

Assessment of Plant Invasiveness

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In November 2003, a conference titled “Invasive Plants in Natural and Managed Systems: Linking Science and Management” was held in conjunction with the 7th International Conference on Ecology and Management of Alien Plant Invasions hosted by the Ecological Society of America. Highlights from the meeting were reported in the Michigan Invasive Plant Council (MIPC) Newsletter (Volume 1, Issue 5, 2004). The following highlights are of particular relevance to the assessment of plant invasiveness:

- A) Weed lists within the United States have been generated by governmental units for regulatory and advisory purposes (federal and state agencies), by professional groups (Exotic Plant Pest Councils) and by private organizations (botany clubs, gardening groups). A total of 113 lists are known at the state or higher level. The vast majority has been produced by government agencies. Only 12% of these lists require any sort of documentation for placing a species on the list. It was stressed that the authors of lists should document reasons for including a species on a list using multiple criteria and expert assessment.
- B) Plant Assessment—the Virginia Dept. of Conservation and Resources started plant assessment work in 1992 with a list of over 100 “invasive” plants with no ranking. Its intended use was for advisory purposes. They were challenged by the American Seed Trade Association officials on 11 species. Lesson learned after considerable legal exchanges was that official

disclaimers need to be put on non-regulatory lists and that plants need to be ranked according to a science-based system.

- C) Invasive Plant Ranking protocol—A new invasiveness assessment system (NatureServe/TNC) will soon be available through the work of The Nature Conservancy. Their system was developed in relation to conservation areas. The system documents ecological impact, current distribution and abundance, trend in distribution, and management ease/difficulty of the species.

Further information supporting the development of a comprehensive and scientific-based assessment was emphasized at the St. Louis and Chicago symposia. The St. Louis Principles specifically encourage the use of available assessment tools, resources and voluntary codes of conduct and stress the fundamental value of broad-based collaboration. Recommendations evolving from the Chicago Meeting stated that: 1) Regional groups must be allowed to develop their own responses to regional invasive plant problems, including guidance on or lists of invasive plant species, since plants may exhibit invasive characteristics in one region and not in another; 2) Efforts to place invasive plant species on official lists must include research, where needed, to ensure that “listed” plants do, in fact, have invasive characteristics. Lists that use anecdotal information to determine the “invasive” potential of a species are not preferred by the nursery industry, since this highly important approach could cause some plants to be deemed “invasive” without sufficient basis; and, 3) Well understood criteria for listing a

plant as “invasive” must be developed prior to completing invasive plant species lists. Industry representatives emphasized the distinction between processes for identifying and ranking invasive plants and processes for selecting and applying non-regulatory or regulatory management measures. Responsible evaluation and assessment of plant invasiveness are essential to fostering collaboration among the diverse audiences interested and involved in the invasive plant issue.

Plant invasiveness assessment protocols have their foundation within the natural resource community. Hiebert, R.D. and J. Stubbendieck, 1993, prepared the “Handbook for Ranking Exotic Plants for Management and Control”. Their ranking system was based on two sections, significance of impact on natural areas and feasibility of control or management. The section on significance of impact examined the current level of impact on natural processes and the character of the natural communities. It also recorded reproductive characteristics, dispersal ability, and competitive nature of the non-native plant. Feasibility of control or management questioned abundance, presence of a seed bank, vegetative regeneration, level of effort required for control, and the side effects of control methods. The purpose of this system was to provide an analytical approach for prioritizing control and management efforts directed at exotic plant species on public lands. This work has contributed significantly to the subsequent generations of assessment systems currently employed today.

Discussions on plant invasiveness assessment can be divided into two

categories: 1) Risk assessment based on predictive models for first-time introductions; and 2) Assessment systems for plants already present in a given region. Risk assessment based on predictive models focuses on first-time introductions to a given region. The Executive Order mandates that risk assessment methodology be employed for first-time introductions prior to their entry into the United States. Predictive risk assessment models are in the developmental stage and not yet effective in predicting possible impacts of a species in a given area. The predictive models evaluate: reproductive characteristics both sexual and asexual; climate matching and adaptive traits from native ranges; presence and activity from other known areas of introduction; and the potential degree of harm caused from introduction. Currently there are no broadly accepted scientific principles or reliable procedures for identifying the invasive potential of plants in new geographic areas. Work on developing scientifically reliable methodology continues and at some point there may be credible predictive models.

Most of the plant invasiveness assessment systems being employed today are evaluating plants already present in a given region. These systems vary in their overall intent and evaluate: biological traits; ecological impact; current distribution and abundance; trend in distribution; management ease/difficulty; and value of the species. Some require scientifically credible documentation; others are based on observations and anecdotal information. Some provide recommendations for use or control associated with their assessment and others simply classify a plant's invasiveness by a scale from highly invasive to insignificant. Most outcomes are non-regulatory and are considered advisory. It is important, as was indicated earlier in this article, that assessments and subsequent lists include documentation and be based on clearly understood criteria and a science-based

system. Assessments must also consider "regionality" and require research where necessary to determine whether a plant is in fact "invasive" according to the accepted definition in the Executive Order.

Here are a few points to consider when reviewing the criteria associated with an assessment system.

- 1) Does the system account for individual characteristic among species and their subgroups such as varieties, cultivars, forma, etc? Most assessments evaluate plants at the species level and include all subgroups in the results. They do not consider differences in growth or reproductive traits of the subgroups that may be deemed non-invasive. This is especially troublesome when species are identified on regulatory lists and no provisions for acceptable cultivars or other subgroups are made. In most instances, blanket statements about species results from the "assessor's" (individual or organization) lack of familiarity with the plants in question and the biology associated with horticultural selections. There are numerous examples where reproductive and growth habits differ among species and their cultivar selections.
- 2) Does or is the plant in question likely to cause environmental or economic harm or harm to human health? Whether it "does or is likely to" requires documentation. Presence does not constitute harm. Much research is needed to identify and substantiate not only whether harm is in fact being caused, but also the extent of harm. Most of the concerns with credible assessment lie in the lack of substantiated documentation of harm being caused.
- 3) Does the system account for regionality, not only in the broad sense such as the Midwest, Northeast, West, but within a more defined geographic or political

boundary such as a state? For example, Michigan is classified according to four eco-regions. Variations in plant behaviors can and does occur across and within these classified "regions". Invasiveness ratings and rankings in Michigan need to be established for each of these areas. The same is true for other geographic or ecological regions. Information gathered nationally may be an aid but the true determination must be made within the boundaries of the given region. Regional differences in plant behavior are commonplace and are a factor strongly considered at the Chicago symposium. The NatureServe/TNC assessment protocol highlighted in the Michigan Invasive Plant Council Newsletter (Volume 1, Issue 5, 2004) established a National I-Rank for evaluated species. Although, the documented information collated in the assessment is useful for review purposes, establishing a National I-Rank is misleading without considering the regional nature of the information and the plant behavior.

- 4) Is a plant's invasiveness based on an ability to disperse over spatial gaps (a distance from the original place of introduction) by natural means? Wind, water, and/or wildlife are natural means of dispersal and move plants away from the site of introduction. This is an important factor in determining whether a plant is truly a problem. Seeds and vegetative fragments with an ability to root can be a problem when dispersed beyond the place of introduction. However, a plant may have the ability to root from a fragment, but if it does not fragment easily then dispersal over spatial gaps is not a potential problem. In addition, many species have been identified as being invasive simply because they spread. There are some species where this is a problem,

such as with Kudzu in the south, however, the extent or degree of spread can be misinterpreted within many assessment systems. The classic example is the misinterpretation and inaccurate classification of *Vinca minor* by some assessment systems.

- 5) Does the system identify the difference between presence and invasion when evaluating distribution? This is a concern when evaluating plants on “public” lands. Many public land holdings such as forests, natural areas, and parks were originally homesteads, agricultural farms, plantations, or involved in other related practices. Plants may be remnants of prior uses and not due to invasive behavior. The extent of their presence may be directly related to the time in which they were planted.
- 6) Does the system identify available control measures and whether there are or have been any efforts to control the plants? Control measures include mechanical means, chemical applications, and in some cases, fire. Control method may be selective or non-selective. There are cases such as with Purple Loosestrife where control methods may suppress but do not eradicate the plant in its entirety. However, on the other hand, there are species where persistence of control can lead to eradication of the plant in a given area. In assessing control, it is important to note whether control of a given species is a priority and if any attempts at control were made.
- 7) Does the system consider the value of the plant? Plant introductions are intentional and unintentional. Unintentional introduction is also referred to as hitchhiking. Hitchhikers for the most part are weed species with no intended value. Intentional introductions enter with a specific purpose and

targeted use. An example is Autumn Olive; its introduction was intended for wildlife conservation as food and shelter with plantings targeted at wildlife areas. There are differences of opinion within Department of Natural Resources Wildlife Divisions as to whether the benefits of Autumn Olive for wildlife populations outweigh its suggested invasiveness. Earlier versions of invasiveness assessment systems were developed by the natural resource community and did not consider value of a species in the equation leading to classifying or listing of a plant. Subsequent generations of assessment protocols questioned value in relation to production and sales at major retail outlets. However, value goes beyond whether a plant is produced in a given region and purchased from national retail chains. Plants are introduced for a number of different reasons, all of which contribute to a plant’s value for food, shelter, aesthetics, recreation, and conservation purposes such as soil and water erosion and wildlife habitat (food and shelter). Value is especially important when selecting and applying non-regulatory or regulatory management measures.

- 8) What are the outcomes of the evaluation and how are they reported? Most assessment systems result in categorized lists. Some rank or rate the species evaluated to a degree of invasiveness; some have accompanying use recommendations. Some will publish the documentation leading to a recommendation; some lists are reported without documentation. Keep in mind that outcomes and their use are only as good as the information used to generate the information.

There are several plant invasiveness assessment systems currently being employed; some of which are cited below. Each addresses the above criteria

in varying degrees. Reviewing these systems and their resultant evaluations will provide an overview of the process of plant invasiveness evaluation.

In 2004, the Michigan Invasive Plant Council completed work on an assessment system tailored to Michigan’s environmental conditions and the diversity of its natural, managed, and built landscapes. It was adapted from several assessment tools currently being used and/or developed for the evaluation of invasive potential and the categorization of invasive plants. It focuses on regionality and is designed to determine whether a plant is invasive in Michigan’s four ecological regions (Albert, 1995). These ecological regions have been delineated based on broad climatic, geologic, edaphic, and vegetation patterns, and provide a meaningful framework for assessing invasiveness under or as influenced by Michigan’s environment. Given the extent and diversity of our Michigan environmental conditions, a plant may be considered a problem in one ecological region and not in others. The overall objective of the Michigan Plant Invasiveness Assessment System (MPIAS) is to identify relevant biological, ecological, management, and economic information that will aid in the evaluation of the impact any given plant may have on our Michigan ecosystems (natural and managed) and become the foundation of an accompanying Michigan Invasive Plant Council recommended plan of action.

The MPIAS requires documentation to support the responses and establishes that anyone whose input is sought is qualified to comment on a particular plant (i.e. they are confident with its identification, familiar with its biological characteristics, and experienced with the zones and habitat/system in which this plant is likely to occur).

Requested documentation is noted as follows:

- Reviewed scientific publication—response is based on a peer-reviewed

publication; please provide complete citation of all sources.

- Other published material— response is based on non-peer-reviewed documents, reports, or other similar documents; please list the title, author, and date of publication.
- Observational— response is supported by confirmed but not-yet-published observations by qualified biologists; please provide name(s) and contact information for source(s).
- Anecdotal— response is supported only by unconfirmed, anecdotal information; please describe the source clearly.

Another important aspect of MPIAS is that a new copy of the assessment is completed for each species, cultivar, or hybrid. Plant cultivars, varieties, and hybrids are genetically different from the parent(s) species and may not exhibit the same reproductive, morphological or physiological traits. It is important that information listed is specific to the plant in question.

The Michigan Plant Invasiveness Assessment System has seven sections; the first six provide information that leads to a Michigan Invasive Plant Council Plan of Action. These sections were developed to evaluate plant characteristics, identify biological and economic impacts (both positive and negative), determine control methods and efforts, document value, and assemble the necessary information to make an informed decision.

The following is an overview of the Michigan Plant Invasiveness Assessment System and the information leading to a recommended plan of action.

Section I – Biological Character.

Reproductive characteristics and dispersal ability strongly relate to the potential of a plant to become invasive. Reproductive ability identifies a plant's tendency to reproduce by seed and/or through vegetative means. Questions

are asked to determine if a plant can regenerate from seed, the extent of seed production, and the viability of the seed bank. Vegetative reproduction focuses on fragmentation, spreading rhizomes, and ability to re-sprout after cutting. Reproductive ability identifies a plant's invasive tendency in Michigan as high, medium, low, insignificant, or none based on seed and vegetative reproductive characteristics.

Dispersal identifies the vectors or agents of dispersal and the likelihood of long distance dispersal. Dispersal agents are environmental influences such as wind and water; wildlife - both mammals and birds; domestic animals - both mammals and birds; and human activity. Dispersal distance refers to the potential for long distance dispersal. Dispersal is reported as:

- Insignificant (One or two vector categories; Little potential for long-distance dispersal);
- Medium (One or two vector categories; Great potential for long-distance dispersal);
- High (Three or four vector categories; Great potential for long-distance dispersal).

The ability for long distance dispersal through natural (wind, water and wildlife) means is an important consideration in determining whether a plant is truly invasive.

Section II – Impact.

Impact identifies the plant's ecological, aesthetic, economic influence on natural areas, constructed habitats, managed landscapes, and production systems. Questions on impact are tailored to the individual characteristics and composition of each of the respective systems. The focus on natural areas is on a plant's ability to invade a natural system; its impact on ecosystem processes; its influence on natural community structure and composition; and the conservation significance of the

natural system impacted. In production /managed forests and Christmas tree plantations we are interested about whether the plant in question has a negative impact on production schedules or practices. Managed landscapes within suburban and urban ecosystems are defined as public and private areas within suburban and urban communities managed for green belts, linear parks, parks, and other recreational uses as well as urban forests and open spaces integrated throughout residential and commercial centers. These areas are typically managed with various degrees of input by individual property owners, public agencies and/or commercial contractors and include unmanaged peripheral areas. Concerns about invasive plants may be with their impact on the overall aesthetics of the area or direct impact on desirable plants. Impacts of invasive plants may also be found on production areas for agronomic, horticultural, and other commodity crops. These include fields, orchards, and plantations. The final area for consideration under impact is on constructed habitat systems. These include woodland, prairie, and wetland construction and/or restoration areas. Concerns with invasive plants are most noted during establishment of the constructed or restored habitats. Due to the disturbed conditions of these areas, they are not considered to be natural systems.

Section III – Distribution.

Distribution identifies known occurrences of this plant. It indicates the area of origin for the plant (Original Range) and the earliest documented occurrence in North America. Then, for Michigan, it identifies the extent to which the plant is reported to be a problem in each of four ecological regions (Albert, 1995). The four Michigan ecological regions are Western Upper Peninsula (WUP), Eastern Upper Peninsula (EUP), Northern Lower Peninsula (NLP), and Southern Lower Peninsula (SLP). Plant

occurrence as a problem in each of these areas is classified as naturalized, widespread, localized, isolated, or absent.

It is important to note that just because a plant is present it does not necessarily mean that it is invasive. Its presence in an area may be due to a homestead or other human activity that occurred at some point in time.

Section IV – Control Methods.

Control Methods document the availability of mechanical, chemical, biological, and fire as a resource in managing or eradicating the plant in question. Control Methods are reported as available, not available, or under development.

Section V – Control Effort.

Control Effort identifies control potential (investment in human and financial resources) and management activity (programs that are presently conducted). Control potential considers feasibility, costs, and unavoidable non-target damage. Control potential is identified as high or low, based on points associated with a series of questions.

Management activity identifies current programs being employed to eradicate or suppress this plant in the public and private arenas. Management activities being employed or not employed are documented for each of the following sectors involved: federal, state, municipal, non-profit organization, and commercial.

Section VI – Value within the State of Michigan.

Value within Michigan indicates economic, aesthetic, erosion control, and wildlife habitat value. Value is designated either as high, low, or none in each of the following categories: Agriculture (crop and forage); Horticulture (fruit, vegetable, herbs, and ornamentals); Turf (sod, golf course, commercial turf (sport fields, schools, etc); Forestry (wood, pulp, Christmas trees); Landscape (public and

private); Erosion Control (soil and water erosion); wildlife habitat (food and shelter). Value and/or benefit should be considered when determining the fate of a given plant.

Section VII – Summary Table, Invasiveness Rank, Plan of Action, and Plant Summary Report.

Section VII is for use by MIPC. The Invasive Plant Assessment Committee will use the information provided in Sections I-VI to establish a Summary Table, an Invasiveness Rank (based on Potential Invasiveness and Impact for each system within the four ecological regions), a MIPC Plan of Action, and a Plant Summary Report.

Invasiveness Rank:

The plant's Invasiveness Rank is based on Potential Invasiveness (sum of Biological Characters) and Impact and is determined for each system within each of the four ecological regions. Potential Invasiveness is based on biological characteristics that may predispose a plant to invasive behavior. Reproductive Ability (Seed and Vegetative) + Dispersal = Potential Invasiveness.

Impact is the expression of potential invasiveness under a given set of environmental conditions within a system (Natural System, Forest Production, Ag/Hort/Turf Production, Constructed Habitats, and Urban and Suburban Landscapes). Impact may vary among or, in some cases, within ecological regions. A plant's impact may occur over a broad set of environmental conditions (temperature, light, water) or be limited by one or more factors specific to a system or ecological region.

Potential Invasiveness and Impact are coupled to identify a plant's Invasiveness Rank in each system (Natural; Managed Forests; Suburban and Urban Landscape; Ag/Hort/Turf Production) within each of Michigan's

four ecological regions. Invasiveness rank will aid in assessing and determining the overall MIPC Plan of Action.

MIPC Plan of Action:

MIPC Plan of Action is based on the information obtained through the assessment. The Plan of Action is developed by the MIPC Invasive Plant Assessment Committee for review and endorsement of the MIPC Board of Directors. The Plan of Action outlines recommendations that may include one or all of the following: Education; Suppression; Restoration; and Elimination.

Education:

Educational efforts are directed at informing property owners/managers of the problems associated with the presence or use of this plant. Education will be tailored for the specific details associated with the system(s) impacted (Natural System, Forest Production, Ag/Hort/Turf Production, Constructed Habitats, and Urban and Suburban Landscapes) and the plant in question. Education can refer to other action plans such as suppression, restoration, and elimination in addition to suggestions on use and sanitation. The following sub-categories are identified to address use more specifically: No – Do not use this plant; Avoid- Avoid the use of this plant; Caution- Caution, prevent the escape of this plant; and OK – Not considered a problem at this time.

Suppression:

Recommendations call for the development of management plans to suppress or eradicate this plant in problem areas. Suppression/eradication may be widespread (across multiple areas) or limited to its occurrence in specific problem areas. MIPC does not endorse any specific control method; however, it encourages the property managers to develop a plan that fits within their overall management objectives and desired outcome.

Restoration:

Management efforts may require restoration of the site to minimize reoccurrence of invasion and aid in the reestablishment of desirable plants. Restoration plans should be specific to the site (natural, managed, constructed, production) and the desired outcome.

Elimination:

This recommendation calls for the plant's potential elimination from commerce. Plants may be directly (primary crop or desirable plant) or indirectly (weed seed, impurity, or by-product) introduced through commerce. Based on the assessment, the plant in question poses problems in multiple systems and has no or limited determined economic, aesthetic, or environmental value.

Plant Summary Report:

Plant Summary Report will include:

- 1) Plant Name (Scientific and Common).
- 2) Invasiveness Rank for each system within Michigan's four ecological regions.
- 3) MIPC Plan of Action (Education, Suppression, Restoration, Elimination).

A Plant Summary Report will be published for each plant that has gone through the Michigan Invasive Plant Assessment System. All information used in developing the Plant Summary Report and MIPC's Plan of Action will be accessible through the Michigan Invasive Plant Council.

The Michigan Invasive Plant Council is in the process of completing the

assessment of the first 21 plants. We will keep you informed of the outcome as it is made available for publication. For more information on latest generations of plant invasiveness assessment systems, search for the following references:

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