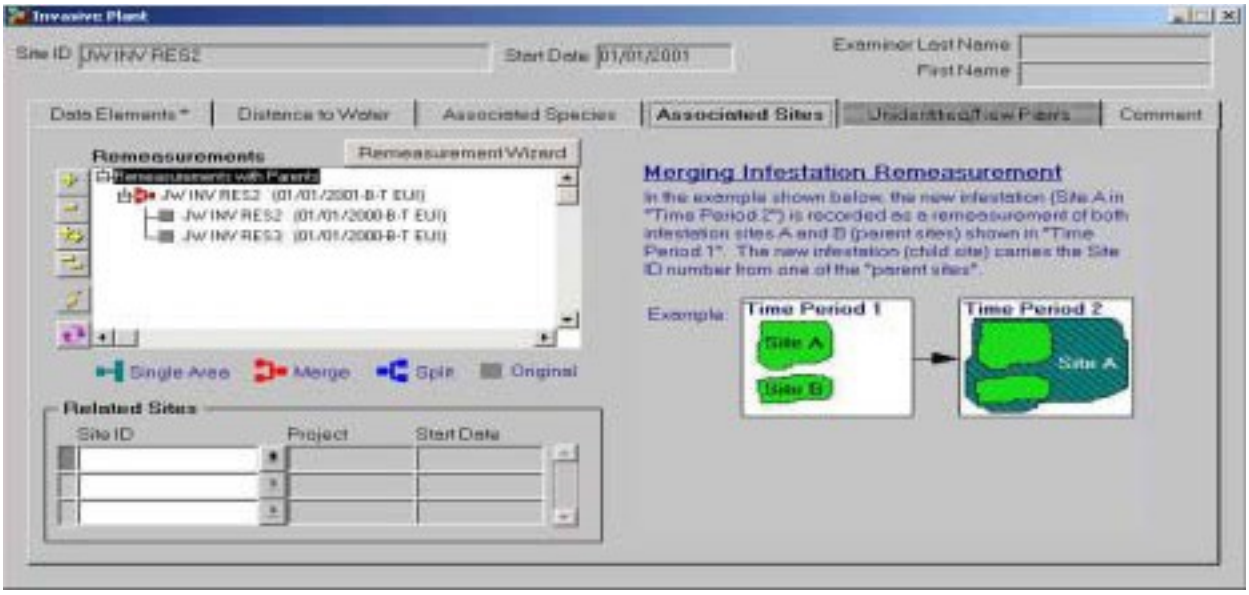


Figure 5: Merging Infestations

Split Infestations

Infestations cannot only merge but may also split and becoming two infestations over time. There are a number of factors that could lead to this split such as treating only part of an infestation. There is value is monitoring the changes in canopy cover of the weed between the treated and untreated areas. Many of the principles in polygon and *Site_ID* management discussed in the previous section are applicable here to splitting infestations. In this case a "parent" infestation will result in two "children". Only one of the infestations can carry the "parent" *Site_ID*. Use the Split Infestation Wizard, Figures 6 and 7, to assist in the naming of the sites. Naming *Site_ID* schemes that will also show this linkage; adding an A and B to the "parent" *Site_ID* where A represents the "parent" *and* B represents the new polygon or "*child*" may be useful.

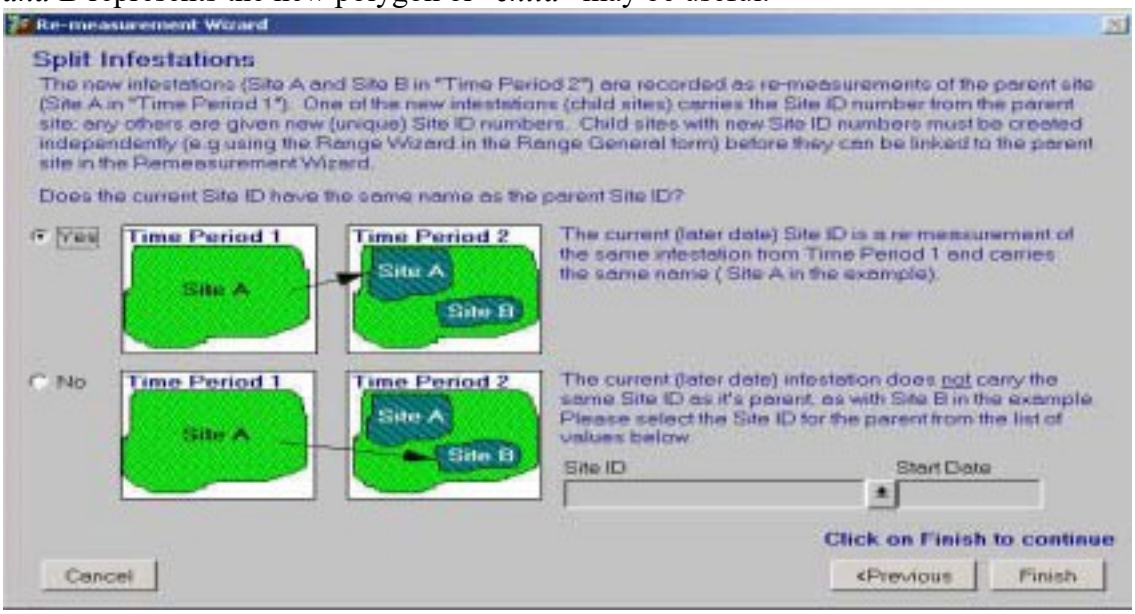


Figure 6: Split Infestations

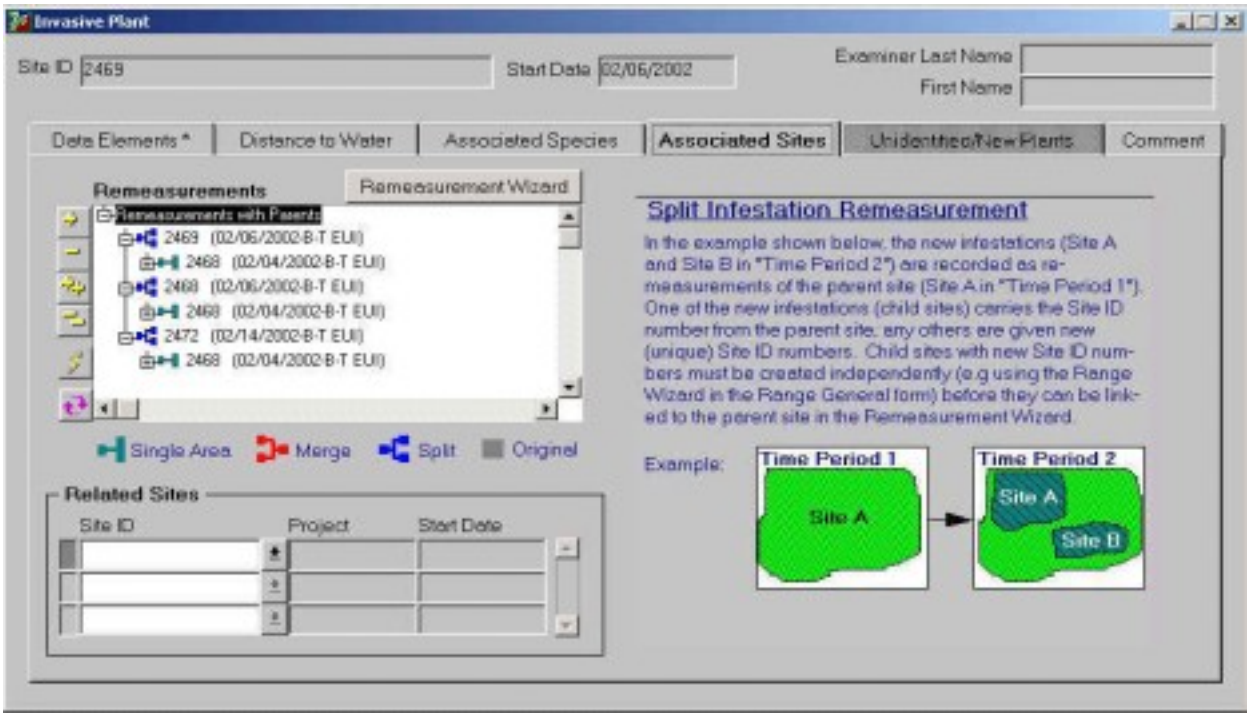


Figure 7: Split Infestations

NRIS will take a snapshot of the GIS coverage at the end of the calendar year. This is not a limitation; the user may store additional GIS overages. This will allow the tracking of historical infestations through GIS as well as through data files. The NRIS default map will be an all species map using the most recent information. The map will likely be a mixture of polygon and inventory information from several years. Some polygons may have been created or re-measured during the most recent field season and some from sites that may not have been visited in several years. The second is a group of map for each species showing changes over time.

Eradicated Infestations

All visual evidence of an infestation may disappear after treatment such as biological control or application of herbicides. Through above ground the weed may have disappeared there may be roots, stems and other plant parts that may recover and sprout. Seeds are stored in the soil profile for many years and may remain viable for 15 years or longer. For these reasons it is important to monitoring sites for many years, even after all evidence of weed has disappeared. A monitoring regime may start with annual monitoring for the first 3-5 years, decreasing the frequency of monitoring to every other year for the next 5-10 years and further decreasing the frequency to every 3 years for the next ten years, until the seed source has been exhausted. For sites that are continually vulnerable to reinfestations such as, roads, trails, recreational facilities and administrative sites, annual monitoring is encouraged.

Changes in an infestation following treatment can be monitored through reduction in canopy cover. Infestations with no visual evidence of weeds may have a canopy cover of zero (0). The map unit or polygon should remain until the seed source has been

exhausted. When an infestation has truly been eradicated reduce the acres infested to 0. This will show the infestation has been eliminated but keeps the polygon active allows monitoring of the site.

DATA ENTRY

Detailed information on data entry can be found on the Terra web site.

INTERNATIONAL MAPPING STANDARDS[5]

The International Inventory Monitoring and Mapping standards were developed by a broad group of scientists, land managers, state and local weed managers. These standards have now been adopted by most federal agencies. Most western states and provinces of Canada have also adopted these standards. Negotiations are now underway to gain acceptance in the eastern portion of the United States. The standards have been devised to facilitate the transfer of information on invasive plant species across ownerships, jurisdictions and property boundaries. These standards include not only the information on what will be collected but how it will be collected and the form or codes that will be used to record the information.

The Forest Service has accepted the standards and incorporated these standards into this protocol. In some cases the Forest Service may be collected or store information in a different form than the International Standard. In those cases the data will be converted to the accepted form before data is shared or transferred. An example is the *Date*. The Forest Service, NRIS uses the format DD/MM/YYYY while the International Standards use the format YYYY/MM/DD. This protocol relies on plant codes from the NRCS PLANTS database. To generate a report and data files, select a geographic area based on any of the location of area fields on the General Form such as: region, forest district, state, county, allotment or project. You must also select what form you would like the data in such as: a spreadsheet or ORACLE. Following is a list of the required data fields for the International Standards and the corresponding fields in the Forest Service Invasive Species Protocol.

International Standards	Forest Service Data Field
Collection Date	Date (General Form)
Country	No equivalent field, all data will be marked as located in the United States
State	State (General Form)
County	County (General Form)
National Ownership	Ownership (General Form)
Location: Use one of the following methods: Legal, metes and bounds, UTM, Lat/Long	Location (General Form): Use one of the following methods: Legal, metes and bounds, UTM, Lat/Long
HUC Code	Watershed HUC Number (General Form)
Source of Data	No equivalent field, all data will be marked as the

[5] International Standards for the Inventory, Monitoring and Mapping of Invasive Plants. 2001 NAWMA

International Standards	Forest Service Data Field
	Forest Service with the Region and Forest as the source of the data
Plant Name Genus Species	Plant Name: PLANTS code will be converted to Genus and Species name (Invasive Plant Form)
Infested Area	Infested Area (Invasive Plant Form)
Infested Area Unit of Measure	Unit of Measure (Invasive Plant Form)
Gross Area	Gross Area (Invasive Plant Form)
Gross Area Unit Of Measure	Unit of Measure (Invasive Plant Form)
Canopy cover (as a percent)	Canopy Cover (as percent or mid point of the canopy class) (Invasive Plant Form)

Figure 8: Crosswalk Forest Service to International Data Standards

Sharing Information

A key component of invasive species management is working and coordinating with others. It is vital that information on the location and extent of invasive plant populations be easily shared. The acceptance of the International Standards will facilitate this task. A standard report/application is available that will automatically gather all this information and readily transfer the information to cooperators like states, counties, Weed Management Areas and regional data bases. The report will ensure that all the required data elements are included and in the accepted format.

DOCUMENTING NEW SPECIES, NEW LOCATIONS

Distribution of invasive species over broad landscapes is held by regional and national data sets such as PLANTS or Invaders. In order for these data sets to be credible, the information they contain must be from verified plant records. Each new record for a county, a state or the country must be recorded and verified. The Forest Service can and should contribute to this information base by documenting new occurrences in counties and states with a voucher specimen. A voucher is a properly mounted and labeled specimen that has been submitted to a herbarium and verified by a qualified botanist or taxonomist. Consult your forest or regional botanist or see Appendix A for the proper procedure to collect, mount and submit a voucher specimen. These specimens can be submitted to a local, state herbarium or to the Forest Service herbarium collection at the University of Wyoming in Laramie.

DATA ELEMENTS

The invasive plant protocol requires the use of two forms, the General Form and the Invasive Plant Form discussed here. Fields 1-3 of this form/ protocol are a duplication of Fields 1-3 on the General Form. These fields are used to ensure that there is a link between the two forms. The information entered on these fields should be identical on both forms.

Site ID [Varchar 2(30)] ***Required***
Enter the 30-digit code that uniquely identifies the site. This field is the identifier for the polygon and links the General Field Form with the Invasive Plant Inventory and Monitoring Form. Although no convention for this field is mandated, it is ***highly, highly, highly*** recommended that the region, forest and district form the beginning of the *Site_ID* number. Using this convention will allow the easy sorting of information and uniquely identify infestations. During data entry into Terra this field will automatically be migrated to the Invasive Form from the General Form. In completing the paper field form enter the *Site_ID* number on both the General and Invasive forms.

Code	Description
0103101111	Region, Forest, District, Site
0310051234	Region, Forest, District, Site

Start Date [Date (12)] ***Required***
Record the calendar month, day, and year the site was visited This is the day that the information was collected in the field, ***not*** the date the data was entered into the computer . The format is MMDDYYYY. This field will also migrate autmatically from the General Form to the Invasive Form.

Code	Description
01/23/1984	January 23, 1984
12/07/1997	December 7, 1997

Examiner's Last, First Name and Middle Initial [Varchar 2(40)] ***Required***
Record the examiner's last, and first name is required. The middle initial is optional. The combination of Site ID, Start Date and Examiner's Last, First Name and Middle Initial will ensure that if the General Form can be associated with the correct Invasive Plant Form.

Last Name	First Name	Middle Initial
MacDonald	John	Q
Montoya	Juanita	

Plant Code [Varchar 2(8)] ***Required***
For vascular plant species, use the (most codes are less than 8 chars long) alpha-numeric code from the NRCS PLANTS data base. Identify plants to species and subspecies, if possible. If plants can only be identified to the genus or family enter the genus/family code from PLANTS. If a code for a species does not exist enter NO-XWALK and refer to the section on Plants Without a Crosswalk in Plants on page 27 of this field guide. The NO-XWALK should not be used for unidentified plants.

Code	Description
LIDAD	Linaria dalmatica (L.) P. Mill. ssp. dalmatica Dalmatian toadflax
CEBI2	Centaurea biebersteinii DC Spotted Knapweed

Common Name [Varchar2(60)] ***Optional***
These are the weed names most commonly used in conversation. They are often descriptive e.g., yellow star thistle. This field will autopopulate from PLANTS when the PlantCode is entered, or enter the common name on the field form.

Code	Description
Yellow Star thistle	Centaurea solistitis
Dalmatian toadflax	Linaria dalmatica (L.) P. Mill. ssp. dalmatica

Genus [Varchar 2(20)] ***Optional***
This refers to the latin, scientific name for the Genera. This field will auto populate from PLANTS when the Plant Code is entered, or enter the genus name on the field form.

Code	Description
Centaurea	Knapweed
Polygonum	Japanese knotweed

Species [Varchar 2(30)] ***Optional***
This refers to the scientific name for the species. This field will auto populate from PLANTS when the Plant Code is entered, or enter the species name on the field form.

Code	Description
Soltitialis	The species name for yellow star thistle
cuspidatum	The species name for Japanese knotweed

Subspecies [Varchar 2(30)] ***Optional***
This field is reserved for finer plant identification, to subspecies. This refers to the scientific name for the subspecies/variety. This field will auto populate from PLANTS when a Plant Code when includes a subspecies is entered.

Code	Description
LIDAD	Linaria dalmatica (L.) P. Mill. ssp. dalmatica Dalmatian toadflax
SOARU	Sonchus arvensis (L.) ssp. uliginosus (Bieb) Nyman

Variety [Varchar 2(30)] ***Optional***
This field is reserved for more pricise identification of species to the variety. This refers to the scientific name for the variety. This field will auto populate from PLANTS when the Plant Code which includes the variety is entered.

Code	Description
LIDAD	Linaria dalmatica (L.) P. Mill. ssp. dalmatica Dalmatian toadflax
SOARU	Sonchus arvensis (L.) ssp. uliginosus (Bieb) Nyman

Authority [Varchar 2(100)] ***Optional***
Enter the abbreviation for the name of the authority. The authority refers to first individual to classify and name the plant. This field will auto populate from PLANTS when the Plant Code which includes the genus, species, subspecies and variety is entered.

Code	Description
L.	Linaeus
Nutt.	Nutall

Phenology [Varchar 2(2)] ***Optional***
The stage of plant development for the invasive plant such as: buds, flowers, or fruit. Record the phenology at the time of sampling.

Graminoids/Grass like plants	
Code	**Class**
G1	Leaves partially developed; no heads
G2	Inflorescence inside the sheath (in the boot)
G3	Inflorescence partially or fully exerted from sheath
G4	Seeds maturing or mature
G5	Senescent; dormancy
RG	Regrowth

Forbs & Shrubs	
Code	**Description**
F1	Pre-flowering (includes vegetative,beginning growth stages and rosettes)
F2	Flowering
F3	Fruiting
F4	Senescent; dormancy

Life Form [Varchar 2(3)] ***Optional***

The characteristic form or appearance of a species, at maturity (e.g., tree, shrub, or herb). Use the following codes to describe the life form of the plant.

Lifeform Code	Definition
AL	Algae - A general name for the single-celled plant plankton, seaweeds, and their freshwater allies.
FB	Herbaceous forb/herb - Vascular plant without significant woody tissue above or at the ground. Forbs and herbs may be annual, biennial, or perennial but always lack significant thickening by secondary woody growth and have perennating buds borne at or below the ground surface..
FU	Fungus -A non-flowering plant of the kingdom Fungi, all lacking chlorophyll.
GR	Herbaceous graminoid - Grass or grass-like plant, including grasses (Poaceae), sedges (Cyperaceae), rushes (Juncaceae), arrow-grasses (Juncaginaceae), and quillworts (Isoetes)
LC	Lichen - Organism generally recognized as a single plant that consists of a fungus and an alga or cyanobacterium living in symbiotic association. Often attached to solid objects such as rocks or living or dead wood rather than soil.
LI	Woody Liana - Climbing plant found in tropical forests with long, woody rope-like stems of anomalous anatomical structure.
NP	Nonvascular Plant - Nonvascular, terrestrial green plant, including mosses, hornworts, and liverworts. Always herbaceous, often attached to solid objects such as rocks or living or dead wood rather than soil.
SH	Woody Shrub - Perennial, multi-stemmed woody plant that is usually less than 4 to 5 meters or 13 to 16 feet in height. Shrubs typically have several stems arising from or near the ground, but may be taller than 5 meters or single-stemmed under certain environmental conditions.
SS	Woody Subshrub/Half-shrub - Low-growing shrub usually under 0.5 m or 1.5 feet tall (never exceeding 1 meter or 3 feet tall) at maturity.
TR	Woody Tree - Perennial, woody plant with a single stem (trunk), normally greater than 4 to 5 meters or 13 to 16 feet in height; under certain environmental conditions, some tree species may develop a multi-stemmed or short growth form (less than 4 meters or 13 feet in height).
UN	Unknown - Growth form is unknown.
VI	Herbaceous Vine - Twining/climbing plant with relatively long stems, can be woody or herbaceous. FGDC classification considers woody vines to be shrubs and herbaceous vines to be herbs.

Distribution [Varchar 2(2)] ***Optional***

The spatial distribution of individual plants within a population and across the landscape. Record the distribution using the codes listed below.

Code	Class
Cl	Clumpy
SP	Scattered patchy
SE	Scattered even
LI	Linear

Infested Area [Numeric(9,2)] ***Required***
This is the area of land containing a single 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. Generally, the smallest area of infestation mapped will be 1/10th (.10) of an acre or 0.04 hectares. This field will be expanded to accept 1/1000 of an acre in the next version of Terra. This field has been referred to as *Occupied_Area* or *Net_Area* in the past.

Code	Description
12.5	12 and a half acres of land are infested with purple loosestrife
.05	5/100 of a hectare or approximately 500 square meter (patch 5 meters by 10 meters) are infested with garlic mustard

Infested Area Unit of Measure [Varchar 2(12)] ***Required***
The convention for measuring infested area is either in acres or hectares. Enter either hectares or acres in this field.

Code	Description
Acres	Acres infested
Hectares	Hectares infested

Gross Area [Numeric(8,0)] ***Optional***
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. It is *not* a measured value. Values in this field are rounded up to the nearest acre. If a value for *Gross_Area* is entered a value for *Infested_Area* must still be entered. The value for *Infested Area* is derived from estimating the actual or percentage of land occupied by weed plants.

Gross Area Unit of Measure [Varchar 2(12)] **Required** if a value for *Gross_Area* is entered

The convention for measuring *Gross_Area* is either in acres or hectares. Enter either hectares or acres in this field.

Code	Description
Acres	Acres Gross area
Hectares	Hectares Gross area

Computing Infested Area
This field(s) are only provided on the field form to assist in the computation of infested area.

Plant Status Set [Varchar 2(30)] ***Optional***.
This field describes the name of the set of the status codes which are developed locally.

Name of the Set	Description
Upper Crow Creek	Set of status values for the Crow Creek Weed Management Area
No Knapweed WMA	Set of status codes for The No Knapweed Weed Management Area
Bear Creek District	Set of status codes for the Beaver Creek Ranger District from the Beaver Creek Weed Control Environmental Impact Statement
California	Set of status codes from the California Noxious Weed List

Plant Status Code [Varchar 2(5)] ***Required*** when a value for *Plant_Status_Set* is entered.
This field is intended to hold information on the status of plants, such as those species that are listed as noxious by counties, states or are on the federal list. There are no national standards for this field as states and counties use varying systems for designating plants as noxious. In those areas where noxious weed lists do not exist or are incomplete this field can be used to identify species of concern. The field is not limted to officialy disignated staus, it could contain status ssytems generated by a WMA, a forest, a districtor through an environmental analysis. This field is reserved for local use, with locally generated codes and definitions. Coding conventions for this field can be entered into the data base by the local NRIS data base steward. Codes can be from one to five characters in length and can be either numbers, characters or a combination of both. This field can be automated with the help of a local data steward. Within a given set each weed species will be associated with a code. There is no limit to the number of *Plant Status_Sets* for a region, forest or district. Following is an example of possible codes from a state weed law.

Code	Description
A	Noxious – Mandatory Control
B	Noxious Control and Contain
C	Noxious No control required

Treatment Priority [Varchar 2(8)] ***Optional***.
This field is intended to hold information on management of invasive plants. In some cases is could refer to the state priorities such as category A, B or C weeds. It could also be used to identify priorities from Weed Management Area, a county and environmental analysis, EA, EIS or from an annual plan of work. This field is reserved for local use and therefore there are no national standards. Codes and definitions will be developed locally, with the agreed to coding conventions entered into the database by the local NRIS data base steward. Codes can be from one to eight characters in length and can be either numbers, characters or a combination of both. Following is an example of sample codes.

Priority	Description
PR1	Priority One, potential Invaders
PR2	Priority II, new Invaders
PR3	Priority III, established Infestations

Canopy Cover is a required data element for invasive plant protocol. You can describe canopy cover by either entering the actual percent (*Cover_Percent*) or by entering a *Canopy_Cover_Class* and *Cover_Class_Code.*

Canopy Cover Set [Varchar2(6)] ***Optional***
The name of the cover class set you are using to describe canopy cover. Only three classess, Daubemire (6 Point), Ten Point Cover Class or the Greater Yellowstone Area are available.

Canopy Cover Set	Description
NRMCOV	Ten Point Cover Class
DAUBEN	Daubemire Cover Classes
GYA	Greater Yelllowstone Area Cover Classes

Cover Class Code [Varchar 2(1)] ***Required*** if using *Canopy_Cover_CLass*
The percent of a fixed area occupied by the plant species, life form, or ground cover type. Percent cover is obtained by projecting the outline of the foliage or surface feature to a horizontal plane and determining what percent of the fixed area it covers. This field is used for measured or estimated percent cover. Some measurement of canopy cover is required but this infomration can be entered in this field or by cover classes.

Ten Point Cover Classes

Class Code	CoverClass	Mid Point
T	0-1.0%	0.5%
0	1.1-5.0%	3.0%
1	5.1-15.0%	10.0%

2	15.1-25.0%	20.0%
3	25.1-35.0%	30.0%
4	35.1-45.0%	40.0%
5	45.1-55.0%	50.0%
6	55.1-65.0%	60.0%
7	65.1-75.0%	70.0%
8	75.1-85.0%	80.0%
9	85.1-95.0%	90.0%
A	91.1-99.0%	97.0%
X	99.1-100%	99.5%

Daubenmire Classes

Class Code	**Cover Class**	**Mid Point**
T	0 - 1.0%	0.5%
1	1.1 - 5.0%	3.0%
2	5.1 - 25.0%	15.0%
3	25.1 - 50.0%	37.5%
4	50.1 - 75.0%	62.5%
5	75.1 - 95.0%	85.0%
6	95.1 – 100%	97.5%

Greater Yellowstone Area Cover Classes[6]
Guidelines for Coordinated Management of Noxious Weeds

Cover Code Class	**Cover**	**Mid Point**
T – Trace	0-1%	0.5%
L – Low	1.1 – 5.0%	2.5%
M – Moderate	5.1 – 25%	15%
H- High	25.1 – 100%	63%

Canopy Cover Percent [Numeric (5,10] ***Optional***
Canopy cover is the percent of the ground, covered by foliage of a particular weed species. Percent cover is obtained by projecting the outline of the foliage or surface feature to a horizontal plane and then determining what percent of the fixed areas covered. This field is used to measure or estimate percent cover. In some cases canopy cover could exceed 100% when multiple layers of weed plants are present such as plants in the rosette and mature stages. Some

[6] Guidelines to Coordinated Management of Noxious Weeds - Development of Weed Management Areas", formerly The Guidelines for Coordinated Management of Noxious Weeds in the Greater Yellowstone Area. 1999.

measurement of canopy cover is required but this information can be entered in this field or by using a combination of *Canopy_Cover_Set* and *Cover_Class_Code.*

Code	Description
18	Canopy cover was estimated at 18%
32	Canopy cover was measured using line interspet as 32%

Horizontal Distance to Water [Numeric (8,2)]. ***Optional***.
Enter the measured or estimated distance to water. The distance is measured as a direct line from the edge of the infestation to the nearest surface water. This is often described "as the crow flies". It is often useful to separate sites by the distance to water. This information is helpful in grouping or classifying weed sites into management or treatment zones. These may be areas where it is likely or possible that surface runoff will result in herbicides entering the water systems. Conversely this field could be used to group sites where it is highly unlikely or improbable that herbicides could enter the water. Groupings based on distance to water can be useful for environmental analysis and discussions of potential effects within NEPA.

Code	Description
145	The distance to Deep Creek from the infestation was measured at 145 feet.
32	The distance from the spotted knapweed infestation was estimated to be 32 meters

Horizontal Distance to Water Unit of Measure [Varchar 2(34)] ***Required*** if a value for *Horizontal_Distance_to_Water* is entered a value for *Unit_of_Measure* must also be entered. Enter the appropriate unit of measure. The unit of measure is limited to the following options.

Code	Description
Feet	The distance was estimated in feet
Meters	The distance was measured in meters

Vertical Distance to Water [Numeric (8,2)]. ***Optional***.
Enter the measured or estimated vertical horizontal distance to water. Distance is measured in a direct line from the site of the infestation to the nearest subsurface water. This is useful information in grouping or classifying weed sites into management or treatment zones. It would identify areas where it is likely or possible that water movement through the soil profile could result in herbicides entering groundwater or other subsurface water systems. Conversely it could be used for grouping sites where it is highly unlikely or improbable that herbicides could enter groundwater systems.

Code	Description
25	The distance was water table was estimated as 25 feet.

130	A well was located in the immediate vicinity of the infestation. Water was found at 130 meters.

Vertical Distance Unit of Measure [Varchar 2(34)] ***Required*** if a value for Verticle Distance to Water is entered.

Enter the appropriate unit of measure: feet, yards or meters.

Code	Description
Feet	The distance was estimated in feet
Meters	The distance was measured in meters

Associated Species

The remaining data fields all refer to associated species, you may enter up to three (3) plant species. An Associated Species is defined as any plant species that occurs, is associated with or commonly found growing with the invasive plant species.

Associated Species Code [Varchar2(8)] ***Optional***.
For vascular plant species, use the alpha-numeric code from the NRCS PLANTS data base. Identify plants to species and subspecies, if possible. For genus identification, enter the appropriate genus code, and enter subspecies code.

Code	Description
ARTRV2	Artemesia tridentata var. vaseyana

Associated Genus [Varchar 2(20)] ***Optional***
This refer to the latin, scientific name for the Genera. This field will auto populate from PLANTS when the Plant Code is entered, or you may enter the genus name on the field form.

Code	Description
Artemesia	Sagebrush

Associated Species. [Varchar 2(30)] ***Optional***
This refer to the scientific name for the species. This field will auto populate from PLANTS when the Plant Code is entered, or enter the species name on the field form.

Code	Description
tridentata	Species name for big sagebrush

Associated Subspecies [Varchar 2(30)] ***Optional***
This field is reserved for finer delinations of species, the scientific name for the subspecies. This field will auto populate from PLANTS when the Plant Code is entered, or enter the subspecies name on the field form.

Code	Description
vaseyana	Subspecies name for mountain big sagebrush

Associated Variety [Varchar 2(30)] ***Optional***
This field is reserved for finer delinations of species variety, the scientific name for the variety. This field will auto populate from PLANTS when the Plant Code is entered, or enter the variety name on the field form.

Code	Description
vaseyana	Subspecies name for mountain big sagebrush

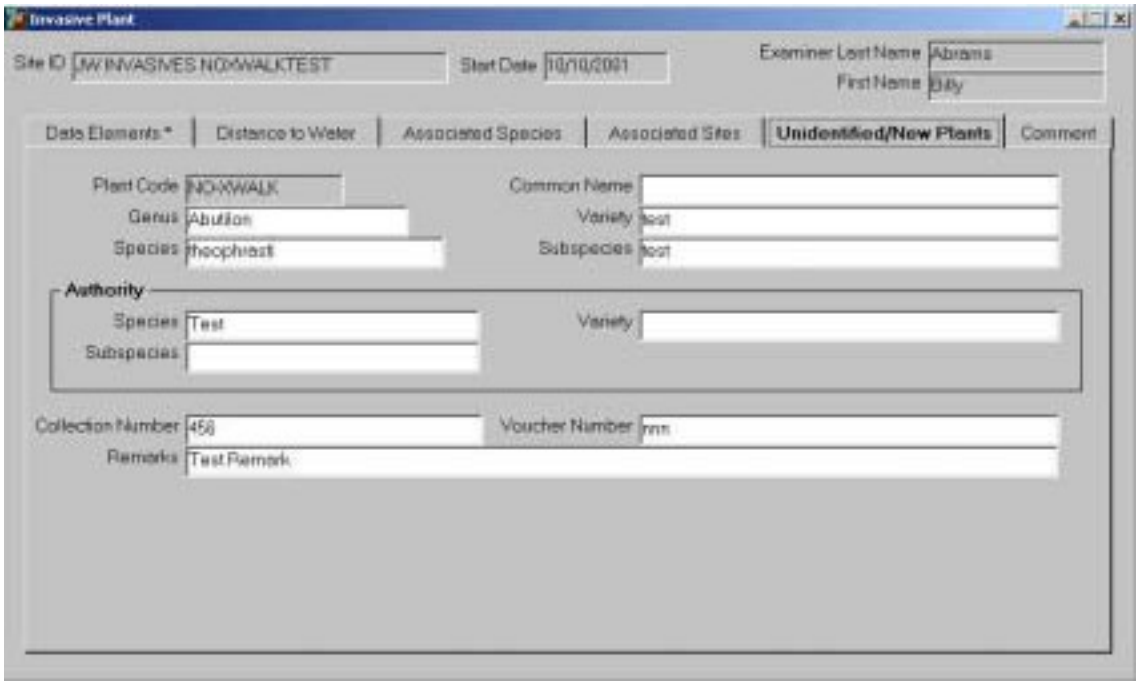
Comment Field [Varchar 2(2000)] Optional
This field is available to the user to enter any relevant information on the weed infestation. There is also a comment field associated with the General Form. Use the comment field on the General Form to describe the site and setting for the weed infestation. Use this comment field to describe the weed infestation

Map

This box is available to draw a map showing directions to the site, map of the general location or display the location of the infestation on the landscape. This sketch map can be scanned and stored in under the "photo information" on the General Form.

PLANTS WITHOUT A CROSSWALK IN PLANTS

Terra uses codes from the PLANTS database to enter plant information. Terra will only allow a *Plant_Code* to be entered it will not allow the user to enter a name in the *Genus, Species, Common_Name* or any of the plant fields. Because of this constraint a plant code from PLANTS must exist for a plant name to be entered. Sometimes a plant will be identified, where a code in PLANTS does not yet exist. This can be the result of new taxonomy, new nomenclature and in the case of invasives new species to North America. It may take up to two years for a new species to be added to PLANTS. This group of fields allow you to record and data base this information in the interim period until PLANTS establishes a code. This field will also be used by regional botanists to alert PLANTS, that a new code is needed. To use these fields enter NO-XWALK in the *Plant_Code* field and then select the Unidentified/New Plants tab. Do not use these fields for plants that you cannot identify. There are a number of codes that allow you to enter identified plants such as codes for genera, family and life form.



NO-XWALK Plant Code 2(8)] ***Required***
This field will autopopulate from the Data Elements screen when NO-XWALK has been entered in the *Plant_Code* field.

Code	Description
NO-XWALK	Centaurea horibilis (Funk.)
NO-XWALK	Euphorpbia godzillipus Swg.

NO-XWALK Common Name [Varchar2(60)} ***Optional***
These are the weed names most commonly used in conversation. They are often descriptive e.g., yellow star thistle.

Code	Description
Evenworse Star thistle	Centaurea horibilis (Funk.)
Godzilla's spurge	Euphorpbia godzillipus Swg.

NO-XWALK Genus [Varchar 2(20)] ***Required***
This refer to the scientific name for the Genera.

Code	Description
Centaurea	Knapweed
Euphorpbia	Spurge

NO-XWALK Species [Varchar 2(30)] ***Required***
This refer to the scientific name for the species

Code	Description
horibilis	The species name for evenworse thistle
godzillipus	The species name for Godzilla's spurge

NO-XWALK Subspecies [Varchar 2(30)] ***Optional***
This field is reserved for finer delinations of species such as subspecies and refers to the scientific name for the subspecies.

Subspecies	Description
Elongatum	Large evenworse thistle
Japonicus	Godzilla Godzilla's spurge

NO-XWALK Variety [Varchar 2(30)] ***Optional***
This field is reserved for finer delinations of species, the variety name.

Code	Description

NO-XWALK Authority [Varchar 2(100)] ***Optional***
Enter the abbreviation for the name of the authority. The authority refers to first individual to classify the plant into this name.

Code	Description
Funk.	J.W. Funkadelic
Swg.	S.W. Guild

Collection Number [Varchar 2(20)] ***Optional***
Enter the collection number from the specimen label. This field can be up to 20 charactrers in length and any combination of numbers and letters.

Collection Number	Description
FS19663783	The collection number
1267902G	The collection number

Voucher Number [Varchar 2(6)] ***Optional***
Enter the voucher number from the voucher label. This field can be up to six (6) characters in length and any combination of numbers and letters. The *Voucher_Number* is usually assigned by the herbarium that verifies the identification.

Collection Number	Description
FS19663783	The collection number
1267902G	The collection number

Remarks [Varchar 2(240)] ***Optional***
This is a comment field. Enter any relevant information up to 240 characters in length.

APPENDIX A

COLLECTION, PREPARATION, AND PRESERVATION OF HERBARIUM SPECIMENS

Introduction: Herbarium specimens are permanent records of plant species or populations. Such specimens are becoming increasingly valuable documentation of native flora, rare plants (TES), rare populations, exotic and invasive species. Herbarium specimens document the existence of species and also provide valuable information on geographic distribution of species across the landscape, region and continent. Computers allow the graphic display of a species occurrence, allowing predictive modeling on likely habitat for other populations and expansion of existing populations. For invasive species predicting and racking expansion into new states and new areas is vitally important. This information is now being housed in such databases as the PLANTS, National Heritage Rare Plant program, Invaders plus state and national floras. For plant data to be included in these large data sets or published floras the existence of the plant must be substantiated. The traditional and current avenue is through peer reviewed publication and herbarium specimens. A herbarium specimen verifies the sighting of new species at a county, state, district, forest, or region. Specimens are also important in documenting ecological and inventory studies for scientific research, publication and environmental impact statements.

The value of a specimen depends upon the care taken by the collector in selecting and preparing the specimen, and providing data to accompany it. Following are directions for collecting, mounting and submitting herbarium specimens with appropriate label data.

1. Specimens should be representative of the plant population, not simply that that fit nicely in the plant press. Plants should be collected in flower and/or fruit stage. Plants that are smaller than a herbarium page (11” x 16”) should be collected in their entirety. For very large plants, such as shrubs and trees, branches with leaves, stems, flowers, fruits should be collected. Underground parts of herbaceous plants are often diagnostic and should be collected where feasible (using a strong trowel, brick hammer, screwdriver, etc.).

2. Avoid collecting specimens from very small populations, less than twenty or so individuals. Collection from small isolated populations may not be represent the species adequately and/or may damage these populations. Documentation of small populations of rare plants may have to rely on photographs or non-vouchered report. In contrast, small populations of invasive or undesirable plants, control of the population is desirable.

3. Site records should be made in the field at the time of collection. Describe the site in sufficient detail to gain an understanding of the plant setting. When multiple specimens are collected at a given site, link the appropriate site information to each specimen.
    a. Use a bound, waterproof notebook or prepared field sheets for records.
    b. Notes should be taken in pencil or indelible ink; ballpoint and fiber pens will run with rain or even moisture from the specimen.
    c. Record the collection number and date.
    d. Some form of location information is essential; country, state, county, legal description or longitude/latitude, GPS.

e. Recording direction from a locatable landmark may provide useful information.
f. Record information on the ecological setting of the plant. Include such information as: habitat type, associated species, elevation, aspect, soils and any other relevant information.
g. Record plant features that may be lost or reduced during the drying and collection process such as: petal color, glaucescence, height and dbh. Some flowers may turn from blue to brown when dried; if no record of flower color has been made, identification may be hampered.

4. Plants should be pressed as soon as possible. If a field press is not available, the material can be placed in a tagged plastic bag. Pressing can be delayed if bagged samples are not exposed to heat or sunlight by keeping bags cold, but not allowing them to freeze (ice chest with ice; refrigerator).

5. Old newspapers are commonly used for pressing plants, but plain newsprint or other porous paper can also be used. Specimens should be prepared for pressing by removing all soil from roots and judicious pruning of superfluous leaves. Care should be taken not to destroy plant parts necessary for identification. Plants that are longer than a folded half sheet of newspaper should be bent accordion-style (V-, N-, or W-shaped, etc.). Arrange the material as naturally as possible and avoid excessive overlapping of parts. Leaves should be arranged to expose both sides in for a dried, mounted specimen. Spread out inflorescences and flowers to show as many details as possible. Extra flowers and/or fruits should be included where possible, so they can be dissected for verification of the specimen. Parts too bulky for pressing, (e.g. cones or large dried fruits) should be labeled and kept in paper bags. Number the newspaper prominently with the collection number, corresponding to the number in the collection notebook.

6. After the plant is positioned on the folded newspaper, place the newspaper between two felt blotters or driers and then between corrugated cardboard. The blotters should be exchanged every day until the specimen is dry. If an artificial heat source is used for drying blotters are not necessary. A portable plant dryer frame can be constructed from an electrical cord with 4 or 5 sockets and 150 watt light bulbs, hot plate, or kerosene or gas lanterns). For instructions on building a press see Appendix A.

7. The dried specimens should be kept stored in the numbered newspapers until identified and mounted.

8. A label is prepared for each specimen, following identification. The label should be printed on high quality rag paper, 25-100% rag content, to assure labels will not deteriorate with age. The label should be 4 x 2.5 in. or larger. The label contains the following information: scientific name with authority, location, habitat, associated species, notes on plant features, date of collection, and the collector's name with collection number. A sample and blank herbarium labels are located on Appendix B. The sample is printer ready and can be reproduced on any printer.

9. If the specimen is to be mounted, it should be attached to a sheet of 100% rag herbarium paper (11.5 x 16.5 in.?). Mounting paper may be obtained from biological supply house

(as with the corrugates, blotters, and other supplies; see addresses below). The label is attached to the lower right-hand corner of the sheet. The specimen may be attached with linen straps, thread, or glue (such as Elmers or Nicobond B), or a combination of these methods. If glue is used, it is spread in a thin layer over a sheet of glass or Plexiglass (14 x 20 in. or larger) with a paintbrush. The specimen, face up, is placed firmly, but without smearing, on the glue, lifted with forceps, and carefully dropped in the desired position on the mounting paper. A piece of wax paper (12 x 18 in.) is then placed over it and moderately weighted until the glue is completely dry. Twigs and other heavy parts of the specimen should be taped or sewed to the sheet for added reinforcement or glued if feasible.

10. The mounted specimen should be stored in standard genus covers in insect- or dust-proof herbarium cabinets, which are housed in a dry place. The sheets should be protected from insect attack by including a small container of paradichlorobenzene (PDB) in the case or by occasional fumigation (with chemicals by specially trained individuals or by placing the plants in a deep-freezer for several days). The climate throughout much of the west may be sufficiently dry that fumigation is not necessary.

At least one specimen from a site should be sent to a recognized herbarium. It is from these herbaria that plant distribution records are compiled. Most State land grant universities maintain a herbarium or specimens can also be sent to the Rocky Mountain Herbarium, which houses the Forest Service plant collection, at the University of Wyoming in Laramie. The Forest Service contracts with the University of Wyoming for maintenance of the Forest Service collection and to provide assistance with plant identification. To send specimens to the herbarium or for assistance in identification contact:

Ronald L. Hartman, Curator
Or
B. Ernie Nelson, Herbarium Manager

Rocky Mountain Herbarium
P. O. Box 3165 University Station
University of Wyoming
Laramie, WY 82071-3165
(307-766-2236

Additional Sources on Field and Herbarium Techniques:

1. Benson, L, 1979. Plant Classification. Heath and Co., pp. 423-444.
2. Jones, S. B., Jr., and A. E. Luchsinger. 1979. Plant Systematics, McGraw-Hill Book Co., pp. 138-156.
3. Lawrence, G. 1951. Taxonomy of Vascular Plants. Macmillan Co., pp. 234-262.
4. Savile, D. B. O. 1962. Collection and Care of Botanical Specimens. Publ. 1113, Research Branch, Canada Department of Agriculture.
5. Smith, C. E., Jr. 1971. Preparing Herbarium Specimens of Vascular Plants. Agric. Information Bull. 348, USDA, Superintendent of Documents, U. S. Govt. Printing Office, Washington, D. C. 20402 (stock no. 001-000-01159-6).

Collection and Herbarium Supplies:

1. Herbarium Supply Company, 955 West Catching Inlet, Coos Bay, OR 97420; John and Sandy Ayers (503/269-2350)
2. St. Louis Paper and Box Company, P. O. Box 8260, St. Louis, MO 63156; 314/531-7900; 800/444-0891)
3. Carolina Biological Supply Company, Powell Laboratories Division, Gladstone, OR 97027 (503/656-1641; 800/547-1733)

APPENDIX B - PLANT PRESS

Constructing a Field Plant Press

1. A press typically consists of 2 hardwood frames
2. Cut 9 strips of wood as follows:
    a. 4 wood strips, 18" long, ¼" to ¾" wide
    b. 5 wood strips, 12" long, ¼" to ¾" wide
3. The 5 short strips are spaced equally at right angles to the 4 long strips. The strips are nailed, riveted or stapled together at the intersection of the strips. The completed frame should measure 12 x 18 inches.
4. A press can also be made from two (2) 12-x 18-inch pieces of 3/8" or 1/2" plywood. A plywood press is not as durable as one constructed from wood strips.

Plant presses can be purchased from herbarium supply houses or hobby stores. Presses are available in a variety of sizes. Make sure when ordering a press make sure the frame measures 12" x18", the required size for herbarium specimens.

Putting the Press Together

Cardboard Spacers – Corrugated cardboard sheets are used to space specimens, provide stability and aid in drying. Regular, used, cardboard boxes can be cut to the required 12 x 18 inches. Cardboard spacers should be place next to the press frame and scattered through the blotters and specimens. A good rule of thumb is cardboard spacer for every two to five specimens.

Blotters or Driers – Blotters are used to absorb or wick moisture from pressed, drying specimens. Blotters can be made from light weight builder's deadening felt, from heavy blotting paper or can be acquired from any herbarium supply store. The driers should measure 12 x 18 inches. When specimens are air dried, a blotter should be placed between each specimen. For very succulent plants or in wetter environments blotters may have to be changed daily until specimens are dry. For occasional pressing, one may substitute several thicknesses of newspaper for the driers, but care should be taken to change these frequently to avoid mildew and inadequate drying

Specimen sheets - The sheets are used to hold and dry the specimens. Newspaper is the most common material, but blank newsprint or other thin absorbent paper can also be used. Sheets should be 24" x 36" folded lengthwise in half or folded 1/3 from the right 1/3 from the left to join at the middle. The finished folded paper should measure 12 x 18.

The order of materials in a press:

Press
Cardboard
Blotter
Newsprint
Blotter
Cardboard
Press

APPENDIX C – LABELS

The following pages are blank printer ready labels. It is best to print label on a high quality rag paper and cut to 3 x 4 inches. The first set of lined labels is intended for field use or hand lettering. The second set of labels, without lines is intended for entering information on screen and then printing out a completed label.

U.S.D.A Forest Service
Collection Date: 06/23/1998 Number: 125
Collector: Harvey Crankshaw
Scientific Name: *Artemesia ludoviciana* Nuttall
Subsp. *mexicana* (Willdenow) Keck.
Family:
State: CO County: Elevation: 4,500’
Location:
Habitat: Grassland site,

Flower Color: Height:
Comments:

U.S.D.A Forest Service
Collection Date:_____Number:_____
Collector: _____
Genus:_____Species:_____
Subsp./Var.:_____Authority:_____
Family:_____
State:____County:_____Elevation:_____
Location:_____
Habitat: _____
_____
_____
Flower Color:_____Height: _____
Comments: _____
_____
_____

U.S.D.A Forest Service
Collection Date:_____Number:_____
Collector: _____
Genus:_____Species:_____
Subsp./Var.:_____Authority:_____
Family:_____
State:____County:_____Elevation:_____
Location:_____
Habitat: _____
_____
_____
Flower Color:_____Height: _____
Comments: _____
_____
_____

U.S.D.A Forest Service
Collection Date: Number:
Collector:
Scientific Name:

Family:
State: County: Elevation:
Location:
Habitat:

Flower Color: Height:
Comments:

U.S.D.A Forest Service
Collection Date: Number:
Collector:
Scientific Name:

Family:
State: County: Elevation:
Location:
Habitat:

Flower Color: Height:
Comments: