A Review of Regulatory and Non-regulatory US State Invasive Plant Lists: Towards Greater Consistency and Efficacy

by

Alexander Johnson

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This thesis was presented

by

Alexander Johnson

It was defended on

April 12, 2021

and approved by

Joshua Galperin, Visiting Associate Professor, School of Law

Deah Lieurance, Extension Scientist, University of Florida Department of Agronomy

Danielle Andrews-Brown, Lecturer/Program Coordinator, Department of Geology

Sara Kuebbing: Assistant Professor, Department of Biological Sciences

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Invasive plants pose a serious threat to ecosystems, economies, and human health (IPBES 2019). A list of invasive plants in each ecosystem is an essential tool for a variety of stakeholders in guiding planning, management, and policy efforts regarding invasive plants. In the US, these lists are typically compiled on a statewide basis and can be regulatory (usually "noxious weed" lists) or non-regulatory. Previous scholarship has shown that regulatory lists do not capture the actual extent of plant invasions and are largely reactive (Lakoba et al. 2020), so non-regulatory listing groups such as "invasive plant councils" work to fill this leadership gap. However, differences in the intent, listing methods, and transparency of the listing process could lead to inconsistencies in list accuracy/efficacy and hinder effective list implementation. Building off previous work from Fox & Gordon (2009), we conducted a comparative survey of regulatory and non-regulatory US state invasive plant lists, comparing between the two list types and investigating differences in non-regulatory listing processes and products. Our findings support prior research showing the inadequacy of regulatory lists. At the same time, we found that non-regulatory lists are generally limited in their intended uses and audiences. Non-regulatory listing processes are inconsistent across states, and criteria for listing plants as invasive varies by listing group. The listing process is usually non-transparent. These findings point to potential problems when trying to implement non-regulatory lists. The listing process might be improved by continued collaboration among listing groups (leading to greater consistency), more transparency and

documentation of the listing process, and increased resources to non-regulatory groups who bear the burden of creating a useful and comprehensive invasive plant list when regulatory listings within a state are insufficient.

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1.0 Introduction

Invasive plant species threaten the global food supply, drive biodiversity loss, alter the structure and function of ecosystems, and threaten human health and safety (IPBES 2019). Because of these adverse environmental impacts, stakeholders including policymakers, land managers, researchers, and home gardeners base control, management, policy, and planting decisions on whether certain plant species are invasive, likely to become invasive, or not. A regional or statewide list of invasive plant species is a primary tool for stakeholders in this regard. Researchers use these lists in deciding what species to study (Allen & Bradley 2016) and aggregating data on invasive species (van Kleunen 2018). Professional gardeners and landscapers include invasive plant lists in vegetation and landscaping guidelines (University of Pittsburgh Sustainable Landscape Design Guidelines), and sustainable landscaping standards direct users to state invasive plant lists (U.S. Green Building Council, 2008) to determine which species to include or exclude in landscaping. Land managers and conservation practitioners use invasive plant lists to prioritize target species for management and control efforts and rely on lists and accompanying documentation of species impacts in making management decisions (Gordon et al. 2016). Invasive species lists can inform invasive species regulations and policy, and their utility even extends to home gardeners and members of the public who wish to learn more about invasive plants in their areas.

Invasive plant lists generally fall into two categories: regulatory lists that prevent the sale, movement, or spread of certain species, and non-regulatory lists that serve as recommendations or guidelines and list plants based on criteria such as reproductive traits or impacts on ecosystems. Nearly all states maintain a regulatory “noxious weed” list that primarily includes species

identified as threats to agriculture and prohibits movement of these species into or within a state. Statewide noxious weed lists generally do not consider natural areas and tend to be reactionary, listing invasive plant species that are already widespread rather than proactively listing species that have not yet become established in a state (Lakoba et al. 2020, Quinn et al. 2013). At the state level, regulatory listing agencies usually do not publish their listing methods or rationale, so the listing process is very opaque (Fox & Gordon 2009). Noxious weed lists also tend to be infrequently updated (Lakoba et al. 2020). The bias of regulatory lists towards agricultural weeds indicates that many plant species invasive in natural areas are probably underregulated, while agricultural pest species unlikely to become invasive in natural areas are probably overregulated (Quinn et al. 2013). But, because the regulatory listing process is not transparent, it is difficult to evaluate the utility of the resulting lists. Additionally, the lack of transparency and lack of justification for listing a species makes resolving potential disputes over listed plants difficult (Fox & Gordon 2009). A recent analysis of the species' composition, listing patterns, and limitations of current state regulatory lists concluded that significant reforms to the regulatory listing process are needed to better capture current and future invasions and increase the utility of lists (Lakoba et al. 2020). Because of these limitations, it is likely that noxious weed lists are relatively unhelpful to many potential end-user groups such as landscapers, gardeners, land managers, and other conservationists (Lakoba et al. 2020).

To meet the need for more comprehensive and natural areas focused invasive plant lists, many organizations maintain non-regulatory lists of invasive plants for a state that serve as recommendations and guidelines for stakeholders (Fox and Gordon 2009). Many different types of groups create these lists, including nongovernmental organizations [referred to as invasive plant councils (IPCs) or exotic pest plant councils (EPPCs)], universities, or government agencies that

lack legislative or executive authority to maintain a regulatory list of invasive plant species. Because different groups within each state create their own lists to meet varying goals, non-regulatory lists differ in their intent and target audience. Furthermore, non-regulatory lists are created using different methods. Some list-making processes rely on "expert testimony" of listing group members or external consultants who curate a list based on their collective knowledge, field experience, and expertise. Others utilize a "status assessment", which is a formal set of criteria organized as either a scoring system or a checklist with a minimum number of necessary criteria a plant must meet to determine its level of invasiveness, thus determining whether it is included on the group's list. The process behind creating a non-regulatory list tends to be more transparent than regulatory listings, but there is still a great deal of variation between listing groups and transparency of listing methods (Fox & Gordon).

The high degree of variation among non-regulatory lists may lead to inconsistencies in the rigor of the listing process, what criteria must be met to merit listing a species, which types of species are commonly listed, who lists are designed for, and ultimately, the utility of lists to stakeholders. Non-regulatory lists may be an obvious source of information for improving regulatory lists, but because the current non-regulatory listing landscape is so variable, a better understanding of current non-regulatory listing processes as well as non-regulatory list efficacy and utility as compared to regulatory lists is needed before reforms can be effectively implemented.

To provide a comprehensive review of non-regulatory invasive plant lists in the United States, we characterize the list intent, listing methods, and transparency of the listing process for non-regulatory invasive plant lists in all 50 US States. This is an updated and more expansive review of the invasive plant listing process from past analyses of non-regulatory invasive plant

lists (Fox and Gordon 2009, Buerger et al. 2016) and heeds recent calls for such an assessment (Lakoba et al. 2020). We answer the following questions: How many regulatory and non-regulatory invasive plant lists exist in each state, and who creates them? How do non-regulatory and regulatory lists differ in length and included species? Among non-regulatory lists, what differences in intent, listing methodology, and transparency of the listing process exist? How do these variations impact the final product of listing? And what potential avenues exist to increase the efficacy of lists and listing processes?

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2.0 Methods

2.1 Sourcing Invasive Plant Lists

To find non-regulatory invasive plant lists for each state, we started with the National Association of Invasive Plant Councils (NAIPC) website to locate affiliated invasive plant councils that serve as the non-regulatory listing body for states. The NAIPC is an interstate group of some prominent invasive plant councils (hereafter IPCs) across the United States. We used the directory provided by the NAIPC to navigate to websites of individual state IPCs and collect lists generated by these groups. This resulted in 27 lists. To find additional invasive plant lists created by groups unaffiliated with the NAIPC, we then searched online using standardized search terms "[state name]" + "invasive plant list"] in Google for all fifty states, finding an additional 19 lists. We cross-referenced the non-regulatory lists we found through our searches with other databases that collect state-based invasive plant lists including the USDA's PLANTS database [www.plants.usda.gov] and the University of Georgia's Center for Invasive Species and Ecosystem Health [www.invasive.org] to locate lists we may have missed. We did not find any additional lists during the cross-referencing process. In total, we collected 46 non-regulatory lists.

We located regulatory lists for topline comparison purposes. To find regulatory invasive plant lists, we utilized the Nexis Uni database, which searches state laws including legislative statutes and state administrative agency regulations. Regulatory lists included legal mandates that restrict the transport, sale, or planting of listed plant species, or dictate management strategies. Thirty-one states regulate plants that are considered problematic in agricultural settings with *noxious weed* laws, while 14 states (Connecticut, Idaho, Illinois, Indiana, Maryland, Maine,

Minnesota, Montana, New Hampshire, New York, Ohio, South Carolina, Texas, and Wisconsin) have statutes or regulations specifically targeted for plants that are considered problematic in natural areas (typically referred to as *invasive plant* laws). Of the 14 states that explicitly regulated invasive plants, six also regulated non-plant invasive species (i.e., animals, fungi, algae). We used the following search terms to locate relevant regulations in each state: "noxious weed", "invasive plant", and "pest plant". Through our searches, we found that several states also have "noxious seed" regulations restricting the permissible amount of invasive or noxious plant propagules in agricultural seed. Because of the strong bias towards agricultural pest species and limited scope of noxious seed regulations, we excluded them from our analysis. We cross-referenced our regulatory lists with a recent publication that compiled invasive species regulations across the United States (Grove & Moltz, 2019), adding two lists that we did not find in our initial search.

In total, we located at least one regulatory list for 41 states and at least one non-regulatory list for 39 states. For many states, we located multiple regulatory and non-regulatory lists. For those 11 states where we could not locate any state-wide non-regulatory lists, we contacted relevant state agencies, colleagues working on invasive plant management or natural resource conservation in the state, members of regional invasive plant councils (for example, Midwestern Invasive Plant Councils, Mid-Atlantic Invasive Plant Council, Southeastern Invasive Plant Council), and members of the NAIPC to ask if they were aware of non-regulatory lists for the state. When our search results yielded no relevant lists and we were told by state or regional contacts that they were unaware of any lists, we recorded that no non-regulatory list was available for the state. We deemed searching complete after we had exhausted search results for both regulatory non-regulatory lists and cross-referenced our results with relevant publications and databases.

Three states (North Dakota, Wyoming, and New Mexico) did not have either a regulatory or non-regulatory list that fit the criteria for our analysis.

We restricted our analysis to only statewide invasive plant lists. However, some statewide lists included subcategories based on various eco-regions within a state, such as the California Invasive Plant Council's list, which is divided into "habitat types". We recorded whether lists included any of these more specific subcategories within them. We did not include lists that were created on a sub-state level, such as lists for individual counties, cities, or regions within a state.

2.2 Collecting Listing Data

For all regulatory and non-regulatory plant lists, we collected information on who created the list and when. We also recorded what taxa were included on the list (plants, algae, animals, and/or pathogens), and the number of plants included on the list. We categorized all lists as one of the following: 1) "invasive plant list" if they were created for only plants that invade non-agricultural natural areas; 2) "invasive species list" if they were created for all invasive species that invade natural areas; or 3) "noxious weed list" if they included plants considered problematic in both agricultural and natural areas. All "noxious weed" lists are regulatory lists.

For non-regulatory lists, we found that groups affiliated with universities, non-governmental invasive plant councils, invasive plant councils with legislative authority, and state agencies all created non-regulatory invasive plant lists. For regulatory lists, we recorded the specific state agency that generated the list. These agencies included: departments of natural resources, state agriculture or plant boards, departments of agriculture, departments of environmental protection or environmental conservation, and noxious weed control boards.

Non-regulatory lists tended to be easier to find online, longer and more comprehensive, and focused on plants that invade natural areas. Because non-regulatory invasive plant lists are the focus of our study, we collected additional, more specific, information on non-regulatory lists. We grouped this data into broad topics adapted from a framework from Fox & Gordon (2009). These include *listing group*, *list intent*, *listing methods,* and *transparency of listing process*.

2.2.1 Listing Group

We categorized listing groups into the following five types: "university" for groups affiliated with universities or university extension services, "NGO council" for nonprofit/nongovernmental invasive plant councils, "legislative councils" for invasive plant councils established by state legislature, "state department" for state agencies or departments such as Departments of Conservation and Natural Resources, Departments of Agriculture, or Natural Heritage Programs, and "other", for other environmental nonprofits, such as Rhode Island's Natural History Survey, that were not invasive plant councils but still maintained state-wide lists of invasive plants. In two cases (IN1 and NE1), we categorized the listing group as both "university" and "legislative council" because they were councils with legislative authority that also had university affiliations.

2.2.2 List Intent

We described list intent using two metrics: stated purpose of list and target users of list. We recorded list purpose using the following categories, which we created based on the language used on listing documents: information: species identification/impacts, information: management

prioritization, information: species distribution, management, inform policy, regulation (prevention, quarantine, enforcement), funding justification, prevention (EDRR), eliminate in landscaping/gardening, education/awareness/outreach, or not specified. We also recorded target users using the categories: “agency staff”, “commercial horticulture industry”, “intrastate groups (conservation commissions, weed management area [WMA], weed control districts)”, “educators”, “natural resource managers”, “nonprofits”, “policymakers”, “public (general)”, “public (landowner/homeowner)”, “universities”, or “not specified”. Many listing groups stated multiple purposes and target users, and we recorded all listed target users and list purposes for each list.

2.2.3 Listing Methods

There are two main strategies used by listing groups to create non-regulatory invasive plant lists. The first strategy is with structured, formal assessment tools which we refer to as “status assessments” as described by Fox & Gordon (2009). Status assessments are used to screen plants and determine a given plant’s threat level. In some cases, they also document the plant’s impacts or justify its management and control. The second strategy listing groups employ is a less structured approach using consensus building based on field experience or expert consultation to select plants for listing. To determine how each group created their list, we first searched the associated website for any status assessments. If the listing group did not have a status assessment document available on their website, we contacted individuals affiliated with the listing group via email or phone to request more information on their listing procedure. In a few instances, these contacts provided us with a document that outlined the process and/or a status assessment that was not available on the public website. In other instances, we learned that the listing process was not

specifically outlined and instead based on a combination of expert opinion or the listing group's collective knowledge and field experience. We scored lists as "used a status assessment" when the listing groups used a systematic series of qualitative or quantitative questions to evaluate a potentially invasive plant's threat level. We scored lists as "expert opinion" when listing groups relied on expert knowledge and experience of the group members and/or consultation with other experts. For seven lists (NC1, NH3, NV3, OK1, TX1, UT1, and WI3), we were unable to find any information about the listing process or criteria on their website or able to contact someone from the listing group who had knowledge of the list's development. We recorded these lists as "unknown development".

If a status assessment was used to create a list, we recorded additional data on the status assessment itself. Status assessments varied in structure and implementation. We recorded whether assessments used a scoring system or a checklist of criteria to determine if a plant is invasive, the format of the criteria on each assessment, how the assessment dealt with unknown or uncertain information, and whether specific criteria were weighted based on importance.

We categorized assessments into two broad types: those that used a scoring system for each criterion in the assessment or those that used a checklist or flowchart to determine a given plant's threat level. Scoring systems were numeric and assigned values based on how a potentially invasive plant met or did not meet various criteria. For example, the Alaska Center for Conservation Science assigns plants a numeric score based on the severity of the plant's ecological impacts, the plant's capabilities for rapid reproduction, and the plant's distribution, among other criteria. These scores are then used to determine whether a nonnative plant was invasive (or, for lists that specified tiers of invasiveness, the specific threat classification of a plant). In some cases, assessors summed these scores, which corresponded to a level of invasiveness, and in other cases,

assessors had to perform one or more calculations before reaching a final score. Assessments that used a checklist format contained a series of yes/no criteria, and if a nonnative plant met a given number of criteria, assessors determined it to be invasive. For example, the Tennessee Exotic Pest Plant Council's assessment tool includes 14 criteria, and a plant must meet a certain number of these 14 criteria to be listed.

We also recorded whether individual criteria on assessments were quantitative, qualitative, or a combination of the two. Qualitative criteria are non-numeric descriptors of plant impact or traits, such as "The plant has the potential for rapid growth, high seed or propagule production and dispersal, and establishment in natural communities or in managed areas where it is not desired **(AL1)**." Quantitative criteria contained numeric indicators, such as "Formation of stands dominated (>75% cover) by the species **(CA1)**." Many assessments included a combination of qualitative and quantitative listing criteria.

We then categorized the response format for criteria as "yes/no", "multiple choice", "multiple choice with corresponding scores", "assessor assigns score", or "open-ended". "Yes/no" criteria included a statement that the assessors responded to with yes or no based on a given plant's characteristics. "Multiple choice" criteria included a series of statements assessors choose from, whereas "multiple choice with corresponding scores" assigned a numeric value to each option, which were later used to score invasion status quantitatively. "Open ended" questions were qualitative, where assessors could write statements about the plant's invasion status, and "assessor assigns score" questions functioned similarly, but were quantitative. We also noted whether scores for specific criteria were weighted based on importance before a plant's overall invasiveness or threat level was determined.

Many lists included a mechanism to account for unknown information or uncertainty in the assessment process. These mechanisms varied in structure, where some assessments deemed plants with unknown information ineligible for listing, some lowered the possible maximum invasiveness score or established a range for maximum possible score, some defaulted to the highest or lowest score for the unknown criteria, and some accounted for uncertainty through a separate metric or qualitative explanation. We sorted these mechanisms as either "favoring listing" or "favoring not listing". We categorized mechanisms that made plants ineligible for listing or defaulted to the lowest score for a question as "favoring not listing." Mechanisms that adjusted maximum possible score, established a minimum-maximum range for overall invasiveness score, defaulted to highest score for a question, or assigned an uncertainty score but still listed a given plant were considered to "favor listing."

We noted if lists included a pre-screening process, where assessment users could skip a longer assessment to determine invasion level through a condensed, quicker process. We also noted whether listing criteria allowed for a "confidence level" to be specified, or if sources and documentation were required before listing a plant as invasive.

Criteria included in status assessments were categorized based on what attributes of invasive plants they evaluated. These categories included: ecological impacts, biological and reproductive characteristics, rarity of impacted communities, role of humans in establishment, density/extent of population, rate of dispersal, economic impacts, management difficulty, human/livestock health and safety, and economic value of assessed species (adapted from Fox & Gordon [2009]). We determined if assessments contained or did not contain criteria in each of these categories.

2.2.4 Transparency of Listing Process

To assess the transparency in the listing process, we evaluated the following three process characteristics: (1) whether the status assessment was publicly available (included on the listing document, included on the listing website, available on request, or not available); (2) whether species-specific assessments or scorecards were available on the website where the list was found (yes or no); and (3) whether the listing process included a public review period (yes or no). If the listing process included a public review period, we also recorded how the public was informed of the listing process and review, the length of the review period, whether public comments were taken online or in person, and whether the listing group responded to public comments.

3.0 Results

3.1 How many and what types of invasive plant lists exist?

We found at least one regulatory or non-regulatory list for 47 states. The average number of invasive plant lists per state was 2.19 ± 0.12 and the median number of invasive plant lists was two. Most states had one regulatory and one non-regulatory list. The total number of lists per state ranged from one (Arkansas, Colorado, Georgia, Kentucky, Louisiana, Massachusetts, Nevada) to five (Montana).

We found that 78% of states (N = 39) had at least one non-regulatory invasive plant list. Eleven states--Colorado, Idaho, Louisiana, Montana, Nevada, New Mexico, New York, North Dakota, South Dakota, Washington, and Wyoming--did not have a non-regulatory list. Six states had multiple non-regulatory lists created by different groups within the same state, including Delaware (Delaware Invasive Species Council, Delaware Natural Heritage Program), Indiana (Indiana Invasive Species Council, Indiana Department of Natural Resources), New Jersey (Department of Environmental Protection, Friends of Hopewell Valley Open Space Invasive Species Strike Team), Rhode Island (two lists by the Rhode Island Invasive Species Council, Rhode Island Natural History Survey), Texas (two lists by the Texas Invasive Plant and Pest Council), and Wisconsin (Invasive Plant Association of Wisconsin, Wisconsin Department of Natural Resources). In total, we collected 46 nonregulatory invasive plant lists from 39 different states.

Forty-one states had at least one regulatory noxious weed or invasive plant list, though some states had multiple lists intended for different purposes or a list split into multiple sections

across a series of state laws, which we treated as separate lists. These states include Idaho (3 lists), Illinois (3 lists), Indiana (2 lists), Montana (5 lists), New York (2 lists), North Carolina (2 lists), Ohio (2 lists), South Dakota (2 lists), and Washington (3 lists), and Wisconsin (2 lists). In total, we identified 57 regulatory lists.

3.2 What species, and how many, are included on invasive plant and noxious weed lists?

The mean number of species on non-regulatory invasive plant lists was 105.6 ± 11.5 (mean ± s.e.) species and the median was 79 species (Fig. 1). The most extensive non-regulatory list in our analysis was the Alaska Center for Conservation Science list (AK1), which included 412 plant species. Our shortest non-regulatory list was the Rhode Island Natural History Survey list (RI4), which included 14 plant species.

Regulatory lists were on average one-third shorter than non-regulatory lists, with an average of 37.0 ± 4.7 species and a median of 28 species (Fig 1). Of states that had both regulatory and non-regulatory lists, regulatory lists were significantly shorter than non-regulatory lists, on average (paired t test, $t=5.19$, $p<0.0001$) (Fig 2). Of regulatory lists, the longest was the West Virginia Dept. of Agriculture's noxious weed list (WV2), which included 164 species. The shortest was an invasive species regulation by the Idaho Dept. of Agriculture (ID3), which listed only two species.

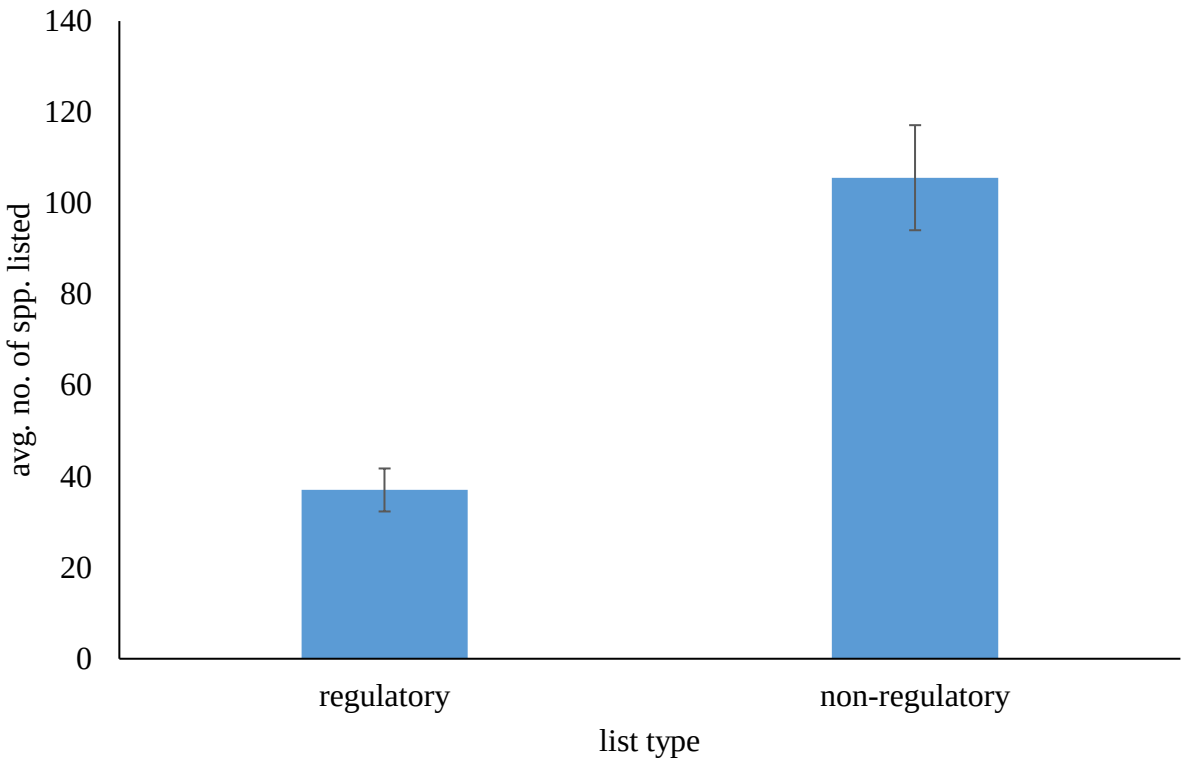

Figure 1 Average number of species on regulatory and non-regulatory lists

Regulatory lists of invasive plants are, on average, three times as short as non-regulatory lists, indicating that regulatory lists may not include species (spp.) widely considered invasive by listing groups in a non-regulatory setting.

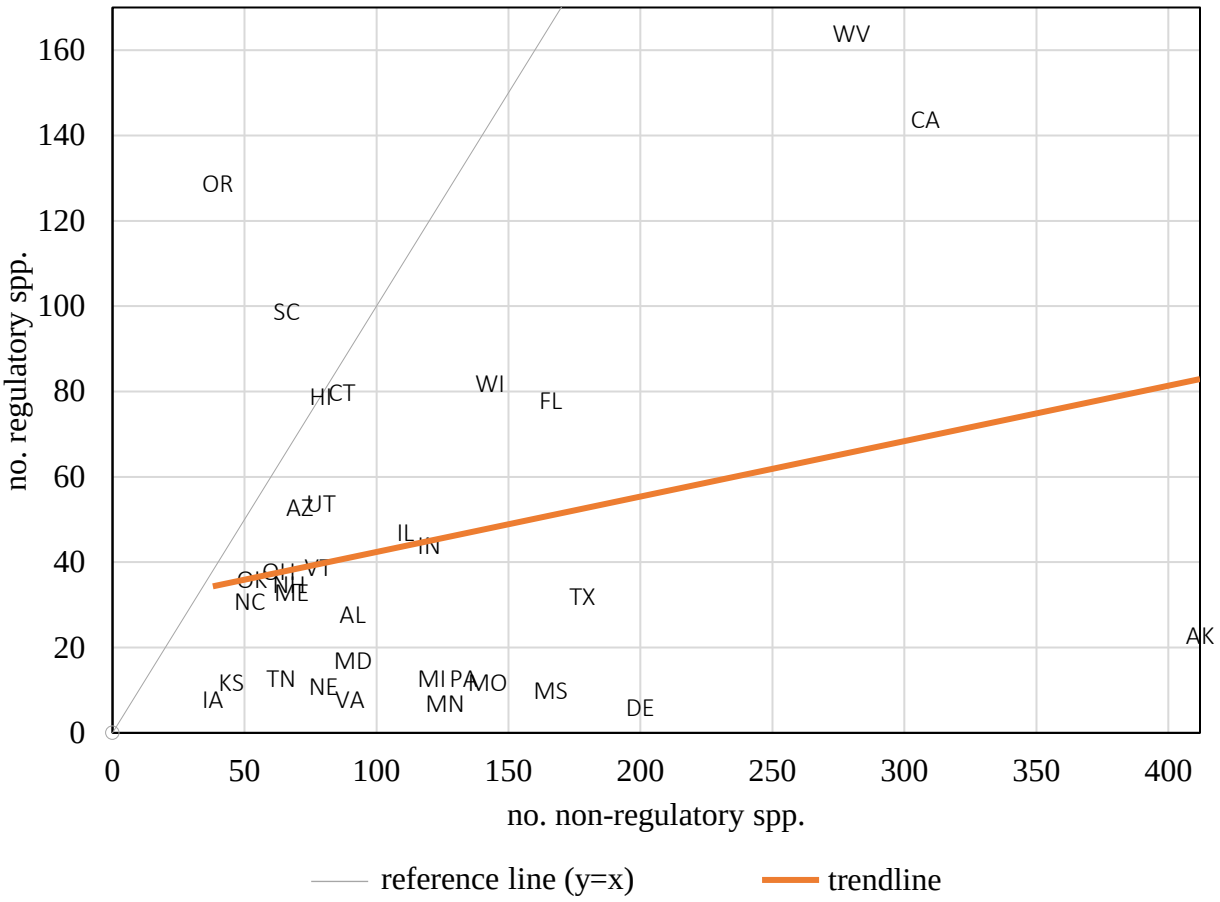

Figure 2 Average number of species on regulatory and non-regulatory lists within a state

Within a given state, non-regulatory lists tend to be longer than regulatory lists. States where the number of regulatory and non-regulatory species are equal would indicate consistency in listing, but most states show under-regulation of species compared to non-regulatory lists.

We analyzed list length as it related to listing group types among non-regulatory (legislative IPC, nongovernmental IPC, state agency, university, or other) and regulatory groups (departments of agriculture, environment, natural resources, noxious weed committee, university, or wildlife committee). We performed two ANOVA tests and found that there was not a statistically significant difference in lists length between group types, for both non-regulatory

(F=1.44, d.f.=4, 41, P=0.24) and regulatory lists (F=0.75, d.f.=5, 51, P=0.59**)**. This may be in part due to large variation in list length, especially among non-regulatory listing groups, which had a very large range (14-412 species). Regulatory list length had a smaller range (2-164 species) (Fig 3, Figure 4).

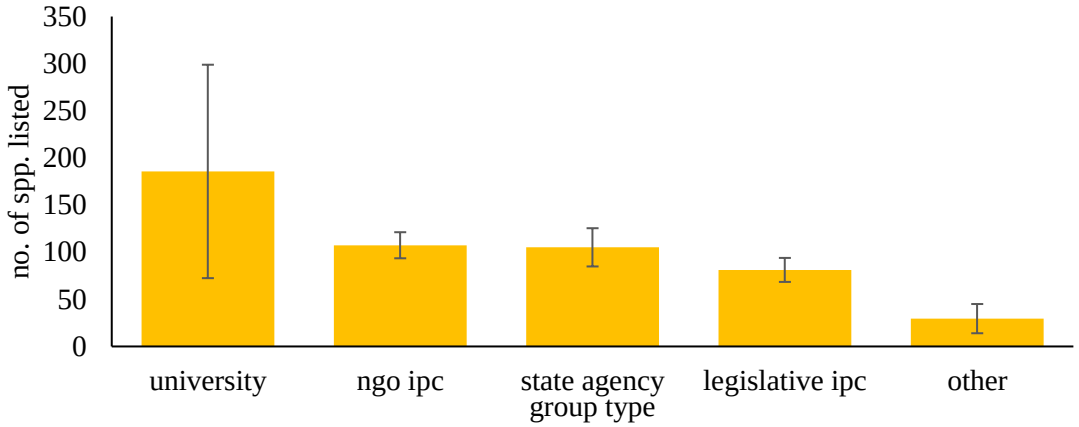

Figure 3 List length by non-regulatory group type

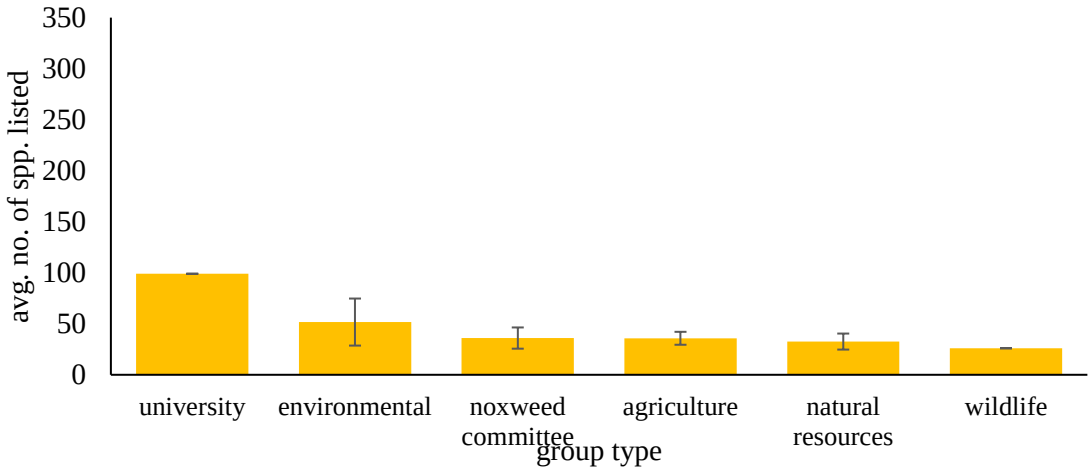

Figure 4 List length by regulatory group type

List length varied by group type in both non-regulatory and regulatory contexts, but non-regulatory lists were generally longer and had more variation in length. Regulatory lists might be artificially limited in scope or constrained by factors other than the listing group.

3.3 Listing Group

A variety of groups publish non-regulatory invasive plant lists. We found that non-governmental invasive plant councils are the primary creators of non-regulatory invasive plant lists (n = 23, 50%). State agencies, such as Departments of Natural Resources, Departments of Environmental Protection, and Natural Heritage Programs, published about one-quarter (n = 13, 28.3%) of non-regulatory lists. Invasive plant councils that have some kind of relationship (the nature of these relationships is unclear, in many cases) with state government (as opposed to non-governmental councils) published five (10.9%) lists. Universities or university extension services, such as the Alaska Center for Conservation Science at the University of Alaska, published three (6.5%) of the lists in our analysis. We categorized two lists (4.3%) as "other": the Kansas Native Plant Society invasive plant list (KS1), and the Rhode Island Natural History Survey list (RI4). These two groups are both independent non-profit groups that do not identify as invasive plant councils.

A variety of state agencies create regulatory invasive plant and noxious weed lists. Of the 57 regulatory lists in our analysis, agencies focused on agriculture created 38 (66.7%). Natural Resource Departments created nine lists (15.8%). Noxious Weed Committees created five (8.8%) lists. Environmental agencies (Departments. of Environmental Protection, Environmental Conservation, or Environmental Management) created three lists (5.3%). One list (1.8%), Louisiana's Invasive Noxious Aquatic Plant list, was created by the state's Department of Wildlife and Fisheries. One other, South Carolina's State Plant Pest List, was published by Clemson University.

3.4 List Intent

Regulatory invasive plant lists are written into state law and take two different forms that reflect the intended purpose of the list. These two categories are: noxious weed lists, which focus mainly on agricultural pest plants; and invasive plant/species lists, which focus on plants or plants and other taxa that invade natural areas. Of the 57 regulatory lists in our analysis, 38 were noxious weed lists and 19 lists were invasive plant or invasive species lists. Twenty-seven states had only noxious weed lists, 10 states (CT, IN, ME, MD, MN, NH, NY, SC, TX, WI) had only invasive plant or species lists, and 4 states (ID, IL, MT, OH) had both invasive plant and noxious weed lists.

Non-regulatory lists have a range of intended purposes that are sometimes specified by the list authors. Of the non-regulatory lists in our analysis, nearly half (n = 21, 44%) had no clearly stated purpose for the list. Of the remaining 25 lists, many stated more than one purpose (for example, identification and management of invasive species). On average, list authors stated 3.2 ± 0.4 (mean ± std. error) distinct purposes. We recorded 80 purposes in total from across these 25 lists. We categorized the purposes into 10 distinct categories, which we created based on common language used by list authors. Listing intent varied widely among groups, and no single list purpose was common across all lists. The most common list purpose was for species identification or impacts but was only found on approximately half the lists. Informing policy, regulation, and justifying funding for control were the most uncommon list purposes, showing up on only a few lists (Fig. 5)

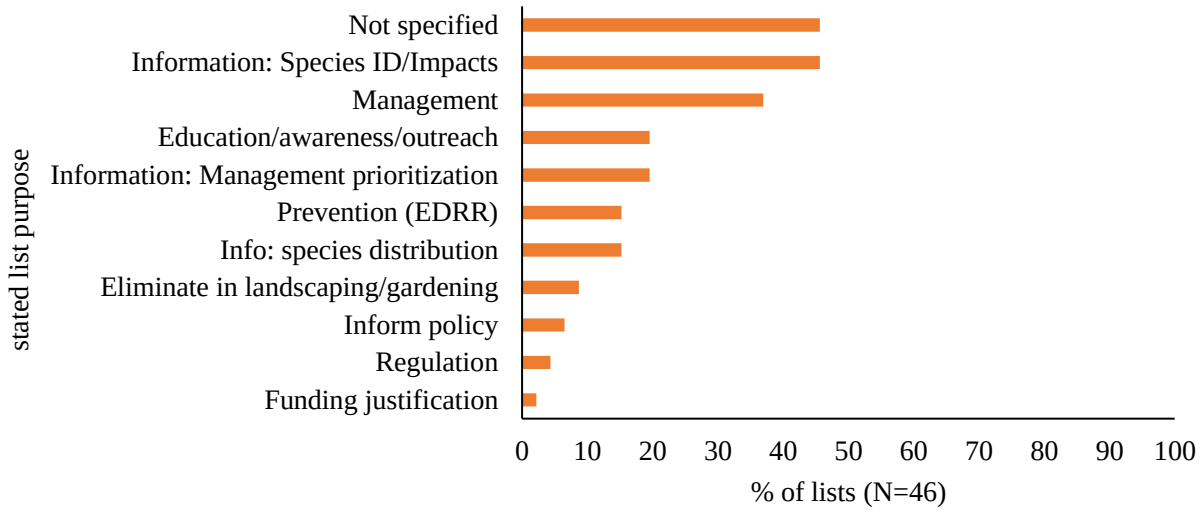

Figure 5 List purpose

Over half of the non-regulatory lists in our analysis did not explicitly state the list purpose, which could cause confusion among stakeholders and list users. Of those that stated an intended purpose, "Species ID/impacts" and "management" were most common, indicating that lists are usually designed for use in management, which could exclude other potential list users.

Almost three-quarters of the lists in our analysis (n = 34, 73.9%) had no stated target users. Of the 12 lists that did state their target list users, we recorded 31 different target users that we divided into 8 categories again based on common language from list authors. On average, lists had 2.2 ± 0.4 (mean ± std. error) stated target users. Of the 12 lists that stated their target users, three quarters (n = 9) were created for "natural resource managers". Half of the lists (n = 6) identified landowners or homeowners as their target users, five of the lists specified "general public", five specified "agency staff", two were for "policymakers", one was for "intrastate groups", and one was for "nonprofits" (Fig. 6).

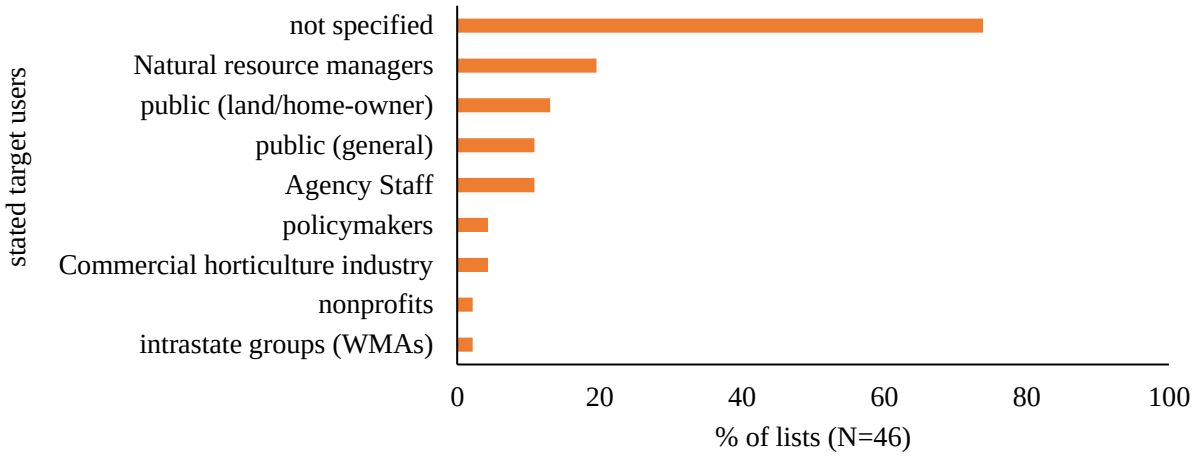

Figure 6 Target list users

The vast majority of non-regulatory lists in our analysis did not state a target user, which could cause further confusion among stakeholders. Of the lists that did state a target user, most were for "natural resource managers", indicating a limited target audience of managers that could exclude other list users.

3.5 Listing Methods

Of the 46 non-regulatory lists in our analysis, 25 employed a formal assessment tool while 15 were based on expert knowledge. We were unable to find any information on the list creation methods for six lists (NH3, NC1, OK1, TX1, UT1, and WI3). In addition to these six lists, we were unable to collect data on the creation methods of Virginia's Department of Conservation and Recreation List. An explanation accompanying Virginia's list stated that it was created with an assessment tool, but we could not locate this assessment tool online and were unable to contact anyone involved with list creation.

We categorized list assessment tools in two ways: using a scoring system to quantitatively evaluate a plant's threat level or using a checklist-type screening system where meeting a certain number of "requirements" determined the plant's invasion status. Of the 25 formal status assessments we included, 11 were checklist-style and 14 used a scoring system. Excluding Virginia's list for which we could not record detailed data, we found that the number of criteria on status assessments ranged from 3 to 64 criteria with an average of 16 criteria per list. Sixteen assessments contained a mix of qualitative and quantitative criteria and eight were purely qualitative.

We analyzed listing methods as they related to listing group type to parse out which groups were most likely to use which listing methods. We found that legislative IPCs were most reliant on scoring systems, while non-governmental IPCs and state agencies tended to use checklist-style assessments or relied on expert testimony to form their lists. Listing group had a moderately significant effect on assessment methods [X^2 (12 degrees of freedom, N = 46) = 20.906, p = 0.05177], though further study is needed to determine what factors drive these differences between groups, i.e., funding levels, personnel, ability to invest time, etc. (Fig 7).

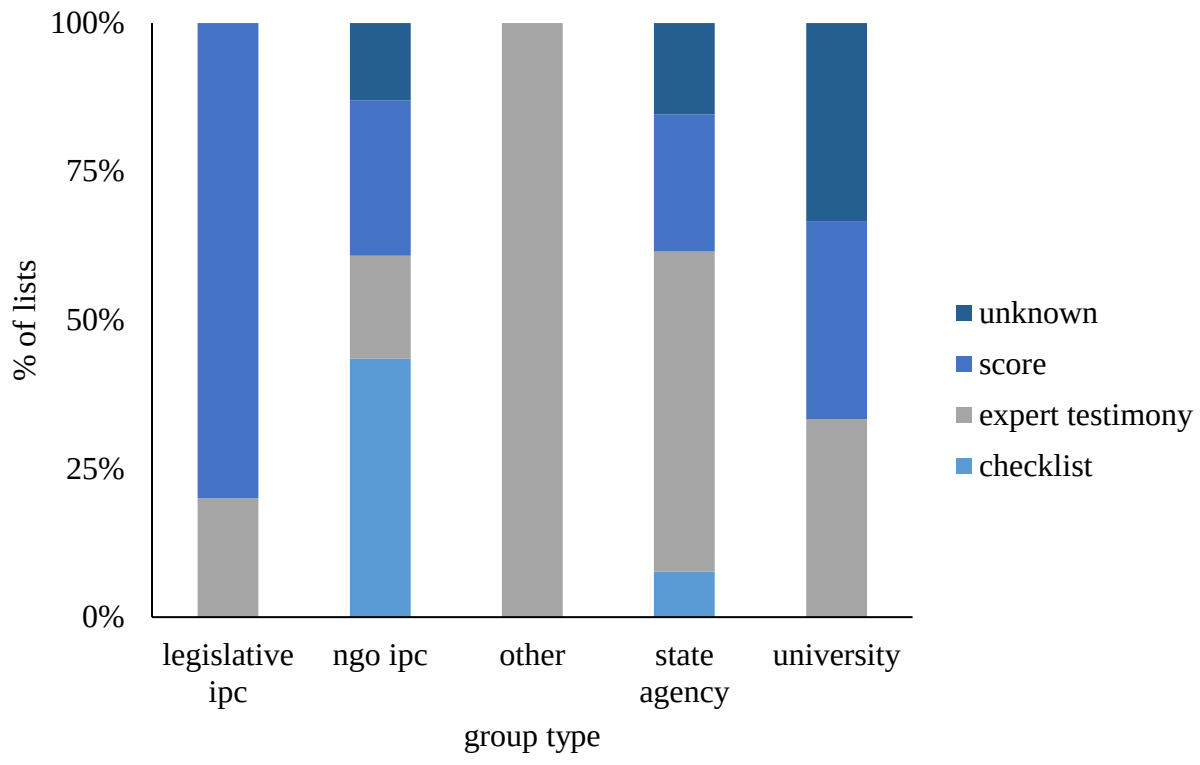

Figure 7 List creation methods by group type

Group type had a moderately significant effect on chosen list creation methods, indicating that differences in group resources, time, personnel, etc. might drive decisions regarding the best listing method for each group.

We sorted all criteria into 9 broad categories (ecological impacts, biological and reproductive characteristics, rarity of impacted communities, role of humans in establishment, density/extent of population, rate of dispersal, economic impacts, management difficulty, human/livestock health and safety, and economic value of assessed species (adapted from Fox & Gordon [2009]), and recorded presence/absence of criteria in each category for each assessment in our analysis. All 25 assessments considered a plant's ecological impacts and the density/extent of the plant's population. Biological and reproductive characteristics of the plant in question was also a common criterion. Relatively few assessments considered a plant's threat to human or livestock health and safety, or a plant's economic value (Fig 8).

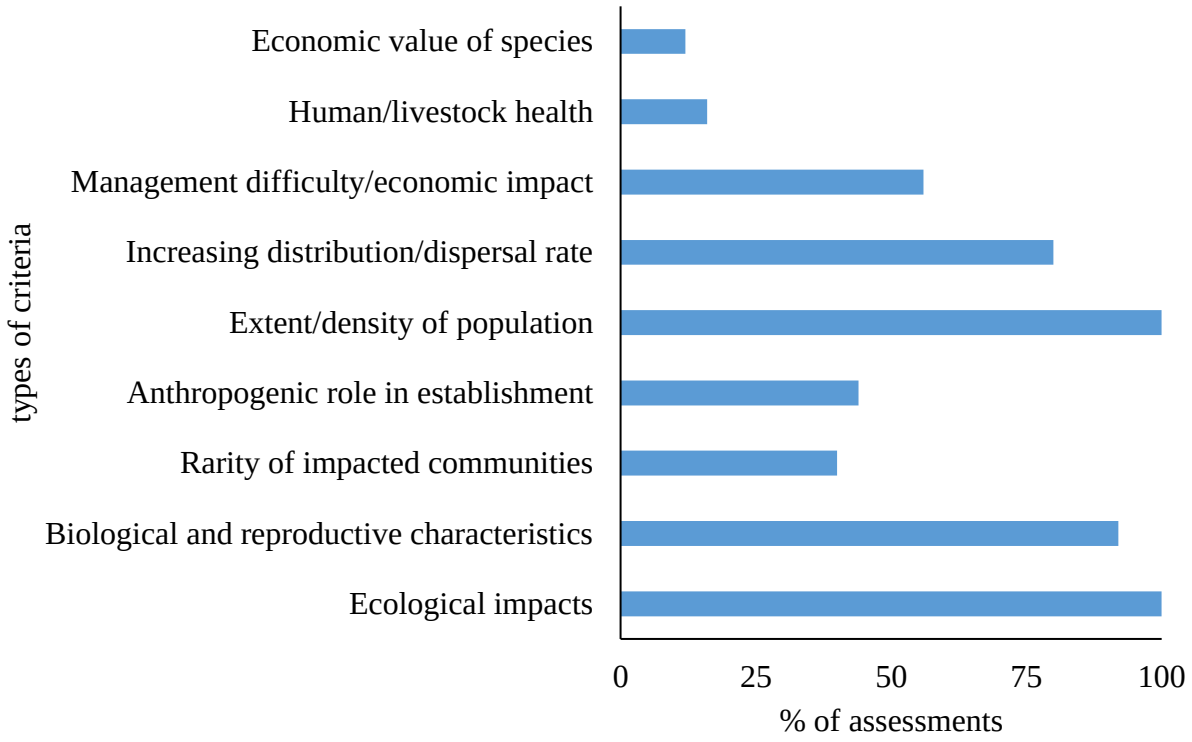

Figure 8 Frequency of criteria types included in status assessments

Of the non-regulatory lists with as assessment, all assessments accounted for ecological impacts, and most considered biological and reproductive characteristics, while few accounted for economic value of a species of human and livestock health. Variation in which criteria are used in assessments could affect a given species' listing status.

The format for responses to each criterion varied among assessments. The most common format, shared by 14 assessments including all checklist-style assessments, was a series of statements that assessors answered yes or no to based on the plant in question. Seven score-style assessments were comprised of multiple-choice questions with a numeric score associated with each answer option, four allowed assessors to assign their own numeric score, three were completely open-ended so assessors could write a more detailed answer to the criteria, and two assessments were comprised of multiple-choice questions without a corresponding "score".

When completing an assessment, assessors may encounter a criterion for which the response is unknown or data is insufficient. Ten of the 25 assessments in our study accounted for unknown or uncertain information with a "system" for dealing with unknowns. We categorized each system as either being liberal in the use of uncertain information, "favoring listing", or conservative in the use of uncertain information, "favoring not listing". The majority (N=6) were liberal in listing a species even if some information was incomplete. Liberal assessments defaulted to a high score or a "yes" response for a plant's potentially invasive traits, while conservative assessments defaulted to a low score, "no" response.

3.6 Transparency of Listing Process

We categorized assessment availability in four ways that reflect the ease with which we accessed the assessment or gained insight into the list creation process. Of the 25 lists with an assessment, five (20%) included the assessment within the listing document itself. Ten (40%) assessments were located on a page linked from the list itself. Five assessments (20%) were located on a separate page that was not linked to the list, but we found through the listing group's website or elsewhere online. Four assessments (16%) were not publicly available but were sent to us after we contacted an individual from the listing group. We were unable to locate the assessment for Virginia's Department of Conservation and Recreation list.

For the lists that used an assessment, we noted if completed assessments with scores and rankings were available for each plant included on the list. Twelve lists had this species-specific assessment data, and thirteen did not.

Of all 46 non-regulatory lists in our analysis, only five involved members of the public before formally publishing the list. These included the Connecticut Invasive Plant Working Group, Minnesota Invasive Species Advisory Council, Ohio Invasive Plants Council, South Carolina Exotic Pest Plant Council, and Tennessee Invasive Plant Council. Public review periods took a few different forms. For example, Connecticut's Invasive Plants Working Group holds public presentations of their list during a 30-day period where the public can provide feedback, whereas the Ohio Invasive Plant Council has a 180-day period where public comments are taken online. For the other three lists, we were unable to determine how comments were taken and for how long, but in the case of the Minnesota Invasive Species Advisory Council and the Tennessee Invasive Plant Council, the original comments and responses to them were published alongside the list itself.

4.0 Discussion

Our results show that many invasive plant lists are limited in their intent, inconsistent in creation methods, and not transparent. Additionally, there is dramatic variation between regulatory and non-regulatory lists. While non-regulatory lists tend to have more transparent listing processes and more utility for a broader range of stakeholders, there is still significant variation between individual listing groups within and across states as they work largely independently. Invasive plants pose a significant ecological threat both presently (Pyšek et al. 2020, IPBES 2019) and in the future as climate change allows for invasive plant range expansion (Allen & Bradley 2016). Lists are currently and will continue to be an important tool in guiding control efforts, and while non-regulatory lists may be a source of information for stakeholders both in formal management and informal landscaping/gardening settings, the current lack of consistency among lists and listing methods may reduce list utility, especially for groups working across state lines. We outline specific issues with regulatory lists, as well as differences in non-regulatory lists that may pose challenges as lists are implemented:

4.1 Non-regulatory listing groups assume responsibility when regulatory lists are insufficient.

Given that nonregulatory lists are, on average, three times as long as regulatory lists, we can infer that regulatory invasive plant and noxious weed lists do not include many species widely considered invasive by conservation practitioners and those involved in non-regulatory listing

efforts. In most states, regulatory invasive plant lists are often non-comprehensive, focused on agricultural pest species, and ultimately not useful for conservation practitioners focused on natural areas (Fox & Gordon 2009, Lakoba et al. 2020). With a few exceptions (New York or Connecticut, for example), the lack of federal or statewide governmental leadership in invasive plant regulation and management has led to leadership gaps in many state governments on defining what are the most concerning or problematic invasive plants within that state.

In a few cases, we observed that states with a longer, more comprehensive regulatory list had fewer or no non-regulatory lists available. This can be seen clearly in New York, which has 75 regulated species between two lists, and no widely used non-regulatory list. Other states such as Oregon--which has a shorter non-regulatory list but a longer regulatory list--and Colorado, Idaho, and Washington--which have no non-regulatory lists, but relatively long regulatory lists--followed this pattern. This might indicate that nongovernmental groups like IPCs fill this leadership gap and take on the responsibility of publishing a more natural-areas management focused plant list when regulatory listings do not meet the needs of managers and other end-users. There is also a clear historical pattern in our data. For many states that maintain both a non-regulated and a regulated invasive species list, the founding year of the non-regulated lists predates the founding year of the regulatory list. By filling gaps in statewide leadership on invasive species issues, non-regulatory groups are creating the foundations of future state leadership in invasion policy by curating a comprehensive list of invasive plants and connecting statewide expertise on these issues.

Non-regulatory lists are more often focused on plants that invade natural areas rather than agricultural land, and thus are likely more comprehensive and useful for land managers and other practitioners wishing to manage invasive plants outside of agricultural settings. However, because

these groups are producing lists as needed to fill gaps in regulatory listing, each state is acting independently, leading to a complex matrix of assessment tools and criteria used by each independent group. This results in wide variability in the number of species included on the lists, no consistency in identifying list purpose and target list users, variability in assessment criteria used, and discrepancies in transparency of the listing process.

4.2 Non-regulatory groups need more resources and support to create effective lists.

While non-regulatory IPCS lists might be more useful to broader audiences, they are typically created by organizations that are underfunded and composed of mostly volunteer members (NAIPC 2019). Developing a rigorous, scientific, and objective assessment tool for screening and listing invasive plants takes time, resources, and personnel that nongovernmental organizations might lack. Although national groups like NAIPC have developed standardized assessment methods for the creation of statewide lists of invasive plants (NAIPC 2017), it appears that non-regulatory invasive plant listing groups have not widely adopted any centralized process for creating invasive plant lists. Nonprofit organizations and ad-hoc working groups likely have inconsistent or insufficient funding sources, and individuals involved in these groups have other full-time careers that demand their time and energy. These obstacles likely make it difficult or impossible to curate frequently updated, comprehensive, science-based lists with extensive screening processes.

As a potential remedy for this issue, Quinn et al. (2013) points to legislative invasive plant councils--referred to as invasive species councils (ISCs)--as a place to improve regulatory invasive plant lists so nongovernmental IPCs bear less of the listing burden. ISCs have regulatory authority

and can guide official, legally mandated noxious weed and invasive plant lists, unlike non-regulatory IPCs, so their lists would carry greater authority. In several cases (i.e., the Connecticut Invasive Plant Working Group, or New York's listing group) ISCs have grown out of what started as a non-regulatory IPC. IPCs thus are a potential place to delegate funding and centralize formal listing responsibilities so they can transition to an ISC with regulatory authority. This shift in responsibility from state agricultural agencies to ISCs would reduce bias towards agricultural pest species, facilitate standardization of the listing process, and likely produce more useful and comprehensive invasive plant lists for a wider variety of users. At the same time, ISCs may have more diverse stakeholder involvement including horticulturalists and Green Industry professionals. This could lead to a more conservative listing process that accounts for species' economic impacts and results in a less comprehensive listing of invasive plants. ISCs may also have limited funding allocated to them, which could further restrict the listing process. Careful consideration of these costs and benefits should be made before moving from IPCs to ISCs.

4.3 More consistent listing methods are needed to ensure comprehensive and comparable lists among groups in different states. Listing methods might be dependent on a listing group's access to resources, time, and personnel.

Different non-regulatory listing groups relied on different listing strategies. Under this status quo, it is difficult to determine whether the absence of a plant on a given list is because it is not invasive, or simply because the assessment protocols used to form the list were different. Most legislative IPCs used a scoring system when assessing plants, while most ngo IPCs used a checklist-style assessment, and state agencies relied on expert testimony to compile their invasive

plant lists (Fig 7). This might indicate that group type--and thus, the structure, purpose, and function of listing organizations--plays a part in determining how much time and how many resources can be devoted to creating an invasive plant list. While using a scoring system might be the most "rigorous" or "methodical" approach to forming a list (NAIPC 2017), it is likely also the most resource and time intensive and therefore left to more formalized, legally backed IPCs with greater funding and personnel than NGO IPCs. Individuals creating lists for state agencies are likely doing so outside of their usual scope of work, and thus rely on expert testimony to assemble their lists as a time and resource saving strategy.

We found that listing methods, however, had little impact on final list length (ANOVA, $F=0.02$, d.f.=2, 37, $P=0.98$). This might indicate that list output is influenced by other factors such as diversity of stakeholders in different listing groups, funding levels, and/or number of personnel working on listing, though further study is needed to confirm this. Ultimately, it seems that no one listing strategy leads to significantly longer or shorter lists. For groups wishing to increase the objectivity or scientific accuracy of their list, it is likely more complicated than a shift to a different listing strategy.

The high degree of variability in lists and the methods used to create them could cause issues for end-users working across state lines. In regional or federal consolidation of lists (i.e., the National Association of Plant Councils, who maintain a database of state lists and use these lists in guiding some internal operations), variation in each listing group's criteria of what constitutes an "invasive" plant might lead some groups to deem a species invasive while other states do not. Also, native species from some states might be considered invasive in other states. For plant growers and sellers working in multiple states, variation in listed species could lead to inconsistencies in stocked plants and possibly lead to disputes when a plant is seemingly arbitrarily

permitted in one state and not permitted in another. It may also lead to issues for sustainable landscapers who wish to implement regional or federal planting guidelines and find discrepancies in listed species across states. A more consistently applied listing methodology could resolve listing discrepancies and provide strong justification in settling any disputes over listed species.

4.4 Differences among non-regulatory listing groups might impact the group's ability to create a comprehensive list.

Among non-regulatory listing groups, list length varied by group type. We found that universities tended to list the most species with 186 ± 113 (mean ± S.E.), followed by nongovernmental IPCs (107 ± 14), state agencies (105 ± 20), legislative IPCs (81 ± 13) and other groups (30 ± 16). There are a few possible explanations for this. Firstly, universities and university extension services might have more consistent sources of funding and personnel than non-governmental IPCs or state agencies creating lists outside their normal scope of work. Another possibility is that list length is affected by stakeholders involved in the listing process. While we did not assess the diversity of stakeholders in different listing groups, it is likely that different groups involve different stakeholders. For example, many legislatively appointed invasive plant councils may be required to contain a diversity of stakeholders including Green Industry professionals and horticultural growers, conservationists and managers, and researchers. Because these stakeholders may have competing interests (economic attachment to some potentially invasive plants vs. environmental concern), the listing process may ultimately be more rigorous, include economic considerations to listing a species, and ultimately lead to more conservative and shorter lists when more diverse stakeholders are present.

Access to invasion biology literature may be another factor in driving list length. While most university employees would have access to primary research that could guide listing and management efforts (i.e., documentation of a plant's invasive characteristics or effects on native species), land managers and conservation professionals might not, making it more challenging to justify listing a plant over which there is uncertainty or dispute. Even if managers do have access to primary literature, managers tend to prioritize knowledge gained through their own management experiences or information conversations with other professionals as opposed to peer-reviewed research publications that are found behind expensive paywalls (Kuebbing & Simberloff 2015, Matzek et al. 2013).

4.5 Non-regulatory lists are intended to guide management but may not be useful to other stakeholders.

Across all states, most non-regulatory lists were designed to help natural resource managers identify and prioritize potential invasive species for management of natural areas. Excluding lists that did not specify target users or list purpose, the most common target user of the lists in our analysis was "Natural resource managers", and the most common purposes of listing were "species identification" and "management". Therefore, most of these non-regulatory lists have been written "by and for" land managers and might therefore be used in selecting target species for management but are less-relevant for other stakeholders--like plant growers, researchers, or gardeners--who may be interested in lists that focus on other attributes of invasive plants or include other details in the assessment process.

While management is certainly an important use for invasive plant lists, there are many other types of end-users including home gardeners, landscapers, researchers, and policymakers that might want to use lists differently. These stakeholders were less-frequently mentioned in the lists purpose or the lists target user. Twenty-one lists (46.65%), a large proportion of those in our analysis, had no stated purpose, and of those that did, there were often multiple, vague, or overlapping purposes that are open to interpretation by end-users. The same goes for target users--34 lists (73.91%) did not specify a target user group, and of those that did, the users were often vague or overlapping. This inconsistency, in combination with the existence of multiple regulatory and nonregulatory invasive plant lists in many states, could lead to confusion among end-users who are unsure of which lists to use for which purposes. The relatively narrow focus on management might exclude these types of users. This could have implications for policy as well. Lists for use in management might focus more on species that are already present in the state, while policymakers might be more interested in species that are not yet present for preventative regulations.

4.6 Non-regulatory lists lack transparency.

Though a highly transparent listing process has been suggested as best practice (Fox & Gordon 2009, Lakoba et al. 2020), we found that the transparency of the listing process was low overall. There are three components of the listing process that indicate a high degree of transparency: whether an assessment was available, whether specific assessments were available for each species listed, whether the listing group took public input before final publication.

We were unable to find assessment methods for six lists in our analysis. Fifteen were created via expert testimony, which leaves room for vastly different considerations before listing a plant and is thus nontransparent. Of the 25 lists that used a status assessment, we were able to view the assessment for all but the Virginia Department of Conservation and Recreation list. Most of the status assessments were located at a page linked from the list itself. Four status assessments were not available online, but an individual from the listing group provided them when contacted. While relatively easy to find, these assessments might be more accessible to end-users if included on the listing document itself.

Only five lists in our analysis had a public review period before they were published. Public review and comment periods are one strategy to increase involvement from diverse stakeholders and give different end-users an opportunity to weigh in on the listed species. Of those five that did include public review periods, it was difficult to find information on the duration and format of the public review, and we were unable to determine how public comments influenced final listing decisions. Providing a more transparent, well-publicized comment period with clear responses to public comments would allow for more diverse stakeholders to influence lists and give an opportunity for public justification of listing decisions should disputes arise.

We also found that half the lists that used an assessment tool did not provide assessments for each listed species. These individual assessments are important for end users such as researchers that want to select study species or for managers looking to learn more about a specific plant's attributes when developing a management plan. Including individual species assessments would also provide justification for each species listed and be useful in resolving any listing disputes.

5.0 Conclusion

Collaboration among non-regulatory listing groups, as well as further research, is needed to better understand and improve the invasive plant listing process. Groups like the National Association of Invasive Plant Councils are taking steps to remedy these issues by connecting conservation professionals from many geographic regions and backgrounds and making efforts to standardize list creation methods. Collaborations like these are an effective way to pool knowledge and resources, centralize and standardize efforts, and secure funding through grants and other programs. However, without legal backing, invasive plant lists that nongovernmental groups generate have little concrete authority and homeowners, horticulturists, and other individuals who wish to use nonnative and invasive plants can essentially ignore them.

Our study opens many avenues for future research. By recording all species included on invasive plant lists, future researchers could compare listed invasive plants to plants widely accepted as invasive (from a database such as USDA Plants) to see which known invasive plant species are excluded from invasive plant lists. We expect that many excluded species would be those commonly used in horticulture. This would better quantify the influence of stakeholders in the horticulture industry on invasive plant listing. Additionally, we found that nonregulatory listing groups have a variety of associations with government agencies, and more qualitative analysis through interviews is needed to understand how these relationships developed and their functional purpose in invasive plant and noxious weed listing. More data on funding levels and personnel is needed to more directly determine how these factors impact a group's ability to produce a comprehensive list with rigorous, well-documented creation methods.

Appendix A Supplemental Tables

Table 1 Summary of non-regulatory lists

state	listing group	group type	group start year	no. of spp. listed
Alabama	Alabama Invasive Plant Council	ngo ipc	2003	91
Florida	Florida Exotic Pest Plant Council	ngo ipc	unknown	166
Illinois	Illinois Department of Natural Resources	state agency	unknown	111
Massachusetts	Massachusetts Invasive Plant Advisory Group	ngo ipc	1995	69
Minnesota	Minnesota Invasive Species Advisory Council	ngo ipc	2001	126
Mississippi	Mississippi Exotic Pest Plant Council	ngo ipc	unknown	166
Missouri	Missouri Invasive Plant Task Force	ngo ipc	2015	142
Rhode Island	Rhode Island Invasive Species Council	ngo ipc	unknown	69
Rhode Island	Rhode Island Invasive Species Council	ngo ipc	unknown	69
South Carolina	South Carolina Exotic Pest Plant Council	ngo ipc	unknown	66

Tennessee	Tennessee Invasive Plant Council	ngo ipc	1993	64
Arkansas	Arkansas Natural Heritage Commission	state agency	1973	50
Delaware	Delaware Natural Heritage Program	state agency	unknown	200
Georgia	Georgia Exotic Pest Plant Council	ngo ipc	1999	144
Hawaii	Hawaii Invasive Species Council	legislative ipc	2003	79
Iowa	Iowa Department of Natural Resources	state agency	1986	38
Kansas	Kansas Native Plant Society	other	1978	45
Kentucky	Kentucky Invasive Plant Council	ngo ipc	2000	171
Maryland	Maryland Invasive Species Council	ngo ipc	2000	91
Michigan	Michigan Department of Natural Resources, Wildlife Division	state agency	unknown	121
New Jersey	Friends of Hopewell Valley Open Space Invasive Species Strike Team	ngo ipc	1987	185
New Jersey	New Jersey Department of Environmental Protection	state agency	unknown	29

Pennsylvania	Department of Conservation and Natural Resources	state agency	unknown	133
Rhode Island	Rhode Island Natural History Survey	other	unknown	14
Vermont	University of Vermont	university	unknown	78
West Virginia	West Virginia Department of Natural Resources	state agency	unknown	280
Alaska	Alaska Center for Conservation Science	university	2002	412
Arizona	Southwest Vegetation Management Association	ngo ipc	2003	71
California	California Invasive Plant Council	ngo ipc	1992	308
Connecticut	Connecticut Invasive Plants Working Group	legislative ipc	1997	87
Delaware	Delaware Invasive Species Council	ngo ipc	2007	30
Indiana	Indiana Invasive Species Council	legislative ipc	2009	120
Indiana	Indiana Department of Natural Resources	state agency	unknown	25
Maine	Maine Natural Areas Program	state agency	unknown	68

Nebraska	University of Nebraska - Lincoln	legislative ipc	2012	80
Ohio	Ohio Invasive Plants Council	ngo ipc	2005	63
Oregon	Oregon Invasive Species Council	legislative ipc	2001	40
Texas	Texas Invasive Plant and Pest Council	ngo ipc	2007	29
Virginia	Virginia Department of Conservation & Recreation	state agency	unknown	90
Wisconsin	Invasive Plant Association of Wisconsin	ngo ipc	2001	66
New Hampshire	New Hampshire Invasive Species Committee	university	unknown	67
North Carolina	North Carolina Invasive Plant Council	ngo ipc	2002	52
Oklahoma	Oklahoma Invasive Plant Council	ngo ipc	unknown	53
Texas	Texas Invasive Plant and Pest Council	ngo ipc	2007	178
Utah	Utah Department of Natural Resources Conservation	state agency	unknown	79
Wisconsin	Wisconsin Department of Natural Resources	state agency	unknown	143

Table 2 Summary of regulatory lists

state	citation	group name	law start year	no. of spp. listed
Alabama	Ala. Admin. Code r. 80-10-14-.04	State Board of Agriculture and Industries	2000	28
Alaska	11 Alaska Admin. Code 34.020	Commissioner of Natural Resources	1959	23
Arizona	A.A.C. § R3-4-245	Department of Agriculture	unknown	53
California	3 CCR 4500	Food and Agriculture Division	unknown	144
Colorado	8 CCR 1206-2	Commissioner of Agriculture	2004	62
Connecticut	Conn. Gen. Stat. § 22a-381d	Department of Environmental Protection	2003	80
Delaware	CDR 3-800-801	Department of Agriculture	1996	6
Florida	5B-57.007, F.A.C.	Department of Agriculture and Consumer Services	1993	78
Hawaii	HAR 4-68	Department of Agriculture, Division of Plant Industry	1992	79
Idaho	IDAPA 02.06.09.220	Department of Agriculture	2017	67
Idaho	IDAPA 02.06.09.149	Department of Agriculture	2014	6
Idaho	IDAPA 02.06.09.150	Department of Agriculture	2014	2
Illinois	8 Ill. Adm. Code 220.60	Department of Agriculture	2002	17

Illinois	525 ILCS 10/3	Department of Natural Resources	1996	47
Illinois	17 Ill. Adm. Code 805.20	Department of Natural Resources	2005	28
Indiana	312 IAC 18-3-25	Natural Resources Commission	2019	44
Indiana	312 IAC 18-3-23	Natural Resources Commission	2012	28
Iowa	21 IAC 58.4	Department of Agriculture and Land Stewardship	unknown	8
Kansas	K.S.A. § 2-1314	Department of Agriculture	unknown	12
Louisiana	LAC, Title 76, Part VII, Chapter 11	Department of Wildlife and Fisheries	unknown	26
Maine	CMR 01-001-273	Department of Agriculture, Conservation, and Forestry	2011	33
Maryland	COMAR 15.06.04.06	Department of Agriculture	unknown	17
Michigan	MCLS Act 359 of 1941 § 247.62	Commissioner of Noxious Weeds	1941	13
Minnesota	Minn. R. 6216.0260	Commissioner of Natural Resources	unknown	7
Mississippi	CMSR 02-001-301	Mississippi Department of Agriculture, Plant Division	1991	10
Missouri	2 CSR 70-45.005	Department of Agriculture	2011	12
Montana	MONT. ADMIN. R. 4.5.206	Department of Agriculture	unknown	4

Montana	MONT. ADMIN. R. 4.5.207	Department of Agriculture	unknown	5
Montana	MONT. ADMIN. R. 4.5.208	Department of Agriculture	unknown	9
Montana	MONT. ADMIN. R. 4.5.209	Department of Agriculture	unknown	17
Montana	MONT. ADMIN. R. 4.5.210	Department of Agriculture	unknown	5
Nebraska	Nebraska Admin. Code Title 25, Ch. 10	Department of Agriculture	unknown	11
Nevada	NAC 555.010	Department of Agriculture	1968	47
New Hampshire	Agr 3802.01 NH Prohibited Invasive Species.	Department of Agriculture, Markets, and Food	2004	35
New York	6 NYCRR § 575.4	Department of Environmental Conservation	2014	6
New York	6 NYCRR § 575.3	Department of Environmental Conservation	2014	69
North Carolina	2 N.C.A.C. 48A.1702	Department of Agriculture and Consumer Services	1991	19
North Carolina	15A N.C.A.C. 2G.0602	Department of Environment and Natural Resources	unknown	31
Ohio	OAC Ann. 901:5-37-01	Department of Agriculture, Plant Industry	1987	31
Ohio	OAC Ann. 901:5-30-01	Department of Agriculture, Plant Industry	2018	38

Oklahoma	O.A.C. § 35:30-25-3	Department of Agriculture, Food, and Forestry	2000	36
Oregon	OAR 603-052-1200	Department of Agriculture	1999	129
Pennsylvania	7 Pa. Code § 110.1	Noxious Weed Control Committee	1997	13
South Carolina	N/A	Clemson University	unknown	99
South Dakota	ARSD 12:62:03:01.06	Department of Agriculture	1997	7
South Dakota	ARSD 12:51:03:01	Department of Agriculture	unknown	22
Tennessee	Tenn. Comp. R. & Regs. R. 0080-06-24-.02	Department of Agriculture	unknown	13
Texas	4 TAC § 19.300	Department of Agriculture	2005	32
Utah	U.A.C. R68-9-2	Commissioner of Agriculture and Food	1988	54
Vermont	CVR 20-031-021	Department of Agriculture, Food and Markets	2002	39
Virginia	2 VAC 5-317-20	Department of Agriculture and Consumer Services	2015	8
Washington	WAC § 16-750-005	State Noxious Weed Control Board	1988	36
Washington	WAC § 16-750-015	State Noxious Weed Control Board	1988	54
Washington	WAC § 16-750-011	State Noxious Weed Control Board	1988	64

West Virginia	W. Va. CSR § 61-14A-5	Department of Agriculture	unknown	164
Wisconsin	Wis. Adm. Code NR 40.04	Department of Natural Resources	2009	82
Wisconsin	Wis. Adm. Code NR 109.07	Department of Natural Resources	unknown	3

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