THE ELEMENT DATABASE

Element Selection and Editing

Objectives

The purpose of the element selection process is to identify important elements that are to be considered in Vista planning analyses. Editing elements changes the properties used in these analyses.

Products

A list of elements to be included in planning analyses results from both the element selection and editing processes.

Inputs

Required inputs for the element selection process can include

- A list of biological elements known or expected to occur in the planning region. These may be obtained from many sources, including NatureServe network programs, the U.S. Geological Survey (USGS) Gap Analysis Program, university and natural history museums, and state wildlife or natural resource agencies.
- A list of legally-protected elements that occur in the planning region, obtained from the planner and/or regulatory institution(s).
- A list of other culturally-valued elements that occur in the planning region, obtained from the planner.

Other helpful information for the element selection process includes

- An inventory and description of the data available for each element, such as
    - o Geographic Information Systems (GIS) layers showing locations of occurrence;
    - o Attribute information for occurrences (needed for Conservation Value analyses), specifically viability/ecological integrity and confidence data;
    - o Legal status information (e.g., state/provincial and federal endangerment status);
    - o Vulnerability status information (e.g., NatureServe conservation status, IUCN ranks).
- The budget available for data development, which can include formatting data for the Vista data model, new mapping or field studies, and predicted distribution modeling

- from the planner and/or regulatory institution(s).

For expedited input of element properties, inputs can include

- A single shapefile containing the required set of attributes for all the elements and formatted to fit Vista specifications;
- Elements with associated attributes (excluding spatial data) selected from a NatureServe Web Service database.

Required inputs for the element editing process are

- Element(s) with assigned properties in the Vista project.

Methods Summary

Select Elements

Elements to be included in planning for the area of interest can be identified using several sets of criteria, along with consideration of the available distribution and attribute data for occurrences of each element. For a typical project three groups of elements will be represented on the list, as follows:

Biodiversity surrogate elements: The subset of all elements occurring in the planning region that, if conserved, is expected to adequately conserve all components of biodiversity.

Legally-protected elements: All elements that must be conserved in the planning region in order to meet legal obligations. There may be considerable overlap of these elements with the biodiversity surrogate group, but the legally protected group may also contain elements not necessary or appropriate for a surrogate role.

Other culturally-valued elements: Any other elements that are desired for conservation in the planning region. The culturally valued group may be comprised of any elements that are compatible with other selected elements. That is, if conserved in the same location as biodiversity surrogate or legally-protected elements, they would not interfere with the viability of those elements. Culturally valued elements need not be biological, and could include such features as scenic views, archaeological sites, prime farmland, etc., provided that the intensity of land use associated with these elements does not increase from current conditions.

Note that before actually beginning the process of selecting elements, the planner and database development team should discuss the values, resources, and time available for developing the element information needed for planning analyses. Ideally, planners will want to evaluate and develop a plan that includes the full suite of biodiversity surrogate elements in their region, but it may be preferable in some cases to select a smaller subset of elements (e.g., legally-protected species). Because developing the element information is likely the most expensive and time-consuming part of implementing Vista for planning analyses, the element selection effort must be scaled to the available time and resources. Vista provides two import functions that can be used to expedite the entry of element

properties - importing from shapefiles and from NatureServe Web Services, both of which are described in the final "Input element names into Vista" task listed below.

Edit Elements

The properties of elements that are already included in a Vista project can be modified. The editing process may be used to change the properties for either a single element individually, or for a designated group of elements simultaneously.

Select the appropriate type of edit to see a description of the process.

➡ Edit properties for a single element

➡ Edit properties for a selected group of elements simultaneously

Background

Many conservation methodologies are focused primarily on conserving natural areas, generally designed in the form of core areas and linkages. While the development of natural areas is important to conservation, designing such areas in the planning region without considering the needs of specific elements cannot ensure the conservation of biodiversity or other elements of value. Rather than focusing exclusively on developing patterns of natural areas on the landscape, the methodology utilized in Vista focuses on maintaining the viability of specific elements, which is more of a content approach to conservation. The identification of an adequate number of viable occurrences within the planning region to meet element conservation goals will then result in identification of the most effective areas in the region for conservation.

Biodiversity Surrogate Elements

Biodiversity is a contraction of the term "biological diversity", which refers to the variety of life forms, the ecological roles they perform, and the genetic diversity they contain (Wilson 1988). The complete biodiversity of any specific area is virtually impossible to catalogue due to the multitude of species that are likely to be present. Understanding ecological processes and dependencies among elements in that area adds even greater complexity to the task of fully characterizing biodiversity. Thus, it is impractical, if not impossible, to include all elements within the planning area for use in analyses. It is, therefore, necessary to select a limited set of elements that is representative of all (or nearly all) biological diversity in the region. Through conservation of occurrences of these elements across the planning area, it is hoped that the ecological environments and dynamic interactions that support the vast majority of species are effectively secured.

Biological elements will range in status and distribution from common elements that are widespread throughout the planning region, to rare

elements that are restricted to perhaps a single, small occurrence. In addition, the status of elements in the region may be related to their global status. For example, an element having many occurrences in the planning region may appear to be very common and, thus, of little conservation interest; however, if the global status of that element indicates that it is very rare and may perhaps be endemic to the planning region, it would then be considered to have very high conservation value.

The objective for the selection of biodiversity surrogate elements is to ensure that different levels of biological and ecological organization (specifically ecological systems, communities, species assemblages, and individual species) are represented within the set of selected elements. This approach to biodiversity surrogate selection reflects a "coarse filter/fine filter" hypothesis. Specifically, this hypothesis states that by conserving multiple, high-quality occurrences of all representative ecological system types for a given planning area, the majority of native biodiversity is likely to be supported. However, this "coarse filter" alone would not likely encompass the ecological processes that support <u>all</u> biodiversity, particularly those elements that are rare, and thus not reliably found within most examples of ecological systems. Therefore, additional elements, specifically those that are imperiled or vulnerable, are also needed &endash; in the "fine filter." Experience suggests that this is the most efficient and effective approach to capturing biodiversity in a network of reserves (e.g., Jenkins 1976, 1985; Noss and Cooperider 1994, Groves et al. 2002, Kintsch and Urban 2002). The coarse filter/fine filter approach also helps to minimize complexity and cost associated with strict species-based approaches (e.g., Scott et al 1987, Beissinger and Westphal 1998, Willis and Whittaker 2002) while allowing sufficient flexibility to integrate new approaches as technical hurdles are overcome (e.g., Fleishman et al. 2001, Carroll et al. 2001, Scott et al. 2002).

Applying the coarse filter/fine filter approach to the element selection process, *all* natural/semi-natural ecological systems (described below) that are native to the planning region should typically be included.

Ecological systems are comprised of assemblages of [biotic communities](#) that occupy similar environments and function under common ecological processes.

Terrestrial ecological systems are defined by NatureServe in a standard classification using vegetation structure and composition and various abiotic components, such as soil features, and natural dynamics, such as riverine flow regime or natural fire dynamics. For example, most recurrent assemblages of vegetation are strongly tied to specific landscape features that influence moisture, nutrient, and often disturbance regimes. These landscape features can also constrain, and therefore define, the typical spatial character of associated vegetation. The integration of these biotic and abiotic components is used to define ecological system types. Examples of terrestrial ecological systems include

- California Central Valley Pine-Oak Woodland and Savanna;
- Atlantic Coastal Plain Tidal Swamp;
- Rocky Mountain Dry-mesic Subalpine Spruce-Fir Forest and Woodland.

Aquatic ecological systems are analogous broad-scale units in the aquatic realm. They are based on environmental or physical features that shape key ecosystem processes (hydrology, water chemistry, sediment transport), and that influence the distribution and composition of biological assemblages. Aquatic ecological systems are defined by unique combinations of 1) general physical features (typically stream size, elevation and hydrologic regime); and 2) the broad geographic area (termed an ecological drainage basin) within which the stream occurs. Examples of freshwater aquatic ecological systems include

- Colorado - San Juan Basin: Headwater/creek, montane elevation, intermittent flow;
- Colorado - San Juan Basin: Montane to Sub-alpine Steep Perennial Headwater and Creek on alluvium, colluvium, and sand.

Along with ecological systems, communities (described below) that are vulnerable or imperiled (i.e., that have a [NatureServe global conservation status](#) of G1-G3, or that lack an assigned status but are known by regional experts to be vulnerable) should also be selected using the coarse filter/fine filter approach. Occurrences of these communities typically represent rare environmental settings, and are thus unlikely to be represented solely through conservation of the coarser-scale ecological systems.

Ecological communities are local-scale units that represent assemblages or combinations of species that recur predictably across the landscape in conjunction with relatively local-scale variations in environmental features.

Terrestrial ecological communities (e.g., *associations* from the National Vegetation Classification; see Grossman et al 1998, NatureServe 2002) are defined by similar structural and environmental features, and are nested or grouped into broader ecological systems. Examples of terrestrial communities include

- *Abies lasiocarpa / Juniperus communis* Woodland;
- Foothill Pine-Interior Live Oak/ Wedgeleaf Ceanothus [*Pinus sabiniana-Quercus wislizeni/Ceanothus cuneatus*] Woodland association, which is nested within the more broadly defined California Central Valley Foothill Pine-Oak Woodland and Savanna ecological system.

Aquatic macrohabitats is a term used by NatureServe for units that are analogous to terrestrial plant associations, representing the ecological community scale in the aquatic realm. Aquatic

macrohabitats are units of streams, lakes, and coastal marine environments that are relatively homogeneous with respect to size, and thermal, chemical, and hydrologic regimes. Each macrohabitat type represents a recurring physical setting that is thought to contain distinct biotic communities. Aquatic macrohabitats that share similar environmental and hydrologic-process features are nested or grouped into broader aquatic ecological systems. An example of an aquatic macrohabitat is

- Colorado - San Juan Basin: Montane to Sub-alpine Steep Perennial Headwater and Creek on alluvium.

In addition to ecological elements, vulnerable or imperiled species should be included (as the fine filter) when utilizing the coarse filter/fine filter approach for selecting elements to insure that biological diversity is adequately represented in the planning region.

Vulnerable species assemblages are areas that support aggregations of multiple migratory species (which may not be imperiled) during periods in their life cycle or during their annual migrations, and should be considered in the element selection process. These areas are deserving of special conservation attention to ensure that healthy populations of these several species persist. Examples of mixed species animal assemblages include shorebird migratory concentration areas, colonial wading bird colonies, salmonid migratory corridors, and bat hibernacula.

Species (or subspecies) known to occur within the planning area should be evaluated using several criteria in order to determine which of these elements would best add to the representation of biodiversity in the planning region. These criteria also extend to species known or believed to be extirpated from the planning area, but which have a high potential for re-introduction. Existing data in one or more NatureServe network program databases, along with local expert knowledge, are needed in order to rigorously apply these criteria, described below.

Imperiled and Vulnerable species (or subspecies), designated with a [NatureServe global conservation status](#) of G1-G3 (T1-T3), are recognized by NatureServe as critically imperiled, imperiled, or vulnerable throughout their range and so are at some risk of extinction. These assigned status ranks are regularly reviewed and updated by experts, and take into account the number of occurrences of the element, the viability or integrity of occurrences, population size, range size, area of occupancy, the trends in each of these preceding factors, threats, protection status, intrinsic vulnerability, and environmental specificity (Master et al. 2003). It is worth noting that the categorization of "vulnerable" as used here is substantially more inclusive than that currently applied by the IUCN Red List of Threatened Species, and typically includes taxa in IUCN's lower risk category of "near-threatened" (Mace et al. 1994).

Special Concern species (or subspecies), designated with a NatureServe global conservation status of G4-G5 (T4-T5), are not

considered at risk of extinction, but merit selection if one or more of the following categories is applicable:

Declining species exhibit significant, long- or short-term declines in habitat and/or numbers across their range, and are subject to a high degree of threat such that if the declines continue they would soon be ranked G3 or higher. Determinations of declining G4-G5 species are based on information from sources such as Breeding Bird Survey trends, expert knowledge, and data from NatureServe network programs.

Vulnerable to future decline is used to characterize species that are usually somewhat abundant and may or may not be declining, but have some aspect of their life history that makes them especially vulnerable to future decline. Examples include migratory species that are concentrated in specific areas during their migrations, and species that range, as individuals, over large areas (i.e., regional-scale species) and are vulnerable to habitat fragmentation due to their broad regional landscape requirements.

Endemic species are restricted (either year-round, or in their breeding or nonbreeding season) to a planning area, or nearly restricted (i.e., greater than 90% of the total distribution/range of the element lies within the area), and therefore conservation action within the planning area contributes disproportionately to their persistence.

Widely disjunct is used to characterize species with subpopulations in the planning area that are geographically isolated from other subpopulations (i.e., greater than several hundreds of miles), at distances that are likely to support distinctive genetic character because of the absence, or near absence, of gene flow to other subpopulations.

Keystone species are those whose presence in viable subpopulations have a disproportionate impact on ecological processes, thus affecting habitat requirements for a large proportion of other species. Examples include beaver and prairie dog.

Relationship between Regional Assessments and Sub-Regional Analyses

Actions undertaken to make land use decisions and implement conservation strategies operate at multiple scales (Johnson et al. 1999, Noss 2000). Therefore, regional biodiversity assessments may impact the element selection process at sub-regional scales. For example, several hundred elements may drive a conservation assessment for a given region. Explicit objectives for element representation may then establish a regional vision for conservation that addresses all of those elements. That process may provide appropriate context such that some conservation elements from

that regional list influence element selection for a county within that region. To illustrate, a species may not strictly meet the Special Concern criteria for "endemic" or "widely disjunct" in the context of a particular county, but would easily meet those criteria from the context of the ecoregion(s) that include(s) the county. In such cases, it would be appropriate to select the species for inclusion in the conservation planning analyses for the county. In other circumstances, a particular element may indeed occur within a specific county, but there may be better places &endash; from a regional perspective &endash; to meet conservation objectives for that element. For example, a vulnerable species or common ecological system type may have only poor quality occurrences within the county and have many, much better occurrences in adjacent landscapes outside the county. Thus, there may be elements occurring in the county that meet the selection criteria but, given the broader regional context, are best left off of the biodiversity surrogate selection list. However, such elements, if valued for their presence in the county, could still be included on the other culturally-valued elements list. In each of these cases, it is important to solicit expert knowledge and judgment when evaluating elements, and then fully document the resulting decisions.

Limitations

The initial selection of elements for consideration is a complex task that requires scientific knowledge, but must also incorporate the social values of the planning region. It should not be done hastily without education about the role the planning region plays in conserving some elements, especially the "non-glamorous" species that might otherwise be ignored. Scientific knowledge is also very incomplete, especially when it comes to less-conspicuous elements and the classification of some types of communities and ecosystems. New elements or new range extensions of elements will likely be discovered in the planning region periodically. Therefore, the act of element selection should be considered a dynamic activity that should be revisited frequently. The methods described in this section for selecting the subset of elements should be considered guidelines to be modified by local experts.

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PROCESS FOR SELECTING ELEMENTS

▸Identify biodiversity surrogate elements

Two sets of criteria are used to select elements that will serve as surrogates for biodiversity in planning for the region of interest. Elements should represent multiple levels of ecological organization, varying degrees of rarity, vulnerability, and endemism, as well as multiple geographic scales of habitat/area requirement (see Table 1 criteria below). Elements of biological diversity (i.e., ecological systems, communities, species assemblages, and species) that meet at least one of the criteria in these tables should be placed on the list of selected elements.

Table 1. Core selection criteria for biodiversity surrogate elements

I. **Ecological systems**

    A. **All** natural/semi-natural terrestrial ecological systems (as defined by NatureServe*that are known to occur in the planning area, representing local, intermediate, and coarse scaled types †).

    B. **All** natural/semi-natural aquatic ecological systems (as defined by NatureServe) that are known to occur in the planning area, representing local, intermediate, and coarse scaled types

II. **Ecological communities**

    A. Rare natural/semi-natural terrestrial plant associations with a NatureServe global conservation status of G1-G3‡

    B. Rare natural/semi-natural aquatic macrohabitats with a global status of G1-G3

    C. Vulnerable species assemblages (e.g., areas where concentrations of migratory species occur)

III. **Species** (including infraspecific taxa)

    A. Species with a NatureServe global conservation status of G1-G3; subspecies/varieties with a global status of T1-T3

    B. Species (subspecies) with a global status of G4-G5 (T4-T5), that on the whole are "of concern" by virtue of:

        1. Experiencing significant **decline** across their range

        2. Currently stable, but **vulnerable to future declines**, due for example to their broad regional landscape requirements or to their concentration in particular areas during their migrations

        3. Considered **endemic** to the planning area

        4. Distributed in **widely disjunct** occurrences in the planning area

        5. Considered to be **"keystone"** species

* Available mapped information will be used to depict the standardized ecological system units, minimizing circumstances where nonstandard units are included in Element Value Layers used for Conservation Value analyses

† Geographic scale sensu Poiani et al. 2000, with applications to terrestrial ecological systems is provided in Appendix C.

‡ NatureServe conservation status definitions are provided in Appendix B.

Additional elements that are determined to be important for representing biodiversity in the planning region and for which occurrence information may be available should also be included on the list of selected elements (see Table 2 criteria below). For example, species with a NatureServe conservation status of G4-G5/S1-S3 (i.e., globally secure / subnationally critically imperiled to vulnerable) for which insufficient knowledge exists to determine whether the "declining," "vulnerable," or "disjunct" criteria in Table 1 apply may serve as adequate additional surrogates for biodiversity based on their subnational status.

In some planning regions, community occurrences with a NatureServe conservation status of G4-G5 (i.e., globally secure) may be one of the only sources of community data, including information on attributes of ecological occurrences (e.g., ecological integrity). Because every community can be linked directly to a standard ecological systems classification, occurrences of communities can be linked to comprehensive ecological systems layers for the planning region that utilize such classifications. This may result in high quality occurrence data for a particular community being substituted for that portion of the coverage designated as the corresponding ecological system.

Availability of information on occurrences and the budget for data development can both influence element selection. For example, where detailed maps and ranked occurrences of ecological systems are lacking and the budget is inadequate to produce such information, maps depicting contiguous natural/semi-natural lands may be the only means of depicting ecological diversity. Such maps may be developed through simple means with land use/land cover data, or through more sophisticated methods, for example using the process outlined for landscape integrity layers in the section on creating element distribution layers.

Table 2. Augmented selection criteria for biodiversity surrogate elements

A.	**Species (subspecies)** with a NatureServe global conservation status of G4-G5 (T4-T5),* that on the whole are "of concern" by virtue of their subnational status 1. G4-G5/S1-S3 species
B.	**Communities** with a NatureServe global conservation status of G4-G5 1. G4-G5 community occurrences 2. Contiguous natural/semi-natural lands

* NatureServe conservation status definitions are provided in Appendix B.

▸Identify legally-protected elements

Legally-protected elements should be identified by the planner and regulating institution(s), such as the U.S. Fish and Wildlife Service, National Marine Fisheries Service, state fish and game agency, etc. Legally-protected elements that meet

either of the criteria in Table 3 below should be placed on the list of selected elements. In addition, elements that are not truly protected under the law but are on "priority" or "watch" lists that cause higher scrutiny of conservation plans are typically treated like legally-protected elements.

Table 3. Selection criteria for legally-protected elements

1. Legally listed species, under federal and/or state law

2. Legally designated lands and waters falling under protective status (e.g., designated wetlands, caves, designated steep slopes, designated riparian set-backs, hydrological recharge areas)

The availability and quality of spatial and attribute data for occurrences of legally-protected elements is likely to be better than that of other elements due to the mandated conservation of these elements. Objectives and product requirements for these elements (e.g., documentation and data resulting from planning analyses must be defensible in court) should be established with the end user prior to evaluating the suitability of occurrence data.

▶**Identify other culturally-valued elements**

Other elements can be imported into Vista and analyzed along with the biodiversity surrogate and legally-protected elements, provided that they are compatible with such elements if conserved in the same location together. Examples include:

Biological elements
- Non-threatened species of economic and cultural importance
- "Heritage" trees of specimen size and age

Culturally-significant features
- Archaeological sites
- Historic farms

Other socially-desired features
- Scenic view areas or features
- Prime agricultural areas
- Characteristic natural areas lacking conservation quality for biodiversity or legal protection.

In order for a culturally-valued element to be considered for inclusion on the list of elements evaluated in planning for the region, the element must meet a set of criteria (see Table 4 below). These criteria are designed to ensure that the element has the necessary attributes for conservation planning analyses, and that it is compatible with other biological elements conserved at the same location (i.e., its conservation will not adversely affect any other elements, considering both present conditions as well as future effects of conservation in terms of, for example, site development or visitation of historic features).

Examples of elements that are typically lumped into open or green space conservation, but which may be incompatible with other conservation elements include

- Recreation parks or trail corridors;
- Agricultural lands where intensity of practices may increase in the future (e.g., clearing hedgerows, drainage, pesticide application);
- Intensely managed forestland, shrubland, or grassland;
- Streams or lakes that may be managed in ways that change habitat structure, temperature, chemistry, or that may be stocked with exotic species.

The emphasis for all elements should be conservation of the compatible features themselves. Associated human activities such as recreation, resource extraction, alteration of the natural land cover, etc. should be described as land-uses in scenario evaluation to determine their compatibility with the conservation elements. In this way ”high quality farmland" can be a conservation element but associated agricultural management practices would be land-uses in a scenario to be evaluated for their potential threat to other elements.

Table 4. Selection criteria for other culturally-valued elements

1. Element can be mapped with distinct spatial boundaries

2. Element can be attributed like other biological elements in terms of viability/integrity of occurrences and confidence in presence (not required, but useful for Conservation Value analyses)

3. Element can be weighted in conservation importance relative to other elements

4. Element can have quantitative representation goals

5. Element is compatible with the other biological elements conserved at the same location

▶Inventory and assess available data for selected elements

The selection of elements can be limited by the adequacy of existing data, and the time and budget available to format available data according to the Vista data model, or to develop new data through mapping, field survey, and modeling. Spatial data requirements for elements are described in the Element Distributions section and, for the Conservation Value analyses, required viability/integrity and confidence attribute data are described in detail in their respective sections. The requisite requirements for different analyses may be useful in evaluating whether a particular element should, on the basis of available data and/or data needed, be included on the selected elements list.

The following information is required in order for an element to be included in planning analyses using Vista:

- A geographic information system (GIS) layer of the spatial distribution of the element, in vector format; the resolution and precision of the layer must be appropriate for the planning analyses (e.g., very coarse field

guide range maps will not be suitable for identifying areas to be conserved in a planning project)

If Conservation Value analyses are to be performed, then the following additional attribute information may be needed:

- Information that can be used to determine a value representing the viability/ecological integrity of each occurrence in the distribution layers

- Information that can be used to determine a value representing the confidence of each occurrence in the distribution layers

If Land Use and Conservation Scenario Evaluations are to be performed, no additional attribute information is required. However, the evaluations will be more informative if a minimum required area (if applicable) and conservation goal for the element (e.g., occurrences, or total area of occurrence, in compatible lands) are established.

▶Input element names into Vista

Elements can be entered into Vista immediately following creation of the selected elements list, or entry can be deferred until distribution layers have been developed and attribute values have been assigned (if appropriate) so that all element information can be entered into the system at once (see the Process for Creating Element Distribution Layers). However, it may be helpful to input the list of elements before obtaining and developing element data, essentially creating the element records to which distributions and other information can later be added.

If the decision is made to create element records before obtaining/developing additional element data, see the Vista Element Properties window, specifically the initial data entry steps on the General tab, and optionally the Categories tab, for a description of the process for entering selected elements into Vista.

Expediting the input of element properties

Entry of elements and some of their associated attributes into the Vista Element Properties window can be expedited through use of a function for importing element data directly from:

- A shapefile, or
- NatureServe Web Services.

Import element properties from a shapefile

This function provides the ability for Vista users to import properties for multiple elements from a single shapefile, and is accessed by selecting **Project▶ Import Element Properties from File...** from the Vista menu. In order to utilize this import function, first a shapefile containing attributes for all the elements to be imported must be created. The shapefile must be formatted to fit Vista specifications, which were designed to be easily compatible with Biotics data exports.

Shapefile Specifications

The following fields are mandatory in order to utilize the Vista functionality for importing element properties from a file:

    FID
    Shape
    FEATURE_ID
    EO_ID
    ELCODE
    EO_NUMBER
    SNAME
    SCOMNAME
    DATASENS
    EORANK
    GRANK
    SRANK
    FEDERAL
    SPROT
    LASTOBS
    DESCRIPTIO
    EODATA
    BESTSOURCE
    MANAME
    COUNTY
    EOSIZE_AC
    REP_ACC
    LOC_UNCERT
    QC_STAT
    SYMB
    MAPLABELDS
    MAPLABEL

Note that the values contained in these fields cannot contain # < > / \ | : + * ? and that entries with unique scientific names must also have unique common names.

Once the shapefile containing these attributes for the elements of interest has been created, from the Vista menu select **Project ▶ Import Element Properties from File...** to import the shapefile, and complete data entry on the resulting Element Import Form.

Import element properties from NatureServe Web Services

Entry of elements into the Vista Element Properties window can also be expedited through the use of NatureServe Web Services, which provides data on over 70,000 of the plant and animal species of the U.S. and Canada. The import from

web services function allows Vista users to search the NatureServe Web Services database, select desired elements, and then import the properties for those elements to the Vista project. Note, however, that spatial files will not be imported because of data sensitivity issues.

The import process populates the Vista Element Properties window with following fields for each element created:

> Name
> Default Name
> URL
> Element Type category
> G-Rank category

To access the function select **Project▸ Import Element Properties from Web Service...** from the Vista menu, and then complete data entry on the resulting Vista Element Import window.

Steps in the Element Editing Process

ELEMENT PROPERTIES WINDOW

The **Element Properties - <New>** window is displayed by either clicking the **New...** button on the Element List window or choosing **Selection ▸New Element** from the NatureServe Vista menu while an element is highlighted in the Vista Table of Contents. The new properties window is used to add a new element, along with associated distribution layers and attribute data, to the project for use in analyses.

The Element Properties window consists of four tabs for recording specific types information on elements General, Spatial, Categories, and Compatibility. Depending on the analyses to be performed, different fields may be used, and data input may occur at different times. Specifically, some of the items on the General and Spatial tabs are completed for Conservation Value analyses only, while the Compatibility tab is used strictly for Land Use and Conservation Scenario Evaluations.

Note that the [image] button located next to an item can be used to record additional information related to that item (see the Documentation Window topic for more details).

Add an element:

GENERAL TAB INPUT

1. Specify a name for the element in the **Name** field. Typically this will be the common name used for the element. The **<New>** on the window title will change to the name of the new element as the entry is typed in.

2. Specify another name for the element in the **Alternate Name** field. Provided that the previous Name field contains the common name for the element, this field is generally used for its scientific name.

3. Enter a web address in the **URL** (Uniform Resource Locator) field that provides information related to the element (e.g., NatureServe Explorer).

   The ⌐⌐ button can be used to open an explorer window that goes directly to the URL entered in the field, or if there is no address specified, the explorer default window will open.

4. If the ability to edit the element data should be limited to members of the data development team, place a check in the **Restricted** checkbox.

5. Enter a brief description of the element in the Description field, if desired.

Note: If records are being created for selected elements before additional data has been obtained/developed, data entry for the remaining fields on this tab, as well as for the Spatial tab and Compatibility tab (if needed), can be deferred until distribution layers have been developed for elements (see the process for developing distribution layers), and any attributes have been assigned (see processes for assigning viability/integrity values and confidence values). It may be a more effective use of data entry time to open each element record only once

to enter all of this information at the same time, rather than repeating the process several times to enter each of these items separately.

6. Indicate whether the distribution of the element is represented by area or by distinct occurrences using the appropriate **Area** or **Occurrences** radio button.

7. Indicate whether there is a minimum size required for viability of the element in the checkbox, and if so, enter the **Minimum Size**. This minimum size value is used to exclude occurrences (i.e., 1 occurrence = 1 record in a distribution shapefile) that do not overlap with both a "compatible" land use and a "reliable" policy in Scenario Evaluation analyses, AND that fail to meet the element's condition threshold, from the total to be compared with the minimum size. If the area of the occurrence is less than the designated minimum size, the entire occurrence is not considered to be viable and is excluded from analyses.

8. Indicate whether there is a threshold for condition of the element in the checkbox, and if so, enter a value (ranging from 0.0 to 1.0, low to high threshold, respectively) for **Condition Threshold**. The condition threshold value is used to exclude data to be included in analyses on the basis of failing to meet minimum condition requirements to be considered viable. Condition threshold values specified in this field should result from running models in the system, rather than from element quality data.

9. To close the window and save the data entered in the element record click **OK**; otherwise, click **Cancel**.

SPATIAL TAB INPUT

1. Select the distribution layer for the element from the drop-down menu of the **Distribution Layer** field, or by using the [ArcCatalog icon] ArcCatalog button to browse to the layer. (Layers will be displayed in the drop-down menu only if the layer is the correct feature type and is included on the Display Type tab of the Table of Contents [TOC].) See the Element Distributions section for more details on distribution layers.

2. Enter a value indicating the cell size to be used for conversion. For a discussion of optimal cell size to be used for a planning project, see the Determining Grid Cell Size topic.

    Note: If Land Use and Conservation Scenario Evaluations are to be performed, the grid cell size used to create the visualization layers generated by a Scenario Evaluation is set in this field. If this cell size differs greatly from the cell size specified for the scenario used in the evaluation (set in the Scenario Properties window), the visualization layers may not overlay the scenario correctly.

If Conservation Value analyses are to be performed, data entry for the fields contained in the *Viability/Integrity* and *Confidence in Distribution* group boxes (described in the following steps 3 and 4) can be deferred until values for these attributes have been assigned (see the sections on Viability/Integrity and Confidence for details on these attributes).

3. **If Conservation Value analyses are to be performed**, indicate whether the viability/integrity value is an **attribute of the distribution**

layer for the element, or is represented by a **raster layer** using the appropriate radio button.

If a raster layer is used, select the layer from the drop-down menu associated with the raster layer, or browse to the layer using the ArcCatalog button.

See the Viability/Integrity section for more details on this attribute.

4. I**f Conservation Value analyses are to be performed**, indicate whether the confidence value is an **attribute of the distribution** layer for the element, is represented by a **raster layer**, or will consist of a single assigned value for all occurrences of the element, using the appropriate radio button.

    If a raster layer is used, select the layer from the drop-down menu associated with the raster layer, or browse to the layer using the ArcCatalog button.

    If a single value for confidence is to be used, record that value in the field next to the **Single Value** radio button.

    See the Confidence section for more details on this attribute.

5. Select from the **Map Context** drop-down menu an existing context to be used in creating reports for the element, if any. If a map context needs to be created for the element, see the topic entitled Map Context Properties Window.

6. To close the window and save the data entered in the element record click **OK**; otherwise, click **Cancel**.

CATEGORIES TAB INPUT

Information on Category Systems to which an element belongs can be entered at any time once the element record has been created. Several default categories are provided in Vista, so it may be useful to indicate any of the default categories that apply initially, and then create additional categories and assign elements later as needed for developing Filters, conservation Goal Sets, and Weighting Systems, and performing analyses. To create a new category system, see the Category System Properties window section for details.

1. To specify a category system to which the element belongs, select the Category System from the drop-down list in the upper left of the window. A list of the categories within that system will be displayed below the system name.

2. Select the category to which the element belongs, and then click the **Add** button. The name of the system and category to which the element belongs will be displayed in the right pane of the window.

3. Repeat the system/category selection and add process to specify additional categories as needed.

4. To delete an element from a category system, select the system and category in the right pane and click the **Del** button.

5. To close the window and save the data entered in the element record click **OK**; otherwise, click **Cancel.**

COMPATIBILITY TAB INPUT

An indication of the degree to which implementation of a specific Land-use Intent (LUI) category (described in Appendix F) is compatible with an element - that is, will permit the element to persist - is recorded using this window. More specifically, implementation of compatible LUIs will permit a species to remain viable or an ecological element to maintain ecological integrity. Scenario Evaluations, used to assess element compatibility with various land use scenarios in terms of meeting conservation goals, are dependent upon these compatibility assignments for accurate results, so it is strongly recommended that only experts on the element assign compatibility. Any decisions related to

compatibility should be recorded (using the [icon] button to access the associated Documentation Window) to allow peer review and/ or legal review.

For more details on compatibility, see the Land Use and Conservation Scenario Evaluations section.

1. **If Land Use and Conservation Scenario Evaluations are to be performed**, indicate the degree to which the element is compatible with each of the NatureServe Vista LUI categories by clicking on the LUI to be assigned, and selecting the appropriate compatibility response from the list in the column to the right.

Assigning a response value to a major LUI category (e.g., "Maintain Primarily for Natural Values") will cause the system to automatically assign the entire category the same value (i.e., both the major category name and all of its associated child [minor] categories). However, assigning a compatibility response for a minor category LUI (e.g., "Biodiversity conservation") will not cause any other items in the category to be automatically designated.

2. To edit or add a new value to the list of compatibility responses, click the **Responses...** button to open the Compatibility List window.

3. To close the window and save the data entered in the element record click **OK**; otherwise, click **Cancel**.

Edit Element Information:

Element properties can be edited either individually, or for multiple elements simultaneously, as described below.

Edit an individual element:

1. Navigate to the Element Properties window populated with existing data for the element by either right-clicking the element name in the NatureServe Vista table of contents and selecting **Element Properties..**. from the resulting menu, or by clicking **Manage Elements...** from the Vista menu, selecting the element in the Element List window that opens, and clicking the **Properties...** button. The resulting properties window displays data for the element.

2. Edit element properties data using the processes described above for adding an element as guidelines. More detailed descriptions of elements and related data can be found in the Element Selection, Element Distributions, Viability/Integrity Attributes, and Confidence Attributes sections.

3. To close the window and save any changes made to the element record click **OK**; otherwise, click **Cancel**.

Edit multiple elements:

1. Click **Manage Elements...** from the Vista menu to open the Element List window, and click the **Edit Multiple...** button to set property values for a designated set of elements simultaneously. See the Multi-Element Property Edit window for details on the process for editing properties for a group of elements.

Developing Distributions

ELEMENT DISTRIBUTIONS

 Objectives

The purpose of the element distribution process is to create a Geographic Information Systems (GIS) layer for each selected element that depicts its spatial distribution within the planning region.

Products

Vector GIS layers that indicate the distribution of each selected element result from the element distribution process.

Inputs

The element distribution process requires the input of vector layers that show occurrences of elements. The Sources of Element Distribution Data section provides information on where these data may be obtained.

Methods Summary

The distribution for a selected element in Vista can be indicated by pointing to a distribution layer obtained and/or developed for that element. Note that, depending on the data available for the selected elements, some of the tasks listed as components of the process for developing distribution layers may not be necessary or appropriate. Note also that this section describes the primary tasks of evaluating existing data and developing new distribution data. There are disciplines and literature focused on the various techniques used to collect, record, map, and model distribution information; therefore, the process described for developing distribution layers does not attempt to address that level of detail. When such knowledge is required, the database development team should be able to provide or access such expertise.

Select a task below to see a detailed description of the process.

Background

An element distribution depicts the individual or multiple incidences of elements that are of conservation interest in a specific planning area. The distribution is made up of mapping units that form the basis for the conservation plan. These may include selected elements of biodiversity, such as populations, communities, or ecological systems. They may also include other elements or features of local interest.

NatureServe and the network of natural heritage programs utilize standard methodology for recording the occurrence of biodiversity elements (Stein and Davis 2000). Element occurrence records delineate the boundaries of a

population, habitat, or ecological classification unit as they have been observed in the field. Representing an element occurrence on a map facilitates the evaluation of associations between the occurrence and other mapped features (e.g., habitat, watershed, counties, observations, or other occurrences). Four key characteristics of NatureServe element occurrence representations are 1) they are polygons (rather than points); 2) they incorporate locational uncertainty; 3) they are developed from source features, each of which corresponds to a discrete observed area based on survey information (i.e., an observation); and 4) they can be comprised of multiple source features.

NatureServe methodology facilitates the development of occurrences that reflect the diverse, often complex ways that elements of biodiversity actually occur on the landscape. For example, occurrences of different elements generally overlap and frequently share boundaries (such as the shoreline of a lake). An occurrence of a single element can contain voids (i.e., holes indicating areas that are not part of the occurrence), be comprised of multiple separate areas/patches, and include different types of contiguous areas (e.g., an occurrence that includes both a stream and pond).

The boundaries of an occurrence are delineated to reflect only what has been actually observed during field surveys, confirmed from remotely sensed data, or derived from historical accounts. Despite the possibilities presented by detailed topographic base maps, occurrences are generally not mapped to include appropriate but un-surveyed nearby areas. Many factors may affect the quality and reliability of locational data for an occurrence, including survey techniques and any equipment used (e.g., GPS unit, U.S. Geological Survey topographic quadrangle map). Therefore, in some cases it may not be possible to pinpoint the actual location at which an observation was seen on a map. In other words, some uncertainty is associated with the mapped representation of that location.

In most planning efforts, NatureServe element occurrence data will be augmented by other mapped information to fully represent features of interest. Mapped features might be represented as discrete points, lines, or polygons. In many instances, a comprehensive land cover map will be integral to representing communities, ecological systems, and other land cover. Planners should evaluate each of these 'r;non-standard' forms of distribution information in light of the standards established by NatureServe for representing elements of biodiversity.

Limitations

Note that element distribution data will rarely satisfy all criteria for completeness, accuracy, currency, and/or precision. Therefore, the user must evaluate which criteria need to be met in order for distribution data to be categorized as acceptable for use in the analysis. (See the Confidence

section for further details on confirmation types and levels of confidence associated with Conservation Value analyses).

References

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APPENDIX D: Sources of Element Distribution Data

There are many sources of data that provide information on the distribution of different elements. The lists of sources below (grouped by categories of elements discussed in the Element Selection section) are by no means exhaustive. The database development team should be familiar with the best sources of data available for the planning region.

Biodiversity Surrogate Elements

Ecological systems and communities data sources:

Note that in many cases, ecological data from different sources can be combined to form a hybrid map, such as using a more recent coarse land cover map to mask out recently converted areas of natural systems.

- NatureServe, which is actively mapping terrestrial ecological systems across the United States and adjacent regions
- The Nature Conservancy
- National Land Cover Database
- USGS Gap Analysis Program
- USDA Forest Service Landfire Program

- NOAA coastal change mapping program
- State mapping programs
- Local government or watershed programs
- Academic mapping projects

Rare elements data sources:

- NatureServe network program Element Occurrence data

  [Element Occurrence](#) (EO) records developed by NatureServe network programs found in each U.S. state, Canadian province, and in several Latin American countries, are a primary source for information on rare elements. NatureServe programs utilize a standard methodology for recording data on occurrences that includes a number of quality control steps to ensure accuracy of the information. Over the last several years, this methodology has been updated and thoroughly reviewed, with programs moving to a new software that utilizes the revised methodology and includes a Geographic Information Systems (GIS) component for recording EO locational information. See http://whiteoak.natureserve.org/eodraft/index.htm for details on the revised EO Data Standard. Other nations and their subnational divisions also maintain databases on rare elements.

- Natural history museum records
- Observations recorded by taxon-specific societies, such as the Native Plant Society
- Academia

Sources for data on other species:

- State agencies such as fish and game, natural resources, wildlife and parks
- Breeding Bird Survey
- USGS Gap Analysis Program predicted distribution maps
- Academia

Legally-protected Elements

- U.S. Fish and Wildlife Service
- Areas or features of natural hazard that are of conservation interest (e.g., flood plains, steep slopes), often regulated and mapped by state/provincial or federal agencies
- Many of the sources listed in the Biodiversity Surrogate section above are also sources of data for legally-protected biological elements

Other Culturally-valued Elements

Note that data sources for other culturally-valued elements will be primarily state/provincial and local in origin.

- Areas or features of natural hazard that are of conservation interest (e.g., flood plains, steep slopes) that are not already regulated as

legally-protected elements are often mapped by state/provincial or federal agencies

- Prime farmland, often mapped by divisions of the U.S. Department of Agriculture, state agriculture agencies, local governments or land trusts, and academia

- Archaeological sites on private or state/provincial and local public lands, mapped by state/provincial agencies or academia

- Historic sites, mapped by local government and academia

- Scenic views, although often not mapped, are sometimes inventoried by local governments; these scenic areas can be mapped using GIS tools

Steps in the Distribution Development Process

PROCESS FOR DEVELOPING ELEMENT DISTRIBUTIONS

▶Obtain spatial data for selected elements

Using the list of selected elements, obtain and evaluate existing spatial data on distributions of the elements. Distribution layers that identify occurrences of elements must be in vector format. If point data has been used to represent occurrences in the layers, the points will need to be buffered to polygons using a distance that represents associated locational uncertainty, precision, or for some animal species, minimum spatial requirements (i.e., Inferred Extent [IE]). See the Develop distribution layers needed task for details on creating polygon distributions from existing point occurrences.

Likely types of distribution data (grouped by type of selected element) follow. For a more complete list of potential sources of this data, see Appendix D. The Sources of Element Distribution Data section provides more complete information on where these data may be obtained.

Biodiversity surrogate elements:

Rare elements distribution sources: Point observations (vector), field-mapped habitat features (vector), or aerial photograph mapped habitat features (vector).

Ecological systems and communities distribution sources: Land cover maps, usually derived from interpreted satellite imagery (raster), or aerial photographs (vector).

Other species: predicted distribution maps created from GIS modeling procedures (raster).

Legally-protected elements: These usually overlap with "rare elements" (described above) but, because of their status are somewhat more likely to have recent, more detailed maps of their known distribution.

Other culturally-valued elements: This is a broad category, so the distribution information will vary and tend to be local in origin. Thus, the data may be

more current than that of other element types, and is likely to be mapped from detailed aerial photographs or field-mapped.

▶Reproject data if necessary

In order to process existing element distribution data, all of the GIS layers must be in the same projection.

Reprojecting data is a basic GIS task that is performed outside of the Vista application. For guidance on performing this task, see the help for the Environmental Systems Research Institute (ESRI) application being used to develop the element distribution layers (e.g., Arc9). To browse or search the contents of the help:

1. From the Help menu, choose Help Topics.
2. Choose a tab.

    - The Contents tab shows a list of topics that can be browsed through.
    - The Index tab provides the ability to search an index of help topics.
    - The Find tab provides the ability to search for a particular word in all of the help topics.

▶Merge data into one layer

In order to permit a number of element distributions to be processed together (instead of repeating the same processes for each layer separately), distribution data for all elements can be merged into a single layer.

Merging data is a basic GIS task that is performed outside of the Vista application. For guidance on performing this task, see the help for the Environmental Systems Research Institute (ESRI) application being used to develop the element distribution layers (e.g., Arc9). To browse or search the contents of the help:

1. From the Help menu, choose Help Topics.
2. Choose a tab.

    - The Contents tab shows a list of topics that can be browsed through.
    - The Index tab provides the ability to search an index of help topics.
    - The Find tab provides the ability to search for a particular word in all of the help topics.

▶Filter out any elements that are not on the selected elements list

Existing distribution data may contain data on both selected elements as well as other elements that were not determined to be of interest for the analyses.

Before continuing the process of developing distributions, these additional elements should be removed.

Applying filters to data is a basic GIS task that is performed outside of the Vista application. For guidance on performing this task, see the help for the Environmental Systems Research Institute (ESRI) application being used to develop the element distribution layers (e.g., Arc9). To browse or search the contents of the help:

1. From the Help menu, choose Help Topics.

2. Choose a tab.

-   The Contents tab shows a list of topics that can be browsed through.

-   The Index tab provides the ability to search an index of help topics.

-   The Find tab provides the ability to search for a particular word in all of the help topics.

▶**Evaluate data and update if needed**

Before using existing element distribution data, it must be evaluated for completeness, currency, accuracy, and precision, as described below. Note that no distribution data is likely to satisfy all of these criteria. Further, evaluation of data using these criteria is subjective, and can be influenced by both its intended use and the data quality requirements of the end user.

Completeness is the degree to which distribution data represents all of the occurrences believed to exist by local experts; most existing databases of observed or mapped distributions are considered to be very incomplete and biased. Predictive distribution modeling by experts is frequently used to overcome these problems, but often over-predict element distributions at the expense of precision.

Completeness can be assessed by comparing a distribution layer developed from remotely sensed data or modeling with field observation records, and calculating the proportion of known observations not found in the distribution layer.

Currency indicates how recently the distribution data was created or updated. If the data is routinely updated, it is important to know how much of it is updated each cycle. The relative importance of data currency is a direct result of the pace at which land use and land cover in the planning region are changing.

Currency can be assessed using the date of the field survey or, if mapped or modeled, the date of any remotely-sensed imagery (satellite or aerial photos), or the date of any other data used in modeling.

Accuracy represents both locational accuracy (i.e., whether the mapped location of an element occurrence reflects the actual location where it was observed on the ground), as well as presence - whether the element truly occurs at the mapped location.

See the [Confidence](#) section for more detailed information on accuracy.

Precision is the degree to which a distribution is complete without depicting the element in locations where it does not actually occur.

True measures of precision are nearly impossible to obtain because they would require perfect information. Often, expert review of distribution layers can provide a qualitative sense of the precision of the data.

The task of evaluating distribution data can be best approached by striking a balance between the set of elements and quality of the data to be included in an analysis. For example, if robust representation of biodiversity surrogate elements is deemed important for planning in the region, data quality must frequently be compromised somewhat in order to retain a sufficient number and variety of such elements. Further, different criteria for evaluating each characteristic can be set for each type of [selected element](#). For example, the criteria for legally protected elements may be much more stringent than that for culturally-valued elements.

Following the evaluation process, records for selected elements that have acceptable data can be pointed to the appropriate distribution layers without further processing (see [Point to Distribution Layers from the Vista Application](#) for details on this procedure). Unacceptable layers should be characterized by the nature of the problem, along with a description of the required action(s) that would result in acceptable data for the element. For example:

- Distribution lacking. *Action:* Create a new distribution using predictive modeling.
- Distribution not current. *Action:* Update using current layers of [converted areas](#).
- Distribution incomplete. *Action:* Update with supplemental field mapping or aerial photo interpretation.
- Distribution imprecise. *Action:* Mask out areas believed to be unsuitable with current layers of converted areas, filter using minimum size, etc.

▶**Remove unacceptable data**

Based on evaluation of element distribution data according to completeness, currency, accuracy, and precision, any that are determined to be unacceptable should be removed (e.g., historical distributions, extinct elements).

Removing distribution data involves basic GIS tasks that are performed outside of the Vista application. For guidance on performing these tasks, see the help for the Environmental Systems Research Institute (ESRI) application being used to develop the element distribution layers (e.g., Arc9). To browse or search the contents of the help:

1. From the Help menu, choose Help Topics.
2. Choose a tab.

- The Contents tab shows a list of topics that can be browsed through.
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▶Develop distribution layers needed, given time and budget constraints

In cases when existing distribution layers are deemed unacceptable for use in analyses, there are a number of different methods available for either updating or creating completely new distribution layers for elements.

The process of developing distribution layers is necessarily an iterative process associated with element selection, balancing the cost of updating or creating new layers with the needs of the project. Having the planner indicate the importance of each selected element may be a useful means for initially determining the distribution layers needed for analysis (i.e., layers for the highest priority elements), as well as the resources to be allocated for updating/creating the layers. However, whether an update or new creation is more appropriate for a particular distribution layer (based on the existing data), and the methods to be used to generate that layer, are decisions best made by experts.

Brief descriptions of some of the methods for updating and creating distributions are provided below.

▶Update existing distribution layers

- Intersect new layers of converted land (e.g., agriculture, development) with the existing distribution layer and mask out areas that are unsuitable for the element.
- Use satellite imagery to detect conversion and/or succession of habitat/landscape to different types; areas of change can be used to update the existing distribution layer.
- Add new field observations or revisit areas to obtain more current data, and update the existing distribution layer(s) accordingly.
- Revise an existing modeled distribution by applying a minimum required area filter, which removes occurrences that are too small to be viable.
- Buffer NatureServe point EOs, typically created using heritage methodology that preceded the methodology currently in use, by applying custom uncertainty distance buffers based on associated precision values (shown below).

NatureServe Precision value (legacy data)	Buffer distance for Precision (in meters)
S = seconds (location mappable within a three-second radius)	100
M = minutes (location mappable with ~2 km or 1.5 mi. radius)	2400
G = general (location mappable with ~8 km or 5 mi. radius)	8000

The resulting circular polygons should be processed into 'standard' NatureServe EOs following NatureServe's current heritage methodology (see the Element Occurrence Data Standard, found at http://whiteoak.natureserve.org/eodraft/index.htm) by applying separation criteria found in the EO specifications for the element. The primary intent of EO specifications is to ensure, through the provision of standard guidance for a species or community type, that occurrences are delineated so that they reflect populations or communities of populations, and that they are consistently defined and mapped. This is accomplished by 1) providing criteria that describe barriers restricting movement and/or dispersal of species elements, or limiting expansion and/or altering function for ecological communities; and 2) specifying practical separation distances across suitable and unsuitable habitat for species, or across intervening areas of different natural/semi-natural communities and cultural vegetation for communities.

▸**Create new distribution layers**

- Field map Element Occurrences (EOs) following NatureServe's heritage methodology (described above), which is well developed and has been peer-reviewed. This is the most direct method for creating a distribution, but it can also be the most expensive, depending on the area of distribution and how easily the element is detected (e.g., some species may require repeated site visits and trapping to confirm presence). Elements most suited to this approach are those having a very limited distribution with known geographic limits, but for which specific locations for occurrences need to be confirmed, and for which presence can be easily detected by direct observation.

- Process nonstandard occurrence information into 'standard' NatureServe EOs, if possible, by applying separation criteria found in the EO specifications for the element. Using this approach to developing distribution layers may be particularly useful if viability/integrity and confidence attributes for occurrences are to be assigned for use in Conservation Value analyses.

- Interpret data from remote sensing techniques (e.g., satellite imagery, aerial photography) to create an element distribution; these techniques are well developed, and often combined with Geographic Information Systems (GIS) modeling. The potential complexity and expense of this

approach are affected by the size of the distribution area, the number of elements, and the difficulty in detecting the elements in the remotely sensed data.

Typically, this process involves initially obtaining sample field observations, using them to train an interpreter to consistently identify or classify these features in remotely sensed data, and then verifying the work through follow-up field visits. The field surveys - collecting the initial field observations and verifying the interpretation through additional field visits - are frequently the most expensive aspects of this approach.

- Model the predicted distribution using GIS and statistical techniques. While very rare elements have traditionally been difficult to model, this technique is well suited for types of elements that have associations to specific biogeophysical characteristics, and/or which are difficult to detect or map directly. Such types of elements include

  - Elements that have very strong associations to one or more environmental variables for which good distribution data exist (e.g., climate, elevation, aspect, land cover types, aquatic features); distributions of the biogeophysical features can be used as surrogates for the elements' distributions.

  - Elements that have broad distributions, but known limiting factors that can be mapped. Such element distributions may be broad because either the element is dominant in the planning area (e.g., grasslands in the Great Plains), or the element is associated with a broad group of variables (e.g., occupies both forest and grasslands; both streams and lakes). Known and mappable limiting factors can include elevation limits, specific land cover types, and soil types.

▶Split data into separate layers by element

Any distribution data that was merged into a single layer to facilitate processing must now be divided into separate layers by element so that the record for each element can be pointed to a single layer containing the distribution for that element alone.

Separating distribution layers involves basic GIS tasks that are performed outside of the Vista application. For guidance on performing these tasks, see the help for the Environmental Systems Research Institute (ESRI) application being used to develop the element distribution layers (e.g., Arc9). To browse or search the contents of the help:

1. From the Help menu, choose Help Topics.
2. Choose a tab.

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   - The Find tab provides the ability to search for a particular word in all of the help topics.

▶Reconcile overlapping features in distribution layers

Evaluate each element distribution layer to identify any features that overlap. Edit these features as needed to ensure that overlapping areas will 'belong' to only a single occurrence. If overlap is not reconciled, Element Conservation Value (ECV) rasters developed for use in Conservation Value analyses will include only one feature out of each group that overlaps.

▶Divide distributions comprised of a single area

Element distributions should not be represented in NatureServe Vista by a single attribute table record. In cases when an element distribution layer consists of a single area, that sole "occurrence" must be divided into separate "occurrence" units. Dividing such an area into smaller sections insures that analyses utilize just that portion of the element's distribution defined by spatial filters and/or conservation goal sets.

▶Document products with metadata

The final products of this process are vector element distribution layers. Metadata should document source data used to develop the distributions, methods used to reproject the data, filters applied to the data, and the rationale used for assessing whether the source data was acceptable.

Vista automates the process of producing metadata that is compliant with the Federal Geographic Data Committee (FGDC) metadata standards. See http://www.fgdc.gov for more details on metadata standards.

▶Point Vista to the distribution layers

If elements have not yet been entered into the Vista application, see the Input Element Names process for guidance on how to do this.

Once an element exists in Vista (i.e., a record has been created by using the Element Properties - <New> window), bring up the properties window for that element by selecting it from the **Element List** window and clicking the **Properties...** button. Use the resulting Vista Element Properties window (specifically portions of the Spatial tab) to associate the distribution layer with the element.

Data for the element can also be entered on the Categories tab of the window during this process, and if Land Use and Conservation Scenario Evaluations are to be performed, it may be most efficient to enter data on the Compatibility tab during this process as well.

VIABILITY/INTEGRITY ATTRIBUTES

Objectives

The purpose of the viability/ecological integrity process is to assign a specific value (ranging from 0.0 to 1.0) for each occurrence of an element that suggests the likelihood that, if current conditions prevail, the occurrence will persist. These values can be used in Conservation Value analyses to identify areas with high conservation value that can support elements with occurrences of high viability/integrity, and areas of impaired condition that cannot.

Products

The viability/ecological integrity attribute can be expressed in either of two products, as follows:

- Values stored in a column in a vector distribution theme that indicate the likelihood of persistence for each associated occurrence.
- Values assigned to occurrences of elements based on separate raster themes having cell values that denote the viability/ecological integrity of occurrences in corresponding locations of the vector distribution layer. Examples of raster themes include landscape integrity layers and/or modeled distributions.

Inputs

Viability/ecological integrity values can be input two ways:

- As an attribute of a vector distribution theme, used when a viability/integrity value is assigned for each individual occurrence polygon. Viability/integrity values range between 0.0 and 1.0, and can be based on several indicators of an element's likelihood of persisting at a particular location over time, such as NatureServe Element Occurrence (EO) ranks.
- As a raster layer with a 0.0 to 1.0 viability/integrity value assigned to each individual grid cell, as in a modeled distribution of an element.

Methods Summary

Relevant viability/ecological integrity data or surrogate landscape integrity raster themes (combined, in some cases, with values for minimum required area) are used to assign values between 0-1.0 that suggest the likelihood that, if current conditions prevail, occurrences will persist. Depending on the data available for elements, some of the tasks listed as components of the process for assigning these values may not be necessary or appropriate. Note that viability/integrity values associated with distribution maps are currently used only in Conservation Value analyses.

While element viability/integrity values provide for a more robust analysis, they may be very difficult and/or time consuming to determine. In the case of some elements, they may be unnecessary to apply. For example, viability/integrity values wouldn't likely have meaning in the case of designated priority zones (priority conservation or wildlife areas), cultural features, protected areas, etc. In the case where viability/integrity in not applicable or difficult to ascertain, constant values (0.5 for example) can be applied equally to elements to fulfill this requirement.

Background

The viability or ecological integrity of an occurrence is based on assumptions about the key ecological attributes that are thought to support the element on-site, and the degree to which these factors occur within expected ranges of natural variation. For example, a particular fire-adapted montane grassland type may naturally occur in patches that range from 500-2,500 acres. It may be assumed to experience patchy natural wildfires as frequently as every 5-25 years, with burned patches that encompass as much as 40-80% of the occurrences. When fire frequency and spatial character fall outside of these ranges there may be correlated signs of degradation visible, such as changes in native species composition and vegetation structure.

Viability or ecological integrity at an occurrence level addresses ecological resilience, that is, the ability and/or likelihood for the species, community, or ecological system to persist in a particular location. Resilience also includes the presence of resources required by the element in sufficient quantity and quality for populations to persist, but also within acceptable levels (e.g., nutrient concentrations not reaching toxic levels). Occurrences with high viability or ecological integrity may retain ecological attributes that can be difficult or impossible to restore through management, so the viability/integrity of the occurrence adds a significant dimension to gauging the relative irreplaceability of the occurrence.

Two principle types of information can be used to indicate the relative viability or ecological integrity of occurrences. If element data consists of NatureServe network Element Occurrences (EOs) and viability/ integrity criteria have been developed and applied according to standard EO rank

specifications, the resulting EO ranks can be relied upon to reflect the likelihood of occurrences persisting. The criteria provided in rank specifications integrate ecological factors in subcategories of size, condition, and landscape context, as appropriate for the element type, to derive an occurrence rank.

In most instances where EO ranks are unavailable, occurrences can be processed in combination with ecological integrity layers, and in some instances, occurrence size ranks, to provide an indirect measure of occurrence viability or ecological integrity.

Limitations

The methods described here for attributing viability or ecological integrity are meant to provide a measure that indicates whether occurrences have relatively high or low viability/integrity to be used in Conservation Value analyses. This process is not a substitute for population viability analysis (PVA) or field surveys to determine probabilities of population persistence or actual ecological quality of occurrences. The user should establish criteria that define 0.0-1.0 viability/integrity values; they may be used as relative values (as suggested in this section), or defined as probabilities of persistence calculated from a PVA.

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Steps in the Viability/Integrity Assignment Process

PROCESS FOR DERIVING VIABILITY/INTEGRITY VALUES

▸**Evaluate available attribute data for element occurrences**

Data on occurrences of elements must be evaluated to determine which have attributes that can be considered indicative of viability (species) or ecological integrity (ecological communities/systems), and which occurrences will need additional work to determine appropriate viability/integrity values.

Attribute information for occurrence viability and ecological integrity may be obtained directly from NatureServe heritage program databases. Using NatureServe heritage methodology, network programs track data for 'standard' Element Occurrences (EOs), including assessments of the viability/integrity of occurrences as EO ranks, which are assigned by applying EO rank specifications to field data. In such cases, the EO ranks can be evaluated and possibly updated by the data development team, and then numeric values assigned for A, B, C, or D ranks for use in Vista Conservation Value analyses.

Determining viability/integrity values for 'nonstandard' occurrence data (e.g., 'modeled' habitat, mapped polygons from remotely sensed data, contiguous landscape areas), as well as for 'standard' NatureServe occurrences with an assigned EO rank other than A, B, C, or D (e.g., E, H, F, X) can involve developing landscape integrity values and, as appropriate, size ranks which can be utilized for such occurrences.

PROCESS FOR DERIVING VIABILITY/INTEGRITY VALUES

▸**Create columns for viability/ecological integrity attributes**

Assigned and calculated values for viability/ecological integrity - that is, values for EO rank equivalent values, landscape integrity values, and size values, as well as the finalized viability/integrity confidence value - must be stored in columns associated with the element distribution layers (in vector format). Four columns should be created for each element distribution layer for recording these attributes.

Creating columns for storing associated attribute data is a basic GIS task that is performed outside of the Vista application. For guidance on performing this task, see the help for the Environmental Systems Research Institute (ESRI) application being used to develop the element distribution layers (e.g., Arc9). To browse or search the contents of the help:

1. From the Help menu, choose Help Topics.
2. Choose a tab.
   - The Contents tab shows a list of topics that can be browsed through.
   - The Index tab provides the ability to search an index of help topics.

- The Find tab provides the ability to search for a particular word in all of the help topics.

▶**Transform attribute values for 'standard' NatureServe EOs into viability/integrity values**

Element data in the form of 'standard' NatureServe network Element Occurrences (EOs) typically have assigned EO ranks that indicate the estimated viability or ecological integrity of these occurrences.

▶*Convert EO rank values*

In cases when the assigned EO rank is an A, B, C, or D, then standard conversions can be applied that translate these ranks into the appropriate viability/ecological integrity values. The recommended EO rank conversions to viability/integrity values (ranging between 0.0 and 0.9) are as follows:

EO Rank	Equivalent Viability/Integrity Value
A	0.9
B	0.8
C	0.6
D	0.3

Recommended EO rank viability/integrity conversion values.

▶*Record values in column of element distribution layers*

If viability/integrity values have been determined on the basis of EO rank for occurrences of the element, populate the appropriate column in the associated distribution layer.

Determining viability/integrity values for NatureServe EOs with assigned ranks other than A, B, C, or D (including E, F, H, and X-ranked EOs), or those without an assigned EO rank can involve developing landscape integrity values and, as appropriate, size ranks; these can then be used to assign surrogate viability/integrity values. The process for assigning size values and landscape integrity maps/values is described in the steps that follow.

▶**Process 'nonstandard' occurrence data to assign viability/integrity values**

'Nonstandard' element data (i.e., occurrences developed using processes other than those embodied in NatureServe heritage methodology) can result from such processes as habitat modeling, mapping from remotely sensed data, and contiguous landscape areas. These 'nonstandard' data may be utilized in Conservation Value analyses.

▸Process into 'standard' EOs

For some 'nonstandard' data it may be possible to apply criteria found in the EO specifications for the element to that data (see the Develop Distribution Layers task for details). In such cases, the data is essentially processed into 'standard' NatureServe Element Occurrences (EOs) by applying separation criteria, and EO ranks could then be assigned using EO rank specifications developed for the element. Any occurrence with an A, B, C, or D rank can then be translated to a viability/integrity value as described in the preceding process step.

▸Record values in column of element distribution layers

If viability/integrity values have been determined on the basis of EO rank for occurrences, populate the appropriate column in the associated distribution layer.

New 'standard' occurrences that cannot be assigned an A, B, C, or D EO rank should, if possible, be evaluated in terms of size (generally used for ecological elements) and/or landscape integrity, as described in the following process steps.

▸Determine size values for occurrences if needed to assign viability/integrity values

Occurrences of ecological elements that cannot be assigned an A, B, C, or D Element Occurrence (EO) rank should, if possible, be evaluated in terms of size. The size factor is based on the area of surrounding suitable habitat needed for the survival of sensitive species populations within the community or ecosystem EO (e.g., the need for undisturbed area surrounding a nest site), and/or the area needed to allow for continuation of the natural dynamic processes essential for supporting that community or ecosystem occurrence (e.g., disturbance by fire or wind). When relevant for an ecological element, the EO rank specifications provide a range of sizes (in the A through D criteria) that can be used to assign a size value.

▸Calculate the area of occurrences and compare with size in EO rank specs

To assign a size value, calculations must be made to determine the area of an occurrence of an ecological element, which can then be evaluated using

the criteria in the EO rank specifications for the element. Any occurrences that meet the criteria for an A, B, C, or D size can be assigned a size value.

▸*Convert size values to numeric equivalents*

Standard conversions to be used for converting assigned size values of A, B, C, or D to numeric equivalents (ranging between 0.0 and 0.9) are as follows:

Size Rank	Numerical Value
A	0.9
B	0.8
C	0.6
D	0.3

Recommended size conversion values.

▸*Record values in column of element distribution layers*

If numeric equivalent values have been determined on the basis of size for ecological occurrences, populate the appropriate column in the associated distribution layer.

The numeric equivalents for size can be used along with landscape integrity values to determine a surrogate ecological integrity value for community occurrence data, either 'nonstandard' data that cannot be translated into 'standard' NatureServe EOs or 'standard' EOs lacking an A, B, C, or D EO rank. Note that 'nonstandard' data that cannot be developed into 'standard' occurrences is primarily the case for ecological elements. The processes for developing landscape integrity maps/values are described in the four tasks that follow.

▸**Determine the stratification for landscape integrity raster(s)**

'Nonstandard' occurrence data that cannot be translated into 'standard' NatureServe Element Occurrences (EOs), or 'standard' EOs that lack an A, B, C, or D EO rank, require an assessment of landscape integrity in order to assign surrogate viability/integrity values.

The process of developing raster maps used to characterize landscape integrity involves two major considerations:

- What uses of land or water are known to significantly impact the viability/ecological integrity of these elements?
- What data are available that provide specific locations of those land and/or water uses in the planning region?

Generally, if the planning problem involves terrestrial ecosystems (uplands and wetlands) and aquatic ecosystems (either freshwater or coastal marine), creation of at least two landscape integrity rasters, one for each ecosystem (terrestrial and aquatic) should be considered. Additional landscape integrity rasters may be developed for certain subsets of elements, as appropriate (e.g., ’forest interior' birds, animals, wetlands, nonvascular plants, terrestrial species) or for individual elements alone.

▶Determine the area(s) to be mapped for landscape integrity

When developing landscape integrity rasters for the planning region, it is important to include a buffer zone surrounding the region in each raster. Each grid cell in the raster landscape integrity layer will be assigned a value based on the land/water use(s) in that cell, taking into account any effects from land uses in the surrounding area/cells. And so, buffering the planning region ensures that information on land/water uses that are adjacent to cells at the edge of the planning region will be included so that these uses can be considered when developing the landscape integrity values for these edge cells.

The size and configuration of the buffer surrounding the area will depend on the overall size of the planning region, and on the elements of interest. For example, if freshwater aquatic ecosystems are a focus, watershed area upstream of the planning landscape should be evaluated for inclusion in the aquatic landscape integrity raster. For efforts limited to terrestrial elements, a 5-20 mile buffer should adequately address most patterns of adjacent land use for planning efforts that range from local to regional scales.

▶Create landscape integrity raster(s)

The data development team will use a Geographic Information System (GIS) (e.g., ESRI ArcGIS and the Spatial Analyst extension) to create one or more landscape integrity rasters from source data. The process for developing these rasters is described below.

▶Obtain potential source data

Most spatial data needed for assessing landscape integrity can be accessed from government agencies. Examples of source data for both terrestrial and aquatic use classes are shown in the Land/Water Use Classes and Weights table below. In many cases, two landscape integrity rasters should be developed &endash; one comprised of source data that would influence the terrestrial landscape, and the other from data that would affect the aquatic environment.

▶Determine grid cell size

The optimal size of the grid cells to be used for the rasters must be determined. (See the Determining Grid Cell Size topic for detailed information on how to select the best raster cell size for different layers created and utilized in Vista.)

▸Evaluate potential source data for spatial resolution and accuracy

While it will be a rare circumstance when all available data depict features at the same spatial resolution, combining data layers of highly disparate resolutions should be avoided; the higher the disparity between layers, the greater the amount of error. For example, 1:24,000 stream layer should not be combined with a 1:2,000,000 roads layer, but using a 1:100,000 stream layer with a 1:250,000 roads layer may result in an acceptable level of error in the landscape integrity layer produced. Note that map accuracy information should be included in metadata.

▸Establish weights for land/water use classes

Each land and water use class depicted in the source data must be assigned a weight that will be used to describe its effect on aquatic and/or terrestrial landscape integrity. These weights reflect expert judgments about the relative severity of impact that each use class could have on the elements of interest in the planning region. Depending on the number and range of values, a scale between 0 and 1000 is generally adequate. For example, land and water use classes may be categorized in terms of "high severity," "moderate severity," and "low severity," with the associated weights initially set at 1000, 500, and 100, respectively. Again, this is an expert judgment; there is no way to fully test the assumptions behind these weights, so it may take some trial and error to determine acceptable values. Examples of assigned weights for different land and water use classes are shown below.

Layer #	Description of Data (Land /Water Use)	Source Raster	Weight
4	Land/Use Urban	DOC/Farmlandmapping	1000
5	Interstate	CASIL	1000
11	Dams	Base data	1000
15	Hazardious Waste Sites	USEPA	1000
16	Toxic Release Inventory	USEPA	1000
12	Mines	DOC/OMR	850
6	State Highways	CASIL	800
18	303D bays	SWRCB	800
18	303D Lakes	SWRCB	800
18	303D Estuaries	SWRCB	800
18	303D streams	SWRCB	800
3	Land/Use Intensive Agricuture	DOC/Farmlandmapping	500
7	Local Roads	CASIL	500
8	Rail Roads	CASIL	500
13	Industrial Discharge Facilities	USEPA	500
9	4 wheel Drive Road	CASIL	250
10	Power Lines	CASIL	250
2	Land/Use Extensive Agricuture	DOC/Farmlandmapping	100
17	Underground Pipelines	CASIL	50
0	water	DOC/Farmlandmapping	0
1	Land/Use Natural	DOC/Farmlandmapping	0
Null	Napa County Boundary	CASIL	
Null	Ten Mile Buffer	Created from Napa County Boundary	
Null	Watershed Boundary	CASIL	

Example showing land/water use classes and weights assigned for a

conservation planning project for Napa County, California, to be used to describe aquatic and terrestrial landscape integrity.

▸Develop distance interval values representing the impact of each use class

A set of values for distance intervals must be developed for each land and water use class that will be used to indicate their effects on elements of interest at different distances. The intervals are based on the resolution of the grid cells in the use class raster, and are essentially the units of the cells. For example, if a raster has grid cells that have a resolution of 90 x 90 meters, then the distance intervals could be: 1 = <90 meters distance (i.e., within 1 grid cell away from an area of a particular use class is represented by a distance of less than 90 meters), 2 = 90-180 m. distance (i.e., located up to 2 grid cells away), 3 = 181-270 m. distance, etc. Each grid cell in a land use raster should be assigned a distance value based on the distance of the cell from areas of land use.

▸Calculate grid cell values based on use class weight and distance effects

Calculate a value for each cell (CV) in a particular land or water use raster using assigned distance values (D) from the previous step, where Weight (W) is a constant, using the formula

$$(1/D) * W = CV$$

where:

D = Distance value for cell based on distance from use class

W = Weight assigned to component use class

CV = Cell value

The values (CV) that are calculated for the grid cells in each use class raster reflect the decreasing impact of the use class with increasing distance from the grid cell (and, thus, from any element occurrences present in the cell).

▸Combine calculated grid values

Sum the CVs calculated in the preceding step for the use class rasters into a single value for each cell in one composite raster. Thus, every grid cell in this summary raster (SCV) has a value that was obtained by adding the CVs assigned in each of the different use class rasters for that cell 'location.' The summary raster represents the combined effects of different use classes in the planning region.

▶*Normalize each summary cell value to produce a relative landscape integrity value*

Take the inverse of the value for each cell (SCV) in the summary use raster (1/SCV) to create a new 'inverse' layer. Normalize the grid cell values of this inverse layer to values ranging from 0.0 to 1.0 by, first, identifying the maximum value assigned to cells in the layer, and then dividing each inverse cell value by that maximum. Each grid cell value in the normalized inverse summary raster represents the relative landscape integrity value for that cell. A value close to 1.0 indicates that the grid cell has relatively high landscape integrity (i.e., is minimally affected by land/water uses); whereas, a value approaching 0.0 indicates relatively low landscape integrity (i.e., significantly impacted by land/water uses). As cells (and the occurrences within) are located closer to a land or water use, the landscape integrity decreases and the resulting impact of the use class increases. The figure below is a graphic representation of the terrestrial landscape integrity within Napa County, California, and the surrounding buffer zone.
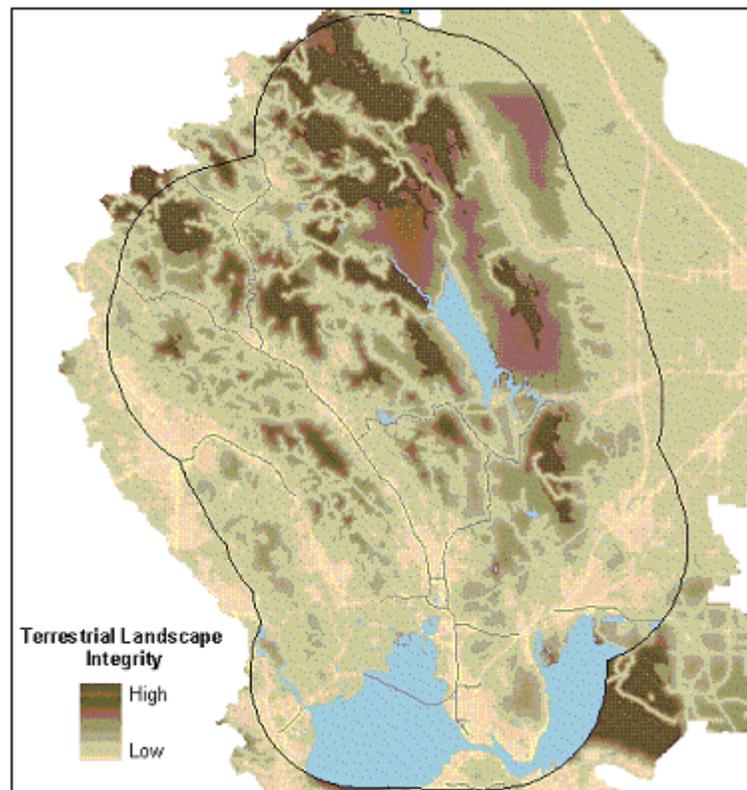
Map indicating the range of terrestrial landscape integrity values for Napa County, CA.

▶**Finalize the viability/integrity value associated with each occurrence**

The final calculation to develop viability/ecological integrity values for 'nonstandard' occurrences and 'standard' NatureServe Element Occurrences (EOs) for which an A, B, C, or D EO rank cannot be assigned involves two factors:

- Landscape integrity value(s) associated with the occurrence, and
- Size of the occurrence, used only for ecological elements (in some cases).

▸*Intersect integrity and distribution layers to assign landscape integrity values*

Assign landscape integrity values for each occurrence by intersecting the appropriate landscape integrity raster, developed in previous steps, with one or more element distribution layers. The resulting landscape integrity values should be recorded in the appropriate column in the associated distribution layers. For occurrences of elements lacking size values, this value serves as the finalized viability/integrity value.

When an occurrence overlaps more than one grid cell, the unique landscape integrity value for each overlapping cell should be combined to establish a single value for the occurrence. An average integrity value calculated from overlapping cells should be adequate for most occurrences, but expert opinion may determine that an alternate method for combining landscape integrity values should be utilized (e.g., minimum integrity value, geometric mean, etc.).

Note: Because many aspects of species viability cannot be ascertained from maps and models of landscape integrity (e.g., population size, population condition), viability values assigned to species occurrences should be limited to B-C (i.e., should be valued 0.8 or less) when based on landscape integrity values alone.

▸*Calculate final integrity values for community occurrences with size values*

Determine the finalized ecological integrity value for each ecological occurrence having an assigned size value by calculating the mean of the associated landscape integrity value and the size value. For example, an occurrence with a landscape integrity value of 0.5 and a size value of 0.9 should be assigned an ecological integrity value as follows: (0.5 + 0.9) / 2 = 0.7.

▸*Record finalized Viability/Integrity values for occurrences*

Record finalized viability/ecological integrity values in the appropriate column of the associated distribution layers.

The table below shows the viability/integrity values based directly on the assigned EO rank, or determined using other inputs (i.e., size and/or landscape integrity).

Viability/Ecological Integrity of occurrences =

EO rank
(numeric equivalent)   OR

Average of
[size (numeric equivalent)   OR   Landscape integrity
+   value
landscape integrity value]

NatureServe 'standard' occurrences with A, B, C, or D EO ranks		'Nonstandard' occurrences and NatureServe 'standard' occurrences without A, B, C, or D EO ranks		
EO ranks	**Viability/ Ecological Integrity** equivalents for EO ranks	Landscape integrity		
		Non-species occurrences		Species occurrences
		Values between 0.0 – 0.9		Values between 0.0 – 0.8
A	0.9	Some non-species occurrences		**Viability/Ecological Integrity** surrogate equal to landscape integrity value
B	0.8	Size values	Size numeric equivalents	
C	0.6			
D	0.3	A	0.9	
		B	0.8	
		C	0.6	
		D	0.3	
		Viability/ Ecological Integrity surrogate equal to avg. of size equivalent & landscape integrity value		

▶**Add viability/integrity values to Vista**

The addition of finalized viability/integrity values to Vista can be deferred until confidence attribute values have been assigned to distribution layers (if appropriate) so that all element information can be entered into the system at once. However, if it is desirable to input viability/integrity values at this point in the process and distribution layers have not yet been associated with elements, the task of pointing to distribution layers must first be completed (see the task Point to Distribution Layers from Vista). Once a distribution has been associated with an element, attributes can be added using the Vista Element Properties window, specifically in the *Viability/Integrity* group box on the Spatial tab.

▶**Document products with metadata**

The final products of the process are numerical values for viability/ecological integrity (ranging from 0.0 to 1.0) assigned to each element occurrence, and supporting landscape integrity rasters used to develop surrogate viability/integrity values.

Metadata should include documentation on the following:

- Source data used to define landscape integrity
- Rationale for making each landscape integrity map (e.g., terrestrial vs. aquatic, etc.)
- Rationale for the surrounding buffer area included with the planning region
- Decisions made for calculating weight and distance values
- Decisions related to the methods used for averaging raster grid cell values for each occurrence

Vista automates the process of producing metadata that is compliant with the Federal Geographic Data Committee (FGDC) metadata standards. See http://www.fgdc.gov for more details on metadata standards.

CONFIDENCE ATTRIBUTES

Objectives

The purpose of the confidence process is to assign a specific value (ranging from 0.0 to 1.0, low to high confidence, respectively) that describes the spatial and temporal confidence associated with each occurrence of an element. These values may represent either a statistically-derived assessment of data accuracy or qualitatively-derived, categorical values of confidence in the data, as specified and documented by the user. Confidence values can be used in Conservation Value analyses to indicate the degree of certainty that the element is actually present in and throughout each location (polygon) indicated in the distribution layer for that element.

Products

The confidence attribute can be expressed in two products, as follows:

- Values stored in a column associated with a vector distribution theme that indicate confidence in presence of the element for each associated occurrence.
- Values assigned to occurrences of an element based on raster themes having cell values that indicate confidence that the element is present

in corresponding locations of the vector distribution layer. Raster themes can include land cover layers and modeled distributions.

In addition to these products, a single value that represents confidence for all occurrences of a particular element can be assigned based on knowledge of data quality without being expressed as either an attribute of a vector theme or as a cell value in a raster theme.

Inputs

Confidence values can be input three ways:

- As an attribute of a vector distribution theme, used when a confidence value is assigned for each individual occurrence polygon. The confidence values range between 0.0-1.0, and are generally derived through calculations based on different measures of confidence for each occurrence, as in NatureServe Heritage Element Occurrences (EOs).

- As a raster layer with a 0.0-1.0 confidence value assigned to each individual grid cell, as in a modeled distribution of an element.

- As a single value representing confidence for all occurrences of a particular element (in either raster or vector format), as in common thematic accuracy assessments of land cover maps.

Values associated with occurrences in vector themes result from any occurrence-specific attributes that can be translated to confidence values. For EOs developed according to NatureServe heritage methodology, such attributes could include associated Representation Accuracy (RA), the date that an occurrence was last observed, assigned EO ranks, and information on the digitizing base used to create the occurrence.

Confidence values assigned to cells in a raster theme can be derived from different source data. For example, probability maps that result from predictive distribution modeling can be used to indicate the confidence that an element occurs at the location represented by a cell.

A single value representing confidence for all occurrences of an element can be associated with either vector or raster themes. There are two primary sources used to determine a single confidence value:

- The results of an accuracy assessment performed on an element distribution, a source that typically applies to land cover-type elements (e.g., ecological systems, vegetative communities) with distributions created from remotely sensed data.

- An educated or expert opinion about the confidence associated with an element distribution based on comparisons to known locations where the element occurs, personal experience with the element in the field, etc.

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Methods Summary

The methods described here are a fairly robust approach to assigning and documenting confidence in element presence. While the methodology assumes that a large amount of information can be used to derive confidence scores, it is flexible enough to allow the use of whatever information is available, including simple expert opinion about data quality. The data development team and decision makers must decide on the definition of confidence attributes to be used for the project, specifically whether confidence will represent the relative value (from low to high) of data quality, or will represent an actual probability of element occurrence. To make that decision, available data must be reviewed to determine whether it supports the definition of confidence to be used, and available time and resources must be evaluated to assess whether they are sufficient to implement that definition.

While element confidence values provide for a more robust analysis, they may be very difficult and/or time consuming to determine. In the case of some elements, they may be unnecessary to apply. For example, confidence values wouldn't likely have meaning in the case of designated priority zones (priority conservation or wildlife areas), cultural features, protected areas, etc. In the case where confidence in not applicable or difficult to ascertain, constant values (0.5 for example) can be applied equally to elements to fulfill this requirement.

A confidence value is a measure of certainty that the element is actually present in a location designated in its [distribution layer](#). Confidence values may be derived from a single input, such as a probability raster, or can be determined from a combination of several inputs that affect confidence. These input types represent spatial and/or temporal characteristics of confidence that can then be used to calculate a net confidence value for an occurrence. Four confidence types can be considered in assessing net confidence, listed below.

> **Locational Precision** - Confidence that the boundary of an occurrence reflects the true location and extent of the element at that location, based on actual field observation rather than on the limitations inherent in portraying occurrences on a map (see Map Resolution confidence below)

> **Presence** - Indication of whether the element is extant at a location (versus extirpated, extinct, or historical) based on field observation, the date of observation, or on the date of the base information used to map or model the element's distribution

> **Map Resolution** - Based on the scale of maps used to represent the occurrence, or to create a distribution through a modeling process

> **Modeled** - Indication that the distribution was developed using modeled or remotely sensed data as surrogates for direct observation of the element

Each type can be assigned a value ranging between 0.0 and 1.0 according to its representation of confidence for the occurrence. The net confidence associated with an occurrence is then derived by multiplying together each of the values assigned for these components, weighted as needed to allow for different confidence types to be more significant in the output (e.g., Map Resolution may be only half as important as Presence, and so would be assigned a lesser weight). The general formula used to calculate a net confidence value to be used for [Conservation Value analyses]() is

Net Confidence = (Locational Precision * w1) * (Presence * w2) * (Map Resolution * w3) * (Modeled * w4)

> where:
>> Locational Precision = Locational Precision confidence, based on the accuracy of occurrences mapped on the basis of field observations, including any uncertainty buffers
>>
>> Presence = Presence confidence, based on the status of the element as extant, extirpated, or historical determined through observation, or on the date that observations were made, or on the date of input maps used to model distributions, or on any other uncertainty associated with its presence
>>
>> Map Resolution = Map Resolution confidence, based on the scale of maps used to create distributions
>>
>> Modeled = Modeled confidence, based on whether the occurrence was derived from a distribution model or remotely sensed data
>>
>> w1 = weight of Locational Precision component
>>
>> w2 = weight of Presence component
>>
>> w3 = weight of Map Resolution
>>
>> w4 = weight of the Modeled confidence

Note that generally all four of the confidence types are not applicable and/or utilized in determining the net confidence for occurrences, although using all confidence types would result in more realistic representation of the certainty of the occurrence data. The net confidence value is significantly affected by the number of types used in its calculation. The greater the number of confidence types used for occurrences in the analyses (i.e., Locational Precision, Presence, Map Resolution, and Modeled), the greater will be their influence on lowering net conservation values. An important consideration, therefore, is to ensure that elements with more information about confidence attributes not have their net confidence score reduced more than other elements with less information. Care should be taken to appropriately weight confidence factors to achieve equitable treatment. In addition to effects on net confidence values, utilizing a greater number of

confidence types to assess confidence can increase both the complexity and cost of data preparation substantially. The user of the information should determine the relative value of confidence information to their application of the data and budget accordingly.

If a particular confidence type is irrelevant or has been excluded uniformly due to project constraints and is not to be included in calculating net confidence, a 1.0 value should be used for that type in the calculation, causing no effect. One way to think about assessing values for the different confidence types associated with an occurrence is to assume an initial value of 1.0; then, based on the amount of uncertainty indicated through evaluation of pertinent data, the value for that confidence type would be down-ranked accordingly. In cases when data is insufficient to assess certainty for a confidence type to be included in net confidence calculations, a confidence value that is appropriate for unknown should be assigned. For example, if the current status of an observation is unknown, the value assigned for the Presence confidence might be 0.5. There should be consistency in determining the confidence values to be used to indicate the same degree of uncertainty.

A number of methods can be used to determine values for the confidence types to be used to calculate net confidence; potential methods are described in the separate process sections for each type of confidence. Depending on the data available for elements, some of the tasks listed as components of the process for assigning confidence values may not be necessary or appropriate.

Although they are very useful for informing data users about the likelihood that an element is actually present in each mapped polygon, confidence values associated with distribution maps are currently used only in [Conservation Value analyses](#).

Select a task below to see a detailed description of the process for assigning confidence.

Background

Uncertainty is inherent in all data and models, and data on elements of biodiversity and their locations are typically subject to greater uncertainty than much other data used in planning, such as topography, hydrography, and infrastructure. The type of uncertainty associated with occurrences of elements in a planning region, and the magnitude of such uncertainty can, and should, affect the planning process for that region. Uncertainty exists in every aspect of the planning process, including

- Input data, based on such factors as data collection techniques and timing, data format (i.e., points, lines, polygons, or rasters), human error, map scale, and natural variability
- Calibration and categorization of the data (e.g., whether the mapped location of an occurrence reflects its actual location,

whether the element present at that location has been correctly identified)

- Data processing (e.g., assumptions incorporated in the model, aggregation and classification of the data, spatial data processing)

While it is recognized that uncertainty associated with data cannot be eliminated, Vista provides both a process and tools to evaluate and document this uncertainty by assigning values that reflect data confidence. There are five separate types of confidence that can potentially be used to determine the overall confidence (uncertainty) associated with data, described in detail below.

Locational Precision, a type of spatial confidence, is indicated through the boundary of the feature used to represent an occurrence. High confidence indicates that the occurrence boundary precisely reflects the true location, size, and shape of the element occurrence (to the extent that it has been surveyed in the field). However, when confidence is low, the boundary of the occurrence may not reflect the actual location and/or extent of the element, insofar as it has been surveyed. The primary concerns with locational precision confidence are that the map may falsely indicate that an element is located in a unit, fail to indicate an actual occurrence, misrepresent the known size of the occurrence, or misrepresent the known shape of the occurrence. Any of these errors could lead to either conservation of areas where goals for the element cannot be achieved, or to failure to conserve important occurrences or portions of occurrences that were not precisely mapped.

Presence, a type of temporal confidence, indicates whether an element is actually extant at the location indicated by an occurrence, or whether the location may represent an extirpated, extinct, or historical occurrence. Presence can be assessed on the basis of two differing sources of data: 1) direct observation of an element, and 2) the date of an observation combined with information on landscape changes over time. In the first instance, actual observation records resulting from field surveys that indicate whether an element can still be found at the location are used to establish presence. In the second case Presence confidence is based on the date of an observation, with the assumption that older observations will have lower confidence because changes on the landscape or in land use since observations were made may have either eliminated the element, or led to changes in the size and/or shape of its distribution. Other data that may be evaluated in terms of date include remotely sensed data or modeled distributions, with the date of the most dynamic input used in the mapping/modeling used to assess presence; this will typically be the date of the imagery used to produce a land cover layer from which an element distribution is mapped or modeled.

When Presence confidence information is available for an individual occurrence, it can be used in determining the net confidence of that

occurrence. However, when presence status is applicable to an element (e.g., a species extirpated in a given jurisdiction), the value for confidence would be applied to each of the occurrences in its distribution (located within that jurisdiction). For example, a historical record could indicate quite precise locations of nests for a bird species that is now known to be extinct or extirpated from a given planning area. All of these extirpated occurrences would uniformly receive a zero percent Presence confidence that the bird would be found if the sites were revisited. The Presence confidence measure is particularly important for restoration, however, since high confidence that an element was once actually extant at a location could suggest some probability for its restoration to that site.

Map Resolution, a type of spatial confidence, is based on either the scale of the maps used to represent occurrences of the element, or the scale of the maps used to create a modeled predicted distribution. This type of confidence is closely related to Locational Precision, but rather than assessing confidence in the mapped occurrence, Map Resolution is concerned with how Locational Precision is affected by mapping unit representation. For example, if an observation of a rare plant occurrence measuring four square feet is represented in a raster cell of one square mile, the confidence value for Map Resolution would be quite low compared to the use of that same mapping to depict the distribution of extensive forest types. In vector maps, the use of very small-scale national range maps to depict the distribution of an element within a county would also be assigned very low Map Resolution confidence.

Modeled confidence, a spatial component, is used to indicate that an element distribution is inferred from surrogates of its presence rather than actual observation. Modeled occurrences are developed partly or entirely from one or more predicted distribution models and/or remotely sensed data (depending on the type of platform, e.g., satellite imagery versus low altitude aerial photography). Because most distributions developed from remotely sensed data include some degree of modeling, this confidence attribute is referred to as simply "Modeled." There is inherent uncertainty in distributions developed from such data since the occurrence of elements was not directly observed and/or measured in the field. These models may be assessed for accuracy in the same way a thematic land cover map is assessed if, in fact, the feature to be modeled could be observed on the ground. In other instances, some initial confidence value might be derived from quantitative accuracy scores for a major model component (e.g., vegetation type), while others might require a qualitative valuation of the model quality to derive a relative score.

Using the recommendations provided in the Vista documentation for data preparation and assessing confidence, different confidence types can be used to determine net confidence values. A net confidence value can be associated with either an individual occurrence or distribution polygon

representing an element, or with a grid cell of a raster confidence layer. Alternatively, a single value representing net confidence can be associated with all occurrences of an element, depending on which confidence types are available to determine that value. Knowledge of uncertainty in the data may help to determine the suitability of the data for addressing particular questions in the planning region, providing an indication on whether additional data should be collected or acquired.

Limitations

Vista currently uses only a single net attribute of confidence per occurrence polygon or raster grid cell. Retaining all of the attributes used to calculate a net confidence value may be valuable; the confidence attributes can be accessed directly through the Environmental Systems Research Institute (ESRI) ArcView application when decisions need to be made on issues that may be sensitive to confidence type (e.g., locational precision versus assumed extirpated versus age of observation, etc.).

When the confidence attributes of elements are included in Conservation Value analyses, they have the effect of lowering the conservation values of grid cells in proportion to the confidence scores of all elements selected and occurring at any particular location. However, low confidence does not necessarily mean that the elements observed or predicted for that location are not present, but rather that characteristics of the data (e.g., age of the observation, scale of the input maps) and/or changes that have occurred at the location reduce certainty that the element is present. It is recommended that different types of Conservation Value Summaries be developed - both with and without confidence in order to evaluate its effect of lowering the value of areas that are otherwise indicated by the data to be of conservation importance. It is important to prioritize areas for near-term conservation action based on confidence in the data, however, the optimal solution for low certainty is to increase the confidence of element observations/predictions (e.g., by obtaining more current data, by using finer resolution maps).

There is inherent uncertainty based on the size of the grid cell used for mapping element occurrences (observed or modeled) in a raster format. This uncertainty is also present in the processing of raster maps for Conservation Value analyses. The larger the cell size used for mapping and processing, the less confidence there is in making decisions for management units at a finer resolution (e.g., parcels from a legal town map). Vista uses the original confidence attributes of the elements and does not recalculate confidence when analytical cell sizes are changed. See the topic Determining Grid Cell Size for further information on the effects of cell size on analyses.

Confidence values are based on locations where elements have been observed or predicted; there are no confidence values assigned to locations where elements are not known or predicted to occur. In other words, Vista

currently does not utilize a value for confidence that a location does *not* contain an occurrence of a particular element. While such knowledge would be very useful, the guiding assumption is that predictive distributions should be employed where existing occurrence information is known to be incomplete (most cases); using only existing data would lead to large errors of omission in element distribution. Errors of commission, that is, mapping elements as present where they are not, is a common result of predictive distribution modeling, which is designed to utilize precautionary principles in predicting element presence. Therefore, when employing predictive distribution maps, there may be higher confidence that areas depicted as lacking elements are truly lacking conservation value, than the opposite and more dangerous case (i.e., low confidence that areas that show the presence of elements have conservation value).

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Steps in the Confidence Assignment Process

PROCESS FOR ASSIGNING CONFIDENCE VALUES

▶**Evaluate available attribute data for element occurrences**

Data on occurrences of elements must be evaluated to determine which have attributes that can be considered indicative of the certainty, or confidence, in that data, and which occurrences will need additional work to determine confidence values. The confidence information available may directly influence which attributes should be included for calculating net confidence values for occurrences, which can then be used in Conservation Value analyses.

Information on the different types of confidence associated with occurrences of elements may be obtained directly from NatureServe Natural Heritage member program databases. NatureServe programs track data for Element Occurrences (EOs), which are developed using standard NatureServe heritage methodology and typically include attributes that can be used to indicate several types of confidence. Representation Accuracy (RA) values, information on the digitizing base used to develop occurrences, associated locational uncertainty, Inferred Extent (IE), and/or, in some cases mapping precision can be used to determine values for spatial confidence. Data including the last date of observation and the assigned EO rank can be used to develop values for temporal confidence. (For additional details on EO methodology, see the *Element Occurrence Data Standard,* found at http://whiteoak.natureserve.org/eodraft/index.htm).

'Nonstandard' occurrence data for elements (e.g., 'modeled' habitat, mapped polygons from remotely sensed data, contiguous landscape areas) may also be utilized in Conservation Value analyses. However, assigning confidence values to 'nonstandard' element data will require some additional processing, depending on the type of confidence to be evaluated.

PROCESS FOR ASSIGNING CONFIDENCE VALUES

▶**Create columns for confidence attributes**

Assigned and calculated values for confidence - that is, the four different types of confidence and the net confidence - must be stored in columns associated with the element distribution layers (in vector format). Five columns should be created for each element distribution layer for recording these attributes.

Creating columns for storing associated attribute data is a basic GIS task that is performed outside of the Vista application. For guidance on performing this task, see the help for the Environmental Systems Research Institute (ESRI) application being used to develop the element distribution layers (e.g., Arc9). To browse or search the contents of the help:

1. From the Help menu, choose Help Topics.
2. Choose a tab.
   - The Contents tab shows a list of topics that can be browsed through.
   - The Index tab provides the ability to search an index of help topics.
   - The Find tab provides the ability to search for a particular word in all of the help topics.

▶**Determine Locational Precision confidence values for occurrences**

Locational Precision, a type of spatial confidence, is generally indicated through the boundary of the feature used to represent an occurrence. High confidence indicates that the occurrence boundary precisely reflects the true location, size, and shape of the element occurrence, to the extent that it has been surveyed in the field. However, when confidence is low, the boundary of the occurrence may not reflect the actual surveyed location and/or extent of the element. In addition, spatial data consisting solely of point locations cannot represent the extent of elements and so will always have associated locational uncertainty and, thus, a decreased Locational Precision confidence.

There are a number of ways that values for Locational Precision confidence (ranging from 0.0 to 1.0) can be derived for use in Conservation Value analyses, depending on the feature type(s) of available spatial data (e.g., points, polygons), the methodology used to develop the data, and the resources and needs of the user. Some of these potential methods are described below, categorized as follows: *'standard'* spatial data (i.e., occurrences developed using NatureServe heritage methodology), which may require different processes for assigning confidence depending on currency and associated locational uncertainty, and other *'nonstandard'*" data.

'STANDARD' NATURESERVE EO DATA

Because the spatial model and methodology for developing mapped representations Element Occurrence (EO) has been revised in the last decade, 'standard' EOs may have somewhat different spatial characteristics. The best method for assigning Locational Precision confidence will vary depending on the type of EO (e.g., point, circular polygon, polygon).

If the current NatureServe heritage methodology was used to develop EO representations, the resulting polygons have several associated attributes that can be used to assess Locational Precision confidence: Representation Accuracy (RA), locational uncertainty, and/or Inferred Extent (IE). Because the boundaries of such EOs are developed to include locational uncertainty (i.e., uncertainty that the true location of an element on the ground is accurately represented by the location of the element on the map), there may be area incorporated in an EO that is not actually occupied by the element, but was included to ensure that the location of each underlying element observation was captured within the boundary of that occurrence. (For additional details on EO spatial methodology, see the Element Occurrence Data Standard, found at http://whiteoak.natureserve.org/eodraft/index.htm) Note that the methods for assigning Locational Precision confidence to 'standard' EOs appear in order, with the preferred method listed first, the second next, etc.

▶*Utilize Representation Accuracy values*

Representation Accuracy (RA) values are assigned to EOs to indicate their accuracy, that is, the relative amount of the polygon that is comprised of the actual element observation(s), as opposed to area included in the

occurrence due to locational uncertainty. Provided that RA values have been assigned (or if they can be assigned), a mapped EO with significant area incorporated for locational uncertainty (i.e., having low RA) should generally be down-weighted in Locational Precision confidence relative to another EO in which the boundary is thought to accurately represent the element location (i.e., having high RA).

▶*Assign high confidence if locational uncertainty type is 'negligible'*

Lacking RA values (and the means to assign RA values), an assigned locational uncertainty type of 'negligible' indicates that EOs have been created on the basis of very precise locational information for the element. Such EOs have no additional area included in their boundaries for locational uncertainty, but may result from application of a procedural buffer in order bring a point or line feature up to the size that equals the minimum mapping unit for the scale map being used (e.g., for a 1:24,000 U.S. Geological Survey topographic map, the minimum mapping unit is 12.5 meters, or approximately 40 feet). The Locational Precision confidence assigned to EOs with associated negligible locational uncertainty should be high - typically, a value of 1.0.

▶*Utilize Inferred Extent features as appropriate for selected animal EOs*

EOs for some animal elements that have a locational uncertainty type other than 'negligible' (i.e., 'linear,' 'areal delimited,' or 'areal estimated') and lack RA values can be utilized to develop Inferred Extent (IE) features that may be useful in assigning Locational Precision confidence. Note that in many instances, IE features may have already been created by the NatureServe member program. In order for IE to be an option for determining confidence, the feature created by buffering the underlying source data for the EO by the IE distance provided in EO specifications for the element must be larger than that EO. If so, then the IE distance can be applied to the Source Feature to create a new IE feature associated with the EO. Note that IE features should be edited to remove any areas known not to be occupied by the element (e.g., for a terrestrial animal, the portion that extends into a body of water should be removed). Because IE distances are based on home range and/or dispersal distances for the element, the Locational Precision confidence value assigned to IE features should be relatively high (0.95) since the areal extent of such features should be generally equivalent to the minimum needed to meet spatial requirements of the animal.

▶*Compare EO area with the average occurrence size for the element*

Lacking RA values and associated IE features, Locational Precision confidence for EOs with 'linear,' 'areal delimited,' or 'areal estimated' locational uncertainty can be determined using area. More specifically, dividing the average area for an occurrence of the element in that

geographic area by the area of the EO will result in a calculated value for Locational Precision confidence, but only if the EO area is greater than the average. In such cases, it could then be surmised that a significant amount of locational uncertainty had been included in the occurrence; thus, Locational Precision confidence would be diminished. Expressed as a formula:

$$LPC = A_A \div A_{EO}$$

where:

$$LPC = \text{Locational Precision confidence}$$
$$A_A = \text{Area of average occurrence}$$
$$A_{EO} = \text{Area of occurrence}$$

and:

$$A_{EO} > A_A$$

In cases when EOs are circular features with a locational uncertainty type of 'areal estimated,' they have been developed by applying a buffer for the uncertainty distance assigned to the occurrence to the underlying point location. Uncertainty distances can be selected from a set of recommended uncertainty distance classes (with the larger value in each range used as the buffer), or a custom distance can be specified. In cases when point EOs developed using the previous methodology have been converted to the current methodology, custom distances equivalent to the legacy mapping Precision values associated with the EO points are used as buffers. Note that if EOs are in the form of points, buffer distances appropriate for assigned Precision values (if available) should be applied to create circular polygons. The table below shows the set of NatureServe uncertainty distance classes and the custom buffer distances used for Precision, along with the resulting area of EOs produced by buffering points with these distances (i.e., the area resulting from added locational uncertainty).

	Buffer distance applied to point EO (in meters)	Area of EO (i.e., area of added uncertainty) (in acres)
NatureServe Uncertainty Distance classes	>6.25 – 25	0.5
	>25 – 50	2
	>50 – 100	8
	>100 – 200	31
	>200 – 400	125
	>400 – 800	500
	>800 – 1,500	1,750
	>1,500 – 4,000	12,400
NatureServe Precision values (legacy data)	Seconds = 100	8
	Minutes = 2,400	4,500
	General = 8,000	50,000

Areas of circular polygons created using uncertainty distance class or Precision buffers.

Example:

An occurrence of California Black Rail with 'areal estimated' locational uncertainty has an assigned uncertainty distance class of >100-200 meters, and has thus been mapped using a 200-meter buffer. The resulting feature has an area of 31 acres (see table above). If the average occurrence of this species is known to be 20 acres, the Locational Precision confidence of the EO is 20 ÷ 31 = 0.65.

The average area for occurrences of a particular element may be obtained from an expert, or may be determined by calculating the average size of occurrences for the element, using those in the distribution layer developed for the project as well as occurrence data from other sources to ensure a more reliable result.

In the absence of sufficient data to calculate the average occurrence size for an element, values developed for groups of species, described below, could be utilized.

Using 1995 data from NatureServe heritage Element Occurrence (EO) records, the average occurrence size was calculated for species in each of the following groups: mammals, birds, reptiles, amphibians, fishes, invertebrates, and vascular plants. The average amount of habitat (in acres) occupied by a species was calculated using values in the Size of EO field of those occurrences records where size was recorded. Extreme values (approximately the upper and lower 5%) were excluded from the calculation. The resulting averages, by group, are: mammals - 989 acres; birds - 525 acres; reptiles - 219 acres; amphibians - 183 acres; fishes - 501 acres; invertebrates - 185 acres; vascular plants - 10 acres. These values were then rounded and combined, resulting in the following average amounts of habitat occupied for each occurrence of a species, by group:

- Mammals -- 1,000 acres
- Birds & fishes -- 500 acres
- Reptiles, amphibians, & invertebrates -- 200 acres
- Vascular plants -- 10 acres

'NONSTANDARD' OCCURRENCE DATA

Spatial data developed using processes other than those embodied in NatureServe heritage methodology are referred to as 'nonstandard.' Such data can result from a number of different processes, including modeled habitat, polygons mapped from remotely sensed data, and contiguous landscape areas.

▸*Process into 'standard' EOs*

For some 'nonstandard' spatial data it may be possible to apply criteria found in the EO specifications for the element to the data (see the Develop Distribution Layers task for details). In such cases, the data is essentially processed into 'standard' NatureServe Element Occurrences (EOs) by applying separation criteria, and Locational Precision confidence could then be assigned as described in the preceding section.

▸*Utilize EO area with the average occurrence size for the element*

'Nonstandard' polygon data that cannot be processed into 'standard' EOs may be evaluated using the average area of occurrences for the element and the actual area of the feature, as described in the 'standard' EO section above.

▸*Assign appropriate value if confidence cannot be determined*

If data (both 'standard' and 'nonstandard' types) for occurrences are insufficient to assign a Locational Precision confidence value but this type will be used to calculate net confidence for occurrences in the project, a value appropriate for unknown (e.g., 0.5, 0.2) should be assigned instead of 0.0. This will insure that the net confidence will not equal 0.0 in cases when there is a lack of data to assign values for all confidence types to be included in the analysis.

Data that may be difficult to assess in terms of Locational Precision confidence include NatureServe network program EOs that lack assigned Representation Accuracy (RA) values, that have a locational uncertainty type other than 'negligible,' that cannot be represented by Inferred Extent (IE) features, and that lack uncertainty distance buffers (e.g., a plant EO with 'areal delimited locational' uncertainty lacking RA). 'Nonstandard' occurrence data that cannot be processed into 'standard' EOs may also be difficult to assess for Locational Precision confidence.

▸*Record values in column of element distribution layers*

Populate the appropriate column in the associated distribution layers with Locational Precision confidence values.

Record a value of 1.0 in the column if Locational Precision confidence is not to be used in assessing net confidence for occurrences in the project. Using 1.0 to represent this confidence will ensure that there will be no effect on net confidence calculations by excluding this type.

▸**Determine Presence confidence values for occurrences**

Temporal confidence indicating whether an element is actually present, i.e., is extant, at the location indicated by an occurrence is represented by Presence confidence. This confidence can be based on actual field survey data for the element, or on the age of associated element information, with the assumption that older data will generally indicate less confidence that the element is still present at a particular location. If the necessary attribute data are available for occurrences, then a value representing Presence confidence can be assigned to each occurrence; alternatively, a single confidence value may be appropriate to assign to all occurrences of a specific ecological element.

There are a number of ways that values for Presence confidence (ranging from 0.0 to 1.0) can be derived for use in Conservation Value analyses, depending on attributes associated with occurrences, the methodology used to develop the data, and the resources and needs of the user. Some of these potential methods are described below, categorized as follows: 'standard' occurrence data (i.e., data for Element Occurrences [EOs] developed using NatureServe heritage methodology), and other 'nonstandard' data.

'STANDARD' NATURESERVE EO DATA

NatureServe Element Occurrences (EOs) have been developed with attributes that can, in most cases, be used to assess Presence confidence. Specific data that can be used to indicate confidence include the last observation date for the occurrence and EO ranks.

▸*Utilize last observation date*

The Last Observation Date field in an EO record contains the most recent date that the element was actually observed at that location. It is generally assumed that older dates indicate lower Presence confidence, but this can be adjusted based on expert opinion, or on the basis of data indicating the land use and/or management policy at an EO location has changed, which may then affect the likelihood of its continued presence.

If date is to be used to assign Presence confidence, there are a number of ways that dates can be translated into a numerical value ranging from 0.0 to 1.0 to represent confidence. In some cases, a straight linear decrease in confidence value from the present day to the date of observation could be used, while in other situations, some nonlinear decreasing function from the present day to the date of observation might be more appropriate.

In areas where data indicating land use and/or management policies that could affect the continued presence of occurrences are available, it may be useful to obtain or develop layers that identify these different areas within the planning region and/or indicate areas where the land use/policy has changed within a specified time frame (e.g., 1 year, 5 years). Intersecting these layers with element distributions would identify occurrences that are more likely to have persisted as well as those that have probably been extirpated, thus facilitating refinement of Presence confidence values assigned on the basis of date. For example, an occurrence last observed

fifteen years ago would have an assigned confidence value based on the date of that last observation; however, if the occurrence is in a national park where little change has occurred in the last 50 years, the confidence value could be increased to reflect greater confidence that the occurrence is still present at that location. Another example would be an occurrence observed two years ago at a site that is now a shopping mall; in this case, the confidence value assigned for a very recent last observation date would be decreased since there would be virtually no confidence that the occurrence remains.

▶*Utilize EO rank*

'Standard' NatureServe EOs typically have assigned EO ranks, determined through the application of EO rank specifications. Ranks of A, B, C, and D indicate the estimated viability of species occurrences, or the ecological integrity of community occurrences, and thus the likelihood of persistence. Other EO ranks are used for locations representing extirpated or extinct occurrences (E rank), or historical occurrences (H rank). (For additional details on EO ranks and rank specifications, see the Element Occurrence Data Standard, found at http://whiteoak.natureserve.org/eodraft/index.htm)

Occurrences that have assigned EO ranks should be evaluated in terms of how current the ranks are, and updated as needed using EO rank specifications developed for the element. For occurrences without ranks, it may be possible to assign EO ranks using rank specifications criteria. EO ranks can then be converted into Presence confidence values (ranging between 0.0 and 1.0), for example:

EO Rank	Presence Confidence Value
A = excellent viability/integrity	1.0
B = good viability/integrity	1.0
C = fair viability/integrity	1.0
D = poor viability/integrity	1.0
E = extant	1.0
U = unrankable	0.75
H = historical	0.50
F = failed to find	0.50
X = extirpated	0

Example of values that could be used to convert EO ranks to Presence confidence.

'NONSTANDARD' OCCURRENCE DATA

Data developed using processes other than those embodied in NatureServe heritage methodology are referred to as 'nonstandard.' Such data can result from a number of different processes, including modeled habitat, polygons mapped from remotely sensed data, and contiguous landscape areas.

▸ ***Determine date of source data used to develop 'nonstandard' occurrences***

Presence confidence for 'nonstandard' occurrences can be assessed using the age of the most dynamic input data that was used in mapping and/or modeling the occurrences. Typically this will be the date of the imagery (e.g., aerial/satellite views) used to produce a land cover map, from which an element distribution is then mapped or modeled. In some cases, the age of the underlying data can be evaluated in terms of EO rank specifications for the associated element, and an appropriate EO rank assigned (e.g., H = historical, E = extant). This rank could then be translated to a value indicating Presence confidence using the conversion table above.

▸ ***Assign presence/absence values to raster source data***

Presence confidence for 'nonstandard' occurrence data in raster format can be indicated through the use of a non-zero value up to 1.0 (i.e., >0.0 to 1.0) for grid cells in which an element is located, and an assigned value of 0.0 to indicate its absence.

▸ ***Down-rank Presence confidence values for modeled occurrences***

Presence confidence values assigned to modeled habitat areas need to be down-ranked to indicate the uncertainty associated with distributions that are modeled rather than actually observed in the field. (See also, the Modeled confidence section.) Considering the confidence equivalents for EO ranks shown in the conversion table in the previous section, modeled occurrences could be assigned a Presence confidence value of 0.25 to indicate the associated uncertainty with the data.

▸ ***Assign appropriate value if confidence cannot be determined***

If data (both 'standard' and 'nonstandard' types) for occurrences are insufficient to assign a Presence confidence value but this type will be used to calculate net confidence for occurrences in the project, a value appropriate for unknown (e.g., 0.5, 0.2) should be assigned instead of 0.0. This will insure that the net confidence will not equal 0.0 in cases when there is a lack of data to assign values for all confidence types to be included in the analysis.

▸ ***Record values in column of element distribution layers***

Populate the appropriate column in the associated distribution layers with Presence confidence values.

Record a value of 1.0 in the column if Presence confidence is not to be used in assessing net confidence for occurrences in the project. Using 1.0 to represent

this confidence will ensure that there will be no effect on net confidence calculations by excluding this type.

▶Determine Map Resolution confidence values for occurrences

Map Resolution, a type of spatial confidence, is indicated through the map scale used to create element distribution layers. Generally, the coarser the scale of the map, the less detail that can be depicted on the map, and the lower the Map Resolution confidence value for occurrences.

There are a couple of ways that values for Map Resolution confidence (ranging from 0.0 to 1.0) can be derived for use in Conservation Value analyses, depending on attributes associated with spatial data for occurrences.

▶*Utilize digitizing base information for NatureServe 'standard' EOs*

For NatureServe Element Occurrences (EOs) developed from one or more observations (i.e., Source Features) according to the current NatureServe heritage spatial methodology, data recorded in the Digitizing Base field in each component Source Feature record (specifically, the digitizing base that was used to develop that feature), can be used to determine the Map Resolution confidence for individual EOs.

▶*Evaluate map scale for layers used to develop 'nonstandard' occurrences*

The Map Resolution confidence for occurrence data developed using processes other than those embodied in NatureServe heritage methodology (e.g., element distributions based on remotely sensed data or modeling) should be adjusted on the basis of the map resolution of the coarsest input layer. For example, if a model utilizes a land use layer at a scale of 1:24,000 and a vegetation layer at a scale of 1:500,000, the vegetation data represents the greatest uncertainty incorporated in the distribution. Map Resolution confidence for the modeled occurrences should be adjusted accordingly.

▶*Assign appropriate value if confidence cannot be determined*

If data for occurrences are insufficient to assign a Map Resolution confidence value but this type will be used to calculate net confidence for occurrences in the project, a value appropriate for unknown (e.g., 0.5, 0.2) should be assigned instead of 0.0. This will insure that the net confidence will not equal 0.0 in cases when there is a lack of data to assign values for all confidence types to be included in the analysis.

▶ *Record values in column of element distribution layers*

Populate the appropriate column in the associated distribution layers with Map Resolution confidence values.

Record a value of 1.0 in the column if Map Resolution confidence is not to be used in assessing net confidence for occurrences in the project. Using 1.0 to represent this confidence will ensure that there will be no effect on net confidence calculations by excluding this type.

▶Determine Modeled confidence values for occurrences

Modeled confidence, a component of spatial confidence, is used to indicate that an element distribution has been developed partly or entirely from a spatial distribution model and/or remotely sensed data. There is inherent uncertainty in distributions developed from such data since the underlying information was not directly observed and/or measured in the field. Note that some mapping projects (e.g., land cover layers) may include a thematic accuracy assessment that can be used to develop a value for this confidence attribute. There are several ways that values for Modeled confidence (ranging from 0.0 to 1.0) can be derived for use in Conservation Value analyses, depending on attributes associated with spatial data for occurrences.

▶*Assign a constant value*

Modeled confidence can be a constant value determined on the basis of expert opinion, or using the results of an accuracy assessment of the model output.

▶*Assign a value based on a probability surface*

In cases when the model used to develop a distribution also results in a probability surface, this can be used to assign a Modeled confidence value.

▶*Assign appropriate value if confidence cannot be determined*

If data for occurrences are insufficient to assign a Modeled confidence value but this type will be used to calculate net confidence for occurrences in the project, a value appropriate for unknown (e.g., 0.5, 0.2) should be assigned instead of 0.0. This will insure that the net confidence will not equal 0.0 in cases when there is a lack of data to assign values for all confidence types to be included in the analysis.

▶*Record values in column of element distribution layers*

Populate the appropriate column in the associated distribution layers with Modeled confidence values.

Record a value of 1.0 in the column if Modeled confidence is not to be used in assessing net confidence for occurrences in the project. Using 1.0 to represent this confidence will ensure that there will be no effect on net confidence calculations by excluding this type.

▶**Calculate net confidence value for each occurrence**

The net confidence associated with an occurrence is derived by multiplying together each of the values assigned for the different component confidence types, weighted as desired.

▶*Determine how component confidence types should be weighted*

Determine any weights to be used for indicating greater or lesser significance of the individual component types (i.e., Locational Precision, Presence, Map Resolution, and Modeled confidence) in confidence calculations.

▶*Calculate net confidence values*

Calculate the net confidence value for each element occurrence using the formula

Net Confidence = (Locational Precision*w1) * (Presence * w2) * (Map Resolution * w3) * (Modeled * w4)

where:

Locational Precision = Assigned value for Locational
        Precision confidence

Presence = Assigned value for Presence confidence

Map Resolution = Assigned value for Map Resolution
        confidence

Modeled = Assigned value for Modeled confidence

w1 = weight of Locational Precision confidence

w2 = weight of Presence confidence

w3 = weight of Map Resolution confidence

w4 = weight of Modeled confidence

Note that a 1.0 value should be used in this formula for any component confidence types determined to be not applicable and/or that are not to be utilized in assessing net confidence.

If there is no value, or a value of 0.0 assigned for any component confidence type to be used in the net confidence calculation, a value appropriate for unknown (e.g., 0.5, 0.2) should be used instead to insure that net confidence will not equal 0.0.

▶ *Record values in column of element distribution layers*

Populate the appropriate column in the associated distribution layers with net confidence values.

▶**Add net confidence values to Vista**

The addition of net confidence values to Vista can be deferred until viability/integrity attribute values have been assigned to distribution layers (if appropriate) so that all element information can be entered into the system at once. However, if it is desirable to input confidence values at this point in the process and distribution layers have not yet been associated with elements, the task of pointing to distribution layers must first be completed (see the task Point to Distribution Layers from Vista). Once a distribution has been associated with an element, attributes can be added using the Vista Element Properties window, specifically in the *Confidence in Distribution* group box on the Spatial tab.

▶**Document products with metadata**

The final products of the process are numerical values for net confidence ranging from 0.0 to 1.0 assigned for each occurrence.

Metadata should include documentation on the following:

- Source data used to define Locational Precision confidence (if applicable)
- Source data used to define Presence confidence (if applicable)
- Source data used to define Map Resolution confidence (if applicable)
- Source data used to define confidence values for Modeled occurrences (if applicable)
- Rationale for assigning the values for each type of confidence
- Decisions made for calculating net confidence values

Vista automates the process of producing metadata that is compliant with the Federal Geographic Data Committee (FGDC) metadata standards. See http://www.fgdc.gov for more details on metadata standards.

Data for Scenario Evaluations

LAND USE COMPATIBILITY

Objectives

The purpose of indicating element compatibility with different Land Use Intent (LUI) categories (described in Appendix F) is to permit the identification of areas within the planning region where responses to specific land uses will permit elements to remain viable or maintain ecological integrity. Element land use compatibility is evaluated using Land Use and Conservation Scenario analyses, with the user designating which responses

should count toward the achievement of conservation goals and which should not.

Products

Element compatibility is stored as an attribute associated with the LUI categories used in the project.

Inputs

Element experts assess LUI compatibility on the basis of information that can be derived from a number of sources, including academic and government studies evaluating element viability (for that specific element or related elements) in the presence of different land uses, recent surveys that have found viable populations in the presence of certain land uses, or expert opinion.

Methods Summary

Compatibility is assigned by indicating whether particular land uses will permit the element to remain viable (species) or to maintain ecological integrity (ecological elements). The customized list of LUI compatibilities can reflect a gradation of impacts for each element. LUI categories deemed compatible would permit an acceptable level of viability/integrity for the element, while land uses with decreasing compatibility would have an increasingly negative effect on the element's continued existence. For example, transmission corridors would not be compatible with most elements that comprise a forest ecosystem, but may be generally compatible with the elements of a grassland ecosystem.

Select the task below to see a detailed description of the process.

➡ Indicate land use compatibility using Vista

Background

Compatibility indicates whether acceptable levels of viability/integrity for the element are likely to occur in the presence of various land uses that may affect key ecological attributes that support the element. Scenario Evaluations are used to identify areas where compatible land uses are likely to permit the achievement of conservation goals for the element through acceptable viability/integrity, as well as areas of incompatible land uses that could be changed to improve goal attainment.

Steps in the Compatibility Assignment Process

PROCESS FOR ASSIGNING COMPATIBILITY

▶**Indicate land use compatibility using Vista**

Using the [Compatibility tab](#) on the [Element Properties window](#), indicate whether each land use intent category used in the project is compatible with continued viability/integrity of the element.

Windows for Element Data

ELEMENT IMPORT FORM

The **Element Import Form** is displayed by clicking **Project ▶ Import Element Properties from File...** from the Vista menu. The form is used to import properties from multiple elements using a shapefile containing their attributes.
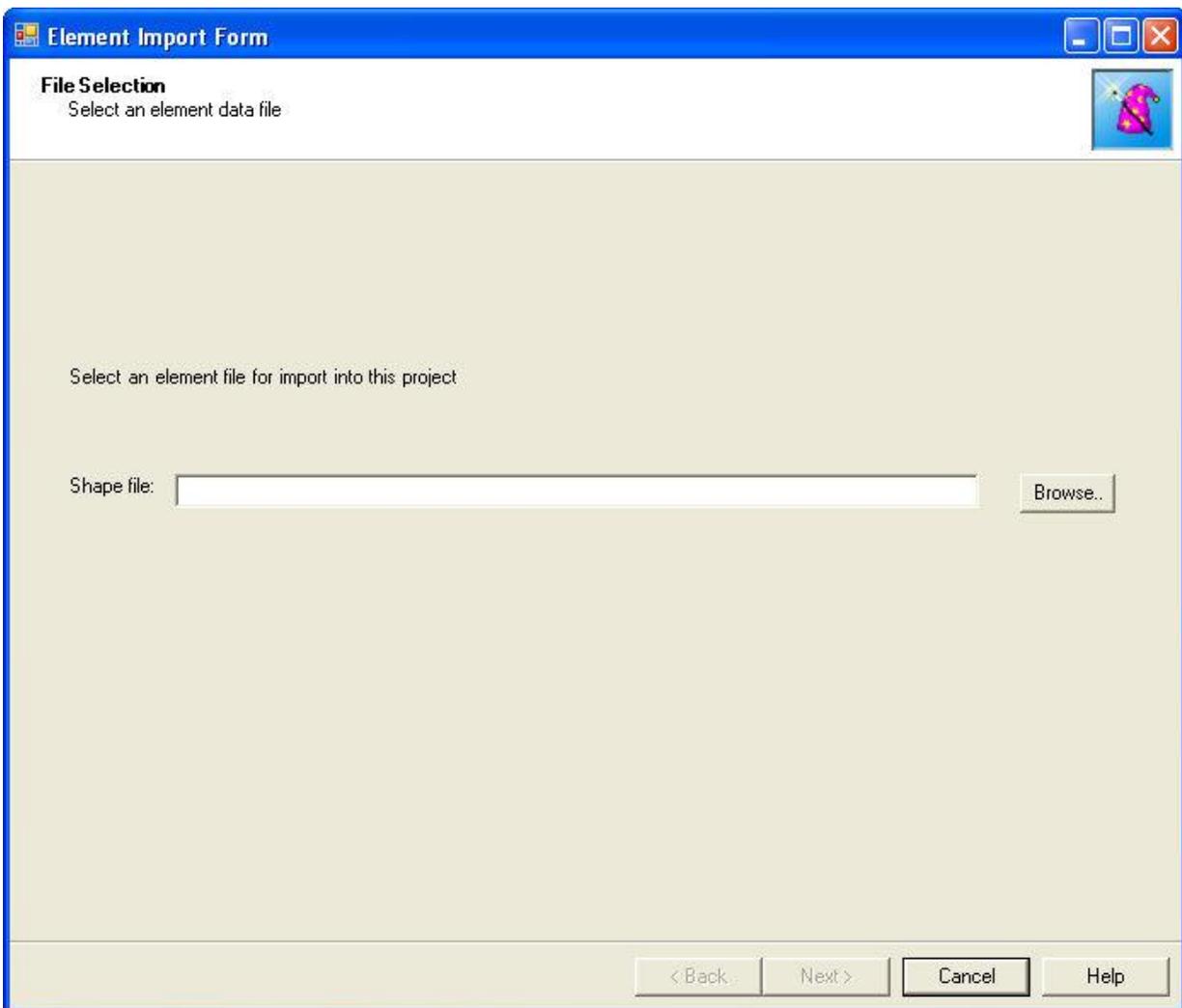
Import element properties:
1. Click the **Browse...** button to navigate to a shapefile containing one or more element distributions, select the file, and click **Open,** or alternatively, enter the name of a shapefile directly into the **Shape File** field. Click **Next>**.
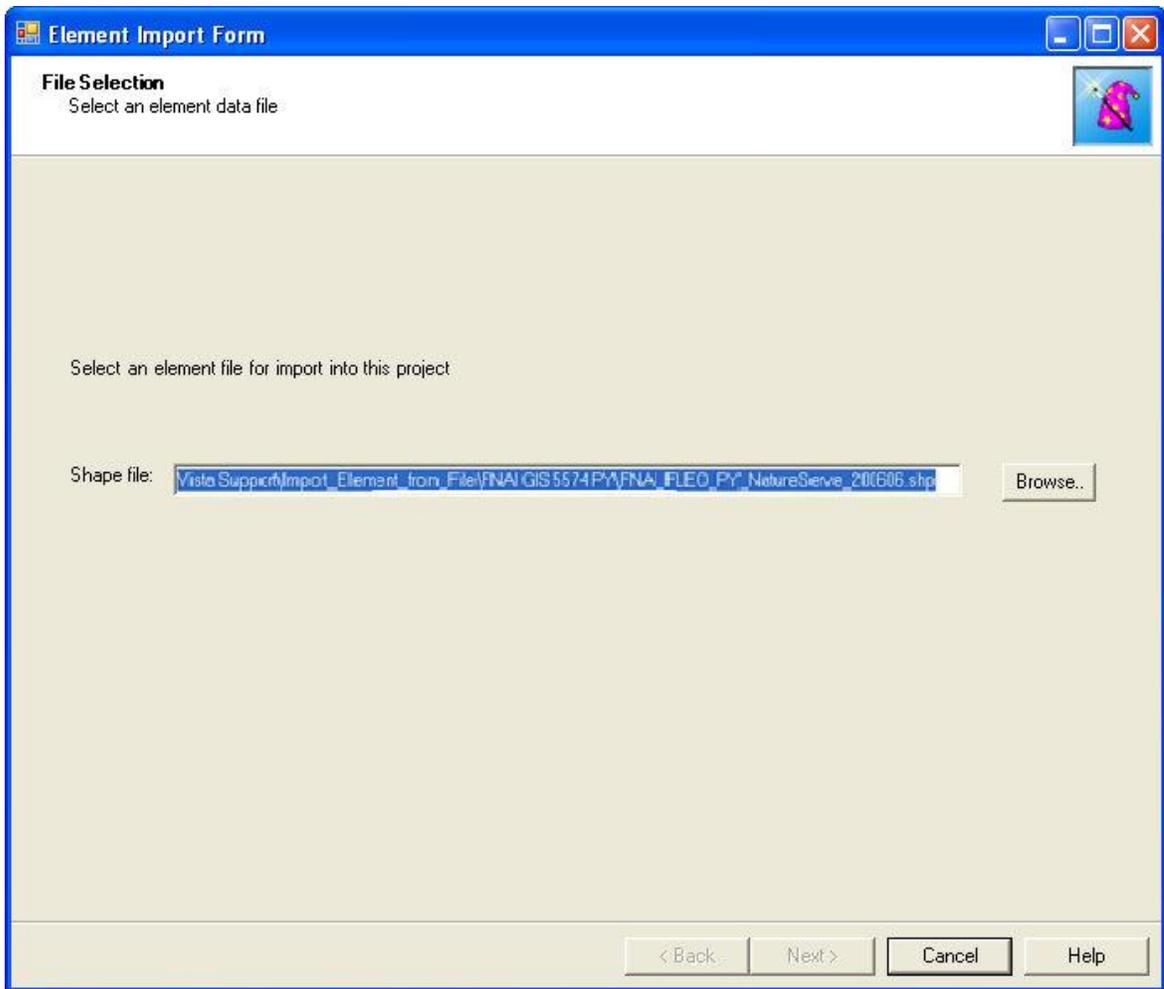
2. Edit EO rank to quality/integrity score conversions. Click **Next>**. CAM THIS IS AS FAR AS I GOT

3. Review the attributes that Vista cannot parse, and designate which to import manually. Click **Next>**.
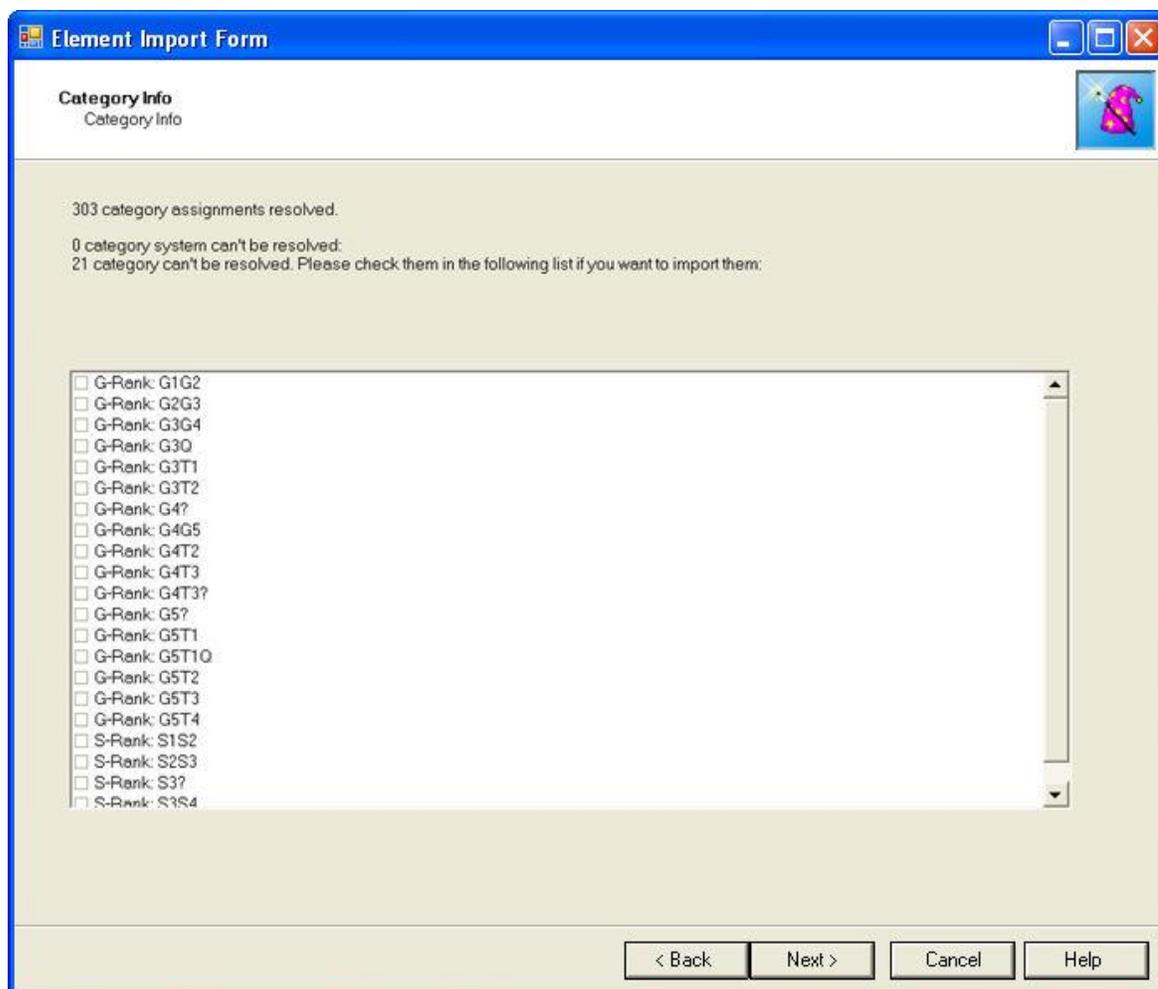
4. After the import process, separate element records will be created for each element in the shapefile. A spatial distribution layer must be specified for each element record before the element can be used in any Vista analyses. By opening the Element Properties window for each element, or by using the **Edit Multiple...** button on the Element List window, additional information can be added or edited.

5. Once the import process has completed and any related data have been entered, all of the elements must be processed by clicking the **Refresh...** button on the Element List window. See Refresh Selected Results for additional information on refreshing elements in Vista.

ELEMENT LIST WINDOW

The **Element List** window is displayed by selecting either **Lists ▸Element List...** or **Manage Elements...** from the NatureServe Vista menu. This window lists all of the elements that have been entered into Vista for use in the project. See the

[Element Selection](#) section for more detailed information on elements to be included in a project.
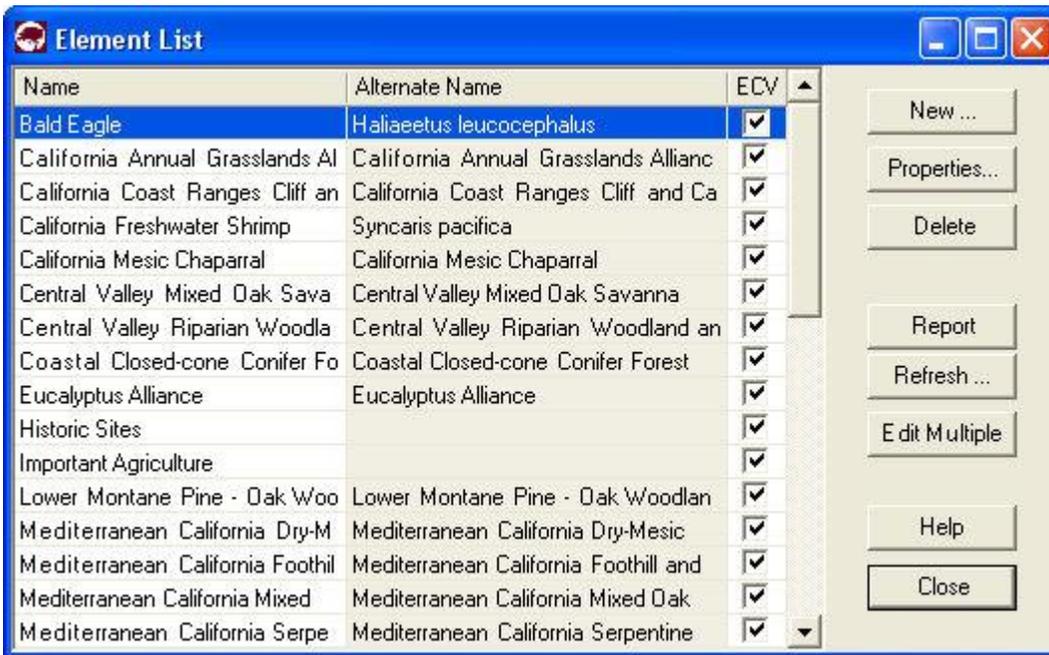
Button functions:

New... displays a new [Element Properties](#) window that can be used to add a new element to the project.

Properties... displays the Element Properties window showing details and allowing edits to the element selected in the list.

Delete deletes the element selected in the list.

A **Confirm Delete** window is displayed before the deletion is implemented, which includes information on any analytical tools and/or analyses that reference the element to be deleted, as shown in the following example.
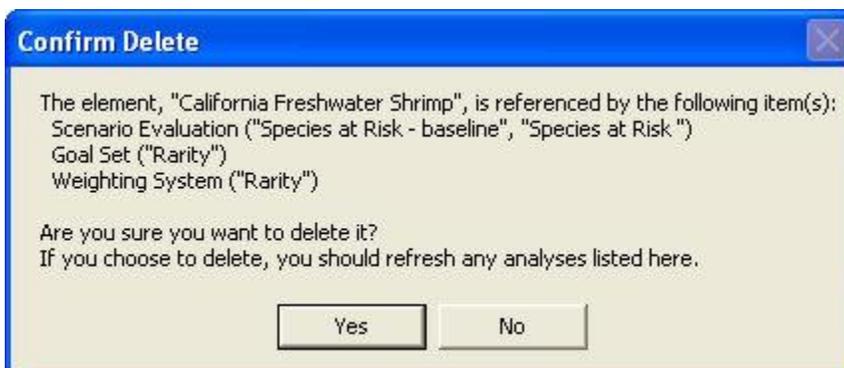
Report displays a report for the selected element that provides data related to the element, including its spatial attributes and distribution, as well as its

inclusion in category systems used in analyses. See the Reports section for more details on Element Details reports.

Refresh... displays the Refresh Selected Results window that can be used to refresh the data for selected elements.

Edit Multiple displays the Multi-Element Property Edit window that can be used to set the value for a selected property across a specified group of elements at the same time.

Help opens the on-line documentation.

Close closes the window.

Columns displayed:

Name - name of an element that will be used in Vista input windows; this is typically the common name for the element.

Alternate Name - secondary name of the element, frequently the scientific name for the element.

ECV - checkbox that indicates that an Element Conservation Value layer has been created for the element.

ELEMENT PROPERTIES WINDOW

The **Element Properties - <New>** window is displayed by either clicking the **New...** button on the Element List window or choosing **Selection ▸New Element** from the NatureServe Vista menu while an element is highlighted in the Vista Table of Contents. The new properties window is used to add a new element, along with associated distribution layers and attribute data, to the project for use in analyses.

The Element Properties window consists of four tabs for recording specific types information on elements General, Spatial, Categories, and Compatibility. Depending on the analyses to be performed, different fields may be used, and data input may occur at different times. Specifically, some of the items on the General and Spatial tabs are completed for Conservation Value analyses only, while the Compatibility tab is used strictly for Land Use and Conservation Scenario Evaluations.

Note that the 🔶 button located next to an item can be used to record additional information related to that item (see the Documentation Window topic for more details).

Add an element:

GENERAL TAB INPUT

1. Specify a name for the element in the **Name** field. Typically this will be the common name used for the element. The **<New>** on the window title will change to the name of the new element as the entry is typed in.

2. Specify another name for the element in the **Alternate Name** field. Provided that the previous Name field contains the common name for the element, this field is generally used for its scientific name.

3. Enter a web address in the **URL** (Uniform Resource Locator) field that provides information related to the element (e.g., NatureServe Explorer).

    The ⌶ button can be used to open an explorer window that goes directly to the URL entered in the field, or if there is no address specified, the explorer default window will open.

4. If the ability to edit the element data should be limited to members of the data development team, place a check in the **Restricted** checkbox.

5. Enter a brief description of the element in the Description field, if desired.

Note: If records are being created for selected elements before additional data has been obtained/developed, data entry for the remaining fields on this tab, as well as for the Spatial tab and Compatibility tab (if needed), can be deferred until distribution layers have been developed for elements (see the process for developing distribution layers), and any attributes have been assigned (see processes for assigning viability/integrity values and confidence values). It may be a more effective use of data entry time to open each element record only once

to enter all of this information at the same time, rather than repeating the process several times to enter each of these items separately.

6. Indicate whether the distribution of the element is represented by area or by distinct occurrences using the appropriate **Area** or **Occurrences** radio button.

7. Indicate whether there is a minimum size required for viability of the element in the checkbox, and if so, enter the **Minimum Size**. This minimum size value is used to exclude occurrences (i.e., 1 occurrence = 1 record in a distribution shapefile) that do not overlap with both a "compatible" land use and a "reliable" policy in Scenario Evaluation analyses, AND that fail to meet the element's condition threshold, from the total to be compared with the minimum size. If the area of the occurrence is less than the designated minimum size, the entire occurrence is not considered to be viable and is excluded from analyses.

8. Indicate whether there is a threshold for condition of the element in the checkbox, and if so, enter a value (ranging from 0.0 to 1.0, low to high threshold, respectively) for **Condition Threshold**. The condition threshold value is used to exclude data to be included in analyses on the basis of failing to meet minimum condition requirements to be considered viable. Condition threshold values specified in this field should result from running models in the system, rather than from element quality data.

9. To close the window and save the data entered in the element record click **OK**; otherwise, click **Cancel**.

SPATIAL TAB INPUT

1. Select the distribution layer for the element from the drop-down menu of the **Distribution Layer** field, or by using the 🪄 ArcCatalog button to browse to the layer. (Layers will be displayed in the drop-down menu only if the layer is the correct feature type and is included on the Display Type tab of the Table of Contents [TOC].) See the Element Distributions section for more details on distribution layers.

2. Enter a value indicating the cell size to be used for conversion. For a discussion of optimal cell size to be used for a planning project, see the Determining Grid Cell Size topic.

   Note: If Land Use and Conservation Scenario Evaluations are to be performed, the grid cell size used to create the visualization layers generated by a Scenario Evaluation is set in this field. If this cell size differs greatly from the cell size specified for the scenario used in the evaluation (set in the Scenario Properties window), the visualization layers may not overlay the scenario correctly.

If Conservation Value analyses are to be performed, data entry for the fields contained in the *Viability/Integrity* and *Confidence in Distribution* group boxes (described in the following steps 3 and 4) can be deferred until values for these attributes have been assigned (see the sections on Viability/Integrity and Confidence for details on these attributes).

3. **If Conservation Value analyses are to be performed**, indicate whether the viability/integrity value is an **attribute of the distribution**

layer for the element, or is represented by a **raster layer** using the appropriate radio button.

If a raster layer is used, select the layer from the drop-down menu associated with the raster layer, or browse to the layer using the ArcCatalog button.

See the <u>Viability/Integrity</u> section for more details on this attribute.

4. I**f Conservation Value analyses are to be performed**, indicate whether the confidence value is an **attribute of the distribution** layer for the element, is represented by a **raster layer**, or will consist of a single assigned value for all occurrences of the element, using the appropriate radio button.

If a raster layer is used, select the layer from the drop-down menu associated with the raster layer, or browse to the layer using the ArcCatalog button.

If a single value for confidence is to be used, record that value in the field next to the **Single Value** radio button.

See the <u>Confidence</u> section for more details on this attribute.

5. Select from the **Map Context** drop-down menu an existing context to be used in creating reports for the element, if any. If a map context needs to be created for the element, see the topic entitled <u>Map Context Properties Window</u>.

6. To close the window and save the data entered in the element record click **OK**; otherwise, click **Cancel**.

CATEGORIES TAB INPUT

Information on Category Systems to which an element belongs can be entered at any time once the element record has been created. Several default categories are provided in Vista, so it may be useful to indicate any of the default categories that apply initially, and then create additional categories and assign elements later as needed for developing Filters, conservation Goal Sets, and Weighting Systems, and performing analyses. To create a new category system, see the Category System Properties window section for details.

1. To specify a category system to which the element belongs, select the Category System from the drop-down list in the upper left of the window. A list of the categories within that system will be displayed below the system name.

2. Select the category to which the element belongs, and then click the **Add** button. The name of the system and category to which the element belongs will be displayed in the right pane of the window.

3. Repeat the system/category selection and add process to specify additional categories as needed.

4. To delete an element from a category system, select the system and category in the right pane and click the **Del** button.

5. To close the window and save the data entered in the element record click **OK**; otherwise, click **Cancel.**

COMPATIBILITY TAB INPUT

An indication of the degree to which implementation of a specific Land-use Intent (LUI) category (described in Appendix F) is compatible with an element - that is, will permit the element to persist - is recorded using this window. More specifically, implementation of compatible LUIs will permit a species to remain viable or an ecological element to maintain ecological integrity. Scenario Evaluations, used to assess element compatibility with various land use scenarios in terms of meeting conservation goals, are dependent upon these compatibility assignments for accurate results, so it is strongly recommended that only experts on the element assign compatibility. Any decisions related to

compatibility should be recorded (using the ⬦ button to access the associated Documentation Window) to allow peer review and/ or legal review.

For more details on compatibility, see the Land Use and Conservation Scenario Evaluations section.

1. **If Land Use and Conservation Scenario Evaluations are to be performed**, indicate the degree to which the element is compatible with each of the NatureServe Vista LUI categories by clicking on the LUI to be assigned, and selecting the appropriate compatibility response from the list in the column to the right.

   Assigning a response value to a major LUI category (e.g., "Maintain Primarily for Natural Values") will cause the system to automatically assign the entire category the same value (i.e., both the major category name and

all of its associated child [minor] categories). However, assigning a compatibility response for a minor category LUI (e.g., "Biodiversity conservation") will not cause any other items in the category to be automatically designated.

2. To edit or add a new value to the list of compatibility responses, click the **Responses...** button to open the Compatibility List window.

3. To close the window and save the data entered in the element record click **OK**; otherwise, click **Cancel**.

Edit Element Information:

Element properties can be edited either individually, or for multiple elements simultaneously, as described below.

Edit an individual element:

1. Navigate to the Element Properties window populated with existing data for the element by either right-clicking the element name in the NatureServe Vista table of contents and selecting **Element Properties..**. from the resulting menu, or by clicking **Manage Elements...** from the Vista menu, selecting the element in the Element List window that opens, and clicking the **Properties...** button. The resulting properties window displays data for the element.

2. Edit element properties data using the processes described above for adding an element as guidelines. More detailed descriptions of elements and related data can be found in the Element Selection, Element Distributions, Viability/Integrity Attributes, and Confidence Attributes sections.

3. To close the window and save any changes made to the element record click **OK**; otherwise, click **Cancel**.

Edit multiple elements:

1. Click **Manage Elements...** from the Vista menu to open the Element List window, and click the **Edit Multiple...** button to set property values for a designated set of elements simultaneously. See the Multi-Element Property Edit window for details on the process for editing properties for a group of elements.

MULTI-ELEMENT PROPERTY EDIT WINDOW

The **Multi-Element Property Edit** window, displayed by clicking the **Edit Multiple...** button on the Element List window, is used to set values for a selected group of elements simultaneously.
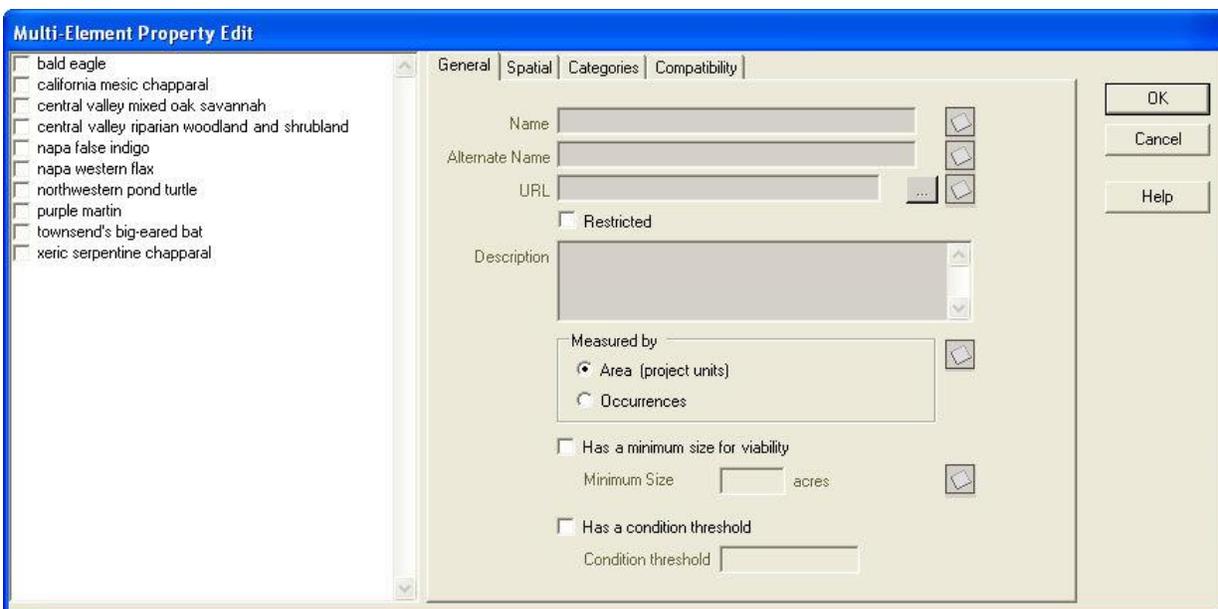
Edit properties for multiple elements:

1. Select the set of elements that is to be assigned the same values for specific properties by clicking either on each element to be included or on the checkbox for each of these elements.

2. Choose the appropriate tab(s) that contain properties to be changed for the designated group of elements. You will notice that the attributes that can be edited are limited, with many "grayed out" and unavailable. In addition, there are no values displayed in any of the fields that can be edited, even if the existing values for the selected elements are the same to begin with. Properties that can be edited for the designated set of elements simultaneously are as follows:

On the **GENERAL** tab, can edit:

> Measured by Area or Occurrences
>
> Has a minimum size for viability
>
> Minimum Size
>
> Has a condition threshold
>
> Condition threshold

On the **SPATIAL** tab, can edit:

> Viability/Integrity - Attribute of Distribution or Raster Layer
>
> Map Context

On the **CATEGORIES** tab all Category Systems can be edited

On the **COMPATIBILITY** tab element compatibility can be edited

3. Edit properties in the records of the selected elements simultaneously by clicking the appropriate radio buttons or checkboxes, entering values, and/or choosing values from drop-down menus for any properties that are to be set to a single value for these elements. Guidance for editing elements is provided in the processes described for adding new elements using the Element Properties window.

4. To close the window and save the edits made in the records of each of the selected elements simultaneously, click **OK**; otherwise, click **Cancel**.

REFRESH SELECTED RESULTS WINDOW

The **Refresh Selected Results** window can be opened several ways, depending on the item(s) to be refreshed.

- To display the Refresh Selected Results window listing all items that can be refreshed in the project (that is, elements, Conservation Value Summaries (CVS), and Scenario Evaluations, seen by scrolling down the list), click **Refresh Results...** from the NatureServe Vista menu.

- To display the Refresh Selected Results window listing only elements in the project to be refreshed, click the **Refresh...** button on the Element List window, or right-click on the major heading "Elements" on the NatureServe Vista tab in the Table of Contents (TOC) and choose **Refresh Results...** from the context window.

- To display the Refresh Selected Results window listing only CVS in the project to be refreshed, click the **Refresh...** button on the Conservation Value Summary List window.

- To display the Refresh Selected Results window listing only scenarios and Scenario Evaluations in the project to be refreshed, click the **Refresh...** button on the Scenario List window or the Scenario Evaluation List window, or right-click on the major heading "Evaluations" on the NatureServe Vista tab in the TOC and choose **Refresh Results...** from the context window.
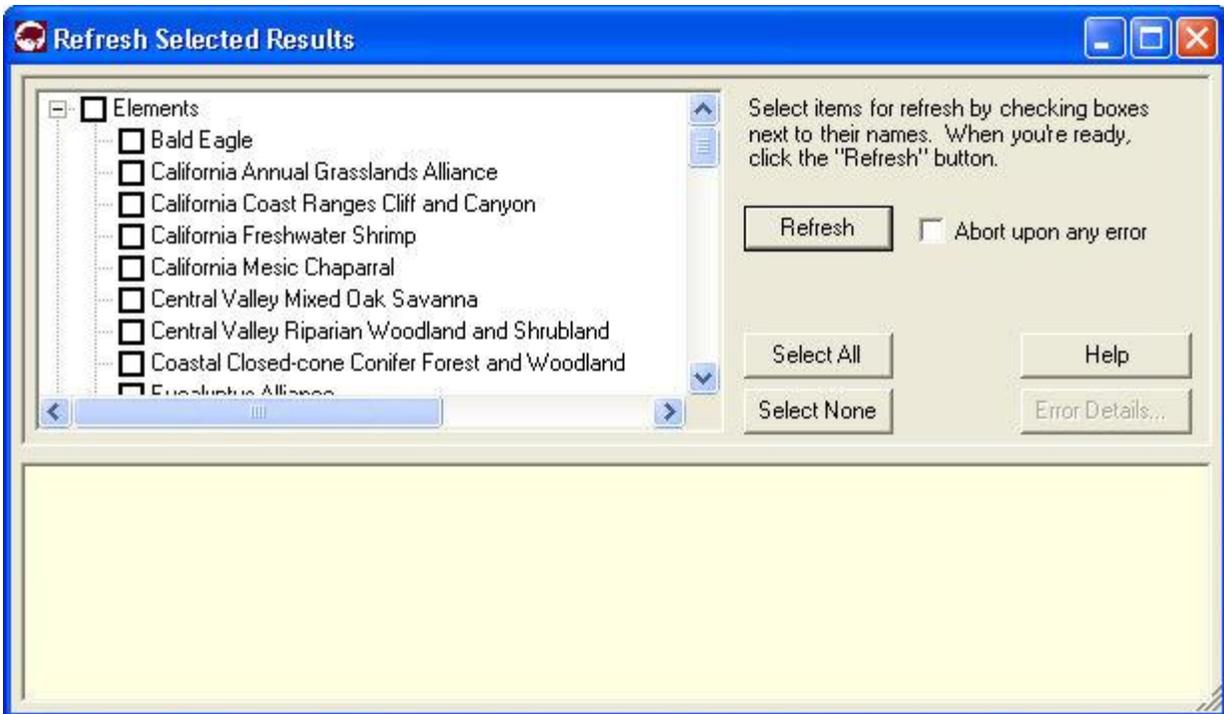
Refresh data:

1. Indicate which data are to be refreshed by using the check-box(es) associated with the element(s) and/or project analyses. The **Select All** button can be used to select the entire list of items; using the **Select None** button will de-select any items that have been selected.

2. Indicate whether the refresh process should be cancelled if an error should occur using the **Abort upon any error** checkbox.

3. Click the **Refresh** button to begin the data refresh process.

If the refresh process completes without errors, the following message is displayed:

If an error occurs during the refresh, the following message will be displayed

and an error log will be displayed in the lower half of the Refresh Selected Results window.
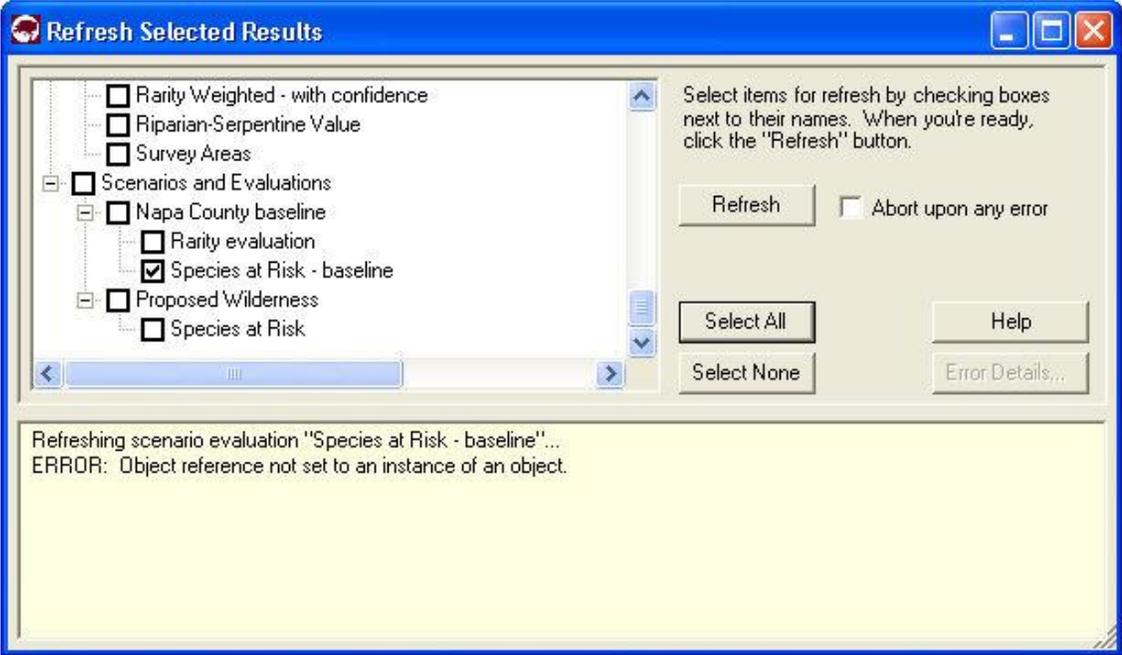
If more detailed information on the error(s) encountered is desired, click on the error log and then click the **Error Details...** button to display an Error Detail window.

_____

Note that elements, CVS, and Scenario Evaluations in the project can be refreshed *without* opening the Refresh Selected Results window. To accomplish

this, right-click on a single element or analysis on the NatureServe Vista tab of the Table of Contents and select **Refresh Result** from the context menu. A Confirm Processing window will be displayed.
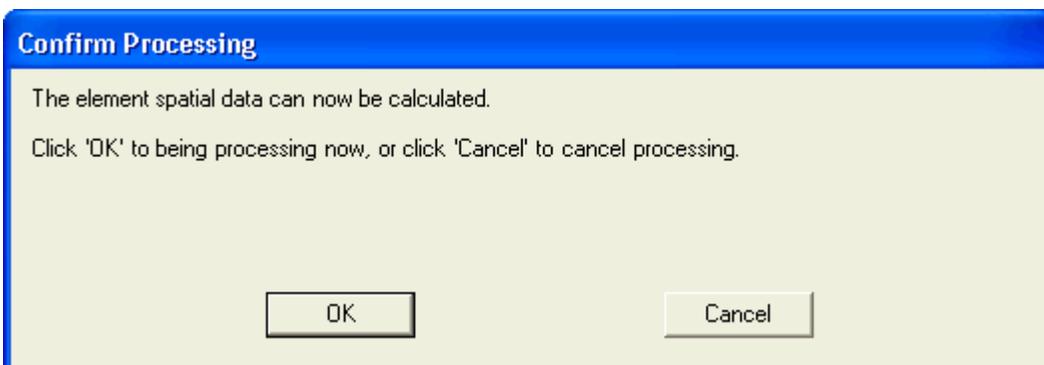
Click **OK** to continue with the refresh process; otherwise, click **Cancel**.

Scenarios in the project can also be refreshed *without* opening the Refresh Selected Results window. To accomplish this, right-click on a single scenario on the NatureServe Vista tab of the Table of Contents and select **Refresh Result** from the context menu. A Refresh Evaluations? window will be displayed.
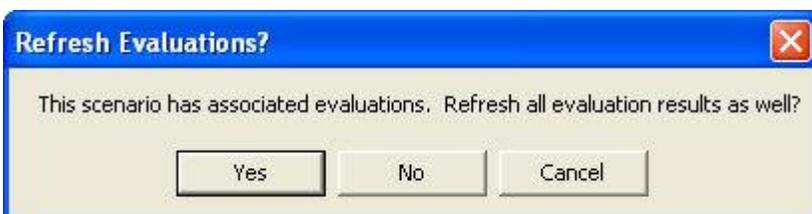
Click **Yes** to refresh both the scenario as well as any Scenario Evaluations that utilize the scenario; click **No** to refresh only the scenario; otherwise, click **Cancel**.

VISTA ELEMENT IMPORT WINDOW

The **Vista Element Import** window is displayed by clicking **Project ▸ Import Element Properties from Web Service...** from the Vista menu, and is used to import properties from multiple elements using NatureServe Web Services.

<u>Import element properties using a web service:</u>

1. If the web service location is not populated automatically, enter: https://services.natureserve.org/idd

2. Select the desired values from the Nation and State drop-down menus.

3. Using the Name Search field, enter the name or part of the name of an element whose properties are to be imported, and click **Search Service**. Note that either common or scientific names can be used in the search. Note also that the wildcard "r;*" is permitted for searches, but caution is recommended as its use may result in a longer search time before results are returned.

    When the search has completed, the results will be displayed as a list of species in the **Available:** field. The listed species can be displayed by using **Common Name** or by **Scientific Name** by selecting the appropriate radio button in the **View Elements By** area.
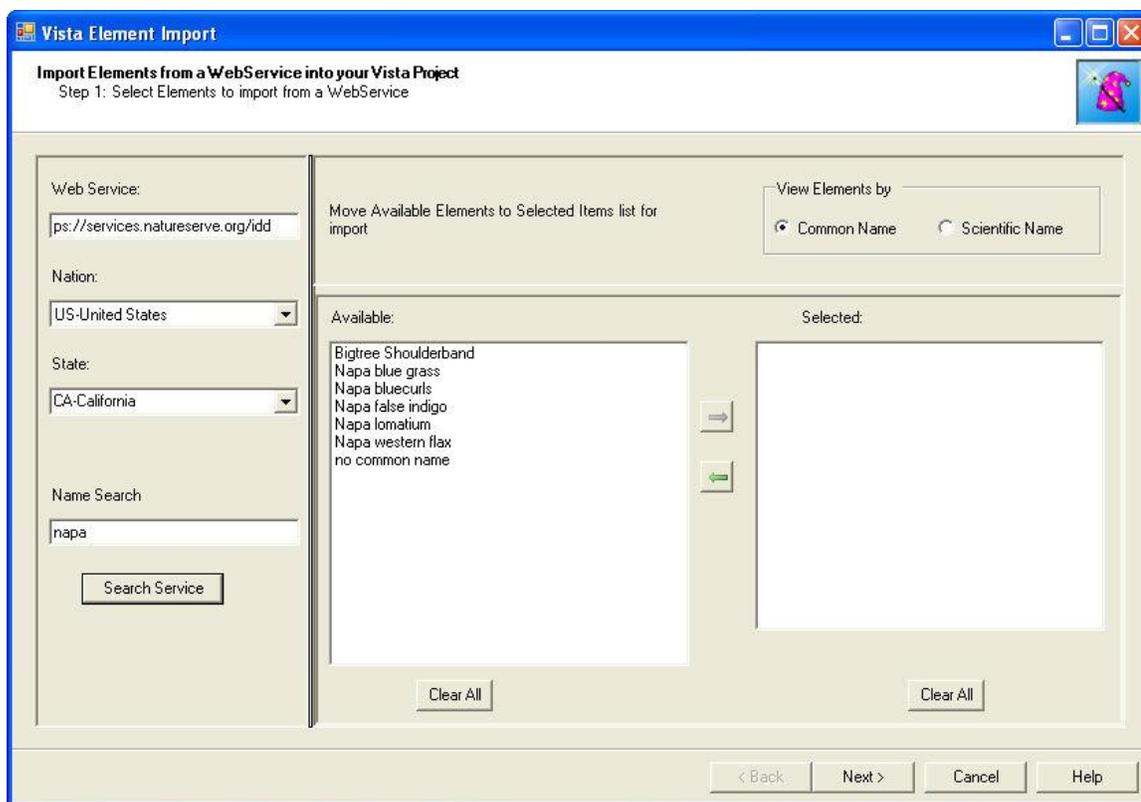
4. Select one or more elements to be imported, and click the ⇒ button. Multiple elements can be selected together using <Control>-Click, and a range by using <Shift>-Click.
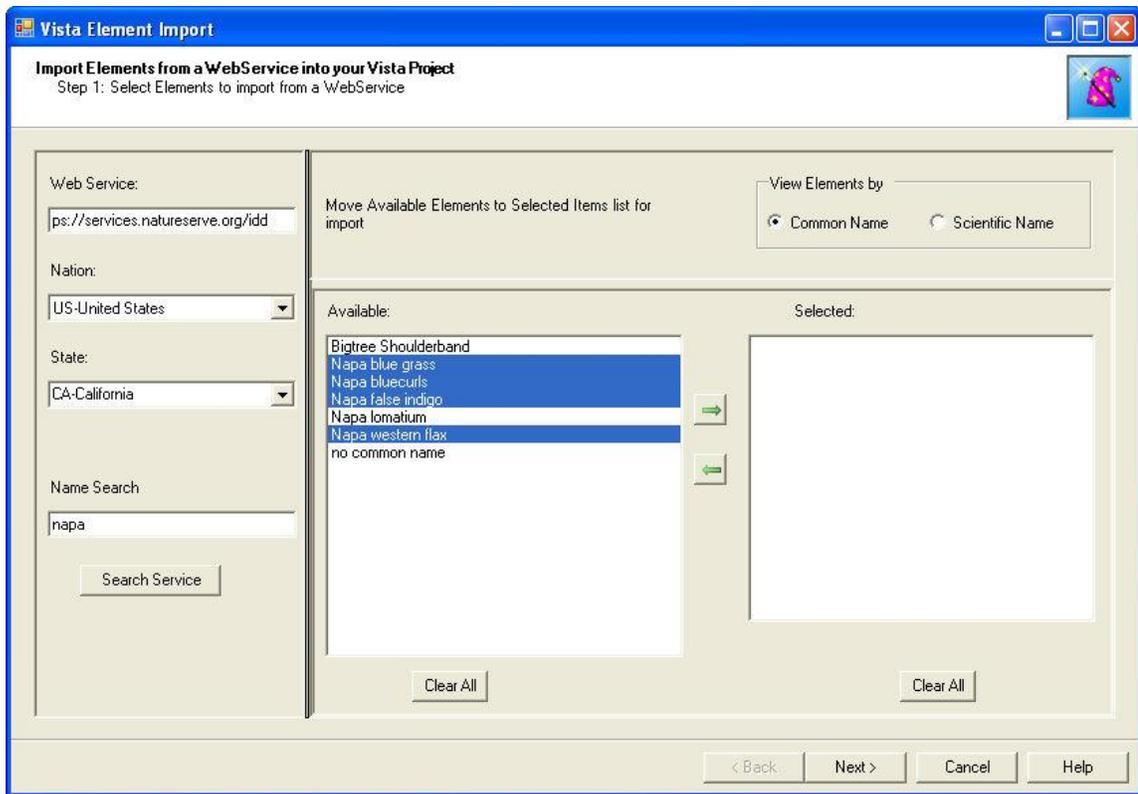
Elements selected for import will be displayed in the **Selected:** list.
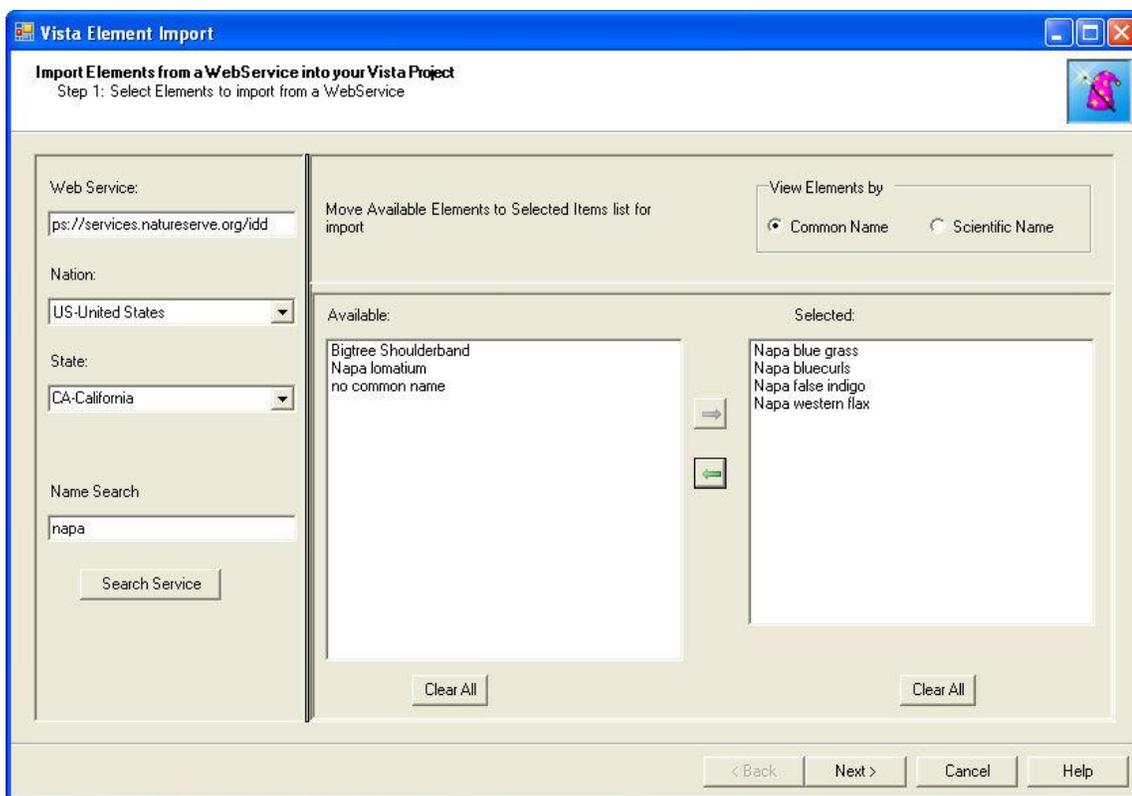
5. Repeat the process from step 4 until all the elements in the **Available:** list that are to be imported have been moved to the **Selected:** list.

   To de-select an element from the list to be imported, click on the element in the **Selected:** list and use the ⬅ button to move the element back to the **Available:** list.

   To re-start the selection process over at any point, click the **Clear All** button under the **Selected:** list.

6. To begin a new search for available elements, click the **Clear All** button under the **Available:** list. Repeat the search process from step 3 and then the selection process in step 4.
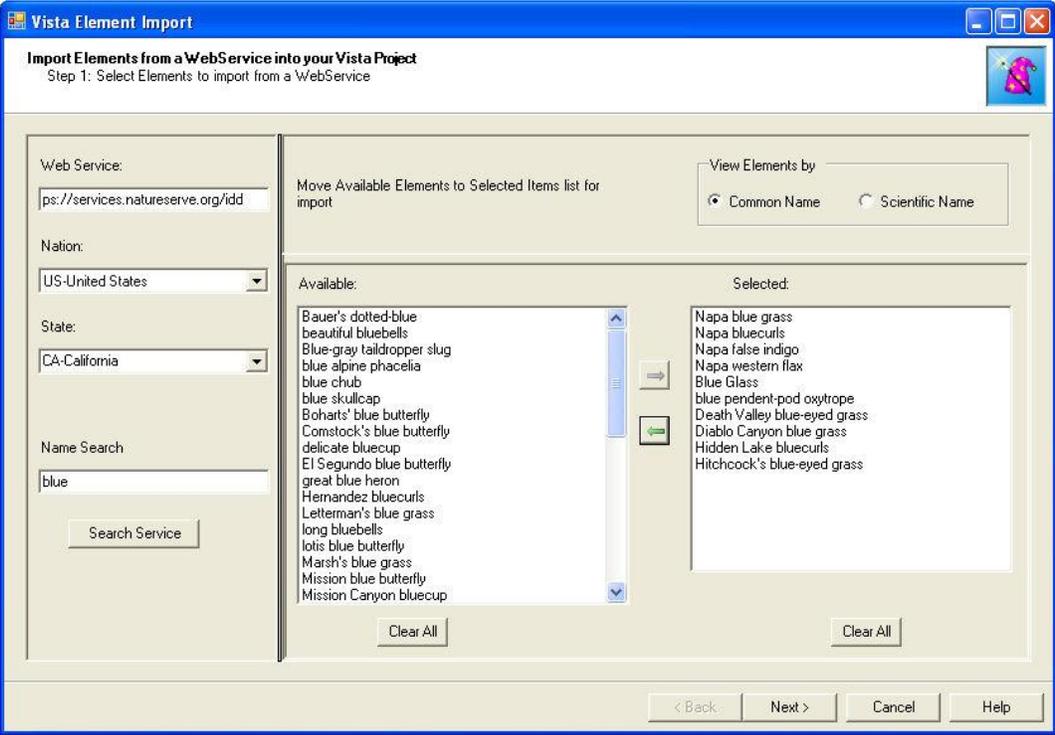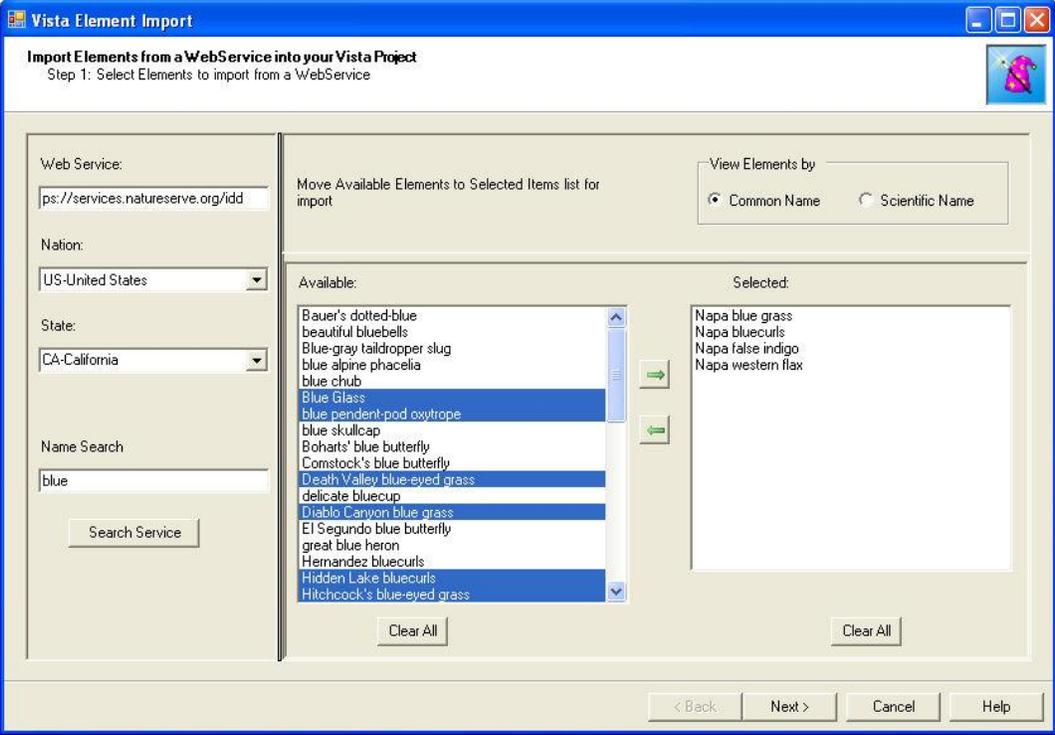
7. When the **Selected:** list contains all of the elements to be included for the properties import, click **Next>**. The data for these elements will be transferred from the web service, and a Category Info report

displayed in an Element Import Form, which provides the status of assignments to Category Systems, specifically whether both the Element Type category and G-Rank category systems have been resolved and assigned for each of the elements.

Note: This Vista Element Import window has changed at this point in the process to one labeled with the same name as the Element Import Form utilized in Vista to import element properties using a shapefile rather than a web service.
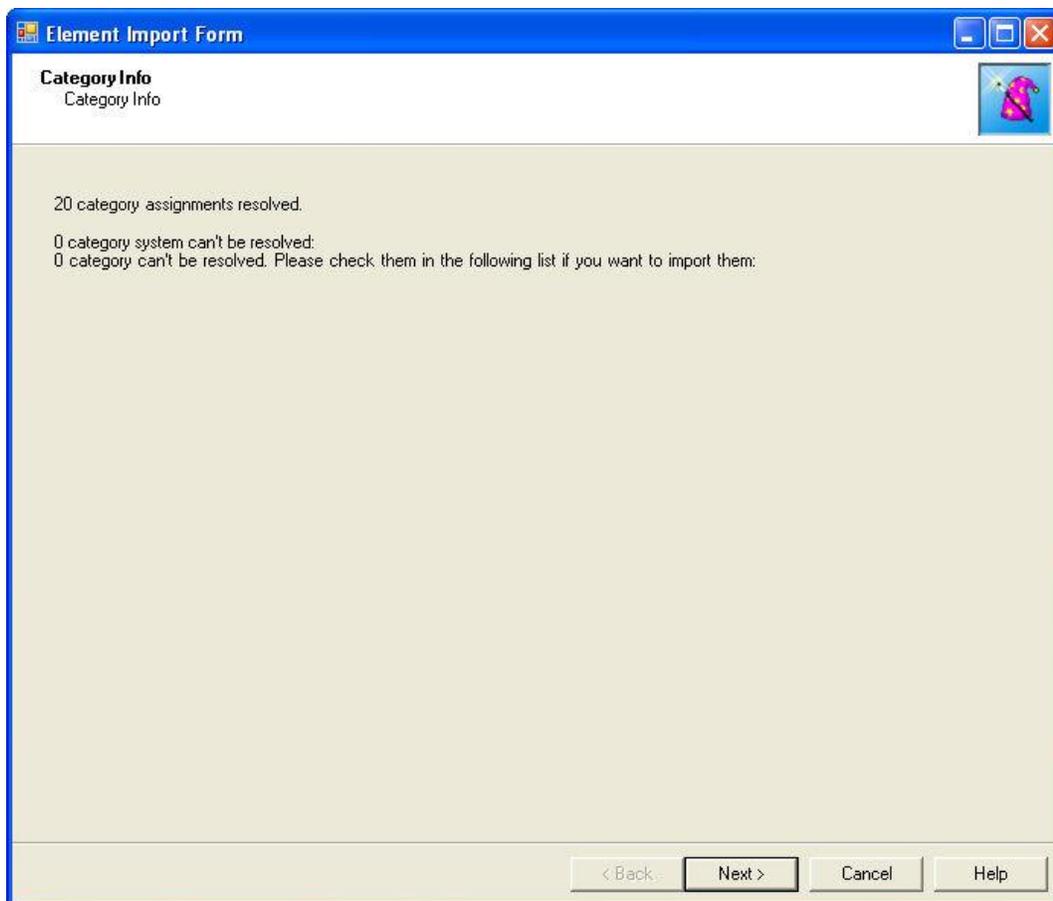
8. Click **Next >**. The system will display a list of the elements transferred.
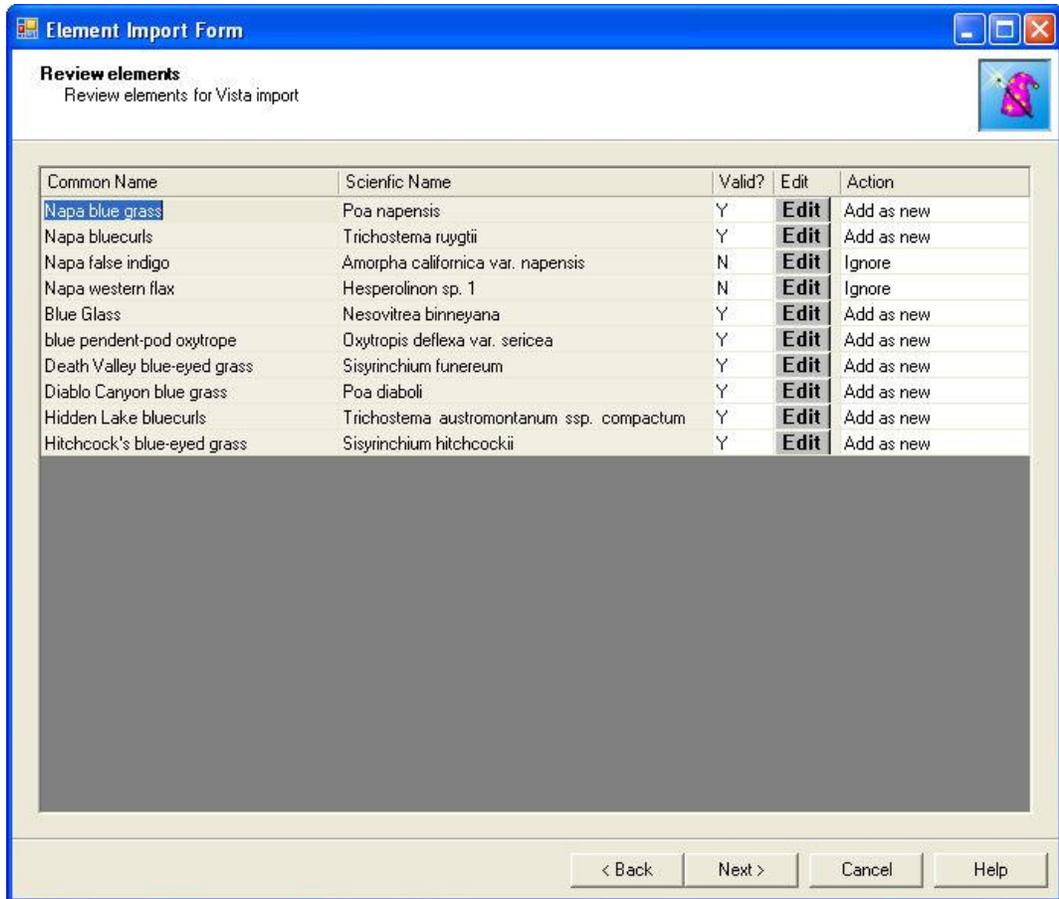
9. Review the elements and attributes that were transferred, and, if desired, perform either or both of the following:

- For any element transferred that lacks an associated valid category, specify or modify a category system by clicking **Edit** and making changes on the Categories tab of the Element Properties window that opens;

- Change the displayed value in the **Action** column using the drop-down menu property in the element list, if appropriate, as follows:

  o **Add as new** will import the element (not previously existing) and associated properties as a new element in the project;

  o **Ignore** will cause the element and associated properties to not be imported into the project;

  o Only in cases when the Action initially displayed is **Ignore**, selecting the additional option to **Overwrite existing element** will result in replacement of that element and associated attributes already existing in the project with the imported element and properties data.
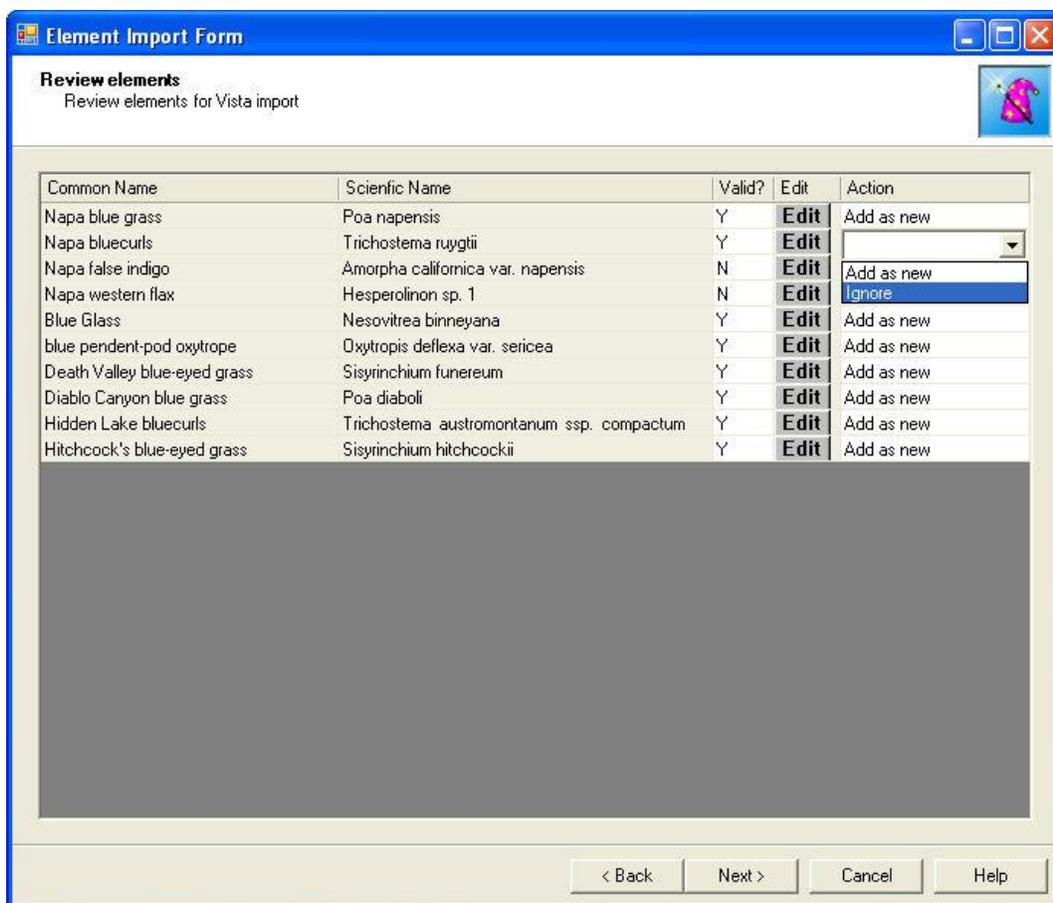
10. Once all desired changes to the elements have been made, click **Next>** to complete the element properties import process. The designated elements and associated properties will be imported into the Element Properties window and a final status report of the import will be shown. (In the example below, 2 of the 10 elements selected for properties import had an Action value of **Ignore**, and the remaining 8 were labeled with the **Add as new a**ction.)
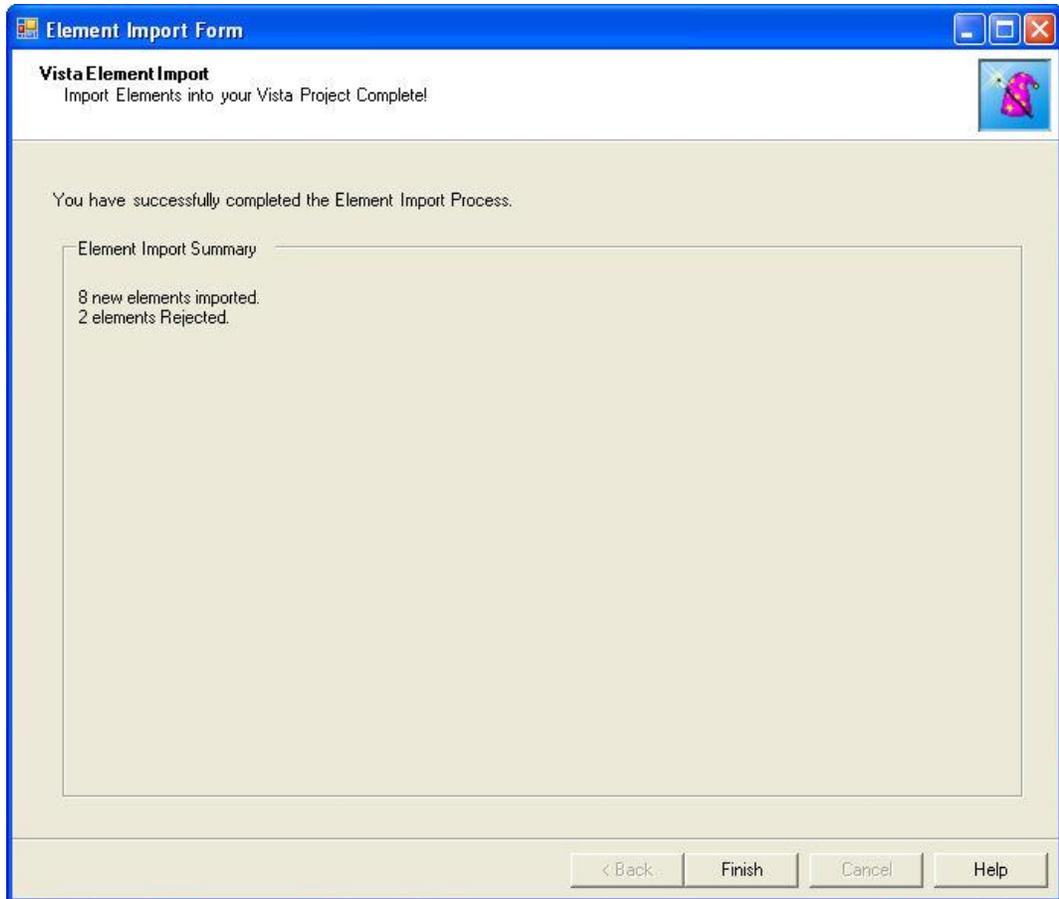
11. Click **Finish** to close the import window.

EDIT LAND-USE INTENT WINDOW

The **Edit Land-use Intent** window is displayed by selecting **Lists ▸Land Uses List...** from the NatureServe Vista menu. This window displays the default Vista land use intent (LUI) categories (described in Appendix F), which are utilized in land use and conservation Scenario Evaluations.

This window is used to customize the LUI categories in order to better capture the important conservation impacts of specific land uses and/or management practices in the planning region. LUI categories are used specifically in assigning land use compatibility for elements (described under the Compatibility tab section of the Element Properties window), and for developing translators that are used to define land use scenarios (described in the Translators section, with details on creating translators found in the Translator Properties window topic).
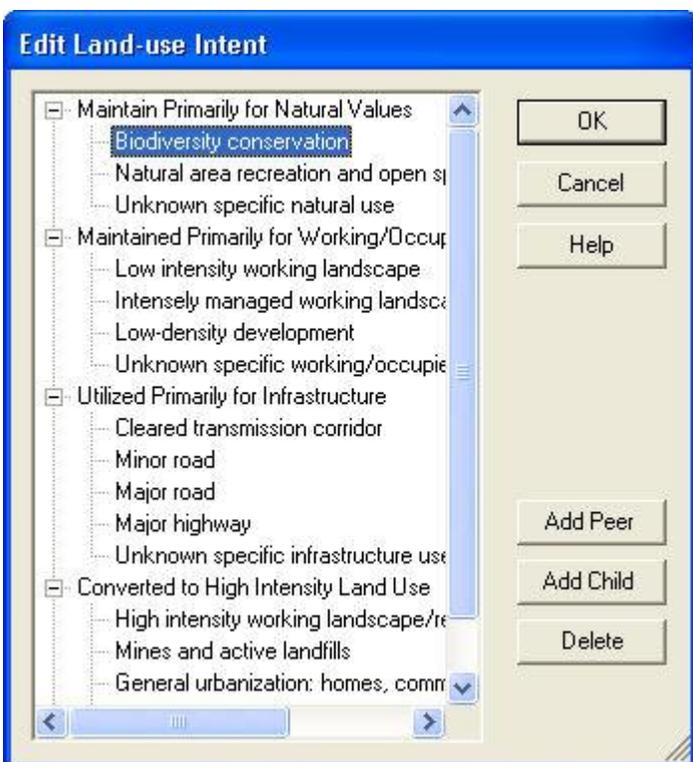
Button functions:

OK saves changes made to the LUI categories and closes the window.

Cancel closes the window without saving any changes made to the LUI categories.

Help opens the on-line documentation.

Add Peer adds a new LUI category at the same hierarchical level as that of the selected land use. The new category will appear as a new entry at the end of existing LUI categories at that level, and can then be labeled as desired. In the following example, selecting the minor category "Biodiversity conservation" and clicking the **Add Peer** button will result in a new LUI category at the same level, added after those already existing beneath the "Maintain Primarily for Natural Values" major category to which it belongs.
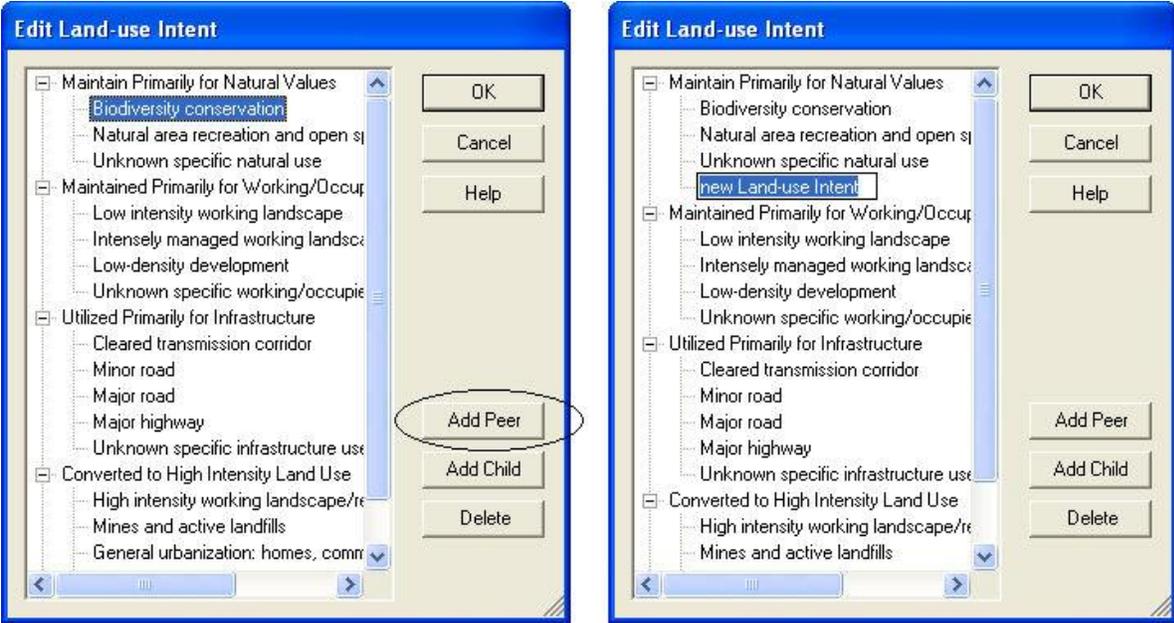
Add Child adds a new LUI category within, or under, the hierarchical level of the selected land use. The new category will appear as a new entry at the end of any existing child categories beneath the selected category, and can then be labeled as desired. In the following example, selecting the LUI category "Unknown specific natural use" and clicking the **Add Child** button will result in a new child land use category within/under that selected LUI.
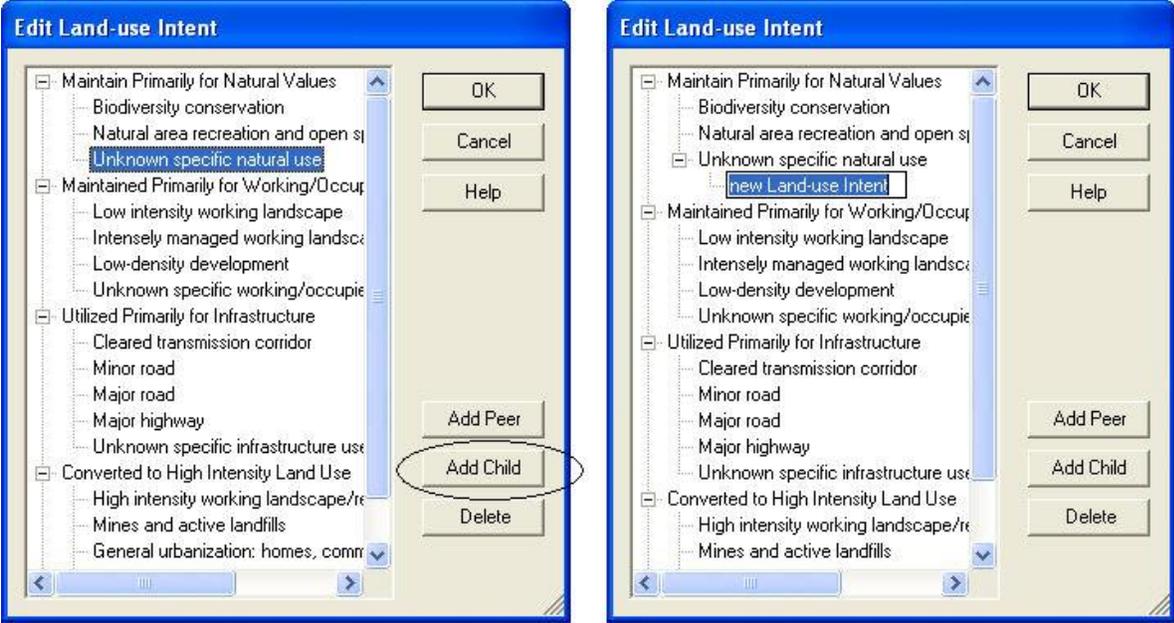
Delete deletes the land use category selected in the LUI hierarchy.

A **Confirm Delete** window is displayed before the deletion is implemented. In cases when the LUI selected for deletion contains child (minor) categories, the **Confirm Delete** window informs the user so that inadvertent deletion of these subcategories can be avoided.

A **Cannot Delete** window is displayed in cases when the LUI category is referenced by one or more items, as shown in the following example.

EDIT COMPATIBILITY RESPONSE WINDOW

The **Edit Compatibility Response** window is displayed by clicking the **New...** or **Properties...** buttons on the Compatibility List window, and is used to create and edit Land Use Intent (LUI) compatibility responses used for Scenario Evaluations. For more details on compatibility, see the Land Use and Conservation Scenario Evaluations section.
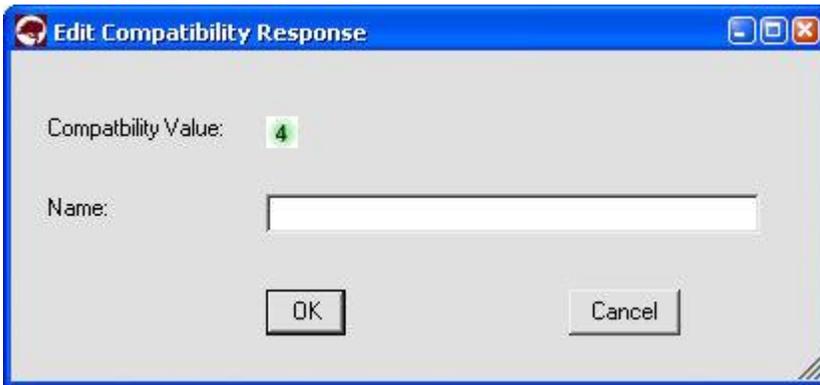
Create a compatibility response:

1. When the Edit Compatibility Response window opens to create a new response, the next numeric compatibility value to be associated with a compatibility response is automatically displayed. Enter the label for the new response in the **Name** field.

2. To close the window and save the new compatibility response, click **OK**; otherwise, click **Cancel**.

Edit a compatibility response:

1. Select the compatibility response to be changed on the Compatibility List window and click the **Properties...** button. The resulting edit window displays the response name and sequential numeric value.

2. Edit the label for the response as desired in the Name field.

Note: The numeric compatibility value cannot be edited in this window. However, this sequential value will automatically change for a particular compatibility response by changing the order of the responses using the **Up** and **Down** buttons on the Compatibility List window.

3. To close the window and save any changes made to the compatibility response click **OK**; otherwise, click **Cancel**.

COMPATIBILITY LIST WINDOW

The **Compatibility List** window is displayed by clicking the **Responses...** button on the Compatibility tab of the Element Properties window, and is used to create and edit the set of Land Use Intent (LUI) compatibility responses used for Scenario Evaluations. For more details on compatibility, see the Land Use and Conservation Scenario Evaluations section.

Button functions:

New... displays an Edit Compatibility Response window that can be used to develop a new compatibility response to be used in the project analyses.

Properties... displays the <u>Edit Compatibility Response window</u> showing details of existing compatibility responses and allowing edits to the response selected in the list.

Delete deletes the compatibility response selected in the list.

A window is displayed in cases when the compatibility response is assigned to one or more LUI categories in the <u>Element Properties window</u> and cannot be removed.

Up Moves the selected compatibility response higher in the list of responses, and changes the associated sequential number accordingly. The resulting order of responses is displayed on the Compatibility tab of the <u>Element Properties window</u>.

Down Moves the selected compatibility response lower in the list of responses, and changes the associated sequential number accordingly. The resulting order of responses is displayed on the Compatibility tab of the <u>Element Properties window</u>.

Help opens the on-line documentation.

Close closes the window.

Columns displayed:

Name – name of the compatibility response.

Compatibility Value – sequential number associated with a particular compatibility response.

DELETE LAYER?

Message displayed by Vista when the layer used to represent an element's distribution, specified on the <u>Spatial tab</u> of the <u>Element Properties window</u>, has been changed to one that is invalid for use in calculating an <u>Element Conservation Value</u> layer.
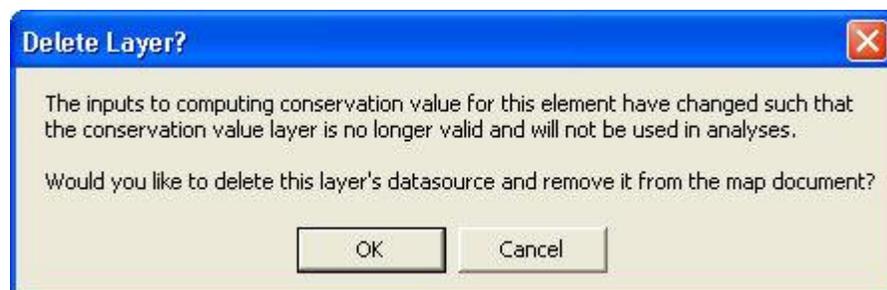
Button functions:

OK &endash; deletes the distribution layer associated with the element and remove it from the map document.

Cancel &endash; closes the window without retaining any changes.