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Education

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Mark Renz, Kevin D. Gibson, Jennifer Hillmer, Katherine M. Howe, Donald M. Waller, and John Cardina*

In 2006, the Midwest Invasive Plant Network's Research Committee conducted a web-based survey to help identify research needs and interactions between land managers and researchers working to manage invasive plants in the Midwest. Of 192 responses, 30% identified themselves as researchers and 70% identified themselves as managers. Researchers and managers rated working together on invasive plant issues as high or medium in importance, but neither group rated the current level of cooperation as high, with over 90% describing current cooperation as low or medium. Both groups self-associate, with 89% of researchers working with other researchers and 77% of managers working with other managers. ''Lack of time'' and ''lack of money'' were the main issues limiting researchers and land managers from working more closely together: money was a greater constraint for researchers and time was more important for land managers. To help researchers and land managers work more effectively together, both groups favored opportunities to develop research-based projects at land managers' sites, with funding from a cooperative grant program. Open-ended responses suggest that on-site experiments and demonstrations of management methods could help researchers and land managers interact more effectively. Researchers rated basic biology as more important than land managers did, but neither group judged testing theories of invasion as a high priority. ''Social/political factors'' and ''risk assessment'' were viewed as less important despite their clear relevance in the introduction and spread of invasive plants.

Key words: Survey, cooperation, research priorities.

Plant invasions in natural areas present challenges for research, management, and restoration that require multifaceted approaches among stakeholders. In particular, effective cooperation is necessary between land managers and researchers with an interest in protecting natural resources from environmental and economic damage caused by invasive plants. Although there is potential for collaboration between these two groups to address problems associated with invasive plants, which extend from basic biology to practical management, deriving common goals and maintaining communication can be difficult (Foxcroft 2004).

Researchers and land managers face different professional pressures and incentives from their respective organizations and constituents. Researchers seek to understand causality in order to develop generalized predictions regarding the systems they study. In contrast, natural area managers are under pressure to address site-specific problems under a variety of social, political, and economic constraints (Berry et al. 1998; McPherson 2004). Such differences between researchers and managers might influence their views of how resources should be directed to address invasive plant issues. Understanding these differences could lead to more opportunities for researchers and managers to work together in ways that enhance the effectiveness of cooperative invasive plant management efforts.

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McPherson (2004) has described a ''disconnect'' between scientists and managers, and suggested that ecological science has not always been useful to managers, who have relied on tradition and emotion rather than science-based information to make management decisions. Others have suggested that the relevant ''gap'' is between groups ''responsible for ecosystem management'' and groups with ''the knowledge required to meet those needs'' (Berry et al. 1998). If the ''knowledge required'' exists but resides with researchers and scientific journals, and is not easily available to managers, then the ''disconnect'' is one of lack of information transfer. Better communication, understanding, and integration will be required in order to connect science to invasive plant management more effectively.

Although differences in perspectives between researchers and land managers have been characterized in general terms (Foxcroft 2004; Luken and Seastedt 2004; McPherson 2004), we know of no efforts to systematically gather information on the views of researchers and land managers with respect to research needs and sources of information that support management efforts. Therefore, the 12-member Research Committee of the Midwest Invasive Plant Network (MIPN) created an Invasive Plant Research and Information Needs Survey to evaluate perspectives of land managers and researchers about the status of and potential for cooperation in addressing the ecology and management of invasive plants in the midwestern United States.

Materials and Methods

We conducted a web-based survey (surveymonkey.com) that was available on-line from August 2006 through December 2007. The target audience was land managers and invasive plant researchers in the states associated with MIPN, which are Iowa, Illinois, Indiana, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.

To encourage participation by researchers and land managers, we distributed information about the survey, along with the web address, through personal contacts, e-mail address lists, and state invasive plant councils in the midwestern United States. We aggressively sought responses by asking invasive plant council members to publicize the survey through listservs and other online discussion groups, including the Ecological Society of America's Ecolog listserv, the Invasive Species Information Network, the Alien Plant Working Group Discussion Via E-mail, the National Park Service e-mail discussion list, the Plant Conservation Alliance's Alien Plant Working Group List, state invasive plant council discussion groups, and the MIPN listserv. The survey and website were publicized at meetings of state invasive plant councils, as well as at the joint North Central Weed Science Society and MIPN meeting in Milwaukee, WI.

Questions for the survey were crafted over several months through communication among members of the MIPN Research Committee. Since the committee is composed of researchers as well as managers, the questions represent a combined perspective on the relevant issues that both groups face in working together. The order of response choices was randomized for each participant and all responses were anonymous. Respondents identified themselves either as ''researcher'' or ''land manager.'' Thereafter, relevant questions were posed using this self-identification to modify the wording of questions appropriately. In other words, land managers were asked ''What obstacles prevent you from working more closely with researchers?'' whereas researchers were asked ''What obstacles prevent you from working more closely with land managers?'' The wording of multiple-choice responses was also different for researchers and land managers, as was necessary to match the questions with the survey. Where possible, following a list of multiple-choice responses, respondents were given an additional choice to provide open-ended responses or comments. For questions designed to evaluate the perspectives about the level of importance of various issues, a three-level response scale was provided, i.e., ''low,'' ''medium,'' and ''high.''

Completed surveys were accessed on-line by the authors, and data were imported into SAS (SAS 2002) for statistical analysis. Composite scores and descriptive statistics were calculated for quantitative questions using the chi-square ''exact'' option in SAS to evaluate differences between researcher and manager responses. The responses for open-ended questions as well as comments were recorded and summarized.

Results and Discussion

One hundred ninety-two individuals responded to the survey, of which 58 (30%) identified themselves as researchers and 134 (70%) as land managers, though not all respondents answered all questions. The difference in numbers of researchers and managers might reflect the relatively low number of scientists who are actively engaged in invasive plant research or the lack of interaction of researchers with management-based societies and listservs that deal with invasive plant management. The respondents were from 14 states from Pennsylvania to Nebraska and Minnesota to Missouri (Figure 1). Even though MIPN represents eight states in the Midwest, we included responses from neighboring states as long as respondents were located within about 100 km of the border of a MIPN state.

In general, all respondents agreed that it is important for land managers and researchers to work together to address invasive plant issues (Table 1), with over 93% of respondents ranking this as high in importance, and none ranking it as low. However, when asked ''How well do you believe land managers and researchers are currently working together?'', 93% of both groups ranked current cooperation as low or medium, and only about 7% ranked

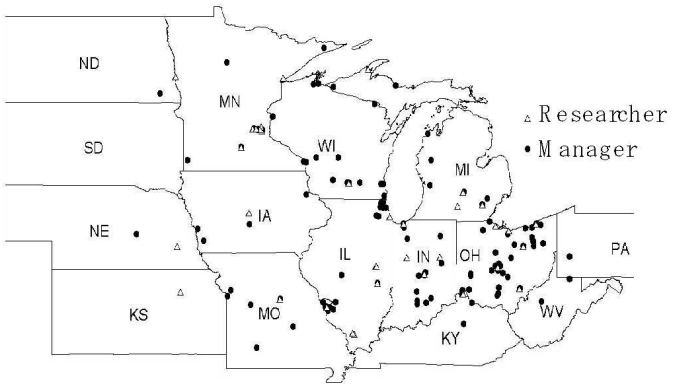

Figure 1. Location of land manager and researcher respondents to the web-based survey.

it as high. These were the questions on which managers and researchers were most in agreement, and the responses indicate awareness, in both groups, of a disparity between the need for cooperation and the potential for improvement. This disparity was reinforced by the responses to the question: ''With whom do you currently work on invasive plant issues?'' Eighty-nine percent of researchers indicated that they work with other researchers, while 77% of managers indicated that they work with other managers on invasive plant issues (Table 2). Managers indicated substantially more interaction with the general public than did researchers (82 vs. 44%), and researchers work more closely with students than do managers (78 vs. 51%). There was no difference between researchers and managers in the extent to which they work with educators, commercial operations, and professional associations or technical audiences. Therefore, although researchers and managers recognized the need to work more effectively together, most acknowledged that they, personally, remain most connected to their respective colleagues.

Among the 12 reasons provided as possible ''obstacles that prevent you from working more closely…'', managers reported that they were more constrained by ''lack of time'' than were researchers (61 vs. 43% rated this as high), and researchers were more constrained by ''lack of money'' (75 vs. 60%) (Table 3). This probably indicates a difference in operational constraints under which the two groups function. Managers and their staff generally operate with a mandate to manage invasive plants across large geographical areas as part of a long list of other duties, and so are constrained by competition from other responsibilities. In contrast, the results suggest that researchers are more often limited by the need to procure funding for technical support, equipment, and supplies from a limited number of granting agencies that might provide funds for invasive plant research. The other response in which managers and researchers differed was the importance of ''Lack of contact with researchers/managers,'' with managers scoring this higher than researchers (37 vs. 21% rated this as high) (Table 3). This difference in views was reinforced in the open-ended responses to the question: ''What other obstacles prevent you from working more closely with researchers/managers?'' Several of the manager responses suggested that researchers were either inaccessible or uninterested in working on the types of projects in which managers are engaged (Table 4). Responses from both groups indicated a perception that researchers are primarily interested in basic biology as opposed to issues of management, which are of greater concern to land managers. However, this contradicts the response from 67% of managers and 74% of researchers who rated ''Lack of interest in researcher/manager issues'' as low, with fewer than 6% rating this as high as an obstacle that prevents closer working relationships. Neither the language of research nor intimidation was viewed as an obstacle preventing the groups from working together, and about 90% of both groups ranked knowledge and training as low as an obstacle (Table 3). This suggests that opportunities for communication, rather than communication and information content, are what need to be strengthened to encourage cooperation.

Managers and researchers provided somewhat different responses to the question: ''What could be done to help researchers and land managers work together more effectively on invasive plant issues?'' Researchers favored ''projects at manager's site'' and a ''grant program designed

Table 1. Manager and researcher evaluation of the need for and current level of cooperation.

	Manager response (n = 134)			Researcher response (n = 58)			
Question	Low	Med	High	Low	Med	High	Chi-square
	%			%			Pr ≤ P
How important do you believe it is for land managers and researchers to work together to address invasive plant issues?	0.0	4.5	95.5	0.0	6.9	93.1	0.4930
How well do you believe land managers and researchers are currently working together?	40.2	53.0	6.8	43.1	50.0	6.9	0.9999

Table 2. Manager and researcher response to the question, ''With whom do you work on invasive plant issues?''

Response choices	Manager response (n = 141)	Researcher response (n = 46)	Chi-square
	%		Pr ≤ P
Land managers	76.6	67.4	**0.0546**
Students	51.1	78.3	**0.0428**
The public	81.6	43.5	**0.0021**
Educators	46.8	47.8	0.6524
Professional associations or technical audiences	37.6	47.8	0.0658
Researchers	46.8	89.1	**0.0035**
Commercial operations	25.5	21.7	0.8922

to bring researchers and land managers together'' more than did managers (Table 5). Since researchers viewed lack of funding as more of a constraint compared to managers, it is perhaps not surprising that researchers viewed a grant program more favorably (77 vs. 60% ranked this as high). Even though neither group judged ''Lack of suitable sites for research'' to be an important obstacle (Table 3), the interest among researchers in working at managers' sites (Table 5) suggests an opportunity for greater cooperation. About 90% of both groups gave medium or high ratings to ''Conferences both groups would attend,'' which supports ongoing efforts by MIPN and state invasive plant councils. For example, the Ohio Invasive Plants Council (www.oipc.info/) and the Invasive Plants Association of Wisconsin (http://www.ipaw.org/) sponsor research symposia and presentations about researcher-manager projects at annual meetings. Managers and researchers gave similar support to other suggestions for working together more effectively, such as a regional research project and demonstration/research field trials. Other response choices, such as tours of invaded or restored sites, and training in research methods, received limited support from both groups. In the open-ended response to this question, several managers provided detailed descriptions of invaded sites and their willingness to make them available to researchers.

Perspectives on the types of invasive plant research that should be conducted were often different between researchers and managers when asked to rate the importance of 19 research areas. Neither group judged ''Test theories of invasion'' as a high priority, with only 39% of researchers and 17% of land managers ranking this research area as high, although this difference was statistically significant (Table 6). The relatively low ranking among researchers for this research area is somewhat surprising given the large number of papers in the published literature that evaluate invasion theories (Barney and Withlow 2008; Blumenthal 2005; Hierro et al. 2005; Levine et al. 2002). One explanation for this result is that the researchers who took the time to respond to the survey were likely those most interested in working on practical issues of invasive plant management rather than ''testing theories.'' Researchers showed a greater interest than

Table 3. Manager and researcher response to the question, ''What obstacles prevent you from working more closely with managers/researchers? Select level of importance.''

	Managers			Researchers			
Response choices	Low	Med	High	Low	Med	High	Chi-square
			%				Pr ≤ P
Lack of money	15.3	25.0	59.7	11.8	13.7	74.5	**0.0428**
Lack of time for experiments, data collection	11.3	27.4	61.3	14.3	42.9	42.9	**0.0407**
Lack of contact with researchers/managers	20.5	42.6	36.9	41.7	37.5	20.8	**0.0471**
Internal (within agency) constraints lack of support	43.4	30.3	26.2	41.3	32.6	26.1	0.9999
Lack of computer internet access	93.3	4.2	2.5	100.0	0.0	0.0	0.9999
Pressure to show results, not science	45.0	36.7	18.3	40.0	60.0	0.0	0.5853
Lack of knowledge/skills, education, training	64.5	27.3	8.3	64.6	27.1	8.3	0.9999
Lack of suitable sites for research	69.4	21.5	9.1	60.4	31.3	8.3	0.9999
Language of research too complicated	71.9	22.3	5.8	70.8	18.8	10.4	0.3246
Lack of access to published research information	44.7	37.4	17.9	100.0	0.0	0.0	0.5869
Lack of interest in manager/research issues	66.7	28.3	5.0	73.5	24.5	2.0	0.6746
Intimidated by research/researchers	85.8	11.7	2.5	100.0	0.0	0.0	0.9999

Table 4. Typical open-ended responses by managers and researchers to the question, ''What other obstacles prevent you from working more closely with researchers/managers?''

Manager responses	Researcher responses
Politics of funding	Scientific community bias against practical research
Access and availability of researchers in this area	Distance from research site and lack of practicality in research ecology
Researchers uninterested in working with managers	The land managers are often not interested in collaboration and participation in grant writing
Not enough interest by researchers in practical applications of research - too much focus on basic, short-term research	Unable to bridge the academics/manager gap sometimes
Lack of communication	Public land managers go to the universities with the expectation that they know how to manage weeds, but they don't, and the managers waste millions in research and don't get any answers they need
Apathy on the part of some land managers	
Competition from larger agencies that have resources to implement programs	

managers in determining ''methods of dispersal,'' ''interrelated causes of invasion,'' and ''site characteristics that favor invasion.'' Managers favored ''determine benefits of invasive plant management'' as a research area more strongly than researchers (51 vs. 34%). Both groups gave high ranking (> 60%) to research that would ''develop methods to prevent invasion,'' ''determine environmental impacts of invasion,'' ''develop control recommendations for specific species and habitats,'' ''develop restoration methods,'' ''develop early detection methods,'' and ''develop rapid response approaches.'' However, fewer than half of respondents gave high rankings to ''map invasive plant distribution'' even though mapping can contribute greatly to detection, prevention, and restoration, which received high rankings. The response choice ''determine basic biology of invaders'' received high rankings from 52% of managers and 67% of researchers, while ''determine invasive traits…'' received 37 and 52% high rankings, respectively. This relatively low ranking for invasive trait studies was unexpected since it has been foundational research in plant invasion biology and continues to be of interest (Baker 1965; Barney and Withlow 2008).

Both groups gave mostly medium and low rankings to areas of research that involve social sciences, such as ''assess public perception about invasive plants,'' ''evaluate social/political factors affecting plant invasion,'' and ''develop and validate risk assessment models.'' The lower rankings in these areas suggest an opportunity for building greater awareness of the importance of human behavior in the introduction and spread of invasive plants, given that commerce of ornamental plants has been the source of many of the most troublesome plant invaders worldwide (Gagliardi and Brand 2007; Kelly et al. 2006; Peters et al.

Table 5. Manager and researcher responses to the question, ''What could be done to help researchers and land managers work together more effectively on invasive plant issues? Select level of importance.''

	Managers			Researchers			
Response choices	Low	Med	High	Low	Med	High	Chi-square
	%						Pr ≤ P
Research projects at manager's site	4.6	33.9	61.5	5.3	14.0	80.7	**0.011**
Grant program designed to bring researchers and land managers together	4.6	34.9	60.1	3.5	19.3	77.2	**0.0307**
Regional cooperative research projects	5.4	34.6	60.0	3.5	26.3	70.2	0.1933
Demonstration/research field trials	5.4	30.8	63.9	14.2	28.6	57.1	0.4138
Educate researchers in land manager issues	6.8	34.9	58.3	8.9	46.3	44.6	0.1093
Conferences both groups would attend	10.5	45.9	43.6	5.4	46.4	48.2	0.6317
Manager-initiated research projects	11.5	45.4	43.1	7.0	50.9	42.1	0.9999
Train land managers in research methods	26.9	50.0	23.1	22.8	45.6	31.6	0.2751
State or regional tour of invaded or restored sites	29.6	41.7	28.8	26.8	55.4	17.9	0.1441

Table 6. Manager and researcher responses to the question, ''What types of research are most important for addressing invasive plant problem? Select level of importance.''

Response choices	Managers			Researchers			Chi-square
	Low	Med	High	Low	Med	High	
	%						Pr ≤ P
Develop control recommendations for specifics species and habitats	0.0	13.6	86.4	1.8	24.6	73.7	0.0585
Develop methods to prevent invasion	3.9	20.0	76.2	7.1	21.1	71.9	0.5844
Develop restoration methods	4.6	26.5	68.9	3.5	24.6	71.9	0.7323
Develop early detection methods	7.7	26.2	66.2	3.5	19.3	77.2	0.1675
Determine environmental impacts of invasion	6.2	27.3	66.7	5.4	26.8	67.9	0.9999
Develop rapid response approaches	3.1	27.7	69.2	10.7	25.0	64.3	0.6082
Determine basic biology of invaders	11.5	36.6	51.9	5.3	28.1	66.7	0.0782
Determine site characteristics that favor invasion	9.3	45.7	45.0	8.8	28.1	63.2	**0.0262**
Determine methods of dispersal	10.1	49.6	40.3	5.3	31.6	63.2	**0.0044**
Determinate interrelated causes of invasion	14.7	46.5	38.8	0.0	37.5	62.5	**0.0038**
Determine economic impact of invasion	8.5	47.3	44.2	10.7	37.5	51.8	0.4226
Map invasive plant distribution	10.7	42.8	46.6	8.9	42.9	48.2	0.8738
Determine traits of invasive species	11.5	51.2	37.4	10.7	37.5	51.8	0.0764
Determine benefits of invasive plant management	9.9	38.9	51.2	14.3	51.8	33.9	**0.0374**
Determine impact of current and historic land use on invasion	26.2	56.2	17.7	8.8	63.2	28.1	0.1203
Assess public perception about invasive plants	21.5	47.7	30.8	26.8	53.6	19.6	0.1519
Test theories of invasion	39.5	43.4	17.1	21.1	40.4	38.6	**0.0025**
Evaluate social/political factors affecting plant invasion	34.6	47.7	17.7	17.9	57.1	25.0	0.3166
Develop and validate risk assessment models	32.8	48.9	18.3	23.2	50.0	26.8	0.2382

2006). The low interest in risk assessment models somewhat contradicts the relatively high interest in early detection and rapid response, given that species that require early detection and response might be identified by some risk assessment method (Leung et al. 2002). However, the low response for risk assessment could be due to the lack of familiarity with this area of study. The lack of interest in research on ''public perception about invasive plants'' was surprising, and might suggest that researchers and managers believe they can solve the problems of plant invasions without public input or support. Neither managers nor researchers ranked the importance as high for ''determine impact of current and historic land use on invasion.'' The wording of this response was taken directly from the USDA-CSREES National Research Initiative call for proposals in the ''Weedy and Invasive Species'' program for 2006, the year the survey was conducted. Recent studies (DeGaspers and Motzkin 2007; Von Holle and Motzkin 2007) have demonstrated the importance of historical landscape changes and timing of species introduction in understanding the pattern of exotic plant invasion.

There was general agreement between managers and researchers on the types of habitats of importance for invasive plant research, with both groups giving high (> 60%) ranking to riparian areas, woodland, lakes and waterways, and nature preserves (Table 7). The relatively low interest in industrial sites and waste areas is not surprising; however, such sites might be important in the early introduction and establishment of invasive species (Wittenberg and Cock 2005). Parks and recreation areas were ranked high by about 51% of managers and 60% of researchers, but no distinction was made between parks that contain natural areas and those that are primarily for sports, which might have led to some confusion among respondents. There was also general agreement on the ''important invasive plant species warranting research.'' The most frequently ranked ''new and emerging'' species was Japanese stiltgrass [*Microstegium vimeneum* (Trin.) A. Camus] (Table 8). In both groups, garlic mustard [*Alliaria petiolata* (M. Bieb.) Cavara & Grande] ranked highest as the ''most important established but localized'' and the ''most important established and widespread'' species. Other top ''established and widespread'' species were reed canarygrass (*Phalaris arundinacea* L.) and bush honeysuckles (*Lonicera* spp.). Many species, such as *A. petiolata*, were listed in all three categories, suggesting that the distinction between a ''widespread,'' ''localized,'' and ''new and emerging'' species was not generally understood. This potentially could be explained by the highly fragmented landscape of the Midwest, which may cause differential spread and invasion of various plant species, resulting in different categorization of the degree of spread. In other

Table 7. Manager and researcher responses to the question ''What types of habitats should invasive plant research focus on? Select level of importance.''

Response choices	Managers			Researchers			Chi-square
	Low	Med	High	Low	Med	High	
	%						Pr ≤ P
Riparian areas	1.5	22.0	76.5	0.0	14.0	86.0	0.1721
Nature preserves	1.5	13.5	85.0	0.0	17.2	82.8	0.6724
Woodland	2.3	23.3	74.4	0.0	20.7	79.3	0.5816
Lakes and waterways	1.5	25.6	72.9	1.7	27.6	70.7	0.8606
Parks and recreation areas	4.5	44.4	51.1	7.0	33.3	59.7	0.3412
Roadsides/railways	13.7	43.5	42.8	17.2	43.1	39.7	0.7503
Utility rights of way	20.5	40.2	39.4	17.5	54.4	28.1	0.1862
Agricultural land	41.5	43.9	14.6	31.6	43.9	24.6	0.1433
Waste areas	46.5	36.4	17.1	55.2	32.8	12.1	0.5131
Industrial sites	63.9	30.0	6.1	57.9	36.8	5.36	1.0000

words, in the upper Midwest a species such as kudzu might be considered as ''new and emerging,'' whereas in the southern part of the region it would be viewed as ''localized.'' These issues should be considered in efforts to raise awareness about species that are be perceived as new threats.

Fifteen choices were given as means to ''raise awareness and educate stakeholders about the problem of invasive plants and benefits of prevention and control.'' Managers gave somewhat higher importance ratings to extension bulletins, handouts, and posters, whereas researchers gave higher ratings to K-12 education and citizen science programs (Table 9). Both groups gave high (> 70%) rankings to ''greater media attention,'' although the specific approaches such as ''public service announcements'' and ''milk cartons, cereal boxes, etc.'' received relatively little interest. Web sites were ranked relatively high by both groups as a means of outreach. The use of conferences to raise awareness received high ratings from only 31% of managers and 22% of researchers. Three approaches that involve community outreach (volunteer programs, training sessions, and tours) were viewed as moderately useful, with high rankings from about 43% of managers and 38% of researchers. The use of messages on billboards, posters, and consumer products received the lowest rankings from both groups, which was somewhat unexpected due to the potential of such media to reach large numbers of people. In the open-ended version of this question (''What other approach would be successful to raise awareness…''), we received eight responses focusing on politics and economics, with suggestions related to legal or other restrictions to curtail sales of exotic species through the landscape horticulture industry. Most other responses focused on education and publicity to increase community awareness about invasive plants through volunteer programs, community groups, and mass media, though there were no suggestions about educating landscape horticulture professionals about invasive plants, which received support in a recent survey of that industry (Peters et al. 2006).

It is difficult to know how well the survey respondents represent the entire population of invasive plant researchers and land managers in the Midwest. A search of the UDSA Current Research Information System database for invasive plant researchers in the MIPN states returned about 80 unique names, depending on how we defined an invasive plant researcher. If there were a dozen researchers working on invasive plants in each of the MIPN states, the total population would be about 100 researchers. If these estimates are accurate, then our survey reached about half of them, an exceptionally good percentage for a survey. With respect to land managers, determining the total population is even more difficult. The definition of "land manager" is not precise, and could include skilled professionals or individuals with a small woodlot. There are about 320 participants on the MIPN listserv, but this is not restricted to land managers. If we accept that number as a good estimate of the population, which would be 40 per state, then our survey would have reached a respectable 42% of land managers. Nevertheless, we recognize that the survey respondents are not a truly random sample of the populations of interest, so we cannot generalize about the entire populations. The responses to this survey, though likely representative of the population of land managers and researchers in the region, pertain only to those individuals who had access to the internet and generously took time to complete the survey.

In spite of some differences between researchers and land managers in priority areas for research, the results suggest that both groups view cooperation in invasive plant research as beneficial. More importantly, they view each other positively, as there was no indication of intimidation or a sense that lack of knowledge and skills are an obstacle to managers and researchers working together. Neverthe-

Table 8. Species most often listed by managers and researchers as the most important invasive plants warranting research categorized as new and emerging, established but localized, and established and widespread. Data are percent of responses for a particular species.

Manager response	%	Researcher response	%
"List the three most important new and emerging invasive plants that warrant research."			
Japanese stiltgrass [*Microstegium vimineum* (Trin.) A. Camus]	13	Japanese stiltgrass	7
giant hogweed (*Heracleum mantegazzianum* Sommier & Levier)	8	garlic mustard	7
garlic mustard [*Alliaria petiolata* (Bieb) Cavara & Grande]	8	water-chestnut *(Trapa natans* L.)	5
cutleaf teasle (*Dipsacus laciniatus* L.)	6	teasles *Dipsacus* spp.	5
oriental bittersweet (*Celastrus orbiculatus* Thunb.)	4	oriental bittersweet	5
Japanese knotweed (*Polygonum cuspidatum* Sieb. & Zucc.)	4	common reed [*Phragmites australis* (Cav.) Trin. ex Steud.]	5
kudzu [*Pueraria montana* var. lobata (Willd.) Maesen & S.M. Almeida]	4	lesser celandine (*Ranunculus ficaria* L.)	3
callery pear (*Pyrus calleryana* Decne.)	4	apple-of-Peru [*Nicandra physalodes* (L.) Gaertn.)	3
Total species listed by managers = 93		Total species listed by researchers = 60	
"List the three most important established but localized invasive plants that warrant research."			
garlic mustard	15	garlic mustard	10
oriental bittersweet	6	spotted knapweed (*Centaurea biebersteinii* DC)	5
Japanese knotweed	6	Norway maple (*Acer platanoides* L.)	3
teasles	5	tree-of-heaven	3
wild parsnip (*Pastinaca sativa* L.)	5	Japanese barberry (*Berberis thunbergii* DC.)	3
tree-of-heaven[*Ailanthus altissima* (P. Mill.) Swingle]	4	American mannagrass (*Glyceria grandis* S. Watson var. grandis)	3
leavy spurge (*Euphorbia esula* L.)	4	Russian-olive (*Elaeagnus angustifolia* L.)	3
purple loosestrife (*Lythrum salicaria* L.)	4	oriental bittersweet	3
reed canarygrass (*Phalaris arundinacea* L.)	4	leafy spurge	3
common reed	4	flowering rush (*Butomus umbellatus* L.)	3
kudzu	4		
lesser celandine	4		
Amur honeysuckle [*Lonicera maackii* (Rupr.) Herder]	4		
Total species listed by managers = 104		Total species listed by researchers = 62	
"List the three most important established and widespread invasive plants that warrant research."			
garlic mustard	50	garlic mustard	30
reed canarygrass	23	reed canarygrass	11
bush honeysuckles (*Lonicera* spp). .	22	bush honeysuckles	11
European buckthorn (*Rhamnus cathartica* L.)	13	common reed	9
Canada thistle (*Cirsium arvense L.)*	13	Eurasian watermilfoil (*Myriophyllum spicatum* L.)	7
spotted knapweed	12	purple loosestrife	7
purple loosestrife	8	Canada thistle	7
Total species listed by managers = 60		Total species listed by researchers = 46	

less, even though managers and researchers indicated that working together is a good idea, over 75% of each group is currently not working with a counterpart. Responses indicated that there should be many opportunities for researchers to make use of sites for studies on land that land managers control. Joint grant programs, regional research projects, and demonstration/research field trials were regarded as the best options to help researchers and land managers work together more effectively on invasive plant issues. The responses also suggest that more reporting by the media and K-12 education about invasive plants might provide broader support for invasive plant research and management from which both groups would benefit.

Results of this survey will provide baseline data for future surveys to determine whether current efforts by federal agencies or private foundations are successful in fostering greater interactions among researchers and managers. Future research should include a similar survey at a national scale to determine if researcher and manager opinions in other regions differ from those in the Midwest. Federal funding agencies are now putting greater emphasis on outreach, citizen science, and stakeholder involvement that should encourage greater interaction among researchers and managers. The "Pulling Together Initiative" is a private-public partnership that has funded invasive plant management projects that engaged both research and

Table 9. Manager and researcher responses to the question, "What are the best ways to raise awareness and educate stakeholders about the problem of invasive plants and benefits of prevention and control? Select level of importance."

	Managers			Researchers			
Response choices	Low	Med	High	Low	Med	High	Chi-square
	%						Pr ≤ P
Greater media attention	2.2	26.9	71.0	0.0	25.5	74.5	0.9123
K-12 education	14.1	36.2	49.7	4.3	37.0	58.7	**0.0478**
Web sites	8.7	35.5	55.7	8.5	44.7	46.8	0.0954
Citizen science programs	10.9	47.0	42.1	4.3	44.7	51.1	**0.0447**
Volunteer programs	7.6	43.8	48.6	6.4	51.1	42.6	0.1846
Training sessions	9.7	47.6	42.7	10.9	52.2	37.0	0.1547
Public service announcements on radio or television	17.2	36.6	46.2	16.7	43.8	39.6	0.0651
Tours	17.6	44.5	37.9	19.1	46.8	34.0	0.8461
Extension bulletins	14.4	50.8	34.8	13.0	67.4	19.6	**0.0426**
Handouts, tri-folds, or pamphlets	10.9	57.6	31.5	14.9	66.0	19.1	**0.0489**
GIS maps of invasive plants	21.1	51.9	27.0	19.1	46.8	34.0	0.0651
Conferences	21.5	47.5	30.9	19.6	58.7	21.7	0.0648
Billboards	33.9	37.8	28.3	28.9	42.2	28.9	0.5364
Posters	24.2	53.8	22.0	19.6	71.7	8.7	**0.0158**
Milk cartons, cereal boxes, etc.	49.5	34.6	15.9	39.1	47.8	13.0	0.8491

management, but the future of this program is uncertain (http://www.nfwf.org). Another avenue to increase interaction between these groups would be efforts to develop and demonstrate control tactics and strategies, with universities, industry, private foundations, or other donor groups as likely sponsors.

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