

DEVELOPMENT OF A CATEGORIZED LIST OF INVASIVE NON-NATIVE PLANTS THAT THREATEN WILDLANDS IN ARIZONA

Final Report of the Arizona Wildlands Invasive Plant Working Group

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EXECUTIVE SUMMARY

Invasive non-native plants, especially those that alter ecological processes such as fire and hydrologic regimes, are a significant threat to Arizona's wildlands. Federal and state noxious weed lists, however, are concerned primarily with agricultural pests that in some cases are not yet in the state. As a result, these regulatory lists do not provide land managers and other stakeholders with a complete picture of those non-native plants that can impact native species, plant and animal communities, and ecosystems. What is needed is objective information that identifies and distinguishes those non-native plants that can invade an area and cause adverse ecological impacts from those non-native plants that, at least based on current knowledge, are relatively innocuous.

To address the above need the Arizona Wildlands Invasive Plant Working Group (AZ-WIPWG) was formed, a partnership of over 20 agency, academic institutions, and non-governmental organizations that included the participation of at least 70 individuals state-wide. The AZ-WIPWG was truly an example of multiple organizations partnering and sharing resources to accomplish a mutual goal. In times of limited resources, these types of partnerships are invaluable. This report documents the process and results associated with an approximately two and half-year year project by the AZ-WIPWG to develop a categorized list of invasive non-native plants that threaten wildlands in Arizona.

Individual plant assessments were based on the "Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands" (hereafter referred to as the Criteria; Warner and others 2003), which is an evaluation protocol developed by representatives from Arizona, California, and Nevada. The AZ-WIPWG set the priorities for which plants were to be assessed using the Criteria from among the 100s of non-native plants that occur in the state, and it implemented a comprehensive review and oversight process that ensured a consistent and objective evaluation of each non-native plant considered. To be evaluated a non-native plant species had to be established in Arizona's wildlands (that is, within lands and waters that support native ecosystems). To further establish credibility, an additional review was conducted by a panel of experts on about two-thirds of the assessments to again ascertain whether the Criteria was applied in a consistent manner. A total of 74 non-native plant taxa were assessed.

Application of the Criteria results in assigning scores to 13 questions divided into three sections—ecological impacts, invasiveness, and ecological amplitude and distribution—and the assignment of an overall score (or rank) of **High**, **Medium**, or **Low**. If current available information was inadequate to enable a sufficient assessment or the sum of effects (score results) were below the threshold for assigning a **Low** score, then the taxon was designated **Evaluated but not listed**. Any plant receiving a **High**, **Medium**, or **Low** ranking is considered to have some degree of negative ecological impact. Taxa with an overall score of **High** or **Medium**, but whose current ecological amplitude and distribution are limited, also received an **Alert** designation. Finally, the AZ-WIPWG included an additional designation not identified in the Criteria referred to as a **Red Flag**. This designation was assigned to a plant when the AZ-WIPWG felt it was important to communicate information not evident in the overall ranking.

The resultant categorized list of Invasive Non-Native Plants That Threaten Wildlands in Arizona consists of:

- Nineteen (19) plants ranked as **High**: These species have severe ecological impacts on ecosystems, plant and animal communities, and vegetational structure; invasiveness attributes are conducive to moderate to high rates of dispersal and establishment; and species are usually widely distributed, both among and within ecosystems/communities.
- Forty (40) plants ranked as **Medium**: These species have substantial and apparent ecological impacts on ecosystems, plant and animal communities, and vegetational structure; invasiveness attributes are conducive to moderate to high rates of dispersal, often enhanced by disturbance; and ecological amplitude (diversity of ecosystems/communities) and distribution (within an ecosystem/community) range from limited to widespread.
- Twelve (12) plants ranked as **Low**: These species have minor yet detectable ecological impacts; invasiveness attributes result in low to moderate rates of invasion; ecological amplitude and distribution are generally limited, but the species can be problematic locally.

Three (3) plants received an **Evaluated but not listed** designation, nineteen (19) plants were designated **Alert** species, and twenty-one (21) plants were assigned a **Red Flag** annotation. Of the 74 taxa evaluated, 22 were in the family Poaceae and 14 were in the family Asteraceae (49% of the total taxa assessed), which is similar to other reported values in the literature for this type of assessment. In addition, 28 (38%) of the taxa evaluated are used in some aspect of the commercial plant trade.

The categorized list is advisory and, as a result, is non-regulatory. Some of the intended uses of the list are to: (1) be a tool for land managers to assist in setting priorities, allocating resources, and developing and justifying management strategies; (2) educate a variety of stakeholders about the ecological impacts and distribution of specific non-native plants; and (3) modify public and industry behavior regarding particular plants that adversely impact wildlands and may be sold commercially. Because of the presence of a significant number of commercial species on the list, an important future need is to work with affected industries to develop non-invasive plant alternatives.

The AZ-WIPWG recognizes that the list should be updated periodically as new information is acquired about a currently listed species' behavior in wildlands or as additional non-native plants become established in Arizona's wildlands.

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DEVELOPMENT OF A CATEGORIZED LIST OF INVASIVE NON-NATIVE PLANTS THAT THREATEN WILDLANDS IN ARIZONA

This report summarizes the efforts of the Arizona Wildlands Invasive Plant Working Group (AZ-WIPWG) to compile a categorized list of invasive non-native plants that are established in and threaten Arizona's wildlands. This report describes the approach followed and results from a 2.5-year project that used a previously developed set of criteria (Warner and others 2003) to evaluate the ecological impacts of each non-native plant considered.

1.0 INTRODUCTION

Numerous species of plants that are not native components of Arizona's flora have established within Arizona wildlands over the last century or more. Areas infested include designated wilderness areas, national parks and forests, national monuments, wildlife refuges, privately owned conservation lands, public recreation lands and lakes and rivers. Plant communities in Arizona's wildlands range from near pristine vegetation (similar to what was present prior to European settlement) to a more common situation in which human activities have altered ecosystems across a spectrum of different degrees of ecological degradation. One consequence of ecosystem alteration is soil disturbance and reduction of native plant cover, which creates an ideal niche for introduction of non-native plant propagules, followed by establishment and subsequent encroachment into non-infested areas.

1.1 Description of Need

Invasive non-native plants collectively constitute one of the gravest threats to the biodiversity of wildlands (Wilcove and others 1998, Pimentel and others 2000). Critical components for protecting native species and natural communities include: (1) identifying those non-native species that threaten biodiversity and ecological processes and (2) prioritizing the most harmful species for management attention. Hundreds of non-native plants are established outside of cultivation in Arizona, yet only a small proportion of these introduced species become invasive and cause unwanted impacts to natural communities and biological diversity. At present, policy makers and land managers concerned with the ecological health of wildlands do not have a comprehensive, systematic, research based tool that enables them to assess, compare, and categorize the ecological impact that may be inflicted by aggressively colonizing non-native plants.

1.2 Definitions

Terms used in this report generally follow the definitions used by Warner and others (2003).

Invasive non-native plants that threaten wildlands are defined as plants that (1) are not native to, yet can spread into, the wildland ecosystems under consideration, and that also (2) do any of the following within wildland ecosystems—displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes.

Non-native plants are species introduced to the ecosystems under consideration [here in reference to Arizona] after European contact and as a direct or indirect result of human activity.

Wildlands are public and private lands [and waters] that support native ecosystems, including national, state, and local parklands, ecological reserves, wildlife areas, national and state forests, Bureau of Land Management lands, and so on. Working landscapes—such as grazed rangeland and active timberlands—that support native ecosystems are included in the definition of wildlands.

2.0 PROJECT HISTORY

2.1 Previous Work by the California Exotic Plant Pest Council

An important project by the California Exotic Plant Pest Council (CalEPPC, now identified as the California Invasive Plant Council) that predated and influenced AZ-WIPWG's formation was the release of "The CalEPPC List: Exotic Pest Plants of Greatest Concern in California." in 1994. The CalEPPC list was revised in 1996 and 1999 with new information and additional species of concern. This list was initially intended to be a resource and educational tool for creating awareness regarding problems and damage caused by non-native plants in wildlands.

Since the CalEPPC list was first published, it has been an important informational resource cited by government agencies and private organizations for planning and management purposes. Because of the frequent use of this list and because in some situations it was used in a quasi-regulatory manner, the CalEPPC board of directors recognized the need for an explicit set of risk assessment criteria that would provide a transparent, repeatable, and creditable process for identifying invasive non-native plants that have ecological impacts within wildlands.

In 2000 CalEPPC appointed a committee tasked with the responsibility of developing a set of criteria to assess and categorize non-native plants according to their relative impacts on ecological processes, species, and native ecosystems. Representatives from Arizona and Nevada subsequently were invited to participate in development of such criteria that could be applied on a state-by-state basis. The resultant criteria document is titled "Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands" (hereafter referred to as Criteria) and was completed in February 2003 (Warner and others 2003).

2.2 Arizona Wildlands Invasive Plant Working Group.

Shortly after the release of the Criteria, the AZ-WIPWG was formed in March 2003. The AZ-WIPWG defined its purpose as:

...to apply a science-based criteria to evaluate and categorize non-native plants that occur in and are potentially detrimental to Arizona's wildlands. The product of the evaluation process will be a non-regulatory list of invasive non-native plants that are a threat to Arizona's wildlands with accompanying documentation that justifies each listing. This list will complement federal and state noxious weed lists and can be used by private and public land managers to prioritize management strategies and to educate a variety of stakeholders about the ecological impacts of listed non-native plants. As new information becomes available and new introductions occur, the list will be re-evaluated.

The AZ-WIPWG adopted the Criteria as its standard for evaluating non-native plants that are established in Arizona's wildlands.

Shortly after organizing, AZ-WIPWG participants realized that Arizona was better served by dividing the Working Group into two regional subgroups. This allowed evaluators with knowledge and experience of plant species in southern and western Arizona to concentrate on non-native species that were present in arid and semi-arid native ecosystems generally south of the Mogollon Rim. Likewise, knowledgeable experts primarily from the northern part of the state could concentrate on non-native species that colonized ecosystems above the rim. This arrangement also contributed to increased participation by providing a more convenient location and by reducing travel time.

Meetings were held monthly and alternated between the northern and southern regions (represented by Flagstaff and Tucson, respectively). Monthly meetings were held from March 2003 to June 2005 for a total of 27 meetings. When it was determined to be appropriate, combined subgroup meetings were held in Phoenix.

2.3 Project Supporters

Initial funding support to coordinate this state-wide effort was obtained by The Nature Conservancy in Arizona through private funding sources, including the Conservancy's Invasive Species Initiative, Packard Foundation, and Fear Not Foundation. Subsequently, funding was provided by a Department of Defense, Legacy Resource Management Program award. Southwest Vegetation Management Association (SWVMA) served as the project's state-level sponsor. The SWVMA also provided information, announcements, and updates regarding AZ-WIPWG work on its web site (www.swvma.org). The US Geological Survey, Colorado Plateau Field Station was generous in providing resources such as web design and development, as well as in providing overall technical support and web domain space. These contributions were instrumental in creating awareness about AZ-WIPWG's collective work and the ecological impact of non-native plants on ecosystem processes and biodiversity. For additional information and details, visit the Southwest Exotic Plant Information Clearinghouse (SWEPIC) web site (www.usgs.nau.edu/SWEPIC) and click on Arizona Wildlands Invasive Plants (AZ-WIP).

3.0 IMPORTANT CRITERIA ATTRIBUTES

The following sections highlight the goals and limitations of the Criteria as applied by the AZ-WIPWG.

3.1 Goals

From the inception of the AZ-WIPWG, participants agreed that the plant evaluation process and resultant categorized list of invasive non-native plants would mirror the goals described in Warner and others (2003). Those goals were to:

- provide a uniform protocol to assess the ecological impacts of non-native plants that threaten wildlands
- provide a clear explanation of the assessment and categorization process

- encourage contributions of data and documentation about any and all species to be evaluated
- develop a non-regulatory categorized list of established, invasive non-native plants
- educate policy makers, land managers, and the public about the biology, ecological impacts, and distribution of invasive non-native plants
- provide guidance on evaluating the reliability of the information used to evaluate plants.

3.2 Limitations

As a complement to the above goals, AZ-WIPWG participants also recognized that the Criteria were not intended to:

- produce a list that itself has regulatory force, though regulators can use the information to determine whether particular species should be added or removed from existing noxious weed lists
- predict behavior of species not yet introduced or established in the ecosystems under consideration
- provide absolute ranks for any site, state, or region—the invasiveness of most species will differ widely from one site, state, or region to another, depending on geography, climate, ecosystems present, and other factors
- prescribe management actions for species assessed, but rather it is to be used as one tool in evaluating management options
- rank species based on bioregions, as state political boundaries are not based on ecological factors.

Furthermore, the Criteria does not consider the economic or human health impacts of the non-native plant under evaluation, nor does it consider the management challenges or costs associated with controlling the plant. Finally, the Criteria is not intended to be used to evaluate predominately agricultural weeds or to pre-screen species not yet introduced to Arizona.

4.0 EVALUATION PROCESS USED BY THE ARIZONA WILDLANDS INVASIVE PLANT WORKING GROUP

4.1. AZ-WIPWG Activities and Procedures

Determining which plants needed to be evaluated began with compiling a master list of introduced species thought to be present in Arizona's wildlands. Existing lists, such as state (available at: www.azsos/public_services/Title_03/3-04.htm) and federal (available at: www.aphis.usda.gov/ppq/weeds/noxiousweedlist.pdf) noxious weed lists, USGS Southwest Exotic Plant Clearinghouse distribution records, weeds of Arizona (Parker 1972), and site-specific lists provided the initial set of species to consider. Additional species were identified by consulting with botanists, restoration biologists, weed scientists, public land managers, and

other interested organizations. Information from these sources resulted in the identification of 155 taxa for evaluation. Further review by AZ-WIPWG participants narrowed the initial list to be evaluated to 64 high priority taxa. Ten additional taxa were added later for a total of 74 plant taxa.

Completing a plant assessment involved applying the Criteria. The Criteria consists of 13 questions that in combination evaluate the ecological impact, invasive potential, ecological amplitude, and geographic distribution of each species to be assessed. To answer each question required preparing written justifications for each score and response. Information used to respond to the questions came from the published and unpublished literature, expert interviews, databases, and personal observations. As applicable, referenced literature was documented in the Literature Cited section at the end of each assessment. A documentation rating also was assigned for each question that provides the reader an indication of the degree of confidence one can have in the information source. All information was recorded in a Plant Assessment Form (PAF). Several sources of information, such as the US Forest Service Fire Effects Information System (www.fs.fed.us/database/fies/index.html), The Nature Conservancy's Element Stewardship Abstracts (<http://tncweeds.ucdavis.edu/esadocs.html>), and Guertin and Halvorson (2003), proved extremely useful.

A person knowledgeable about a plant under consideration first filled out the PAF in draft form. These individuals were responsible for accessing the available literature and other information, documenting the ecological impacts and invasive characteristics of the plant, assigning initial scores, documenting the rationale for such scores, and determining documentation ratings. During the monthly meetings, AZ-WIPWG members served as the review panel for draft plant assessments and as such they provided recommendations and suggestions for completing the assessments. Other responsibilities of the Working Group included: (1) identifying knowledgeable individuals to prepare the plant evaluation, (2) reviewing the accuracy and clarity of the supporting information and documentation, (3) identifying the appropriate score for each assessment question, and (4) ensuring consistency throughout the process. The AZ-WIPWG made every attempt to objectively distinguish and document an invasive non-native plant from a seemingly innocuous non-native plant.

Scores indicating severity of impacts, invasiveness, or extent of ecological distribution were determined from scoring guidelines provided in the Criteria instructions for each question. Scores could range from **A** to **D**, with **A** indicating a severe level of impact, invasiveness, or distribution, respectively, and **D** indicating negligible impact, low invasive potential, or limited distribution, respectively. In some cases, **U** or Unknown was used when insufficient information was available to assign a score. After scores were assigned to each question, a score was separately determined for Section 1 – Ecological Impact (questions 1.1 to 1.4), Section 2 – Invasiveness (questions 2.1 to 2.7) and Section 3 – Distribution (questions 3.1 and 3.2). Again, scores could range from **A** (severe) to **D** (negligible) or **U** for unknown. Section scores were based on either scoring matrices included in the protocol (Sections 1 and 3) or a numerical point system (Section 2). Section scores were used to establish an overall species or other taxon ranking (score) of **High**, **Medium**, or **Low** (see Box 1 for definitions) through a scoring matrix. In determining the overall ranking for a plant, Section 1 was more heavily weighted in the matrix than the other sections.

Another possible outcome of the evaluation process was “**Evaluated but not listed**,” which resulted when current information was inadequate to enable a listing or the sum of effects (score results) were below the threshold for listing. Two annotations can occur in addition to the overall score: **Alert** and **Red Flag**. **Alert** is a designation for a species that has an overall

Box 1 Definitions of Overall Taxon Ranking Scores and Additional Annotations

High: Severe ecological impacts on ecosystems, plant and animal communities, and vegetational structure; invasiveness attributes are conducive to moderate to high rates of dispersal and establishment; and species are usually widely distributed, both among and within ecosystems/communities.

Medium: Substantial and apparent ecological impacts on ecosystems, plant and animal communities, and vegetational structure; invasiveness attributes are conducive to moderate and high rates of dispersal, often enhanced by disturbance; and ecological amplitude (diversity of ecosystems/communities) and distribution (within an ecosystem/community) range from limited to widespread.

Low: Minor yet detectable ecological impacts; invasiveness attributes result in low to moderate rates of invasion; ecological amplitude and distribution are generally limited, but the species can be problematic locally.

Alert: Additional designation for some species in either the high or medium category, but whose current ecological amplitude and distribution are limited. This designation **alerts** managers to species capable of invading unexploited natural communities, based on initial, localized observations or behavior in similar ecosystems/communities elsewhere.

Red Flag: Additional designation assigned by AZ-WIPWG to identify and document a critical piece of information not evident in the overall ranking.

Evaluated but not listed: Designation when current information is inadequate to respond to Criteria questions or sum effects of ecological impacts, invasiveness, and ecological amplitude and distribution are below the threshold for listing.

score of **High** or **Medium**, but whose current ecological amplitude and distribution are limited (see Box 1 for more explanation). The **Red Flag** annotation was not part of Warner and others' (2003) protocol, but was added by AZ-WIPWG participants to signify that a critical piece of information was necessary to convey that was not evident in the overall ranking. **Red Flag** annotations are provided in conjunction with the plant's overall score or rank. Additional detail about the **Red Flag** annotation can be found in Appendix 1.

4.2 Taxonomic Authorities

The PLANTS Database (USDA 2005) generally served as the taxonomic authority for nomenclature at the species and lower taxonomic levels. This database also was used as the primary source for citing synonyms and some common name information. Kearney and Peebles (1960) was used to determine whether a species was a component of Arizona's pre-European plant communities. For the purposes of this project, taxa below species (i.e. cultivars, varieties, subspecies, forma, etc.) were considered equivalent to the species in respect to ecological impacts and were assessed at the species level, unless otherwise specifically stated.

4.3 AZ-WIPWG Administration

Tasks such as communication, scheduling, coordination, document management, data entry, outreach, and facilitating meetings were initially handled by The Nature Conservancy staff in

Tucson, AZ. John Hall, a program manager for the Conservancy, served as the liaison with the funding agency throughout and Dana Backer, Conservation Ecologist, was the project coordinator for the first two years of the project. Francis E. Northam assumed duties as the coordinator, through a contract with The Nature Conservancy, during the last seven months of the project.

4.4 AZ-WIPWG Participants

Appendix 2 summarizes the agencies and organizations represented among AZ-WIPWG participants and plant reviewers. Seventy individuals, representing over 20 organizations, contributed to this project. These individuals served as plant evaluators, review panel members, or experts contributing knowledge and observations. Federal and state agency representatives were the predominate members of the Working Group. Group expertise ranged from botany, ecology, wildlife biology, weed science, and work disciplines included university professors, regulatory specialists, conservationists, scientists, and private citizens interested in biological invasions by non-native plants.

Seven to ten participants attended each meeting, which typically lasted six to seven hours. Based on an average of eight participants per meeting, a minimum of 1296 person-hours was expended during PAF review committee meetings. Keep in mind this total does not include each plant evaluator's time involved in preparing and revising the plant assessment, nor does it include the time contributed by outside experts during phone interviews. In addition, the Consistency Review Panel (see section 6.2) also contributed about 80 person-hours to accomplish their review.

5.0 OUTREACH PRESENTATIONS

Numerous public presentations were given to private, industry, educational, governmental, and professional groups to explain the Criteria and state-wide listing process and to seek their support of the process and final list. Specific groups are listed below in Table 1.

6.0 RESULTS AND DISCUSSION

This project generated widespread interest in the problem of non-native invasive plants in Arizona and support for documenting the ecological impacts of non-native plants that are established in Arizona wildlands.

6.1 Categorized List of Invasive Non-Native Plants that Threaten Wildlands in Arizona

As a result of the efforts of the AZ-WIPWG, 74 plant taxa were evaluated for their ecological impacts to wildlands in Arizona. Those taxa that ranked either **High**, **Medium**, or **Low** in combination constitute the categorized list of Invasive Non-Native Plants that Threaten Wildlands in Arizona (Appendix 3). It is important to note that regardless of the category a plant is ranked within, **any** plant on this list receiving a **High**, **Medium**, or **Low** ranking is considered to have some degree of negative ecological impact.

Because of the desire by the AZ-WIPWG to make a list available for stakeholder use in a timely manner, some non-native plants, that are currently established in Arizona's wildlands, were not evaluated that if they were may have been ranked. Still, the Working Group feels the

TABLE 1 Outreach Presentations

Group	Date of Presentation	Location
Arizona Botanists annual meeting	8 Feb. 2003	Phoenix; AZ
Southwest Vegetation Management Association annual meeting	7 Nov. 2003	Camp Verde, AZ
West Yavapai Cooperative Weed Management Area monthly meeting	12 April 2004	Prescott, AZ
Sonoran Desert Invasive Species Council semiannual meeting	13 April 2004	Yuma, AZ
Biodiversity and Management of the Madrean Archipelago II conference	11 May 2004	Tucson, AZ
Southwest Vegetation Management Association, Board meeting	13 May 2004	Payson, AZ
Southwest Noxious Weed Short Course	22 July 2004	Farmington, NM
Arizona Interagency Weed Action Group meeting	19 Aug. 2004	Phoenix, AZ
Department of Defense, Conservation Committee	3 Nov. 2004	Arlington, VA
Southwest Vegetation Management Association annual meeting	7 Nov. 2004	Phoenix, AZ
Southwest Strategy, Water Task Team meeting	13 Jan. 2005	Phoenix, AZ
Arizona Botanists annual meeting	12 Feb. 2005	Phoenix, AZ
Southwest Strategy, Regional Executive Committee quarterly meeting	9 Mar. 2005	Phoenix, AZ
Arizona Native Plant Society, Conservation Committee meeting	18 May 2005	Tucson; AZ
Arizona Nursery Association, Board of Directors meeting	19 May 2005	Phoenix, AZ
Arizona Chapter of the Society of Landscape Architects, Central Section monthly meeting	15 June 2005	Phoenix, AZ
Arizona-Sonora Desert Museum	16 June 2005	Tucson, AZ
The Nature Conservancy in Arizona, Conservation Management Team meeting	27 June 2005	Tucson, AZ
Arizona Association of Environmental Professionals meeting	12 July 2005	Phoenix, AZ
Arizona Cattle Growers' Association, Federal Lands Committee meeting	19 July 2005	Sedona, AZ
Arizona Cooperative Extension	26 July 2005	Tucson, AZ
Arizona Natural Resources Cabinet (state agency heads)	16 Aug. 2005	Phoenix, AZ

prioritization process followed provides a reasonable level of assurance that the plants that were evaluated are those that are most likely to have significant, adverse ecological impacts to wildlands. Invasions by non-native plants, however, are a dynamic process and the list will need to be updated periodically.

The Criteria application and evaluation process resulted in 19 taxa categorized as **High**. These taxa are considered to have severe ecological impacts on ecosystems and plant and animal communities. Forty taxa were categorized as **Medium**. These taxa are considered to have substantial and apparent (but generally not severe) ecological impacts. Twelve taxa were categorized with an overall score of **Low**. The ecological impacts of these taxa are considered minor, yet apparent, and they have low to moderate invasive attributes. The ecological

amplitude and distribution of these taxa are generally limited, but they may be locally persistent and problematic. Finally, three taxa were **Evaluated but not listed**. *Hydrilla verticillata* and *Tribulus terrestris* received this designation because no evidence was found that these species existed either outside of human-constructed water bodies or in wildlands apart from areas heavily disturbed by human activities. *Verbascum thapsus* was not listed because the scores for ecological impact, invasiveness, and ecological amplitude and distribution were below the threshold for listing.

Nineteen taxa qualified for an **Alert** designation and 21 taxa were assigned a **Red Flag** designation with an associated annotation that conveyed important information about each taxon. In regard to the assignment of **Red Flag** annotations, the following example illustrates the type of information that the AZ-WIPWG deemed important to convey. *Bromus inermis* (smooth brome) received an overall score of **Medium**; however, because of its ability to rapidly establish from seed and quickly produce cover, smooth brome is commercially available as a reclamation species. For this reason, the Working Group added the following statement to the **Red Flag** comment box: "*Bromus inermis* should not be used for reclamation purposes in wildlands because of its persistence and invasive potential."

Of the 74 taxa evaluated, 22 were in the family Poaceae and 14 were in the family Asteraceae. As a result, these two families accounted for 49% of taxa assessed as having ecological impacts according to the Criteria. This percentage is of interest in comparison with similar percentages cited by Radosevich and others (1997). These authors reported 40% of the 250 weed species that are recognized as world-wide agricultural weeds are members of either Poaceae or Asteraceae. In addition, 28 (38%) of the taxa evaluated have been used in some aspect of the commercial plant trade in the recent past and may still be available for purchase in Arizona through direct public retail/wholesale outlets in Arizona, catalog sales, or over the internet (Table 2). In other words, these plants are sold for ornamental, reclamation (replacement of vegetative cover and soil stabilization where restoration of native plant species is not necessarily an objective), forage for livestock, or landscaping (that is, large area plantings) purposes.

6.2 Consistency Review

Because of the significance of the invasive plant problem and the complexity of the assessment process, the Working Group wanted to insure that the application of the Criteria, documentation of responses, and score assignments were consistent between the two regional groups, as well as consistent across and within species. To address these concerns, an independent review was conducted by a panel of five individuals involved with various aspects of plant biology including: a habitat restoration biologist, University of Arizona rangeland professor, wholesale nursery botanist, Arizona Department of Agriculture manager, National Park Service biologist, and botany consultant. These individuals reviewed how the Criteria was applied to 51 plant assessments completed through December 2004. The review panel was looking specifically for evidence of bias or other incongruities affecting the question scores and documentation of responses. Its findings could affect scoring associated with the 51 plant taxa reviewed, as well as future scoring and documentation procedures. The panel prepared a report that summarized its findings (Appendix 4), which was presented to the AZ-WIPWG in January 2005. The panel concluded that the overall consistency across all questions was 87%. In other words, the review panel agreed with 87% of the scores assigned by the Working Group across all questions for all species.

TABLE 2 Commercially Sold Invasive Non-Native Plants That Threaten Wildlands In Arizona¹

Family	Scientific Name	Common Name	Commercial Use
Anacardiaceae	<i>Rhus lancea</i>	African sumac	Ornamental, landscaping
Apocynaceae	<i>Vinca major</i>	Bigleaf periwinkle	Ornamental
Asteraceae	<i>Leucanthemum vulgare</i>	Oxeye daisy	Ornamental
Aizoaceae	<i>Mesembryanthemum crystallinum</i>	Common iceplant	Ornamental, landscaping
	<i>Mesembryanthemum nodiflorum</i>	Slenderleaf iceplant	Ornamental, landscaping
Elaeagnaceae	<i>Elaeagnus angustifolia</i>	Russian olive	Ornamental, reclamation
Fabaceae	<i>Melilotus alba</i>	White sweetclover	Reclamation
	<i>Melilotus officinalis</i>	Yellow sweetclover	Reclamation
Haloragaceae	<i>Myriophyllum aquaticum</i>	Parrot's feather	Ornamental
Hydrocharitaceae	<i>Hydrilla verticillata</i>	Hydrilla	Ornamental
Poaceae	<i>Arundo donax</i>	Giant reed	Ornamental, reclamation
	<i>Bromus inermis</i>	Smooth brome	Reclamation, forage
	<i>Cortaderia selloana</i>	Pampas grass	Ornamental, landscaping
	<i>Cynodon dactylon</i>	Bermudagrass	Ornamental, reclamation, landscaping, forage
	<i>Eragrostis curvula</i>	Weeping lovegrass	Forage, reclamation
	<i>Eragrostis lehmanniana</i>	Lehmann lovegrass	Forage, reclamation
	<i>Lolium perenne</i>	Perennial ryegrass	Forage, reclamation
	<i>Panicum antidotale</i>	Blue panicum	Forage, reclamation
	<i>Pennisetum ciliare</i>	Buffelgrass	Forage, reclamation
	<i>Pennisetum setaceum</i>	Fountain grass	Ornamental, landscaping
	<i>Saccharum ravennae</i>	Ravennagrass	Ornamental
	<i>Sorghum halepense</i>	Johnsongrass	Forage
Pontederiaceae	<i>Eichhornia crassipes</i>	Water hyacinth	Ornamental
Salviniaceae	<i>Salvinia molesta</i>	Giant salvinia	Ornamental
Tamaricaceae	<i>Tamarix chinensis</i>	Fivestamen tamarisk	Ornamental, reclamation
	<i>Tamarix parviflora</i>	Smallflower tamarisk	Ornamental, reclamation
	<i>Tamarix ramosissima</i>	Saltcedar	Ornamental, reclamation
Ulmaceae	<i>Ulmus pumila</i>	Siberian elm	Ornamental, reclamation

¹Sources of information: seed vendor lists, nursery catalogs, Arizona Department of Agriculture enforcement records, and personal observations (F.E. Northam).

6.3 Uses of the List and Plant Assessments

Appendix 5 contains copies of the individual plant assessments. In some cases multiple, related taxa are addressed in the same assessment. To address the 74 taxa evaluated by the AZ-WIPWG, 64 plant assessments were completed that document the scoring, rationale, and literature cited associated with each evaluation. As a result, each assessment represents a compendium of the current state of knowledge—ecological impacts, invasiveness, and distribution—for particular non-native plants that are established in Arizona’s wildlands. Each of these plant assessments will be posted on the SWEPIC web site (www.usgs.nau.edu/SWEPIC) so that they are available for others to use. Future updates to the list, which can involve new evaluations of currently listed plants, will be facilitated by having this archival information available.

In combination the list and associated plant assessment documentation can serve many potential uses. During the course of conducting outreach about the AZ-WIPWG and the listing process, a number of broad potential uses were identified. These include:

- tool to assist land managers in prioritizing invasive non-native plant management focus and actions
- facilitate preparation of environmental documents
- justification for funding
- coordinate activities with adjoining land owners
- inform stakeholders about ecological impacts
- influence additions to regulatory lists
- complement noxious weed lists.

As the list and associated documentation were being completed, additional discussions among AZ-WIPWG members identified several specific uses of the information compiled during this project. These uses are further described below.

First, agency environmental planners and land managers will be able to use the list and assessment information to justify control measures and to provide authoritative evidence concerning problems caused by specific non-native plants in wildlands, as well as in transportation corridors, urban interface areas, and public recreation areas that may be similarly affected. In addition, the assessment information regarding the types of ecosystems/plant communities infested by a particular plant can be used to help narrow the scope of what may need to be considered as invasive in a particular geographic area. Alternatively, it can suggest which plants may be capable of invading an area that are not already present. As a result, the list can be useful as a foundation to a watch or early detection list for warning land managers about species established in specific areas of Arizona that may be capable of moving into and establishing in other regions of the state that may have similar ecosystems/plant communities.

Second, the list also can serve as an initial checklist of non-native species present in various regions of Arizona for anyone working with restoration of disturbed sites. This will enable restoration biologists to anticipate which problems may arise during site restoration attributable

to the presence of invasive non-native plants. In addition, land managers can use the list to develop procurement specifications associated with construction materials, hay, and planting seed applicable to restoration projects and management of wildlands in general.

Third, landscape architects will be able to use both the list and assessment information as a guide during their analysis of site conditions, as invasive non-native plants have become an important component of vegetation characteristics at a site, and, more importantly, to guide their recommendations to clients regarding appropriate plants to use in landscaping. Plant assessment information also will be useful to guide site monitoring after landscape projects are installed. In summary, efforts to educate landscape clients about the detrimental environmental effects of planting invasive non-native plants will be enhanced by the information contained in the list and individual assessments. Similarly, nurseries and other purveyors of plant materials can use the list as a guide to help determine what plants they may choose to sell.

Fourth, the list and assessment information can be used to raise public awareness about invasive non-native plants and the human role in facilitating both their introduction and spread. These materials also can serve as an educational tool for influencing municipal, county, and state governments and Natural Resource Conservation Districts decisions concerning local landscaping ordinances, state noxious weed regulations, and invasive non-native plant control priorities.

Fifth, academic members of the Working Group noted that the individual plant assessments provide a starting reference for student research papers. Their value as a reference source includes the comprehensive bibliography of ecological information compiled for each plant evaluated. The assessments in general can be used to identify specific research needs associated with each plant.

Sixth, the list also provides an initial prioritization of what should be tracked in state and regional invasive, non-native plant occurrence databases. Entering occurrence information into these databases can enable modeling the potential for future spread of such species.

6.4 Additional Considerations

Limitations associated with applying the Criteria were described in section 3.2. These Criteria limitations do have some implications for how the final categorized list can be used and interpreted. Warner and others (2003) recognized that the Criteria themselves could be considered a work in progress. As currently constructed the Criteria enable list preparation based on political units: states. Ideally, however, future updates of the Criteria would be enhanced by basing the evaluation process on entire biotic regions that share similar climatic, physiographic, and vegetative characteristics.

Based on the use of the Criteria as currently conceived, the ranking categories were designed to reflect the degree of ecological impact a particular plant species is having on a state-wide basis. Some species, however, potentially threaten wildlands in only a portion of Arizona. In other geographic locales, they may not be able to establish and survive outside human cultivation. The answers to Criteria question 3.1, ecological amplitude, indicate those ecosystems/plant communities occurring within Arizona within which a species likely will have an ecological impact based on current information. These ecosystems/plant communities often have a close correspondence with geographic location. Although a lack of information on impacts does not rule out that a particular plant may be problematic in other locales in the state, it might suggest geographic areas where such a plant may not be of ecological concern.

Plants sold commercially and on the list may behave in the manner described above. Two approaches are possible relative to the use of the list in these situations. First, plant taxa presumed to be non-invasive in particular geographic areas of Arizona might still be used. Because, however, the Criteria and its application for Arizona were not designed to provide positive recommendations on where (or within which ecosystems/plant communities) particular plants might be non-invasive, each commercially sold plant should be assessed on a case-by-case basis and used with caution. Future modifications to the Criteria that enable plant assessments on a bioregional basis may improve the above determination. Second, ecosystems/plant communities within which invasion does not occur by a particular plant may occur in close proximity to ecosystems/plant communities that are invaded and impacted by the same plant. Moreover, plant materials sold in one location may be used in another inappropriate location. It would be difficult to manage all the potential pathways for moving a plant within the state to inappropriate locations. As a result, a conservative approach to this situation would be to err on the side of caution and not sell the plant within Arizona. Because the categorized list of Invasive Non-Native Plants that Threaten Wildlands in Arizona is a non-regulatory list, the AZ-WIPWG cannot dictate which of the two preceding approaches should be followed. To the extent that non-invasive plant alternatives can be identified and promoted for any of the commercially sold plants on the list that may fit under this situation, the ideal situation is that industry itself will eventually have sufficient incentive and motive not to sell listed plants anywhere within the state.

7.0 FUTURE DIRECTIONS

The AZ-WIPWG does not view development of an initial categorized list of invasive non-native plants as a static product of its efforts. Working Group members recognize that the ecological behavior of already established plants may be a dynamic process, new information may come to light about plants already on the list, and new non-native plants may become established in Arizona that require assessment. As a result, list maintenance itself will need to be a dynamic process. Even with the current list, additional outreach will be necessary to enable the list to achieve its full utility to land managers and other stakeholders. With the preceding in mind, the following ideas can be considered as some potential next steps.

First, the categorized list of Invasive Non-Native Plants that Threaten Wildlands in Arizona needs to be released to the public domain, in both printed and web media formats. The intent of the AZ-WIPWG is to publish the list with multiple organizational endorsements to show the strong level of support for the listing process, list, and list uses among Arizona stakeholders.

Second, the experience of the AZ-WIPWG in developing the categorized list and the information assembled in its compilation may be of interest to others. As a result, it would be beneficial to publish a peer-reviewed article in a conservation journal that: (1) describes the AZ-WIPWG's evaluation process, (2) discusses uses of the categorized list produced by AZ-WIPWG, (3) synthesizes information from the individual plant assessments, and (4) interprets what the list and assessment information contribute to wildland management.

Third, some plants on the list have commercial value and are now or have been sold in Arizona (see Table 2). As a result, it is imperative to work in partnership with affected industry interests to develop non-invasive plant alternatives to these plants. Once non-invasive plant alternatives have been identified, industry may be in a position to voluntarily phase out its sale of plants on the list.

Fourth, although the Criteria was not intended to be used to pre-screen plants not yet established in Arizona, potentially it could be adapted to fit such a need. As a result, a potential next step is to develop a protocol for assessing and categorizing non-native plants not yet established in Arizona, but known to ecologically threaten environments similar to Arizona's wildlands. Such a protocol could become a key component of an early detection and rapid response initiative focused on those plant taxa that have the potential to be introduced into Arizona, based on proximity or pathway analysis, and pose the threat described above.

Fifth, at a minimum, future updates to the categorized list will be needed based on the reasons articulated at the beginning of this section. The mechanism through which this may happen—whether it is through a future manifestation of the AZ-WIPWG or some other approach—is uncertain at present. With the impending establishment of the Arizona Invasive Species Council through an Executive Order issued April 1, 2005, another possibility has arisen. As the umbrella coordinating body for invasive species issues in Arizona, the new Council can choose to take ownership of the list and assume responsibility for future updates.

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APPENDIX 1

Criteria for Categorizing Invasive Non-Native Plants that Threaten
Wildlands (December 2004 Arizona User Guide and Notes)

Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands

California Exotic Pest Plant Council
Southwest Vegetation Management Association

Arizona Wildlands Invasive Plant Working Group Members

USER GUIDE and NOTES

-comments in blue font have been added to the original criteria to assist the Arizona plant evaluators and Arizona's Wildlands Invasive Plant Working Group (last revision December 2004)

Printable version, February 28, 2003

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Acknowledgements

These criteria are adapted from the “A New Tool to Categorize and List Invasive Non-native Plant Species that Threaten Native Biodiversity,” originally developed by The Nature Conservancy and NatureServe (formerly the Association for Biodiversity Information) in cooperation with the National Park Service and the Plant Conservation Initiative's Alien Plant Working Group (Randall et al. 2003). The Criteria Development Committee, comprising representatives from the California Exotic Pest Plant Council, the Southwest Vegetation Management Association, and the University of Nevada Cooperative Extension, reviewed and modified these criteria for the specific purpose of developing categorized lists of invasive non-native plants.

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Part I: Introduction

BLUE & ITALIC FONT HAS BEEN ADDED AS USER'S NOTES

Background

Invasive non-native plants collectively constitute one of the gravest threats to the biodiversity of wildlands—conservation areas and other native habitats. Two critical components of managing invasions by non-native species are (1) identifying those species that threaten biodiversity and other ecological functions and values, and (2) prioritizing species for management efforts, which must be based, at least in part, on the ecological impacts imparted by the invaders.

For the purposes of identifying agricultural pests, many states and the U. S. Department of Agriculture have compiled regulatory “noxious weed lists” focusing on species that threaten agricultural production (both cultivated crops and rangeland) and other economic interests. However, existing state and federal lists do not focus on species that damage native ecosystems. We therefore developed this new set of risk assessment criteria to provide a transparent, repeatable, and credible basis for states to identify invasive non-native plants that threaten wildlands.

The idea of producing a list of invasive non-native plant species for California was first introduced to the California Exotic Pest Plant Council (CalEPPC) Board of Directors by Ann Howald in 1992, with the Board adopting the effort in 1993. The so-called “CalEPPC list” was envisioned as a quick-reference educational resource about non-native species that were problems in wildlands, areas managed for conservation of biodiversity and natural resource values and not primarily for agriculture. Based on the professional opinions of “weed” scientists and land managers statewide, the compilation entitled *The CalEPPC List: Exotic Pest Plants of Greatest Ecological Concern in California* (1994) was printed in September, 1994. A CalEPPC committee subsequently revised the list in 1996 and again in 1999 based on substantial new information about certain species, including some that had not been listed previously.

In recent years some state and local agencies have used the list to guide management priorities and to restrict plantings on public or private lands. In fact, the list is now frequently cited as an authoritative

document for planning and management purposes. In light of this evolved status and the consequent need for the list—and the factors it uses to determine which species are included and how they are ranked—to stand up to close scrutiny, the CalEPPC Board of Directors charged a committee with developing a set of repeatable, science-based criteria for listing species. The new criteria would be required to clearly distinguish between those non-native plants that pose a significant threat to wildlands and those that do not pose a threat.

In 2000, with the Board’s backing, a CalEPPC committee assumed responsibility for developing such a set of criteria and using them to create the next revised version of the CalEPPC list. Subsequently, CalEPPC invited representatives from Arizona and Nevada to participate in a Criteria Development Committee. Ecologists and land managers in these neighboring states had also identified a need to develop—through a defensible process—science-based lists of invasive non-native plants that threaten their wildlands. Participation by the three states also offered the opportunity to develop consistent regional criteria for ranking invasive non-native plants. The full Criteria Development Committee now included members from CalEPPC, the Southwest Vegetation Management Association (in Arizona), and the University of Nevada Cooperative Extension.

The committee’s work began with a delineation of primary goals, which included the development of the criteria, a revision of the list for California and development of lists for Arizona and Nevada, and the compilation of supporting documentation on all species evaluated with the criteria. Early in the process, the committee reviewed several criteria-based, invasive species ranking systems from other areas of the United States and from other countries (Smallwood and Salmon 1992; Timmins and Williams 1987; Hiebert and Stubbendieck 1993; Hiebert 1998; USDA 1999; Weiss and McLaren 1999; Fox et al. 2000; Mehrhoff 2000). Based on the regional goals identified by the committee, including the development of criteria focused on ecological impacts, the committee chose to adapt the format and content of protocols being devised by NatureServe and The Nature Conservancy (Randall et al. 2003).

During the committee’s initial determination of goals and tasks, the list committee adopted the following definitions to guide its work:

Invasive non-native plants that threaten wildlands are defined as plants that (1) are not native to, yet can spread into, the wildland ecosystems under consideration, and that also (2) do any of the following within wildland ecosystems—displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes.

Non-native plants are species introduced to the ecosystems under consideration after European contact and as a direct or indirect result of human activity.

Wildlands are public and private lands that support native ecosystems, including national, state, and local parklands, ecological reserves, wildlife areas, national and state forests, Bureau of Land Management lands, etc. Some working landscapes—such as grazed rangeland and active timberlands—can support native ecosystems, and are included in our definition of wildlands

■ General Description of the Criteria

Following this introduction, Part II presents the criteria themselves and Part III lists the references cited in this document. The Plant Assessment Form (Part IV) has tables and instructions for scoring and documenting the answers to the evaluative questions in Part II.

The criteria portion of this document consists of four sections. The first three sections contain questions designed to assess attributes of any species not native to the ecosystem under consideration: Section 1 addresses the **ecological impacts** of a species; Section 2 addresses a species' **ability to invade natural vegetation**; and Section 3 addresses the species' **current ecological amplitude** (occurrence across different ecological types) and the **extent of invasion** within infested ecosystems. Section 4 provides a format for ranking the relative level of the documentation cited throughout the evaluation process.

All but one question within the first three sections are multiple-choice, requiring a quantitative or qualitative assessment of the particular effect or characteristic under consideration. The Plant Assessment Form provides tables in which to answer each question and to record the source of the information (literature, personal communications, unpublished data, etc.) used to answer questions.

Scoring for each of these sections is intended to yield a convenient abbreviation for the attributes of the species, based on available information. The scoring scheme is structured into a tiered format, with the individual questions contributing to a section score, and the section scores used in turn to generate an overall score.

Overall scores for Sections 1 and 3 employ scoring matrices, in which the section score is determined using a table that lists all possible combinations of responses to the individual questions. A point system is used to develop an overall score for Section 2. Finally, a matrix is used to combine the section scores and determine the overall score for the species. Scoring instructions are provided with the Plant Assessment Form.

The scores derived from these criteria can then be used to generate statewide lists of invasive plant species, with this overall score guiding whatever categories are devised to communicate this information in abbreviated form. See further information provided below about the categories and how these criteria can be used to generate statewide lists.

Goals:

The goals of this project are to:

- Provide a uniform methodology for categorizing invasive non-native plants that threaten wildlands;
- Provide a clear explanation of the process used to evaluate and categorize invasive plants (i.e. make the process transparent);
- Provide flexibility so the criteria can be adapted to the particular needs of different regions and states;
- Encourage contributions of data and documentation about any and all species to be evaluated;
- Educate policy makers, land managers, and the public about the biology, ecological impacts, and distribution of invasive non-native plants.

Products:

The products expected from this project include:

- A document explaining the criteria available in print and on the internet;
- State-wide lists of invasive non-native plants that threaten wildlands for Arizona, California, and Nevada;
- Regional lists for specific areas within these and other western states and provinces;

- Evaluation results for each species appearing on these lists available in an internet-based format;
- Compilations of available information on invasive species evaluated and a list of gaps in this information;
- Articles in newsletters and other publications discussing the criteria and its use in revising CalEPPC's list and creating lists for Arizona and Nevada;
- Widely available forms and an internet interface that can be used to submit or update information on invasive species.

Limitations:

These criteria are not intended to:

- Produce a list that itself has regulatory force, though regulators can use the information to determine whether particular species should be added or removed from existing noxious weed lists;
- Predict behavior of species not yet introduced or established in the ecosystems under consideration;
- Provide absolute ranks for any state or region—the invasiveness of most species will differ widely from one state or region to another, depending on geography, climate, ecosystems present, and other factors;
- Dictate management actions for considered species, but rather to be used as one tool in evaluating management options.

The committee did not consider difficulty of management for each species as part of the criteria. Managers assessing management priorities for a specific conservation area will need to consider factors not covered by these criteria (such as specific management goals and constraints, conservation values on their sites, and the relative feasibility of control or prevention) and to give further consideration to the local impacts of the invasive species in question and the likelihood of further spread. Hiebert and Stubbendieck (1993) present a system designed specifically to prioritize invasive non-native plants for control at a specific site.

Uses of the criteria

How the criteria will be used to create lists of invasive non-native plant species

The criteria are primarily intended for use in categorizing and listing invasive non-native plant species that are most threatening to wildlands in Arizona, California, and Nevada. The criteria are designed for application to species that are not native to the ecosystems under consideration (though they may be native to other ecosystems in Arizona, California, or Nevada). Lists for regions or localities within each state will differ from each other due primarily to differences in the degree of local ecological impacts. The following paragraphs outline the approach envisioned by the committee for using the criteria to create state lists of invasive non-native plants that threaten wildlands. Individual states are expected to make modifications to best facilitate development of state lists.

For the compilation of a statewide list, a committee comprising people with experience in invasive species biology, plant ecology and taxonomy, and land management should be formed. This “list committee” will consider for evaluation any non-native plant species that is brought to its attention, but for the sake of efficiency the committee may need to focus on those species already widely acknowledged as invasive (based on existing records and data, such as previously published lists of invasive species or recommendations from observers, managers, scientists, and others). In addition, each state committee should solicit further information from all available sources, primarily those people with expertise and experience regarding the species to be evaluated.

Information sought may be in any of several formats, including the following: published research and review papers; official reports, book chapters, planning documents, and biological assessments; unpublished data, including sampling or monitoring statistics, photographs, or detailed written descriptions; and personal observations or anecdotes (which may be useful when published information is unavailable). As an integral part of this process, the committee should solicit and welcome contributions from as wide a diversity of potential sources of information as possible, but it will base its conclusions primarily on sources of information that possess the highest degree of reliability.

For each species, a designated evaluator(s) compiles the available information and conducts a preliminary assessment using the criteria. The evaluator provides this information to the list committee, which then considers the evaluation and supporting data in order to render a **consensus group decision** on ranking or categorizing the species.

Notes to the Participants:

***Evaluator-** responsible for completing a draft of the Plant Assessment Form for a specific species. Provide the supporting documentation including literature reviews; interviews with public/private land managers, habitat specialist, botanist, extension agents, etc.; and personal knowledge and experience. Include observations by yourself and other qualified profession. Often in the discussion section of technical reports and peer-reviewed journal articles, the author(s) draw upon observations and inference to imply conclusions. In such cases, the evaluator needs to clearly state that it is an observation, the location of observation, etc. Provide information to support responses and clearly state its origins (refer to the level of documentation section to determine which category is appropriate). It is important to completely fill out the PAF so subsequent reviewers can evaluate the original assessments.*

Inference can be used in the evaluation to support responses when a strong case is presented in the literature or the evaluator(s) has deduced this from observation. The rationale should be stated in a manner such that it is clear the response to the criteria question was based on inference and a clear line of reasoning to justify the response is provided; the level of documentation for this type of evidence is Observational/Inference. Be cautious not to overuse inference for the sake of a higher score.

*Role of Arizona Working Group members is to review and discuss the draft PAF prepared by the reviewer; provide input to the documentation, and a broader perspective to the plant assessment. To maintain **consistency** in the interpretation of the criteria, reduce inter-reviewer variation, and consistent use of appropriate level of documentation. To identify the thresholds of inference and ensure a clear line of reasoning is documented. To make decisions by consensus or group and continue the review process. When responses to criteria questions are divided, include in the rationale section of Table 3 the opposing thoughts and document the reason for ultimate response. Note that responses to will often have an element of subjectivity.*

Once a categorical list is generated from these individual evaluations, the committee can make the list and individual species evaluations public. They may want to publish the information in two formats: a simple list and a list accompanied by the more extensive background information, including scoring and supporting documentation tables. The latter

format may be most appropriately published on a public website.

At this point, the initial stage of evaluation for a particular species will have been completed. However, evaluation and ranking is an ongoing, iterative process. The list committee (*AZ Wildlands Invasive Plant Working Group*) should continue to welcome new information that supplements knowledge about the ecology or distribution of any non-native species. When substantial and substantiated new information becomes available, the committee can re-evaluate, especially if the new data would potentially influence the ranking outcome.

The committee should also be willing to address comments about the composition of the list to the extent possible. The evaluation and ranking process is intended to provide public access to the decision-making process, as well as to serve as an educational resource on the factors that render invasive non-native plants a threat to wildlands.

The set of criteria is itself a work in progress which may need adjustment in the future. In time, the criteria will ideally serve as a basis for creating lists for entire biotic regions in addition to lists for political units such as states.

The Substance of the Lists

Statewide lists resulting from the systematic application of these criteria will group invasive non-native plant species into categories based directly on the overall scores derived from the criteria-based evaluations. Species categorized as High, Medium, and Low, *and Evaluated but not listed*, including Alerts *and Red Flags*, will be included in published lists. As stated above, the Plant Assessment Form—including score sheets, available references, and results for all non-native species evaluated—should be made available on a public website and retained as unpublished data.

The printed and web-based lists will include Latin binomials and common names of each species and the three section scores from the criteria-based evaluations, as well as information on geographic distribution within the state. Additional information on some species may be included, such as comments on ecological distribution, sources of infestation, means of dispersal, or other pertinent details.

A verbal description of each of the list categories follows. These categories correspond directly to the overall criteria scores that derive from the responses to individual criteria questions and section scores. Accordingly, the individual questions and section scoring matrices have been designed to appropriately

weigh the ecological impacts, invasiveness, and ecological distribution of each species, conveying a synopsis of these factors through categorical groupings. A review of the questions and the completed Plant Assessment Forms, for each species posted on the website will provide the most detailed and comprehensive explanation for the inclusion of a particular species within a category. The categories are defined as follows:

High: These species have severe ecological impacts on ecosystems, plant and animal communities, and vegetational structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. These species are usually widely distributed ecologically, both among and within ecosystems.

Severe ecological impacts

Medium: These species have substantial and apparent—but generally not severe—ecological impacts on ecosystems, plant and animal communities, and vegetational structure. Their reproductive biology is conducive to moderate to high rates of dispersal, though establishment is generally dependent on ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

Substantial and apparent (but generally not severe) ecological impacts on ecosystems

Low: The ecological impacts of these species are minor. Their reproductive biology and other invasiveness attributes result in low to moderate rates of invasion. Ecological amplitude and distribution are generally limited (these species may be locally persistent and problematic).

Ecological impacts of these species are minor

Alert: This is an additional designation for some species in either the high or medium category, but whose current ecological amplitude and distribution are limited. The designation alerts managers to species that are capable of rapidly invading unexploited ecosystems, based on initial, localized observations, and on observed ecological behavior in similar ecosystems elsewhere.

If Section 3 receives a score of A or B, no alert status will be assigned.

Red Flag

If the Working Group agrees that some critical piece of information is not evident in the overall ranking the Working Group can assign a Red Flag. This notation and the specific comments that justify it (documented in Table 2) will give the Working Group

an opportunity to provide the essential information to land managers and others that may use and interpret the categorized list for individual plants.

This section is to be completed by the list Working Group when they determine a critical piece of information about the species needs to be communicated to the end user of the categorized list. Indicate in this section if the plant should be re-evaluated and within what time frame.

Examples include: (1) a rare community is infested, (2) a particular ecological type is >50% infested but is currently restricted geographically, and (3) a plant occupies many ecological types (A or B for 3.1), but none greater than 20% (C or D for 3.2) which results in Section 3 score of B thus, not qualifying it for Alert status.

Evaluated but not listed: In general, this designation is for species for which information is currently inadequate to respond with certainty to the minimum number of criteria questions (i.e., too many “U” responses) or for which the sum effects of ecological impacts, invasiveness, and ecological amplitude and distribution fall below the threshold for listing (i.e., the overall rank falls below Low). Many such species are widespread but are not known to have substantial ecological impacts (though such evidence may appear in the future). All species receiving a “D” score for ecological impact (Section 1), regardless of what other section scores they receive, are by default placed into this category.

Instructions for Using the Criteria

Part IV provides a Plant Assessment Form for summarizing scores and documentation. It contains all scoring tables and worksheets needed to record answers to the questions in the criteria and matrices and instructions needed for determining section scores and an overall rank. Instructions for completing the Plant Assessment Form as part of the evaluation process are described below.

General Instructions

- Evaluate each species separately and independently.
- Base all responses, scores, and comments (unless a question indicates otherwise) on current, documented impacts or species biology, rather than on potential impacts or speculatively attributed species characteristics.

- Base information on ecological impacts on the species' behavior in ecosystems within the state; however, species behavior elsewhere within similar ecosystems can be used when a non-native species previously unknown within a state is newly discovered and requires judgment as to whether it qualifies for rapid response. Evaluators should clearly indicate when they are basing ecological impact on observations made outside the state.
- *When no information is available from within AZ use information on ecological impacts from elsewhere and document the location and under what conditions (e.g., greenhouse, field)*
- Be succinct when asked to provide supporting information, comments, and sources of information—the purpose of providing comments and identifying information sources is to justify and support the score, and to indicate what remains unknown, not to provide detailed biological or management information.
- Do not submit published papers, photos, or other evidence as supporting information unless requested.

Steps to completing the Plant Assessment Form

- **Step 1:** Identify yourself as the evaluator and species you are evaluating (Table 1).
 - **Step 2a:** Respond to the criteria questions in Part II and fill your answers into Table 2. To help answer question 2.4, complete Worksheet A in the Plant Assessment Form. For questions 3.1 and 3.2, first complete the appropriate ecological type worksheet for your state (either Worksheet B, C, or D) by following the instructions in Section 3, then respond to questions 3.1 and 3.2.
 - **Step 2b:** While responding to specific criteria questions in Table 2, record information and documentation for each question in Table 3. For each question, record your supporting information, the rationale for your answer, and sources of information, including complete citations for published information. Complete Table 3 by providing a brief comment summarizing all known, available information about the species for that specific question. Identify major gaps in information that could be critical for improving the accuracy of ranking the species. This information will assist in assessing the “level of documentation” score described below and in Section 4.
- For each question, select the one letter corresponding to the response that best characterizes the species under evaluation and reflects the information recorded in Table 3. Enter the letter (score) in Table 2. On questions for which little or no information is known, write “unknown” or “not found” in the comments and select “U” as a response.
- **Step 3:** Determine scores for Sections 1, 2, and 3 by referring to the appropriate scoring matrices following Worksheet D. Record scores in Table 2.
 - **Step 4:** Determine an overall score and alert status for the plant by using the section scores and referring to the overall scoring matrix. These ranks—High, Medium, Low, or Not Listed, and any special designation for Alert species—form the basis for an invasive non-native plant list. Record overall score and alert status in Table 2.
 - **Step 5:** Use the criteria in Part II, Section 4 to assess the relative level of supporting documentation that is recorded in Table 3. Record level of documentation in Table 2.
 - **Step 6:** Return completed Plant Assessment Form to the applicable state list committee representative (addresses listed in Part IV), ideally by attaching the form via email.

Part II. The Criteria

BLUE & ITALIC FONT HAS BEEN ADDED AS USER'S NOTES

Sections 1-3 present evaluative questions that constitute the criteria for ranking invasive, non-native plants that threaten wildlands. Section 4 presents a protocol for assigning a reliability rating to the documentation used in scoring the criteria for a particular species. Before using these criteria, refer to instructions on the preceding page.

- *Has to be present in wildlands/natural areas to be considered for evaluation; does not include fields/ranges that have been seeded for pasture*
- *Use current and actual information, not potential unless stated as such*
- *Use information from within state; if use information from outside the state, indicate where the information is from and under what conditions (greenhouse, crop, natural areas, etc.)*
- *Use inference only when there is a strong case noted in the literature or observations strongly suggest it.*
- *Often difficult to decipher between scores, especially D and U—decision by Working Group consensus, conservative responses and best judgement should be guiding principles.*

Section 1. Ecological Impact

Where possible, **assess the cumulative impact** (e.g., over a period of several decades) of the species on the wildlands where it typically occurs in Arizona, California, or Nevada, or other places with similar environmental conditions. The assessment should apply to **impacts within the area currently occupied by the species** within the states of concern (to the extent that this area is known).

In areas where invaded, what are the impacts(positive and negative)? Stated another way, in a patch/stand where it is most invaded in your state, what are the impacts?

This section is arranged **hierarchically**: species that significantly alter ecosystem processes and system-wide parameters (Q1.1) almost always have significant impacts on plant community composition, structure, and interactions (Q1.2), and higher trophic levels and interactions (Q1.3). *The questions are related but not redundant.*

When there is any level of type conversion, some level of biotic and abiotic change will result. Thus, when discussing monotypic stands of infestations, consider the impacts.

For questions 1.1, 1.2, & 1.3, it is often difficult to find literature documenting these impacts that is why it is IMPORTANT to talk to land/resource managers or other knowledgeable entities.

For questions 1.1, 1.2, & 1.3 (as compared to question 2.5) it is not necessarily a matter of how many different types of impacts there are but rather the severity of any one impact. Question 2.5 refers

*more to the **number** of potential opportunities for human dispersal.*

Question 1.1

Impact on abiotic ecosystem processes

Consider the impact on the natural range and variation of abiotic ecosystem processes and system-wide parameters in ways that significantly diminish the ability of native species to survive and reproduce. Alterations that determine the types of communities that can exist in a given area are of greatest concern.

AZ has chosen to not treat positive abiotic impacts for question 1.1 (i.e. soil stabilization) in a manner that negates or lessens the question score.

If there are abiotic process impacts, there are likely to be biotic process impact.

Examples of abiotic processes include:

- fire occurrence, frequency, and intensity; (*ex. cheat grass*)
- geomorphological changes such as erosion and sedimentation rates; (*ex. spotted knapweed as compared to native bunch grasses*)
- hydrological regimes, including soil water table;
- nutrient and mineral dynamics, including salinity, alkalinity, and pH; (*ex. tamarisk, iceplant*)
- light availability (e.g. when an aquatic invader covers an entire water body that would otherwise be open). (*ex. salvinia*)
- *Others: dune stabilization; stream channelization*

Select the one letter below that best describes this species' most severe impact on an abiotic ecosystem process:

- A. Severe, possibly irreversible (*don't get too caught up in this phrase*), alteration or disruption of an ecosystem process.
- B. Moderate alteration of an ecosystem process.
- C. Minor alteration of an ecosystem process.
- D. Negligible perceived impact on an ecosystem process.
- U. Unknown.

For questions 1.2 & 1.3, a stand or patch is one unit and it will not necessarily be consistent across all the habitats it invades. Need to consider impacts at both the patch level and a monotypic stand.

Question 1.2

Impact on plant community composition, structure, and interactions

Consider the cumulative ecological impact of this species to the plant communities it invades. Give more weight to changes in plant composition, structure, and interactions that involve rare or keystone species or rare community types.

Use current impacts from within the state if possible, otherwise use known impacts from other states.

Examples of severe impacts include:

- formation of ~~stands~~ *patches* dominated (>75% *relative* cover) by the species;
- occlusion (>75% cover) of a native canopy, including a water surface, that eliminates or degrades layers below;
- significant reduction or extirpation of populations of one or more native species.

Examples of impacts usually less than severe include:

- reduction in propagule dispersal, seedling recruitment, or survivorship of native species;
- creation of a new structural layer, including substantial thatch or litter, without elimination or replacement of a pre-existing layer;
- change in density or depth of a structural layer;
- change in horizontal distribution patterns or fragmentation of a native community;
- creation of a vector or intermediate host of pests or pathogens that infect native plant species.

Select the one letter below that best describes this species' impact on community composition, structure and interactions:

- A. Severe alteration of plant community composition, structure, or interactions.
- B. Moderate alteration of plant community composition.
- C. Minor alteration of community composition.
- D. Negligible impact known; causes no perceivable change in community composition, structure, or interactions.
- U. Unknown.

Question 1.3

Impacts on higher trophic levels

Consider the cumulative impact of this species on the animals, fungi, microbes, and other organisms in the communities that it invades. Although a non-native species may provide resources for one or a few native species (e.g. by providing food, nesting sites, etc.), the ranking should be based on the species' net impact on all native species. **Give more weight to changes in composition and interactions involving rare or keystone species or rare community types.**

NET impact on native species, in the documentation include both the positive and negative impacts.

Examples of severe impacts include:

- extirpation or endangerment of an existing native species or population;
- elimination or significant reduction in native species' nesting or foraging sites, cover, or other critical resources (i.e., native species habitat), including migratory corridors. *Example from Montana: spotted knapweed reduces 97% of elk forage where there is a dense infestation*

Examples of impacts that are usually less than severe include:

- minor reduction in nesting or foraging sites, cover, etc. for native animals;
- minor reduction in habitat connectivity or migratory corridors;
- interference with native pollinators;
- injurious components, such as awns or spines that damage the mouth and gut of native wildlife species, or production of anti-digestive or acutely

toxic chemical that can poison native wildlife species.

Other impacts: impact on mycorrhizae (e.g., cheat grass); insect diversity (purple loosestrife)

Select the one letter below that best describes this species' impact on community composition and interactions:

- A. Severe alteration of higher trophic populations, communities, or interactions.
- B. Moderate alteration of higher trophic level populations, communities, or interactions.
- C. Minor alteration of higher trophic level populations, communities or interactions.
- D. Negligible impact; causes no perceivable (*negative*) change in higher trophic level populations, communities, or interactions.
- U. Unknown.

D. No known hybridization. *Use this score when there are no native congeners in Arizona or when there are no possible means for hybridization.*

U. Unknown. *Use this score if the potential exists but it is not known to hybridize with native species.*

Question 1.4

Impact on genetic integrity

Consider whether the species can hybridize with and influence the proportion of individuals with non-native genes within populations of native species.

*If no native plant in the same genus is known to exist in the state (unless the non-native plant is known to hybridize across genera), the response is D and the resource is Kearney and Peebles 1960 or a more current treatment (Journal of AZ-NV Academy of Sciences) in which case the level of documentation is **Other Published Material**. Source of information can also be a known taxonomist or plant geneticist.*

Mechanisms and possible outcomes include:

- production of fertile or sterile hybrids that can outcompete the native species;
- production of sterile hybrids that lower the reproductive output of the native species. (*ex. of pollen swamping*)

Select the one letter below that best describes this species' impact on genetic integrity:

- A. Severe (high proportion of individuals).
- B. Moderate (medium proportion of individuals).
- C. Minor (low proportion of individuals). *Use this score if the potential exists*

Section 2. Invasive Potential

The seven questions in this section rate a species' potential to establish itself, spread, and increase in abundance in wildlands.

Information should be from within Arizona unless noted otherwise.

For questions of scale (spatial and temporal) use averaging phenomena (2.2 and 2.3) especially for episodic populations

Question 2.1

Role of anthropogenic and natural disturbance in establishment

Assess this species' dependence on disturbance—both human and natural—for establishment in wildlands. Examples of anthropogenic disturbances include:

- grazing, browsing, and rooting by domestic livestock and feral animals;
- altered fire regimes, including fire suppression;
- cultivation;
- silvicultural practices;
- altered hydrology due to dams, diversions, irrigation, etc.;
- roads and trails;
- construction;
- nutrient loading from fertilizers, runoff, etc.

Examples of natural disturbance include:

- wildfire;
- floods;
- landslides;
- windthrow;
- native animal activities such as burrowing, grazing, or browsing.

It is understood that there is some level of disturbance everywhere.

Select the first letter in the sequence below that describes the ability of this species to invade wildlands:

- A. Severe invasive potential—this species can establish independent of any known *large* natural or anthropogenic disturbance. *Can establish into a natural area without any disturbance.*

B. Moderate invasive potential—this species may occasionally establish in undisturbed areas but can readily establish in areas with natural disturbances. (*'readily'-- the Working Group decided it does not necessarily have to be readily*). You may consider using the following phrase if appropriate “Grazed range provides an environment where gaps are repeatedly created and therefore suitable sites for establishment are usually available”

→ use B if disturbance is required can be natural or anthropogenic (if plant requires only anthropogenic then use C).

C. Low invasive potential—this species requires anthropogenic disturbance to establish.

D. No perceptible invasive potential—this species does not establish in wildlands (though it may persist from former cultivation).

U. Unknown.

Question 2.2

Local rate of spread with no management

Current NOT potential

No management is implied to mean no control. Consider rate of spread in the area that is most susceptible to invasion, not over its entire area of infestation. If you can not ascertain the rate of spread because there is management then state it as such and either provide the best approximation or select unknown.

Assess this species' **rate of spread in existing localized infestations** where the proportion of available habitat invaded is still small when no management measures are implemented.

Consider rate of spread in the ecological type where most susceptible to invasion.

Select the one letter below that best describes the rate of spread:

- A. Increases rapidly (doubling in <10 years)
B. Increases, but less rapidly
C. Stable
D. Declining
U. Unknown

Question 2.3

Recent trend in total area *RANGE* (extent of distribution) infested within state

*Example: Is the species spreading farther north or south, **not** is it filling in at higher infestation densities within its known range.*

Management activity (control) may be causing species to decline, if this is the case, document it in the rationale section.

If all niches are filled within a state the answer would be C unless some control activity was reducing the range of the species.

Assess the overall trend in the total **area *RANGE*** infested by this species statewide. Include current management efforts in this assessment and note them.

Select the one letter below that best describes the current trend:

- A. Increasing rapidly (doubling in total range statewide in <10 years)
- B. Increasing, but less rapidly
- C. Stable
- D. Declining
- U. Unknown

Question 2.4

Innate reproductive potential

Assess the innate reproductive potential of this species by counting the attributes below that apply to this species. (Note any other related traits this species possesses.) Score this question by counting the number of questions to which the answer is “Yes.” Some questions are worth 2 points, the rest 1 point. Worksheet A is provided in the Plant Assessment Form for recording the responses and computing the score.

Most of this information can be found online or in the literature.

Rate of maturation:

Reaches reproductive maturity in 2 years or less.

Yes No Unknown (1 point)

Reproduces by seed:

Dense infestations produce >1,000 viable seed per square meter.

Yes No Unknown (2 points)

Populations of this species produce seeds every year.

Yes No Unknown (1 point)

Seed production sustained over 3 or more months within a population annually.

Yes No Unknown (1 point)

Seeds remain viable in soil for three or more years.

Yes No Unknown (2 points)

Viable seed produced with both self-pollination and cross-pollination.

Yes No Unknown (1 point)

Reproduces vegetatively:

Has quickly spreading vegetative structures (rhizomes, roots, etc.) that may root at nodes.

Yes No Unknown (1 point)

Fragments easily and fragments can become established elsewhere.

Yes No Unknown (2 points)

Resprouts readily when cut, grazed, or burned

Yes No Unknown (1 point)

Based on your total from counting “Yes” answers above, select the one letter below that best describes the reproductive characteristics of this species (Worksheet A in the Plant Assessment Form will help you tabulate this):

- A. High reproductive potential (6 or more points).
- B. Moderate reproductive potential (4-5 points).
- C. Low reproductive potential (3 points or less and less than 3 Unknowns).
- U. Unknown (3 or fewer points and 3 or more Unknowns).

Question 2.5

Potential for human-caused dispersal

Assess whether this species is currently spread—or has high potential to be spread—by direct or indirect human activity. Such activity may enable the species to overcome natural barriers to dispersal that would not be crossed otherwise, or it may simply increase the natural dispersal of the species. Possible mechanisms for dispersal include:

- commercial sales for use in agriculture, ornamental horticulture, or aquariums;
- use as forage, erosion control, or revegetation;
- presence as a contaminant (seeds or propagules) in bulk seed, hay, feed, soil, packing materials, etc.;
- spread along transportation corridors such as highways, railroads, trails, or canals;
- transport on boats or boat trailers.

Select the one letter below that best describes human-caused dispersal and spread:

- A. High—there are numerous opportunities for dispersal to new areas.
- B. Moderate—human dispersal occurs, but not at a high level.
- C. Low—human dispersal is infrequent or inefficient.
- D. Does not occur.
- U. Unknown.

Question 2.6

Potential for natural long-distance dispersal

We have chosen 1 km as the threshold of “long-distance.” (*a distance measure*) Assess whether this species is frequently spread, or has high potential to be spread, by animals or abiotic mechanisms that can move seed, roots, stems, or other propagules this far. The following are examples of such natural long-distance dispersal mechanisms:

- the species’ fruit or seed is commonly consumed by birds or other animals that travel long distances;
- the species’ fruits or seeds are sticky or burred and cling to feathers or hair of animals;
- the species has buoyant fruits, seeds, or other propagules that are dispersed by flowing water;
- the species has light propagules that promote long-distance wind dispersal;
- The species, or parts of it, can detach and disperse seeds as they are blown long distances (e.g., tumbleweed).

Dispersal does not need to be associated with a direction. For example, Salvinia can travel only one direction a long distance (downstream) were as a bird eating a seed or a seed stuck to an animal’s fur, it has the potential to disperse long distances in all directions.

Select the one letter below that best describes natural long-distance dispersal and spread:

- A. Frequent long-distance dispersal by animals or abiotic mechanisms.
- B. Occasional long-distance dispersal by animals or abiotic mechanisms.
- C. Rare dispersal more than 1 km by animals or abiotic mechanisms.
- D. No dispersal of more than 1 km by animals or abiotic mechanisms.
- U. Unknown.

Question 2.7

Other regions invaded

→It is helpful to first complete worksheet B (see instructions under Section 3) before responding to this question.

Assess whether this species has invaded ecological types in other states or countries outside its native range that are analogous to ecological types not yet invaded in your state (see Worksheets B, C, and D for California, Arizona, and Nevada, respectively, in Part IV for lists of ecological types). This information is useful in predicting the likelihood of further spread within your state.

There is not a direct parallel between ecological types from the different states or region, therefore use your best judgement and include information from personal interviews, Working Group members, and solicit information from outside of the state.

Provide the names of the ecological types and if using a different classification system, provide the equivalent ecological type that is similar in Arizona.

Select the one letter below that best describes the species’ invasiveness in other states or countries, outside its native range.

- A. This species has invaded 3 or more ecological types elsewhere that exist in your state and are as yet not invaded by this species (e.g. it has invaded Mediterranean grasslands, savanna, and maquis in southern Europe, which are analogous to California grasslands, savanna, and chaparral, respectively).
- B. Invades 1 or 2 ecological types that exist but are not yet invaded in your state.
- C. Invades elsewhere but only in ecological types that it has already invaded in the state.

D. Not known as an escape anywhere else.

U. Unknown.

Section 3. Ecological Amplitude and Distribution

This section rates the number and proportion of different ecological types invaded. The “ecological amplitude” of the species indicates the diversity of ecological types invaded. The “distribution” addresses the extent of infestation in any given ecological type. Ecological types are characterized by a combination of factors: for example, floristic composition, hydrology, and physiography. *Examples of dominant and common species are provided in an appended worksheet B for Arizona; based on Brown et al. 1979, Brown 1994, and Brown et al. 1998.*

Although one of the purposes of this section is to determine the ecological amplitude for each species evaluated, we recognize the inherent inconsistency among the three states’ lists of “ecological types.” Ideally, a nationwide (or more global) vegetation classification system would enable the scoring in this section to be uniformly applied. However, even for the limited three-state area covered by these criteria, such a system does not currently exist—at least not one that captures the complexity and diversity of ecosystems commensurate with the purposes of this section. In addition, as noted earlier, we intend that these criteria will initially be used primarily on a state-by-state basis to support the development of statewide lists of invasive non-native plants. The development of biogeographically-based lists in the future will depend on common vegetation classification systems that can be uniformly applied across state political boundaries.

For the time being, we decided that state-by-state evaluations should be based to the extent possible on existing classifications that are generally understood within each state and can enable the evaluation of ecological amplitude in a similar manner. We have selected what we believe are well-known and comparable vegetation classification systems for each state, and we have devised state-specific scoring instructions for Question 3.1.

Should these criteria be adapted for use in another state or region, the best-suited and most comparable vegetation classification system for that state must also be adopted, pending the development of a nationwide (or more global) classification system that

can be applied uniformly to considerations of ecological amplitude.

First, complete the ecological types worksheet for your state (Worksheet B, C, or D in the Plant Assessment Form). To complete the worksheet, assign one of the following letter codes below to **each** ecological type that has been invaded by the species. Think of this as that percentage of the ecological type’s total number of occurrences (frequency) that has been invaded, not as an estimate of the average percent cover occupied by the species within each ecological type. Leave rows blank for ecological types the species does not occupy.

This is a FREQUENCY measurement--consider one system such as a time such as semi-desert grassland, respond by estimating the percentage of semi-desert grasslands where this species has invaded.

***If the species occurs only along the transportation corridor in any of the ecological types, it is not considered to have yet invaded these types yet it is adjacent to the ecological type, it should be noted in the rationale section and complete worksheet B with U* (see AZ-WIPWG protocol below for sample language to include in rationale).*

It is especially important for Section 3 to interview people familiar with the species’ occurrence and for the Working Group to come to a group consensus on the estimated frequency.

Suggested terminology corresponding to the quantitative parameters.

- A. >50% of type occurrences are invaded.
Widespread throughout the community type; most of the ecological type have the plant present
- B. >20% to 50%.
Frequently or commonly found throughout the community type; many of the ecological type have the plant present.
- C. >5% but <20%.
Less commonly found throughout the community type; a limited percent of the ecological type have the plant present.
- D. Present but ≤5%.
Infrequent in the community type; very few of the ecological type have the plant present

U. Unknown (unable to estimate percentage of occurrences invaded).

Known to occur in the ecological type but unknown how frequently

AZWIPWG protocol for plants only along disturbed routes (roads, paved trails, etc.)

***Questions 3.1 and 3.2 were scored with U* based on working group consensus. The letter U* was used because Tribulus is naturalized through out Arizona and exists in all ecological types but it is within the anthropogenically disturbed areas where it is known to be present. Working group members could not identify an ecological type or place outside of urban or wildland-urban interface where Tribulus was known to invade or exist. This is not to say that it does not exist in natural areas. If there is a soil disturbance in an area, Tribulus has the potential to invade.*

Question 3.1

Also include information about the typical habitat, range of tolerance, abiotic and biotic requirements or preferences for germination, establishment, and reproduction.

Ecological amplitude / Range

Refer to the worksheet and select the one letter below that indicates the number of different ecological types that this species **has** invaded in your state.

- A. Widespread—the species invades at least three major types **or** at least five (AZ), six (CA), or five (NV) minor types.
- B. Moderate—the species invades two major types **or** four (AZ), five (CA), or four (NV) minor types.
- C. Limited—the species invades only one major type **and** two to three (AZ), two to four (CA), or two to three (NV) minor types.
- D. Narrow—the species invades only one minor type.

U. Unknown.

Include the species abiotic and biotic requirements or preferences for germination, establishment, and reproduction.

Question 3.2

Distribution / Peak frequency/disturbance

To assess distribution, record the letter that corresponds to the highest percent infested score entered in the worksheet for any ecological type.

Record the highest letter in Worksheet B as the response to this question.

Note: the level of documentation for 3.1 and 3.2 is most often going to be observational.

Section 4. Rating Level of Documentation

This section assesses the reliability of the documentation supporting the section scores and overall ranking for each species. The system used aims to represent an acceptable standard for ranking documentation—one based on sound scientific practices, peer review, and professional expertise—while also allowing for the incorporation of repeated observations, anecdotes, and other information into the species-ranking process. The degree of documentation is not used in calculating the overall rank of a species; instead, this information is provided to indicate the degree of confidence that can be ascribed to a particular ranking and to point the way toward future research in areas for which quantitative or reliable information is lacking.

The most reliable level of documentation includes refereed journal articles (includes refereed proceedings and articles in press). The second tier includes un-refereed book chapters, proceedings, newsletter articles, staff reports, environmental or regulatory documentation, and so on. The third tier includes unpublished observations by qualified biologists and unpublished data, maps, or photographs. The fourth tier includes unconfirmed (or third-person) anecdotal observations and uncorroborated reports.

Use the following scale to indicate the level of documentation used to answer each of the criteria's questions in the table on the scoring sheet in Part IV. Where appropriate, use the same scale to indicate the level of documentation available regarding other topics (biology and ecology, management, etc.) for this species.

When information comes from a variety of sources, select the highest level of documentation category for the information used in the rationale. In the case of conflicting evidence, select the level of documentation that corresponds to the reason used to justify the answer.

*When non peer-reviewed, peer-reviewed, or synthesis documents are used to justify responses to the questions, state this within the rationale and select other published material as the level of documentation. Such documents include fact sheets, element stewardship abstracts, or certain books (e.g. *Weeds of the West*, *The Worlds Worst Weeds*, *Invasive Plants of California*).*

When a publication provides background information on a species and cites other references for the specific piece of information being used,, unless the original citations are checked, the level of documentation is other published material. Regardless of whether the publication is peer-reviewed or not, the level is other published material because we are relying on the particular author's or authors' understanding or interpretation of the original information.

If peer-reviewed scientific literature is the original source of information, then the level of documentation is reviewed scientific publication.

Reviewed scientific publication—the response to this question is supported by published, peer-reviewed scientific evidence.

If the author(s) includes in the manuscript possible explanations (even though this may not be the particular research question being addressed) or an observation as a result of the covered research and this manuscript is peer-reviewed, the appropriate category is reviewed scientific publication. If authors indicate they are inferring something based on observation and general scientific principles, then it should be stated as such in the rationale and reviewed scientific publication is still the correct level of documentation. The assumption is the peer-reviewers have confidence in the authors conclusions or speculations.

For section 3, voucher samples or herbarium specimens from a particular ecological type qualify for this level of documentation.

Other published material—the response to this question is supported by reports, non-peer-reviewed documents, etc.

Includes documents such as agency reports, technical reports, in-house documents, conference proceedings, fact sheets, element stewardship abstracts, and books covering numerous invasive plants that may be edited but whose individual contributions are not peer-reviewed.

Floras are considered this type of documentation

If authors of other published material indicate they are inferring something based on observation and general scientific principles, then it should be stated as such and observational is the correct level of documentation. This represents a more "conservative" approach and follows the

reasoning that it is only the author(s) observation or inference.

Note: State in the Source of Information or Rationale section that the information used is a summary article or review.

Observational—the response to this question is supported by little published information, but there is confirmed but not-yet-published observations by qualified professionals.

Expanded to include INFERENCE, either inference based on the evaluator's review of the literature (rev. sci or other published literature) or inference based on the evaluator's personal observation and general scientific principles. Inference is identified as the level of documentation when a particular observation or experimental result is not available for the species under evaluation, but some degree of deductive logic can be used to arrive at a reasonable conclusion that enables the evaluator to respond to the criteria question with something other than "unknown".

For section 3, voucher samples or herbarium specimens from a particular ecological type qualify for this level of documentation.

Note: Include in rationale a statement indicating the inference and provide a clear description of the line of reasoning used.

For more discussion on why inference was included and how it should be used in responding to criteria questions, see the end of this section.

Anecdotal—the response to this question is supported only by unconfirmed, anecdotal information.

Includes newspaper articles, third hand information, or information from a non-qualified professional.

If you answer a question with "U" for "unknown," you can rate the level of documentation using one of the four categories above or by responding "No Information."

No information was available to justify this response.

Use of voucher specimens, herbarium records, herbarium databases, and SWEMP (or something similar):

When using voucher specimens or herbarium records (or the herbaria record database for AZ <http://seinet.asu.edu>) as rationale for presence in an ecological type, ensure that the collection was not roadside, parking lot, urban park etc. In addition to geographic location, sometimes the collection record has information on plant community type, associated species, etc. which can help identify the ecological type. If the evaluator does NOT use inference to assign the ecological type then the level of documentation is "Other Published Material." When herbarium records are used in conjunction with personal observations, SWEMP, other databases, or inference is used to assign the ecological type then the appropriate level of documentation is "Observational/Inference."

When using databases such as SWEMP to assign ecological types, one should use caution. Because descriptive information is usually not included in database records, one should NOT assume that these were reported from natural areas or that they were properly identified. When information from this source is used, the level of documentation is "Observational/Inference."

INFERENCE

Discussion topics among AZ Working Group members and the development committee regarding the use of inference in responding to criteria questions.

AZ Working Group agreed that inference by a qualified professional is an acceptable form of “information” and can be used to inform the response to the criteria questions. The alternative of “unknown” and “no information” is not always an accurate depiction of our knowledge even in the absence of direct observation or published empirical data. A qualified professional relies upon their knowledge of ecological principles, field experience, and familiarity with the ecological systems and species natural histories, can infer impacts by non-native species.

There is a lack of empirical studies on the impacts of invasive non-native species as well as impact studies on higher trophic levels (and their habitat relationships with natural communities) as they relate to questions 1.1 through 1.3. These studies rarely occur until after the species infests relatively large areas and becomes a focus of research attention.

Therefore, inference is a vital component of the rationale and providing a clear line of evidence (as opposed to speculation) is necessary. The burden of providing sufficient indirect evidence to support a clear line of reasoning is on the evaluator and the Arizona Wildlands Invasive Plant Working Group.

Inference is to be used conservatively and a clear distinction should be made between inference, observation and speculation.

Quote from development committee:

The Criteria distinguishes reliability at the edge of inference as “observational” (observations by a qualified profession). I guess what you are really asking is, at what point is unconfirmed information ignored, and not factored in to answering the questions. This is totally up to the reviewers, and could vary among reviewers. This is why the PAF needs to be completely filled out so that subsequent reviewers can evaluate the original assessments. It may be helpful to direct reviewers to take into account every bit of information, and not be afraid to use anecdotal information, as long as they can in their own mind justify it and document it. I am not sure how much more advice/direction we can give reviewers, except to encourage them to use their own best judgement. The decision-by-committee should reduce inter-reviewer variation, but in the end, we need to remember that these ranking are all going to be subjective.

Part III. Literature Cited

Use the citation format described on page 26, not the one below.

- AQIS The Weed Risk Assessment System (<http://aqis.gov.au/docs/plpolicy/wrmanu.htm>).
- Brown, David E., ed. 1994. *Biotic Communities: Southwestern United States and Northwestern Mexico*. University of Utah Press, Salt Lake City. 342 p. [Plus companion 60-inch by 48-inch map, *Biotic Communities of the Southwest*]
- Brown, D. Reichenbacher, F. Franson, S. 1998. *A Classification of North American Biotic Communities*. University of Utah Press. Salt Lake City. 141 p.
- California Exotic Pest Plant Council. 1994 (revised 1996, 1999). *The CalEPPC List: Exotic Pest Plants of Greatest Ecological Concern in California, September, 1994*. California Exotic Pest Plant Council, Berkeley, CA. 12 p.
- Fox, Alison M., Doria R. Gordon, Joan A. Dusky, Linda Tyson, and Randall K. Stocker. 2000. *IFAS Assessment of Non-Native Plants in Florida's Natural Areas*. University of Florida Extension, Institute of Food and Agricultural Sciences, Gainesville, FL. 32 p.
- Hiebert, Ronald D. and James Stubbendieck. 1993. *Handbook for Ranking Exotic Plants for Management and Control*. U. S. Department of the Interior, Natural Resources Report NPS/NRMWRO/NRR-93/08. National Park Service, Natural Resources Publication Office, Denver, CO.
- Hiebert, Ronald D. 1998. *Alien Plant Species Ranking System*. Unpublished document.
- Holland, Robert F. 1986. *Preliminary descriptions of the terrestrial natural communities of California*. Sacramento, CA: California Department of Fish and Game. 156 p.
- Mehrhoff, Leslie J. 2000. *Criteria for Including a Species as a Non-Native Invasive Species or a Potentially Invasive Species in New England* (unpublished). University of Connecticut, George Safford Torrey Herbarium. 2 p.
- Randall, John R., Larry E. Morse, Nancy Benton, Ron Hiebert, and Stephanie Lu. 2003. *A New Tool to Categorize and List Invasive Non-native Plant Species that Threaten Native Biodiversity*. In press.
- Smallwood, K. Shawn, and Terrell P. Salmon. 1992. A rating system for potential exotic bird and mammal pests. *Biological Conservation* 62:149-159.
- Timmins, S.M., Williams, P.A. 1987. Characteristics of problem weeds in New Zealand's protected natural areas. D.A. Saunders, G.W. Arnold, A.A. Burridge & A.J.M. Hopkins (eds.), *Nature Conservation and the Role of Native Vegetation*. Surrey Beatty and Sons, Chipping Norton, Australia.
- United States Department of Agriculture. 1999. *Concept Paper: Classification of Taxa of Pest*. USDA, Animal and Plant Protection Inspection Service, Raleigh Plant Protection Center, Raleigh, NC. 4 p.
- Weiss, John, and David McLaren. 1999. *Invasive Assessment of Victoria's State Prohibited, Priority & Regional Priority Weeds*. Keith Turnbull Research Institute, Agriculture Victoria, Frankston, Victoria, Australia. 16 p.

Part IV. Plant Assessment Form

**For use with “Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands”
by the California Exotic Pest Plant Council and the Southwest Vegetation Management Association**

Printable version, February 28, 2003

Instructions

For each species assessed, complete and return the Plant Assessment Form including the three tables, Worksheet A, and the appropriate state ecological types worksheet (either Worksheet B, C, or D). All light blue cells should be filled in for each of these tables and worksheets. This “printable” version of the Plant Assessment Form is formatted to allow an evaluator to fill in blanks by hand (you may need extra paper for listing documentation). This form is provided to assist the evaluator during the assessment process. The “electronic” version of this form is preferred for final submissions to the list committee.

Step 1: Complete Table 1 with information on the species being assessed and the individual(s) performing the assessment. Enter the information in the light blue spaces below.

USDA Plants database (<http://plants.usda.gov/>) is the authority the AZ-WIPWG is using.

Table 1. Species and Evaluator Information

Species name (Latin binomial):	<i>Include author in the scientific binomial (see http://plants.usda.gov/)</i>
Synonyms:	<i>(see http://plants.usda.gov/)</i>
Common names:	<i>(see http://plants.usda.gov/)</i>
Evaluation date (mm/dd/yy):	
Evaluator #1 Name/Title:	
Affiliation:	
Phone numbers:	
Email address:	
Address:	
Evaluator #2 Name/Title:	
Affiliation:	
Phone numbers:	
Email address:	
Address:	

Section below for list committee use—please leave blank

List committee members:	
Committee review date:	
List date:	
Re-evaluation date(s):	

Step 2a: Complete the first portion of Table 2 by circling the appropriate score to each of the thirteen criteria questions in Part II.

For question 2.4, first complete Worksheet A located below Table 3.

For questions 3.1 and 3.2, first complete the appropriate ecological type worksheet for your state (either Worksheet B, C, or D found below Table 3) by following the instructions in Section 3, then respond to questions 3.1 and 3.2.

Table 2. Criteria, Section, and Overall Scores

1.1	Impact on abiotic ecosystem processes	A B C D U	Doc'n level:
1.2	Impact on plant community	A B C D U	Doc'n level:
1.3	Impact on higher trophic levels	A B C D U	Doc'n level:
1.4	Impact on genetic integrity	A B C D U	Doc'n level:

“Impact”

Enter four characters from Q1.1-1.4 below:

Use matrix to determine the score; circle below:

Section 1 Score:
A B C D U

2.1	Role of anthropogenic and natural disturbance	A B C D U	Doc'n level:
2.2	Local rate of spread with no management	A B C D U	Doc'n level:
2.3	Recent trend in total area infested within state	A B C D U	Doc'n level:
2.4	Innate reproductive potential	A B C D U	Doc'n level:
2.5	Potential for human-caused dispersal	A B C D U	Doc'n level:
2.6	Potential for natural long-distance dispersal	A B C D U	Doc'n level:
2.7	Other regions invaded	A B C D U	Doc'n level:

“Invasiveness”

For questions at left, recall that an A gets 3 points, a B gets 2, a C gets 1, and a D or U gets=0. Enter the sum total of all points for Q2.1-2.7 below:

_____ pts

Use matrix to determine score and circle below:

Section 2 Score:
A B C D U

“Plant Score”

Using matrix, determine the Overall Score and Alert Status from the three section scores and circle them below:

Overall Score:
High Med Low

Evaluated but not listed

Alert Status:
None Alert

3.1	Ecological amplitude	A B C D U	Doc'n level:
3.2	Distribution	A B C D U	Doc'n level:

“Distribution”

Use matrix; circle score:

Section 3 Score:
A B C D U



Something you should know.



Committee comments to the reader:

This section is to be completed by the list committee when they determine a critical piece of information about the species needs to be communicated to the end user of the categorized list. Indicate in this section if the plant should be re-evaluated and within what time frame.

Examples include: (1) a rare community is infested, (2) a particular ecological type is >50% infested but is currently restricted geographically, and (3) a plant occupies many ecological types (A or B for 3.1), but none greater than 20% (C or D for 3.2) which results in Section 3 score of B thus, not qualifying it for Alert status.

(Delete the flag and this box if nothing warrants using it.)

Step 2b: In Table 3 document key information for each particular criteria question, summarize the rationale for the score assigned, and cite the sources of information. Citations should provide complete bibliographic information for published materials, and contact information and observation dates for anecdotal reports (see samples below). Identify major gaps in information that could be critical for improving the accuracy of answering the particular question for this species, and indicate whether out-of-state information was used as a basis for documenting ecological impact (enter this information in the “Rationale” section for each question). Enter text directly into the light blue cells. Attach additional sheets, formatted similarly, to supplement information and documentation that cannot fit into Table 3.

Sample citations: see below Worksheet B

Record full citations in the Literature Citations section below Worksheet B. Under sources of information provide (1) in text citations for those references that were not directly cited; most commonly used when rationale is documented in a review or summary article; (2) websites that are not listed in the Literature Citations, and (3) personal communications and observations not listed in the Literature Citations.

Table 3. Documentation

Question 1.1 Impact on abiotic ecosystem processes	<i>Score: Doc'n Level:</i>
Identify ecosystem processes impacted:	
Rationale:	
Sources of information:	
Question 1.2 Impact on plant community composition, structure, and interactions	<i>Score: Doc'n Level:</i>
Identify type of impact or alteration:	
Rationale:	
Sources of information:	
Question 1.3 Impact on higher trophic levels	<i>Score: Doc'n Level:</i>
Identify type of impact or alteration:	
Rationale:	
Sources of information:	
Question 1.4 Impact on genetic integrity	<i>Score: Doc'n Level:</i>
Identify impacts:	
Rationale:	

Sources of information:	
<i>If only citing a flora use Other Pub Mat for level of documentation</i>	
Question 2.1 Role of anthropogenic and natural disturbance in establishment	Score: Doc'n Level:
Describe role of disturbance:	
Rationale:	
Sources of information:	
Question 2.2 Local rate of spread with no management	Score: Doc'n Level:
Describe rate of spread:	
Rationale:	
Sources of information:	
Question 2.3 Recent trend in total area infested within state	Score: Doc'n Level:
Describe trend:	
Rationale:	
Sources of information:	
Question 2.4 Innate reproductive potential	Score: Doc'n Level:
Describe key reproductive characteristics:	
Rationale:	
Sources of information:	
Question 2.5 Potential for human-caused dispersal	Score: Doc'n Level:
Identify dispersal mechanisms:	
Rationale:	
Sources of information:	
Question 2.6 Potential for natural long-distance dispersal	Score: Doc'n Level:
Identify dispersal mechanisms:	
Rationale: <i>describe mechanisms</i>	
Sources of information:	
Question 2.7 Other regions invaded	Score: Doc'n Level:
Identify other regions: <i>provide the names of the ecological types and if using a different classification system, provide the equivalent ecological type that is similar in Arizona</i>	
<i>Usually need to complete worksheet B before answer this question</i>	
Rationale:	
Sources of information: <i>If only citing a flora use Other Pub Mat for level of documentation</i>	
Question 3.1 Ecological amplitude	Score: Doc'n Level:
How many major and minor ecological types invaded?	
Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known:	
<i>Include typical habitat, range of tolerance, abiotic and biotic requirements or preferences for germination, establishment, and reproduction.</i>	
<i>for date of introduction, see herbarium records for earliest date (for AZ see www.seinet.asu.edu which is a work in progress therefore include date visited website)</i>	
Sources of information: <i>most often this will be observational</i>	

Question 3.2 Distribution	Score: Doc'n Level:
Describe distribution:	
Rationale: <i>Where located in state (from personal observations, herbaria records, personal communications, etc.).</i> <i>If the species occurs only along the transportation corridor in any of the ecological types, it is not considered to have yet invaded these types but it should be noted in the rationale section of 3.2.</i>	
Sources of information: most often this will be observational	

Sample documentation for a species that is only in human disturbed areas:

***If the species occurs only along the transportation corridor in any of the ecological types, it is not considered to have yet invaded these types yet it is adjacent to the ecological type, it should be noted in the rationale section and complete worksheet B with U* (see AZ-WIPWG protocol below for sample language to include in rationale).*

Questions 3.1 and 3.2 were scored a U based on working group consensus. U* was used because Tribulus is naturalized through out Arizona and exists in many ecological types but it is within the anthropogenically disturbed areas where it is known to be present. Working group members could not identify an ecological type or place outside of urban or wildland-urban interface where Tribulus was known to invade or exist. This is not to say that it does not exist in natural areas. If there is a soil disturbance that also resulted in an open area, Tribulus has the potential to invade. The amplitude of Tribulus is such that it invades most all ecological types in Arizona anthropogenically disturbed to a some degree (i.e. not natural areas).*

The Working Group felt having this documentation was relevant because it represents a unique case and it distinguishes itself from those species that are present in a variety of ecological types (truly those that are wildlands) but it is unknown the frequency in which they occur in these ecological types.

Worksheet A

Complete this worksheet to answer Question 2.4.

Reaches reproductive maturity in 2 years or less	Yes	No	1 pt.
Dense infestations produce >1,000 viable seed per square meter	Yes	No	2 pt.
Populations of this species produce <i>viable</i> seeds every year.	Yes	No	1 pt.
Seed production sustained for 3 or more months within a population annually	Yes	No	1 pt.
Seeds remain viable in soil for three or more years	Yes	No	2 pt.
Viable seed produced with <i>both</i> self-pollination and cross-pollination	Yes	No	1 pt.
Has quickly spreading vegetative structures (rhizomes, roots, etc.) that may root at nodes	Yes	No	1 pt.
Fragments easily and fragments can become established elsewhere	Yes	No	2 pt.
Resprouts readily when cut, grazed, or burned	Yes	No	1 pt.
			Total pts: ___ Total unknowns: ___
			Score : ___

Note any related traits: *Document references and rational here or under question 2.4*

Worksheet B

The ecological types are derived from the hierarchical classification described in Brown et al. (1979), Brown (1994), and Brown et al. (1998) at the vegetation mapping units of biomes, communities (series), and associations. The following is provided to assist evaluators in completing Worksheet B and to convey some logic on how "ecological types" were developed. For additional information of plants (and animals) in a given ecological type refer to Appendix II of Brown 1994.

Major Ecological Types	Minor Ecological Types	Examples of communities within the minor ecological types
Dunes	dunes	
Scrublands	Great Basin montane scrub	oak-scrub series, mountain mahogany series, brittlebush series, serviceberry series
	southwestern interior chaparral scrub (133.3)	scrub-oak series, manzanita series, ceanothus series, mountain mahogany series, silktassel series
Desertlands	Great Basin desertscrub (152.1)	sagebrush series, blackbrush series, rabbitbrush series, winterfat series, saltbrush series
	Mojave desertscrub (153.1)	creosote series, blackbrush series, mesquite series, Joshua tree series, saltbush series Include Mojave ephemeral system here
	Chihuahuan desertscrub (153.2)	creosote-tarbrush series, sandpaper bush series, whitethorn series, mesquite series, saltbush series, mixed scrub series
	Sonoran desertscrub (154.1)	creosote-bursage series (Lower Colorado Valley), paloverde-mixed cacti series (Arizona Upland), brittlebush-ironwood series; xeroriparian; ephemeral systems
Grasslands	alpine and subalpine grassland (141.4)	bunchgrass series(including <i>Festuca thurberi</i> association, <i>Festuca arizonica</i> association, and mixed grass-forb association), sedge-forb-grass association ; meadows within conifer forests
	plains and Great Basin shrub-grassland (142.1 and 142.2)	bluestem (<i>Andropogon</i>) tall-grass series, grama (<i>Bouteloua</i>) short-grass series, buffalo (<i>Buchloe</i>) grass series, wheat grass (<i>Agropyron smithi</i>) series, other mixed bunchgrass series; short grass steppe
	semi-desert grassland (143.1)	grama grass-scrub series (<i>Bouteloua</i>), tobosa grass (<i>Hilaria mutica</i>)-scrub series, curly mesquite grass (<i>Hilaria belangeri</i>)- scrub series, sacaton-scrub series, mixed grass-scrub-shrub series
Freshwater Systems	lakes, ponds, reservoirs, <i>springs</i>	submergent and emergent vegetation in standing water; hydrilla, Eurasian watermilfoil; cattails; horsetail
	rivers, streams (no canals)	submergent and emergent vegetation in moving ephemeral, intermittent or perennial water; cattails; horsetail; salvinia
Non-Riparian Wetlands*	Sonoran wetlands	some species common to these areas include alkali bulrush, phragmites, bulrush, tamarisk; cienegas
	southwestern interior wetlands	some species common to these areas include cordgrass, pickleweed, saltgrass, bulrush, glasswort
	montane wetlands	some species common to these areas include cattail, rushes, sedges, willows
	playas	
Riparian*	Sonoran riparian	cottonwood-willow series, mesquite series; palm series; intermittent and perennial systems
	southwestern interior riparian	cottonwood-willow series, mixed deciduous broadleaf series (<i>Oak Creek Canyon</i>)
	montane riparian	mixed deciduous broadleaf series; fir, alder, sedges, spike rush, willow, maple
Woodlands	Great Basin conifer woodland (122.4)	pinyon-juniper series
	Madrean evergreen woodland (encinal, 123.3)	douglas fir-mixed conifer series, pine (ponderosa) series; madrona, oaks, manzanita
Forests	Rocky Mountain (121.3) and Great Basin subalpine conifer forest	Engelmann spruce-alpine fir series, bristlecone pine-limber pine series
	montane conifer forest (122.3)	Ponderosa Pine Forests; douglas fir-white fir series, ponderosa pine series, gambel oak series
Tundra	tundra (alpine, 111.5)	lichen-moss series (<i>Rhizocarpon geographicum</i>), mixed herb series, woodrush series with prevalence of bristlecone pine, corkbark fir, Engelmann spruce

+Similar in vegetation but not connected to a riparian area

*Generalized from schematic Biotic Communities (Brown 1994) page 226.

Brown, D.E., C.H. Lowe, C.P. Pase. 1979. A digitized classification system for the biotic communities of North America, with community (series) and association examples for the southwest. *Journal of the Arizona-Nevada Academy of Science* 14 (Suppl. 1): 1-16.

Brown, D.E. (ed.). 1994. *Biotic communities southwestern United States and northwestern Mexico*. University of Utah Press. Salt Lake City, Utah. 342 pp.

Brown, D.E., F. Reichenbacher, S.E. Franson. 1998. *A classification of North American biotic communities*. University of Utah Press. Salt Lake City, Utah. 141 pp.

Complete the worksheet that corresponds to your state using the letter codes and instructions in Section 3.

If the species occurs only along the transportation corridor in any of the ecological types, it is not considered to have yet invaded these types but it should be noted in the rationale section of 3.2.

Leave a blank in the Code column if the species does NOT occur in a particular ecological type. If you know the species is present in an ecological type but can not estimate the percent of occurrence, U is the appropriate code. Attempt to provide a code to those ecological types that you can so that question 3.2 can be answered.

Worksheet B - Arizona Ecological Types

(*sensu* Brown 1994 and Brown et al. 1998)

Major Ecological Types	Minor Ecological Types	Code*
Dunes	dunes	
Scrublands	Great Basin montane scrub	
	southwestern interior chaparral scrub	
Desertlands	Great Basin desertscrub	
	Mohave desertscrub	
	Chihuahuan desertscrub	
	Sonoran desertscrub	
Grasslands	alpine and subalpine grassland	
	plains and Great Basin shrub-grassland	
	semi-desert grassland	
Freshwater Systems (Aquatic)	lakes, ponds, reservoirs	
	rivers, streams, canals	
Non-Riparian Wetlands	Sonoran wetlands	
	southwestern interior wetlands	
	montane wetlands	
	playas	
Riparian	Sonoran riparian	
	southwestern interior riparian	
	montane riparian	
Woodlands	Great Basin conifer woodland	
	Madrean evergreen woodland	
Forests	Rocky Mountain and Great Basin subalpine conifer forest	
	montane conifer forest	
Tundra (alpine)	tundra (alpine)	

A. means >50% of type occurrences are invaded; B means >20% to 50%; C. means >5% to 20%; D. means present but ≤5%; U. means unknown percent of occurrences (i.e., unable to estimate percentage of occurrences invaded *but it is present at some frequency*).

Suggestion terminology to correspond to the quantities (similar to question 3.1 responses).

A. Most of the ecological type have the plant present (≥ 50% of type occurrences invaded)

B. Many of the ecological type have the plant present (≥ 20% and < 50%)

C. A limited percent of the ecological type have the plant present (≥ 5% and < 20%)

D. Very few of the ecological type have the plant present (>0% and < 5%)

CITING LITERATURE:

When responding to the question in the PAF, use the in text citation format in the first box (“Impacts” or “Describe”) and second box (“Rationale”) for each question. Cite each statement with the appropriate author(s) or personal communications. If all of the information comes from a single source, include that in the “Sources of Information” box. If the information comes from more than one source and you have included the in text citation, use the phrase “see literature citations” in the “Sources of Information” box.

USE THE FOLLOWING FORMAT FOR LITERATURE CITATIONS AND BIBLIOGRAPHY

In text: 1 author (Jones 2000); 2 authors (Smith and Jones 2001); 3 or more authors (Smith et al. 2003)

In text personal communication: (Smith, pers. comm. 1998)

Book: Kearney, T.H. and R.H. Peebles. 1960. Arizona Flora. University of California Press, 2nd Edition. Los Angeles, California. 1085 pp.

Journal Article: Anable, M.E, M.P. McClaran and G.B. Ruyle. 1992. Spread of introduced Lehmann lovegrass *Eragrostis lehmanniana* Nees. in Southern Arizona, USA. Biological Conservation 61:181-188.

Technical Report: Brown, E.O. and R.H. Porter. 1942. The viability and germination of seeds of *Convolvulus arvensis* L. and other perennial weeds. Agricultural Exp. Station, Iowa State College, Research Bulletin, # 294.

Citations in other literature:

Turner, C.E., J.B. Johnson, and J.P. McCaffrey. 1995. Yellow starthistle, *Centaurea solstitialis* L.

(Asteraceae). In: Nechols, J.R., L.A. Andrews, J.W. Beardsley, R.D. Goeden, and C.G. Jackson, eds. Biological control in the western United States: Accomplishments and benefits of regional research project W-84, 1964-1989. University of California Division of Agricultural and Natural Resources, Publication 3361, Oakland, California. pp. 270-75.

Proceedings: Kelsey, R.G. and D.J. Bedunah. 1989. Ecological significance of allelopathy for *Centaurea* species in the Northwestern U.S. In: P.K. Fay and J.R. Lacey (eds.), Proc. Knapweed Symposium, April 4-5, 1989. Plant and Soil Sci. Dept. and Coop. Ext. Service. Montana State Univ., Bozeman. EB45, 10-32.

Web Site: Hoshovsky, M. 1986. Arundo donax Element Stewardship Abstract. The Nature Conservancy. San Francisco, CA. Available online at: <http://tncweeds.ucdavis.edu/esadocs/Arundona.html>, accessed April 24, 2003.

Personal observation or communication:

Last name, first initials. Date. Position. Affiliation. Contact information (i.e. address, email, phone #, if available).

Commonly used references:

Guertin, P. and W.L. Halvorson. 2003. Status of Fifty Introduced Plants in Southern Arizona Parks. USGS Sonoran Desert Research Station, School of Natural Resources, University of Arizona, Tucson. Available online at: <http://sdrsnet.snr.arizona.edu/index.php?page=datamenu&lib=2&sublib=13>, accessed *provide date*.

Makarick, L.J. 1999 Draft Exotic Plant for Grand Canyon National Park. Grand Canyon, AZ. National Park Service.
Northern Arizona Weed Council. 2002. Information sheet on Genus species. Flagstaff, AZ.

Step 3: Determine each section score by using the matrices below. Record each section score in Table 2.

This matrix for Section 1 addresses all potential combinations of answers for questions 1.1-1.4, although many combinations are unlikely in the real world. The scoring system is conservative. When a question is scored as “U” for unknown, the overall scoring for that section assumes the most conservative scenario, which is that additional information would result in a “D” score for that question. Species therefore have potential to be scored higher for “Impact” in the future when additional information is available.

If three or more questions receive a score of “U,” Section 1 receives a score of “U.”

Section 1 Scoring Matrix				
<i>Q 1.1</i>	<i>Q 1.2</i>	<i>Q 1.3</i>	<i>Q 1.4</i>	Score
A	A	Any	Any	A
A	B	A,B	Any	A
A	B	C,D,U	Any	B
A	C,D,U	Any	Any	B
B	A	A	Any	A
B	A	B	A	A
B	A	B,C	B-D,U	B
B	A	C,D,U	A	A
B	A	C,D,U	B-D,U	B
B	B	A	A	A
B	C,D,U	A	A	B
B	B-D	A	B-D,U	B
B	B-D	B-D,U	Any	B
B	D,U	C,D,U	A-B	B
B	D,U	C,D,U	C,D,U	C
C-D,U	A	A	Any	A
C	B	A	Any	B
C	A,B	B-D,U	Any	B
C	C,D,U	Any	Any	C
D	A,B	B	Any	B
D	A,B	C,D,U	Any	C
D	C	Any	Any	C
D	D,U	Any	Any	D
U	A	B,C	Any	B
U	A	D,U	Any	B*
U	B,C	A,B	Any	B
U	B,C	C,D,U	Any	C
U	D	Any	Any	D
U	U	Any	Any	U

* AZ Wildlands Invasive Plant Working Group decision

For Section 2: Use the information and matrix below to calculate the section score based on answers to questions 2.1 – 2.7.

questions answered A: ___ x 3 = ___ pts

questions answered B: ___ x 2 = ___ pts

questions answered C: ___ x 1 = ___ pts

questions answered D: ___

questions answered U: ___

Total = ___ pts

Section 2 Scoring Matrix	
Total points	Score
17-21	A
11-16	B
5-10	C
0-4	D
More than two U's	U

Section 3 Scoring Matrix		
Q 3.1	Q 3.2	Score
<i>A</i>	<i>A, B</i>	A
<i>A</i>	<i>C, D, U</i>	B
<i>B</i>	<i>A</i>	A
<i>B</i>	<i>B, C</i>	B
<i>B</i>	<i>D</i>	C
<i>C</i>	<i>A, B</i>	B
<i>C</i>	<i>C, D</i>	C
<i>D</i>	<i>A</i>	B
<i>D</i>	<i>B, C</i>	C
<i>D</i>	<i>D</i>	D
<i>A, B</i>	<i>U</i>	C
<i>C, D</i>	<i>U</i>	D
<i>U</i>	<i>U</i>	U

Step 4: Determine the overall rank and alert status from the section scores recorded in Table 2 using the matrix below. Record the overall score and alert status in Table 2.

Overall Scoring Matrix				
Sec. 1	Sec. 2	Sec. 3	Overall Score	Alert Status
A	A,B	A,B	High	
A	A,B	C,D	High	Alert
A	C,D	A-D	Med	
B	A,B	A,B	Med	
B	A,B	C,D	Med	Alert
B	C,D	A-D	Low	
C	A	A,B	Med	
C	A	C,D	Low	
C	B	A	Med	
C	B	B-D	Low	
C	C	A-D	Low	
D	A-D	A-D	Not listed	

Step 5: For each of the thirteen questions, select the appropriate level of documentation below used to answer each of the criteria’s questions as recorded in Table 3. Record the level of documentation in Table 2.

When information comes from a variety of sources, select the highest level of documentation category for the information used in the rationale. In the case of conflicting evidence, select the level of documentation that corresponds to the reason used to justify the answer.

When non peer-reviewed, peer-reviewed, or synthesis documents are used to justify responses to the questions, state this within the rationale and select other published material as the level of documentation. Such documents include fact sheets, element stewardship abstracts, or certain books (e.g. Weeds of the West, The Worlds Worst Weeds, Invasive Plants of California).

When a publication provides background information on a species and cites other references for the specific piece of information being used,, unless the original citations are checked, the level of documentation is other published material. Regardless of whether the publication is peer-reviewed or not, the level is other published material because we are relying on the particular author’s or authors’ understanding or interpretation of the original information.

If peer-reviewed scientific literature is the original source of information, then the level of documentation is reviewed scientific publication.

Reviewed scientific publication—the response to this question is supported by published, peer-reviewed scientific evidence. [Abbreviate as “Rev. Sci. Pub.”]

If the author(s) includes in the manuscript possible explanations (even though this may not be the particular research question being addressed) or an observation as a result of the covered research and this manuscript is peer-reviewed, the appropriate category is reviewed scientific publication. If authors indicate they are inferring something based on observation and general scientific principles, then it should be stated as such in the rationale and reviewed scientific publication is still the correct level of documentation. The assumption is the peer-reviewers have confidence in the authors conclusions or speculations.

Other published material—the response to this question is supported by reports, non-peer-reviewed documents, etc. [Abbreviate as “Other pub.”]

Includes documents such as agency reports, technical reports, in-house documents, conference proceedings, fact sheets, element stewardship abstracts, and books covering numerous invasive plants that may be edited but whose individual contributions are not peer-reviewed. If use review /synthesis article as only source of

information then state this in the rationale and the level of documentation is “other published material” unless the original citations are actually reviewed by the evaluator him/herself (in which case it would be “reviewed scientific publication”). Even if it is a book or synthesis article (often both are considered peer-reviewed) it is still “other published material” because the evaluator is relying on the author’s understanding and interpretation of the original literature.

If authors of other published material indicate they are inferring something based on observation and general scientific principles, then it should be stated as such and observational is the correct level of documentation. This represents a more “conservative” approach and follows the reasoning that it is only the author(s) observation or inference.

Note: State in the Source of Information or Rationale section that the information used is a summary or review article.

Use of voucher specimens, herbarium records, herbarium databases, and SWEMP (or something similar):

When using voucher specimens or herbarium records (or the herbaria record database for AZ <http://seinet.asu.edu>) as rationale for presence in an ecological type, ensure that the collection was not roadside, parking lot, urban park etc. In addition to geographic location, sometimes the collection record has information on plant community type, associated species, etc. which can help identify the ecological type. If the evaluator does NOT use inference to assign the ecological type then the level of documentation is “Other Published Material.” When herbarium records are used in conjunction with personal observations, SWEMP, other databases, or inference is used to assign the ecological type then the appropriate level of documentation is “Observational/Inference.”

When using databases such as SWEMP to assign ecological types, one should use caution. Because descriptive information is usually not included in database records, one should NOT assume that these were reported from natural areas or that they were properly identified. When information from this source is used, the level of documentation is “Observational/Inference.”

Observational—the response to this question is supported by little published information, but there are confirmed, not-yet-published observations by a qualified professional. [Abbreviate as “Obs.”]

Expanded to include **inference**, either inference based on the evaluator’s review of the literature (rev. sci or other published literature) or inference based on the evaluator’s personal observation and general scientific principles. Inference is identified as the level of documentation when a particular observation or experimental result is not available for the species under evaluation, but some degree of deductive logic can be used to arrive at a reasonable conclusion that enables the evaluator to respond to the criteria question with something other than “unknown”. Be cautious not to overuse inference for the sake of higher score.

Note: Include in rationale a statement indicating the inference and provide a clear description of the line of reasoning used.

Anecdotal—the response to this question is supported only by unconfirmed, anecdotal information. [Abbreviate as “Anec.”]

Includes newspaper articles, third hand information, or information from a non-qualified professional.

No Information [Abbreviate as “No Info”]

No information was available to justify this response.

Step 6: Return the Plant Assessment Form.

Please email filled in forms as an attachment to the appropriate contact for your state listed below. If necessary, materials can be mailed to the postal addresses. For further information, refer to websites listed.

Arizona

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dbacker@tnc.org

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1510 East Ft. Lowell Rd.
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Nevada

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U.N. Cooperative Extension
2345 Red Rock Street
Las Vegas, NV 89146-3160

(702) 257-5550

Please refer all comments regarding this document to Peter Warner at pwarn@parks.ca.gov or pwarn@mcn.org.

APPENDIX 2 Organizations that Contributed Participants to the Work of the Arizona Wildlands Invasive Plant Working Group

Organization or Affiliation	Organization Subdivision or Professional Status	Location	Number of Participants
Agricultural Research Service	US Water Conservation Laboratory	Phoenix, AZ	1
Animal and Plant Health Protection Service	Plant Protection and Quarantine	Phoenix, AZ	1
Arizona Department of Agriculture	Plant Services Division	Phoenix, AZ	1
Arizona Department of Transportation	Natural Resources	Tucson, AZ	1
Arizona Game and Fish Department	Mesa Office	Mesa, AZ	1
Arizona-Sonora Desert Museum	Habitat Preservation	Tucson, AZ	1
Arizona State University	Department of Applied Biological Sciences	Mesa, AZ	2
Bureau of Indian Affairs	Natural Resources	Fort Defiance, AZ	1
Bureau of Land Management	National Science and Technology Center	Denver, CO	1
Bureau of Land Management	Arizona Strip Field Office	St. George, UT	1
Bureau of Land Management	Yuma Field Office	Yuma, AZ	2
Bureau of Reclamation	Lower Colorado Regional Office	Boulder City, NV	1
Bureau of Reclamation	Phoenix Area Office	Phoenix, AZ	1
JZ Design	Landscape architect	Phoenix, AZ	1
Mountain States Nursery	Nursery botanist	Glendale, AZ	1
National Park Service	Colorado Plateau Inventory and Monitoring	Flagstaff, AZ	1
National Park Service	Glen Canyon National Recreational Area	Page, AZ	1
National Park Service	Grand Canyon National Park	Flagstaff, AZ	2
National Park Service	Lake Mead Recreational Area	Boulder City, NV	1
National Park Service	Organ Pipe Cactus National Monument	Ajo, AZ	2
National Park Service	Saguaro National Park	Tucson, AZ	2
National Park Service	Sonoran Desert Network	Tucson, AZ	1
Natural Resources Conservation Service	Tucson Plant Materials Center	Tucson, AZ	2
New Mexico State University	Cooperative Extension	Las Cruces, NM	1
Northern Arizona University	Herbarium	Flagstaff, AZ	1

APPENDIX 2 Organizations that Contributed Participants to the Work of the Arizona Wildlands Invasive Plant Working Group—continued

Organization or Affiliation	Organization Subdivision or Professional Status	Location	Number of Participants
Prescott College	Environmental Studies (faculty and student)	Prescott, AZ	2
Private consultant	Weed biologist	Tempe, AZ	1
Private volunteer	Botanist	Las Cruces, NM	1
Private volunteer	Botanist	Tucson, AZ	2
Southwest Strategy	Arizona Office	Phoenix, AZ	1
The Nature Conservancy	Conservation	Tucson, AZ	6
University of Arizona	Cooperative Extension	Prescott, AZ	1
University of Arizona	Cooperative Extension	Flagstaff, AZ	2
University of Arizona	Cooperative Extension	Wilcox, AZ	1
University of Arizona	School of Renewable Resources	Tucson, AZ	6
University of California at Davis	Weed Science Program	Davis, CA	1
US Army Corps of Engineers	Planning Section C	Phoenix, AZ	1
US Fish and Wildlife Service	Arizona Ecological Services Field Office	Flagstaff, AZ	1
US Fish and Wildlife Service	Cabeza Prieta National Wildlife Refuge	Ajo, AZ	1
US Fish and Wildlife Service	Lower Colorado River coordinator	Phoenix, AZ	1
US Forest Service	Apache-Sitgreaves National Forest	Springerville, AZ	1
US Forest Service	Coconino National Forest	Flagstaff, AZ	3
US Forest Service	Tonto National Forest	Phoenix, AZ	1
US Geological Survey	Desert Laboratory	Tucson, AZ	1
US Geological Survey	Colorado Plateau Field Station	Flagstaff, AZ	4
Wild About Wildflowers	Biological consultant	Glendale, AZ	1

APPENDIX 3 Invasive Non-Native Plants That Threaten Wildlands in Arizona

Scientific Name/Authority (Common Name)	Ecological Impacts	Invasiveness	Distribution	Overall Score	Alert	Red Flag¹
01. <i>Acroptilon repens</i> (L.) DC. (Russian knapweed)	A	A	B	High		
02. <i>Aegilops cylindrica</i> Host (Jointed goatgrass)	C	B	B	Low		X
03. <i>Alhagi maurorum</i> Medik. (Camelthorn)	B	A	A	Medium		
04. <i>Arundo donax</i> L. (Giant reed)	A	B	B	High		
05. <i>Asphodelus fistulosus</i> L. (Onionweed)	C	B	D	Low		
06. <i>Avena fatua</i> L. (Wild oat)	C	B	A	Medium		
07. <i>Brassica tournefortii</i> Gouan (Sahara mustard)	B	B	A	Medium		X
08. <i>Bromus diandrus</i> Roth (Rippgut brome)	B	B	C	Medium	X	
09. <i>Bromus inermis</i> Leyss. (Smooth brome)	B	B	B	Medium		X
10. <i>Bromus rubens</i> L. (Red brome)	A	B	A	High		
11. <i>Bromus tectorum</i> L. (Cheatgrass)	A	A	A	High		
12. <i>Cardaria chalapensis</i> (L.) Hand.-Maz. (Lenspod whitetop)	B	B	C	Medium	X	
13. <i>Cardaria draba</i> (L.) Desv. (Whitetop)	B	B	C	Medium	X	
14. <i>Cardaria pubescens</i> (C.A. Mey.) Jamolenko (Hairy whitetop)	B	B	C	Medium	X	
15. <i>Carduus nutans</i> L. (Musk thistle)	B	B	B	Medium		
16. <i>Centaurea biebersteinii</i> DC. (Spotted knapweed)	B	B	B	Medium		X

APPENDIX 3 Invasive Non-Native Plants That Threaten Wildlands in Arizona—continued

Scientific Name/Authority (Common Name)	Ecological Impacts	Invasiveness	Distribution	Overall Score	Alert	Red Flag¹
17. <i>Centaurea diffusa</i> Lam. (Diffuse knapweed)	B	A	B	Medium		
18. <i>Centaurea melitensis</i> L. (Malta starthistle)	B	B	B	Medium		
19. <i>Centaurea solstitialis</i> L. (Yellow starthistle)	A	B	B	High		
20. <i>Chondrilla juncea</i> L. (Rush skeletonweed)	B	A	C	Medium	X	
21. <i>Cirsium arvense</i> (L.) Scop. (Canada thistle)	B	B	B	Medium		X
22. <i>Cirsium vulgare</i> (Savi) Ten. (Bull thistle)	C	B	B	Low		
23. <i>Conium maculatum</i> L. (Poison hemlock)	B	B	C	Medium	X	
24. <i>Convolvulus arvensis</i> L. (Field bindweed)	B	B	A	Medium		
25. <i>Cortaderia selloana</i> (J.A. & J.H. Schultes) Aschers. & Graebn. (Pampas grass)	B	B	B	Medium		X
26. <i>Cynodon dactylon</i> (L.) Pers. (Bermudagrass)	B	B	A	Medium		
27. <i>Cynoglossum officinale</i> L. (Houndstongue)	C	B	D	Low		
28. <i>Echinochloa crus-galli</i> (L.) Beauv. (Barnyardgrass)	C	C	B	Low		
29. <i>Eichhornia crassipes</i> (Mart.) Solms (Water hyacinth)	A	B	D	High	X	X
30. <i>Elaeagnus angustifolia</i> L. (Russian olive)	A	A	B	High		
31. <i>Elymus repens</i> (L.) Gould (Quackgrass)	C	C	C	Low		

APPENDIX 3 Invasive Non-Native Plants That Threaten Wildlands in Arizona—continued

Scientific Name/Authority (Common Name)	Ecological Impacts	Invasiveness	Distribution	Overall Score	Alert	Red Flag¹
32. <i>Eragrostis curvula</i> (Schrad.) Nees (Weeping lovegrass)	C	B	B	Low		X
33. <i>Eragrostis lehmanniana</i> Nees (Lehmann lovegrass)	A	B	A	High		
34. <i>Erodium cicutarium</i> (L.) L'Her. ex Ait. (Redstem filaree)	C	B	A	Medium		
35. <i>Euphorbia esula</i> L. (Leafy spurge)	A	A	C	High	X	
36. <i>Euryops multifidus</i> (Thunb.) DC. (Sweet resinbush)	A	B	B	High		X
37. <i>Hordeum murinum</i> L. (Mouse barley)	B	B	A	Medium		X
38. <i>Hydrilla verticillata</i> (L.f.) Royle (Hydrilla)	A	B	U	Evaluated but not listed		X
39. <i>Lepidium latifolium</i> L. (Perennial pepperweed)	A	B	C	High	X	X
40. <i>Leucanthemum vulgare</i> Lam. (Oxeye daisy)	C	B	B	Low		
41. <i>Linaria dalmatica</i> (L.) P. Mill. (Dalmatian toadflax)	B	B	A	Medium		X
42. <i>Linaria vulgaris</i> P. Mill. (Yellow toadflax)	B	B	C	Medium	X	
43. <i>Lolium perenne</i> L. (Perennial ryegrass)	B	B	B	Medium		
44. <i>Melilotus alba</i> Medikus (White sweetclover)	C	B	A	Medium		X
45. <i>Melilotus officinalis</i> (L.) Lam. (Yellow sweetclover)	C	B	A	Medium		X
46. <i>Mesembryanthemum crystallinum</i> L. (Common iceplant)	C	B	D	Low		
47. <i>Mesembryanthemum nodiflorum</i> L. (Slenderleaf iceplant)	B	B	C	Medium	X	

APPENDIX 3 Invasive Non-Native Plants That Threaten Wildlands in Arizona—continued

Scientific Name/Authority (Common Name)	Ecological Impacts	Invasiveness	Distribution	Overall Score	Alert	Red Flag¹
48. <i>Myriophyllum aquaticum</i> (Vell.) Verdc. (Parrot's feather)	A	B	C	High	X	
49. <i>Myriophyllum spicatum</i> L. (Eurasian watermilfoil)	A	B	C	High	X	
50. <i>Onopordum acanthium</i> L. (Scotch thistle)	C	B	B	Low		
51. <i>Panicum antidotale</i> Retz. (Blue panicum)	C	C	C	Low		
52. <i>Pennisetum ciliare</i> (L.) Link (Buffelgrass)	A	A	A	High		X
53. <i>Pennisetum setaceum</i> (Forsk.) Chiov. (Fountain grass)	A	B	B	High		X
54. <i>Rhus lancea</i> L. f. (African sumac)	B	B	C	Medium	X	
55. <i>Rubus armeniacus</i> Focke (Himalayan blackberry)	B	B	C	Medium	X	
56. <i>Rubus discolor</i> Weihe & Nees (Himalayan blackberry)	B	B	C	Medium	X	
57. <i>Saccharum ravennae</i> (L.) L. (Ravennagrass)	B	B	D	Medium	X	
58. <i>Salsola collina</i> Pallas (Slender Russian thistle)	B	B	A	Medium		
59. <i>Salsola paulsenii</i> Litv. (Barbwire Russian thistle)	B	B	A	Medium		
60. <i>Salsola tragus</i> L. (Prickly Russian thistle)	B	B	A	Medium		
61. <i>Salvina molesta</i> Mitchell (Giant salvinia)	A	B	C	High	X	
62. <i>Schismus arabicus</i> Nees (Arabian schismus)	B	B	A	Medium		
63. <i>Schismus barbatus</i> (Loefl. ex L.) Thellung (Common Mediterranean grass)	B	B	A	Medium		

APPENDIX 3 Invasive Non-Native Plants That Threaten Wildlands in Arizona—continued

Scientific Name/Authority (Common Name)	Ecological Impacts	Invasiveness	Distribution	Overall Score	Alert	Red Flag¹
64. <i>Sonchus asper</i> (L.) Hill (Spiny sowthistle)	C	B	A	Medium		
65. <i>Sonchus oleraceus</i> L. (Annual sowthistle)	C	B	A	Medium		
66. <i>Sorghum halepense</i> (L.) Pers. (Johnsongrass)	B	B	A	Medium		
67. <i>Tamarix aphylla</i> (L.) Karst. (Athel tamarisk)	B	C	D	Low		X
68. <i>Tamarix chinensis</i> Lour. (Fivestamen tamarisk)	A	A	A	High		X
69. <i>Tamarix parviflora</i> DC. (Smallflower tamarisk)	A	A	A	High		X
70. <i>Tamarix ramosissima</i> Ledeb. (Saltcedar)	A	A	A	High		X
71. <i>Tribulus terrestris</i> L. (Puncturevine)	D	C	U	Evaluated but not listed		
72. <i>Ulmus pumila</i> L. (Siberian elm)	B	B	B	Medium		
73. <i>Verbascum thapsus</i> L. (Common mullein)	D	C	A	Evaluated but not listed		
74. <i>Vinca major</i> L. (Bigleaf periwinkle)	B	B	C	Medium	X	

¹**Red Flag** annotations are provided below for each species marked with an “X” under **Red Flag**.

RED FLAG ANNOTATIONS

Aegilops cylindrica—Above 1,220 meters (4,000 feet) elevation, *Aegilops cylindrica* can replace native herbaceous and shrub vegetation subsequent to its removal on highly disturbed soil surfaces. *Aegilops cylindrica* infestations alter natural fire regimes during the summer months when wildfires are most likely to occur by increasing fine-fuel loads relative to native vegetation. Roadside populations of *A. cylindrica* connect rights-of way that serve as fire corridors to wildlands and, as a result, increase the risk of wildfires in the wildland-urban interface. Because *A. cylindrica* can occur as a contaminant in revegetation seed lots, seed mixes should be checked for the presence of this species.

Brassica tournefortii—Abundant rainfall during the latter part of 2004 and early 2005 resulted in an undocumented response by *Brassica tournefortii* in terms of number of individuals and total biomass. These increases potentially contributed to the altered fire regimes (that is, increased number and areal extent of fires) that occurred in Arizona at lower elevations during 2005. Should these trends persist in future years, then the scores and rank reported here for *B. tournefortii* should be revisited.

Bromus inermis—*Bromus inermis* should not be used for reclamation purposes in wildlands because of its persistence and invasive potential.

Centaurea biebersteinii—*Centaurea biebersteinii* likely has not yet reached its full invasive potential in Arizona. Its ecological impacts and reproductive capacity are well documented in other states, especially in Montana. *Centaurea biebersteinii* has great potential to increase its abundance and areal extent in Arizona on sites that are subjected to fire suppression, mechanical fuel treatment (that is, thinning), or timber harvest activities on public lands.

Cirsium arvense—*Cirsium arvense* has been observed in a variety of ecosystems/plant communities across Arizona and in even more ecological types in other states, but it currently has few occurrences within any specific ecological type in Arizona. Above elevations of 1,525 meters (5,000 feet), *C. arvense* has a high potential to invade many ecological types. It may not have had, however, enough time or opportunity to exploit these types. Because this plant is extremely difficult to control, land managers currently without infestations may want to consider this plant as a priority for early detection and monitor accordingly.

Cortaderia selloana—*Cortaderia selloana* is widely sold as both a live plant or seed in Arizona and on the internet. It also is promoted as a low water-use plant in Arizona. As a relatively new plant to Arizona, *C. selloana* has only started to appear in wildlands. Based on the species broad ecological ecological amplitude, it potentially can become as problematic in Arizona as it now is in California and other places. At present *C. selloana* exists only in small patches in the state; however, plenty of unoccupied niches, such as riparian corridors, are available to this species to invade.

Eichhornia crassipes—At present no wildland aquatic ecosystems within Arizona are known to be infested with *Eichhornia crassipes*. Records at the Arizona Department of Agriculture, however, indicate several small (< 0.4 hectares [1 acre]) populations have been discovered and eradicated from Arizona wildland streams, park ponds, and irrigation tail-water pits during the past 20 years. *Eichhornia crassipes* is listed as a regulated and restricted noxious weed in Arizona.

Eragrostis curvula—This assessment does not pertain to *Eragrostis curvula* var. *conferta* (Boer lovegrass). This taxon has different moisture and temperature limits relative to the species as whole and likely behaves differently in regard to its ecological impacts, invasiveness, and ecological amplitude. *Eragrostis curvula* var. *conferta* as a valid taxon is ambiguous as the U.S. Department of Agriculture Plants Database regards it as a synonym of *E. curvula*. Because of the differences in environmental tolerances and ploidy between *E. c.* var. *conferta* and the species as a whole, for the purposes of this list *E. c.* var. *conferta* is considered a separate taxon and is not evaluated as part of *E. curvula*.

Euryops multifidus—Only about 10 known populations of *Euryops multifidus* occur in Arizona. Those populations have been mapped and most locations have active control efforts. Vegetation survey projects should be aware that undocumented populations may exist on historic Civilian Conservation Corps project sites.

Hordeum murinum—Some authorities recognize *Hordeum glaucum*, *H. leporinum*, and *H. murinum* as separate species; however, based on the use of the U.S. Department of Agriculture Plants Database as the authority for reconciling taxonomic questions, *H. murinum* is recognized herein as the valid species taxon and *H. m. glaucum*, *H. m. leporinum*, and *H. m. murinum* are recognized as subspecies.

Hydrilla verticillata—Although based on its question and section scores related to Impact and Invasiveness *Hydrilla verticillata* potentially could have been ranked as a High, Alert taxon, it was assigned an **Evaluated but not listed** designation to reflect its current distribution status: present in the state but only in human-constructed water bodies. If inadvertently introduced into natural, low-elevation water bodies in Arizona, *H. verticillata* easily could establish and flourish in Arizona's wildlands.

Lepidium latifolium—*Lepidium latifolium* is not widely distributed in Arizona. Established populations occur mostly near the northern borders of the state. Land managers should be on the alert for isolated plants or small nascent populations that can be eradicated before they can spread. *Lepidium latifolium* is a difficult species to eradicate so addressing infestations while they are small is critical.

Linaria dalmatica—*Linaria dalmatica* occurs within a variety of ecosystems/plant communities that experience different natural fire regimes. *Linaria dalmatica*, however, established in these various ecological types after the onset of habitat alteration and fire exclusion that characterizes these types today. Because *L. dalmatica* was not present when historic (natural) fire regimes were functioning, it is unclear how the presence of *L. dalmatica* might affect the ability to restore a natural fire regime. Little empirical evidence exists to enable anticipating these potential effects. The expanding wildland-urban interface and projected increases in the intensity of forest restoration/fuel treatments may provide new opportunities for *L. dalmatica* to spread into forested areas. Only a portion of *L. dalmatica* seeds may germinate in any given year. As a result, dormant seeds may germinate at sites following herbicide applications or other site disturbances that reduce native plant competition.

***Melilotus* spp. (*M. alba*, *M. officinalis*)**—*Melilotus* spp. is invasive in a number of ecosystems/plant communities in Arizona. *Melilotus* spp. also may be used, however, in semiarid habitats in northern Arizona for reclamation purposes where it has been difficult to reestablish native species after disturbances such as fire. Once suitable native alternatives can be identified and successfully restored in these areas, use of *Melilotus* spp. for reclamation purposes should be discontinued.

Pennisetum ciliare—At present *Pennisetum ciliare* is only occasionally observed in semi-desert grasslands and Chihuahuan desertscrub and has not been observed in southwestern interior chaparral scrub, and Madrean evergreen woodland. Invasion into these “cooler” ecological types could increase or begin if the new cold-tolerant cultivar “Frio” is released into Arizona. Continued development of cold tolerance or drought tolerance in *P. ciliare* cultivars poses a significant ecological threat if such cultivars are released into Arizona wildlands.

Pennisetum setaceum—Although *Pennisetum setaceum* is established in a number of ecosystems/plant communities, it is not yet present in many individual occurrences of these types. Large areas of suitable wildland habitat still remain for this species to colonize. The misnamed *Pennisetum setaceum* “Rubrum” (with dark purplish foliage and purplish crimson spikes) or *P. setaceum* purple-type is actually a distinct species, *P. advena*. *Pennisetum advena* is sold commercially in Arizona as an ornamental but reportedly does not reproduce reliably from seed and, as a result, was not evaluated.

Tamarix aphylla—*Tamarix aphylla* currently has a limited distribution within Arizona wildlands even though many thousands of populations are present in agricultural and urban areas of southwestern Arizona. The species was introduced to provide windbreaks for homesteads. Until recently seeds were thought to be sterile and the only means of spread into wildlands was via vegetative reproduction. It is now known that *T. aphylla* can hybridize with other *Tamarix* spp. One documented occurrence of this is along the Gila River in western Maricopa County. It is unclear at this point what the morphology, physiology, reproduction by seed, and invasiveness of the hybrids will be, as well as the attributes of any subsequent backcross progeny.

***Tamarix* spp. (*T. chinensis*, *T. parviflora*, *T. ramosissima*)**—The ecological impacts associated with invasion by *Tamarix* spp. should be considered within the context of the specific riparian community invaded. In addition, such impacts may be mediated by previous changes to a variety of ecological processes associated with the particular riparian community. Land managers planning riparian restoration projects involving the control of *Tamarix* spp. should consider and address, as appropriate, other factors, such as existing hydrologic regimes, fluvial processes, and whether *Tamarix* spp. stands are providing habitat for southwestern willow flycatchers (*Empidonax traillii extimus*), before proceeding with such projects.

DEFINITIONS

Overall Score

High: Severe ecological impacts on ecosystems, plant and animal communities, and vegetational structure; invasiveness attributes are conducive to moderate to high rates of dispersal and establishment; and species are usually widely distributed, both among and within ecosystems/communities.

Medium: Substantial and apparent ecological impacts on ecosystems, plant and animal communities, and vegetational structure; invasiveness attributes are conducive to moderate to high rates of dispersal, often enhanced by disturbance; and ecological amplitude (diversity of ecosystems/communities) and distribution (within an ecosystem/community) range from limited to widespread.

Low: Minor yet detectable ecological impacts; invasiveness attributes result in low to moderate rates of invasion; ecological amplitude and distribution are generally limited, but the species can be problematic locally.

Section Scores (Ecological Impacts, Invasiveness, Distribution)

Section scores can range from **A** to **D**. In some cases **U** or Unknown is used when insufficient information is available to assign a score. Section scores are based on scores (**A** to **D**, or **U**) assigned to individual questions within each section. For Ecological Impacts, the scores represent a range of severity with **A** assigned for the most severe impacts and **D** assigned for a negligible impact. For Invasiveness, **A** represents the greatest potential to invade an ecosystem/community, whereas **D** would indicate a low potential. For Distribution, **A** indicates that the species has a wide ecological amplitude, is widespread within particular ecosystems/communities, or both. A **D** score would indicate the converse.

Other Designations

Alert: Additional designation for some species in either the high or medium category, but whose current ecological amplitude and distribution are limited. This designation alerts site managers to species capable of invading unexploited natural communities, based on initial, localized observations or behavior in similar ecosystems/communities elsewhere.

Red Flag: Additional designation assigned by the Arizona Wildlands Invasive Plant Working Group to identify and document a critical piece of information not evident in the overall ranking.

Evaluated but not listed: Designation when current information is inadequate to respond to Criteria questions or sum effects of ecological impacts, invasiveness, and ecological amplitude and distribution are below the threshold for listing.

Other Definitions

Invasive non-native plants that threaten wildlands: Plants that (1) are not native to, yet can spread into, the wildland ecosystems under consideration, and that also (2) do any of the following within wildland ecosystems—displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes.

Non-native plants: Species introduced to the ecosystems under consideration [here in reference to Arizona] after European contact and as a direct or indirect result of human activity.

Wildlands: Public and private lands [and waters] that support native ecosystems, including national, state, and local parks and forests, ecological reserves, wildlife areas, Bureau of Land Management lands, and so on. Working landscapes—such as grazed rangeland and active timberlands—that support native ecosystems are included in the definition.

APPENDIX 4

Consistency Review Summary Report

Review of the Consistency of Application
of the *Criteria for Categorizing Invasive
Non-native Plants that Threaten Wildlands*

Review Conducted: December 10, 2004
Report Submitted: January 15, 2005

Consistency Review Panel:

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George Hull, Mountain States Wholesale Nursery; Glendale Community College, Agribusiness; Arizona State University, School of Landscape Architecture

David Madison, Plant Quarantine/ Nursery Programs Manager, Arizona Department of Agriculture, 1688 West Adams Street, Phoenix, AZ 85007

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Judy Ward, Independent botanist, 322 W. Mountain Avenue, Las Cruces, NM 88005

Statement of Purpose: Evaluate how consistently the Arizona Wildlands Invasive Plant Working Group (AZ-WIPWG) has applied the *Criteria for Categorizing Invasive Non-native Plants that Threaten Wildlands* for the 51 species evaluated since March 2003.

Objectives:

1. Systematically review the consistency in which the Criteria have been applied to the 51 plant species thus far evaluated.
2. Identify specific problems of which the working group should be aware.
3. Make general recommendations to the Working Group to facilitate consistent application of the criteria in the future.
4. Provide an independent perspective to increase credibility and reduce bias in the evaluations.

Consistency Review Methods:

Two general approaches were identified by the Consistency Review Panel. The first approach involved looking across all species for each question and identifying potential inconsistencies between species for each question in turn. The second approach involved looking at the overall rating for each species and based on our familiarity with the species identifying potential overall inconsistencies, followed by identifying specific inconsistencies by working backwards to each question for the problematic overall ratings. The Panel was concerned about the time requirements for each approach and how well these approaches would meet the objectives of the review process and the needs of the Working Group. We decided to attempt the first method for the first question to determine the time requirements. We grouped the set of species for each consecutive letter score and identified potential inconsistencies based on our familiarity with the species relative to other evaluated species receiving the same letter score. After quantifying the amount of time it took to go through the first question and a clarification of the needs of the review team, we decided to go forward with this approach.

Review results:

Our consistency review revealed that the initial efforts by the Working Group were very good, with 87% overall average consistency across all of the questions (Table 1). The percentage of total scores for each questions considered consistent and therefore unquestioned by our panel varied from 73% to 98%. The average number of potential inconsistencies

identified by the Review Panel per question was 7; however the number of inconsistencies identified for each question varied from 1 to 14 (Table 1). After discussion, there were some letter scores that the panel felt should be moved up (Table 1, yellow highlight) and just a few that the panel felt should be moved down (Table 1, red highlight). During our review, we identified a few species which might warrant further literature review and discussion by the Working Group (Table 1, blue highlight). We identified species that seemed particularly problematic based on the number of times which concerns over them were raised these species include: *Bromus madritensis* ssp. *rubens*, *Centaurea melitensis*, *Convolvulus arvensis*, *Schismus arabicus*, *Schismus barbatus*, *Sonchus asper*, *Sonchus oleraceus*, *Tamarix aphylla*, and *Tribulus terrestris* (Table 1, purple highlight).

Recommendations and Considerations:

The Review Panel recommends that the Working Group reevaluate the problematic species with new information. The following Panel members familiar with the species will be available to contribute specific information on new observations or to provide references:

Malta star – Larry Howery

Athel tamarisk – Curt Deuser, Lori Makarick

Sonchus – Lori Makarick

Puncture vine – Lori Makarick

Bromus rubens – Curt Deuser, Lori Makarick

Knapweeds – Larry Howery

Field bindweed – Dave Madison

Although the Review Panel did not take a thorough look at the sources of information, we suggest that questions that were particularly problematic were based on observation or inference thus differences in knowledge base could be contributing to inconsistencies. For example, some of the problems we identified were based on very recent observations by members of the Review Panel. This raised the concern that other species less familiar to the Review Panel may have been overlooked. Consequently, the Review Panel recognizes a potential bias to identify inconsistencies for species with which they are familiar.

To alleviate, some of these inconsistencies, we recommend that the working group or individual evaluators send request for new information to relevant land resource managers periodically. These requests could target species currently ranked low or moderate or red flags in their area and motivate reconsideration of Questions: 2.2 (Local rate of spread), 2.3 (Recent

trend in total area infested within the state), 3.1 (Ecological Amplitude) and 3.2 (Distribution). This communication with resource manager could also facilitate distribution of information for species with Alert status and provide a source for records of new occurrences, as well as raise the overall level of communication about non-native invasive species across land management agencies. Finally, the minutes of the consistency review meeting are available as an appendix. These minutes serve as a record of the comments raised by the Review Panel regarding potential inconsistencies of a species score by question.

Table 1. Review of the consistency in which the *Arizona Wildlands Invasive Plant Working Group (AZ-WIPWG)* has applied the *Criteria for Categorizing Invasive Non-native Plants that Threaten Wildlands* for the 51 species evaluated since March 2003.

Latin Name	Common Name	Questions													Overall Score	Alert Status	Red Flag
		1-1	1-2	1-3	1-4	2-1	2-2	2-3	2-4	2-5	2-6	2-7	3-1	3-2			
<i>Acroptilon repens</i>	Russian knapweed	B	A	A	D	A	A	B	A	A	B	B	A	C	High	None	No
<i>Ailanthus altissima</i>	tree of heaven	B	A	U	D	B	B	C	A	B	C	???	B	C	Med	None	???
<i>Alhagi maurorum</i>	camel thorn	B	A	B	D	B	A	B	A	B	A	B	A	B	Med	None	No
<i>Arundo donax</i>	giant reed	A	A	A	D	B	B	B	B	B	B	C	B	B	High	None	No
<i>Brassica tournefortii</i>	African mustard	B	B	U	U	B	A	B	A	B	A	C	A	A	Med	None	No
<i>Bromus inermis</i>	smooth brome	B	B	C	C	B	B	C	A	B	B	C	A	D	Med	None	Yes
<i>Bromus madritensis ssp. rubens</i>	red brome	A	A	B	U	A	B	C	A	A	B	C	A	A	High	None	No
<i>Bromus tectorum</i>	downy brome	A	A	A	D	A	A	A	A	A	A	C	A	A	High	None	No
<i>Cardaria chalapensis</i>	lenspod whitetop	B	A	B	D	B	B	C	A	A	B	C	B	D	Med	Alert	No
<i>Cardaria draba</i>	whitetop	B	A	B	D	B	B	C	A	A	B	C	B	D	Med	Alert	No
<i>Cardaria pubescens</i>	hairy whitetop	B	A	B	D	B	B	C	A	A	B	C	B	D	Med	Alert	No
<i>Carduus nutans</i>	musk thistle	C	B	C	D	B	A	A	A	B	C	B	A	D	Med	None	No
<i>Centaurea biebersteinii</i>	spotted knapweed	B	A	B	C	A	B	B	A	B	B	B	A	D	Med	None	Yes
<i>Centaurea diffusa</i>	diffuse knapweed	B	A	B	U	B	A	A	A	A	B	C	A	C	Med	None	No
<i>Centaurea melitensis</i>	Malta starthistle	C	C	D	D	B	B	B	A	A	C	B	B	D	Low	None	No
<i>Centaurea solstitialis</i>	yellow starthistle	A	A	B	U	C	A	B	A	A	B	C	A	D	High	None	No
<i>Cirsium arvense</i>	Canadian thistle	B	A	B	U	B	A	U	A	B	C	A	C	A	Med	None	Yes
<i>Conium maculatum</i>	poison hemlock	U	C	B	D	C	B	B	A	B	B	A	B	D	Med	Alert	No
<i>Convolvulus arvensis</i>	field bindweed	C	B	C	U	B	C	C	A	A	B	C	A	B	Med	None	No
<i>Eichhornia crassipes</i>	common water hyacinth	A	A	A	D	A	U	C	A	B	C	C	D	U	High	Alert	No
<i>Elaeagnus angustifolia</i>	Russian olive	A	A	B	D	A	A	B	B	A	A	C	A	C	High	None	No
<i>Eragrostis curvula</i>	weeping lovegrass	D	C	C	U	C	C	C	A	A	C	C	A	C	Low	None	No
<i>Eragrostis lehmanniana</i>	Lehmann lovegrass	A	A	B	D	B	A	B	A	A	B	C	B	A	High	None	No
<i>Erodium cicutarium</i>	redstem filaree	D	C	C	U	B	B	C	A	A	B	C	A	A	Med	None	No
<i>Euphorbia esula</i>	leafy spurge	A	A	B	U	A	A	B	A	A	A	B	B	D	High	Alert	No
<i>Euryops subcarnosus ssp. vulgaris</i>	sweet resinbush	A	A	A	D	A	B	C	A	B	B	D	B	D	High	Alert	No
<i>Hordeum murinum</i>	wild barley	B	B	C	U	B	B	C	A	A	A	C	A	A	Med	None	No
<i>Leucanthemum vulgare</i>	oxeye daisy	D	C	D	D	C	B	U	A	B	C	C	A	D	Low	None	No

Table 1 continued. Review of the consistency in which the *Arizona Wildlands Invasive Plant Working Group (AZ-WIPWG)* has applied the *Criteria for Categorizing Invasive Non-native Plants that Threaten Wildlands* for the 51 species evaluated since March 2003.

Latin Name	Common Name	Questions													Overall Score	Alert Status	Red Flag
		1-1	1-2	1-3	1-4	2-1	2-2	2-3	2-4	2-5	2-6	2-7	3-1	3-2			
<i>Linaria dalmatica</i>	Dalmatian toadflax	B	A	B	D	B	B	B	A	A	C	C	A	A	Med	None	Yes
<i>Linaria vulgaris</i>	yellow toadflax	B	A	B	D	B	A	B	A	A	C	B	B	D	Med	Alert	No
<i>Melilotus alba</i>	white sweetclover	C	C	D	D	B	B	C	A	B	A	C	A	A	Med	None	No
<i>Melilotus officinalis</i>	yellow sweetclover	C	C	D	D	B	B	C	A	B	A	C	A	A	Med	None	No
<i>Myriophyllum spicatum</i>	Eurasian water milfoil	A	A	A	U	A	C	C	A	A	B	C	C	D	High	Alert	No
<i>Panicum antidotale</i>	blue panic	C	C	D	U	C	D	B	A	C	C	B	B	D	Low	None	No
<i>Pennisetum ciliare</i>	buffelgrass	A	A	A	D	A	A	B	A	A	B	B	A	A	High	None	Yes
<i>Pennisetum setaceum</i>	fountain grass	A	A	B	D	A	B	B	A	A	B	C	A	C	High	None	Yes
<i>Rhus lancea</i>	African sumac	C	C	U	D	B	B	B	C	B	B	U	B	D	Low	None	Yes
<i>Salsola collina</i>	slender Russian thistle	B	B	D	D	B	B	C	A	A	A	C	A	B	Med	None	No
<i>Salsola paulsenii</i>	barbwire Russian thistle	B	B	D	D	B	B	C	A	A	A	C	A	B	Med	None	No
<i>Salsola tragus</i>	prickly Russian thistle	B	B	D	D	B	B	C	A	A	A	C	A	B	Med	None	No
<i>Salvinia molesta</i>	Kariba-weed	A	A	A	D	B	A	B	B	A	B	B	C	D	High	Alert	No
<i>Schismus arabicus</i>	Mediterranean grass	C	A	C	D	B	B	C	A	C	C	C	A	A	Med	None	No
<i>Schismus barbatus</i>	common Mediterranean grass	C	A	C	D	B	B	C	A	C	C	C	A	A	Med	None	No
<i>Sonchus asper</i>	spiny sowthistle	D	D	D	D	C	C	C	A	C	B	C	A	A	NL*	None	No
<i>Sonchus oleraceus</i>	annual sowthistle	D	D	D	D	C	C	C	A	C	B	C	A	A	NL*	None	No
<i>Sorghum halepense</i>	Johnson grass	B	A	B	D	B	B	B	A	A	B	C	A	B	Med	None	No
<i>Tamarix aphylla</i>	Athel tamarisk	B	B	U	D	C	C	C	C	C	C	C	B	D	Low	None	No
<i>Tamarix sp.</i>	tamarisk	A	A	A	D	A	A	B	A	A	A	B	B	A	High	None	Yes
<i>Tribulus terrestris</i>	puncturevine	D	D	D	D	C	U	D	A	B	B	C	U	U	NL*	None	No
<i>Ulmus pumila</i>	Siberian elm	C	B	C	D	B	B	U	A	B	C	??	A	C	Med	None	No
<i>Verbascum thapsus</i>	common mullein	D	D	D	D	B	B	C	A	C	D	C	A	A	NL*	None	No
Number of "Inconsistent" Scores per Question		14	8	4	2	5	14	14	1	3	6	2			Average # of Inconsistencies = 7		
Percent "Consistency" for Question		73	84	92	96	90	73	73	98	94	88	96			Average Consistency = 87%		

 Species With Frequently Raised Concerns
 Denotes Score Group Thinks Assessment Team Should Review Further

 Denotes Score Panel Thinks Should Move Up
 Denotes Score Panel Thinks Should Move Down

APPENDIX 5

Individual Plant Assessments by Species
(Reserved)