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Working across Cultures to Protect Native American Natural and Cultural Resources from Invasive Species in California

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Invasive species know no boundaries; they spread regardless of ownership, and actions by neighboring landowners can influence local and regional populations and impacts. Native Americans and mainstream Western society (representing the prevalent attitudes, values, and practices of US society) both depend on forests for food, fiber, and emotional well-being, but in different ways. We surveyed Native American and nontribal environmental leaders in California to gauge differences in importance, impacts, and control strategies for invasive species and management of forest health. There were differences between Native American and nontribal responses in the pests of highest concern and in the understanding and perceived application of integrated pest management (IPM) techniques. Native American respondents prioritized established weed species, whereas nontribal participants highlighted recently introduced, quarantine pests or insects and pathogens with limited distribution but potentially high impact. These differences may stem from divergence in both cultural values and interpretations of terminology. Forest management based on traditional ecological knowledge has fundamental similarities to programs following IPM; increasing agency and Native American awareness of these connections can capitalize on areas of agreement, thereby assisting Native Americans, tribes, and agencies.

Keywords: invasive species management, integrated pest management (IPM), traditional ecological knowledge (TEK)

In California, Native Americans comprise less than 2% of the population (Norris et al. 2012), with 109 federally recognized tribes managing 200,000 acres of forestlands and 73,000 acres of woodlands (US Department of Interior [USDI] 2015).

In addition to tribal holdings, ancestral lands and traditional gathering areas extend over multiple ownerships, encompassing areas of cultural and environmental significance (Baldy 2013). Native American values and traditional land management strategies

are prone to being overlooked or are considered low priority and incompatible with contemporary landownership patterns and management practices (Wolfley 1998, Bullard and Johnson 2000, Charnley et al. 2008).

To Native Americans, land management practices are especially important since they may not completely distinguish “forest health” from “human health”; forest habitats embody Native American cultural and spiritual traditions and are essential for water, foods, medicines, and other goods (Pierotti and Wildcat 2000, Bussey et al. 2016). Families often return regularly to particular collecting areas that have been used by their ancestors for generations (Baumhoff 1978, Daniel et al. 2012, Bowcutt 2013). Native American gathering practices not only garner resources but also serve to tend and respond to the land; they embody a worldview of land, space, and memory and inspire a sense of responsibility

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to steward traditional gathering areas (Baldy 2013). Native American land management is often rooted in traditional ecological knowledge (TEK), a cumulative body of knowledge, concerning the relationship between living organisms and their environment that is handed down through generations and evolving by adaptive processes (Berkes et al. 2000).

Threats to Native American natural and cultural resources come in many forms; here we focus on forest pests (primarily insects, fungi, plants, and animals), including many nonnative, invasive species that infest and alter forest habitats. An invasive species is defined in Executive Order 13112 (USDI 1999) as a species that is nonnative (or alien) to an ecosystem and whose introduction causes or is likely to cause economic or environmental damage or harm to human health. Impacts of invasive species to forests in the United States have been well documented, whether economic, ecological, or social (Mooney and Cleland 2001, Pimentel et al. 2005, Holmes et al. 2009, Moser et al. 2009, Pejchar and Mooney 2009, Simberloff et al. 2013). Less well documented are the cultural impacts invasive species and other forest pests may have when they disrupt traditional Native American practices and the management options available to control forest pests while also preserving Native American forest values (Pfeiffer and Voeks 2008). Government agencies have trust responsibilities to assist Native Americans in managing forests and wildlands, but agency norms and recommendations may conflict with Native American values. For example, the use of herbicides to control roadside weeds and the exclusion of burning from strategies to manage species competition have caused contention between Native Americans and nontribal forest managers (Mensing 2006, Lake 2007, Norgaard 2007, Mason et al. 2012).

As a bridge between Native American and nontribal perspectives, the Western Region Tribal Integrated Pest Management Work Group (“Work Group”) was formed in 2012 to facilitate integrated pest management (IPM) approaches that protect Native American natural and cultural resources. IPM, defined as an ecosystem-based strategy that focuses on long-term prevention of pests and the damage they cause through a combination of techniques such as habitat manipulation and modification of cultural practices (University of California 2015), provides a context for addressing invasive

forest pests that may be appealing to traditional land managers who object to chemical controls. The Work Group brings together Native Americans, tribes, government agencies, and other entities focused on forest pest management to enhance mutual understanding of the principles, nuances, and biases that drive invasive species management actions in California forests. The Work Group is composed of Native American and nontribal representatives from federal, state, and local organizations who recognize their institutions’ mandates to support engagement with and learning from Native Americans (California Department of Forestry and Fire Protection 2012, Farley et al. 2015).

Given California’s diverse society, increased understanding and articulation of the values and attitudes underlying invasive species management is needed to foster relationships and enable acceptance of treatments to sustain an array of natural and cultural resource needs. In this study, we examined the issue of invasive species management on Native American lands and traditional gathering areas to identify Native American needs, concerns, and attitudes to sustain forest health and to explore to what extent Native American and nontribal management styles and priorities differ.

Methods

We developed a University of California, Davis, Institutional Review Board approved survey to gauge the interests and concerns of Native American and nontribal environmental managers, regulators, researchers, and others involved in invasive

species management. Survey questions asked about the top three invasive species of current versus future concern, knowledge and practice of IPM techniques, and perceptions of limitations to active management.

In 2013 and 2014, the Work Group convened four meetings in California (Klamath, Lakeport, San Diego, and Santa Rosa) where representatives from a total of 33 tribes, 17 federal, state, and county government agencies, and 9 research institutions came together to discuss IPM needs and barriers, identify priorities, and strengthen relationships and understanding among one another (Figure 1). Each meeting was open to all, although invitation lists were compiled to bring in participants of similar geography to focus on the natural resource issues of the region where the meeting was held. Tribal and agency representatives from the greater area surrounding the meeting site were invited to attend. Native American attendance included primarily environmental staff and Tribal elected officials. Nontribal representatives included employees from federal, state, and local agencies that interact with tribes concerning forest and wildland management. At these meetings, individuals were invited to participate in the survey; an online version was also available and was e-mailed to potential participants from a compilation of Native American tribes and nontribal government agency contacts. Each respondent was asked to self-identify as “tribal” or “nontribal,” and we assumed respondents represented that viewpoint in their survey answers. Participation was voluntary and all answers

Management and Policy Implications

In California, several recently introduced quarantine or highly damaging forest invasive pests and pathogens, such as *Phytophthora ramorum*, the cause of sudden oak death, and the goldspotted oak borer (*Agrilus auroguttatus*), have infested traditional gathering areas, Native American land holdings, and publically and privately owned forests. Federal and state quarantine regulations require consultations with tribes, and, when new quarantine pests are recognized, rapid action is needed to prevent spread while infestations are still small and treatable. If nontribal and Native American government forest health managers are not accustomed to working together, responses to invasive species can be hindered or impeded; people need to know and understand each other to build a level of trust to enable coordinated responses. Recognition by all parties that forest management based on traditional ecological knowledge has fundamental similarities to programs following integrated pest management can assist agencies and tribes in developing invasive species management programs that support the values of both groups. Native American concerns for established pests, e.g., common weeds, may be overshadowed by the attention and funding for recent invasive species introductions with limited geographic distribution. Developing relationships between Native American and nontribal forest managers around managing local common pests on tribal lands or in gathering areas can facilitate cooperation for responding to future pest threats.



Figure 1. Work Group meetings brought together many people and perspectives to share information about managing natural resources and invasive species. Outdoor field sessions included expert guidance in identification and management of emerging pests, such as the polyphagous shot hole borer in San Diego (left); indoor demonstrations provided an opportunity to discuss the cultural importance of at-risk plants (right).

were anonymous. The survey period ran from September 2013 to August 2014.

Similar investigations took place in the Midwest: in 2014, the Native American Integrated Pest Management and Invasive Species Management Work Group (IPM/ISM) conducted a web-based, snowball (chain referral) survey on IPM and invasive species management tribal issues. The survey aimed to identify the scope of Native American IPM and invasive species management issues. Respondents to the IPM/ISM survey in the Midwest covered 32 states and 261 stakeholders, both Native American and nontribal, and representatives from tribal governments, colleges/universities, extension services, and other organizations. We compare some of their results with those from the Work Group survey and discussions in California.

Results and Discussion

From the Work Group survey, we gathered 64 responses, almost evenly split between Native American (30) and nontribal (32) participants (plus 2 that were unidentified). Table 1 shows the top invasive and other forest pest species of concern, currently and for the future, as identified by the Work Group as a whole.

When Native American and nontribal answers were analyzed separately, Native American current pest concerns were different from those of nontribal respondents. Although there was overlap on the majority of the responses, more than 40% of the pests listed by one group were not included by the

Table 1. Ten most commonly listed responses to the questions “What are the top three invasive forest insects, diseases, or weeds you currently have on your lands” and “What are the top three invasive forest insects, diseases, or weeds you are concerned about for the future?”

1. Goldspotted oak borer (*Agilus auroguttatus*)
2. Sudden oak death (*Phytophthora ramorum*)
3. Polyphagous shot hole borer (*Euwallacea* species vectoring *Fusarium euwallaceae*)
4. Broom and gorse (*Cytisus*, *Genista*, and *Ulex* spp.)
5. Star thistle (*Centaurea* spp.)
6. Mistletoe (*Phoradendron* spp.)
7. Tamarisk (*Tamarix* spp.)
8. Beetles (*Curculionidae*, *Scolytinae*)
9. Giant reed (*Arundo donax*)
10. Laurel wilt (*Raffaelea lauricola*)

Species are listed in order of the highest number of responses, top to bottom, and are combined for the entire Work Group, regardless of respondent affiliation.

other. For example, Native American responses included four pests not mentioned as important by any nontribal participant: true mistletoe, *Phoradendron* spp.; Himalayan blackberry, *Rubus armeniacus*; acorn weevil, *Curculio* spp., a native pest; and periwinkle, *Vinca major*. Conversely, four pest concerns mentioned by nontribal participants were not included in any Native American responses: Port-Orford-cedar root disease, *Phytophthora lateralis*; Gray pine [*Pinus sabiniana*] dieback of unknown cause; wild mustards, *Brassica* spp. and *Sinapis* spp.; and several bark beetles (some were native pests). Even among agreed-on species, the importance each group gave an individual pest differed greatly (Figure 2).

The invasive and other forest pests Native American respondents mentioned were primarily plant species: 10 of the 14 were weeds. The next most common species listed were pests that can kill or weaken trees, such as invasive wood-boring insects and fungal pathogens. Also mentioned was an acorn pest, the acorn weevil. Native American respondents were more concerned with widely established pests than more recently introduced and quarantine species. The one established weed (wild mustards) of concern to nontribal respondents was not mentioned by Native Americans. Nontribal respondents frequently listed recently introduced pests of limited distribution such as sudden oak death (*Phytophthora ramorum*), the goldspotted oak and polyphagous shot hole borers (*Agilus auroguttatus* and *Euwallacea* spp., respectively), and Port-Orford-cedar root disease. Certain pests garnered across-the-board concern, at least regionally, including feral pigs, polyphagous shot hole borer and goldspotted oak borer in Southern California, and sudden oak death in Northern California.

The self-assessment of knowledge and practice of IPM techniques also differed between Native American and nontribal respondents (Table 2). A much higher proportion of nontribal responses (94% versus 57% for Native Americans) stated familiarity with and practice of IPM; more nontribal responders were also actively managing pests: 90% versus 48% for Native American respondents. However, the reasons why

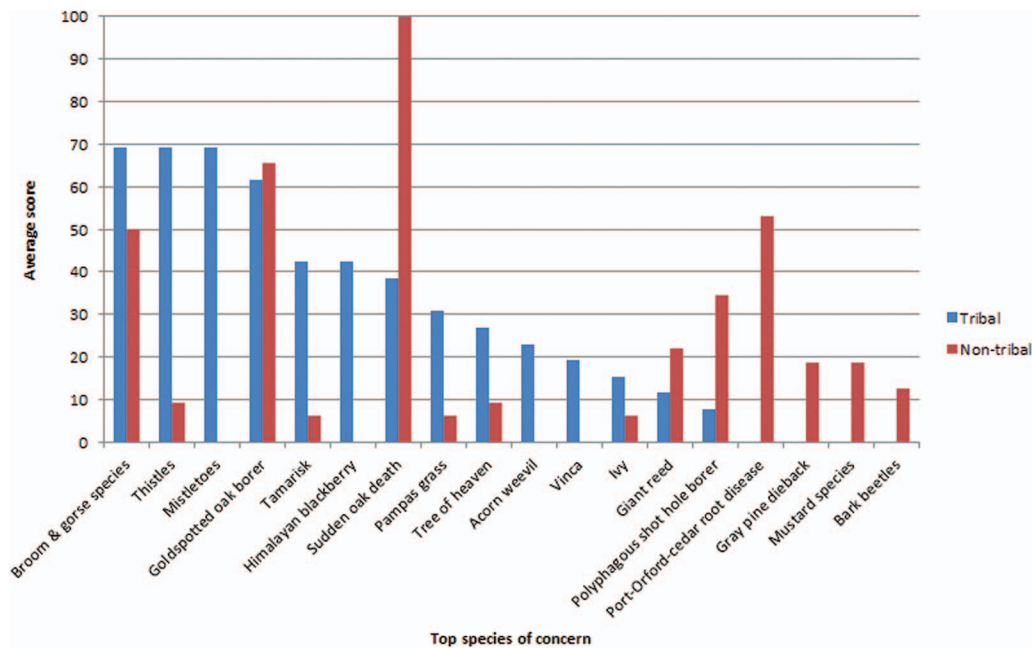


Figure 2. Comparison of responses for the total list of species identified by the survey to be the most important invasive species currently impacting natural resources. Self-identified “Tribal” responses are in blue, self-identified “Nontribal” responses are in red. Species listed on the x-axis are the top 14 mentioned by each group, ordered left to right by highest concern to Tribal respondents. Values on the y-axis are the average score each species received ($n = 64$) after weighting the top three survey responses from each respondent.

Table 2. Responses to the questions “Are you familiar with integrated pest management (IPM) techniques?” “Do you practice IPM techniques in your management of invasive pests?” and “Are you actively managing for any of these pests?”

Group	<i>n</i>	Are you familiar with IPM techniques?	Do you practice IPM techniques?	Are you actively managing any pests?
	 (%)		
Total	64	76	65	69
Tribal	30	57	38	48
Non-tribal	32	94	96	90

Results are shown for the total of survey responses and by self-identified groups, “Tribal” and “Nontribal.”

management might not be occurring were similar across the groups, with lack of funding being the primary stated reason (Table 3).

Comparisons with Midwest Findings

Many of the Midwest survey findings were similar to those of the Western Region survey. Invasive species were rated by respondents as “important or very important” 90–96% of the time. As far as barriers, lack of support and knowledge were commonly mentioned with a lack of resources and financial support an apparent barrier to Native American management (Phillips 2015). The IPM/ISM survey suggested several next steps to aid Native American invasive species management: (1) actions to better understand the nature of Native American IPM stakeholders, (2) development of an invasive

species IPM resource toolkit; (3) determination of sustained funding sources and technical assistance; and (4) strengthening the Native American IPM community of practice (Phillips 2015).

Differences between Native American and Nontribal Responses

In terms of invasive species management, priorities differ between personnel self-identifying as Native Americans and those representing nontribal agencies. The differences may be due to contrasts in resource use, terminology, and cultural values, as explained below.

Resource Use. Differences in pest priority reflect how each group utilizes particular resources. Public land management agencies have favored conifers important to commercial forestry (Oswalt et al. 2014),

Table 3. Most common responses to the question “What is the biggest limitation to managing your pest problems?”

Response	Tribal	Non-tribal
Money/funding	20	22
Knowledge	12	3
Environmental concerns	3	
Approval of community/neighbors	3	
Regulations		4
Public opinion		2

“Tribal” and “Nontribal” columns show the number of times a particular response was mentioned by an individual from those self-identified groups.

whereas Native Americans place high importance on hardwood trees, shrubs, and herbaceous species in the forest environment (Long et al. 2015). The value of particular species attributes to various cultures underlies perceptions of damage. For example, an insect species such as the native acorn weevil probably is a greater concern to Native Americans who rely on acorns for food and ceremony than to land management agencies who may view these insects as a minor detriment to oak regeneration.

Native Americans are focused on weeds because they are a clear and persistent hindrance to traditional activities. Weeds can take over areas of native plants valuable for gathering or eliminate habitats of valued animals (Levine et al. 2003, Pfeiffer and Ortiz

2007, Pfeiffer and Voeks 2008, Mason et al. 2009, Nordby et al. 2009). The effects of forest insect and disease threats may be less immediate, or the species that could be damaged may not be as frequently used or valued. Immediate weed concerns may then be perceived as more important than future, and therefore more theoretical, pests. Outside of weedy plants, newer insects and pathogens that attack oaks (goldspotted oak borer, sudden oak death, and polyphagous shot hole borer) also were of concern to Native Americans. This is probably a reflection of reliance on oaks for food and other cultural purposes, as well as concern generated due to current infestations on California Native American lands.

Differences in resource use and value can cause Native Americans to be reluctant to use pest management practices commonly used on lands of other ownerships, for example, recommendations to control sudden oak death. Removal of pepperwood (California bay laurel, *Umbellularia californica*) is recommended to protect oaks (*Quercus* spp.), since pepperwood can serve as an inoculum reservoir for spores that spread to highly susceptible oaks (Swiecki and Bernhardt 2013). Favoring oaks over pepperwood is a preference many Native Americans adamantly do not agree to because both oaks and pepperwood trees are used by Native Americans for food and ceremony.

Another sudden oak death treatment that is not amenable to Native Americans due to their resource use is preventative phosphonate treatment (potassium phosphite), which is registered for tanoak (*Notholithocarpus densiflorus*) and California live oak (*Quercus agrifolia*) trees in California. The fungicide is sprayed or injected into trees to prevent trees from infection and suppress disease progression in very early infections (Lee et al. 2011). Because Native Americans collect and consume acorns from both these species, they are concerned that the systemic pesticide may contaminate acorns. A preliminary study of the efficacy of potassium phosphite to protect tanoak was conducted on Kashia Tribal lands, after Kashia staff conducted extensive education and outreach with the tribal community concerning the risks of sudden oak death and the use of potassium phosphite. Only with agreement from the Kashia community was the application allowed (N. Hapner, Kashia Band of Pomo Indians, pers. obs.). Tanoak acorn composition was analyzed (Meyers et al. 2006), but there was insuffi-

cient information to determine toxicity. Despite the desire to protect tanoak trees, the Kashia Band of Pomo Indians is reluctant to treat trees over concerns for pesticide exposure to the acorns (N. Hapner, Kashia Band of Pomo Indians, pers. obs.). This observation is consistent with findings that Native Americans have a higher concern than Caucasians for pesticide exposure and risk due to their consumption of wild plants (Harper et al. 2008, Burger 2011).

Differences in Terminology—Knowledge and Practice of IPM. Differences in the background and training of the Native American versus nontribal respondents may be influencing each group's interpretation of management practices. Nontribal respondents, primarily professionally trained biologists working for government agencies or universities, may be more likely to be formally educated in IPM theory and techniques via agriculture or forestry university curricula. Native American respondents include trained staff but also Native Americans who use the land but who may not have been educated in academic theories of pest management. Seen in this context, it is logical that more nontribal participants would characterize themselves as knowledgeable of and practitioners of IPM.

However, it became apparent in Work Group discussions that Native American management practices based on TEK integrate many IPM practices but are not typically labeled as such by either Native American or nontribal representatives. IPM focuses on alternatives to chemical controls, and TEK practices were developed long before industrially produced pesticides were formulated. Both IPM and TEK are rooted in environmental awareness, focus on long-term prevention, and use a combination of techniques. Native American management, based on TEK, then seems to contain many of the elements of IPM programs. For example, using pepperwood (California bay laurel) leaves to protect baskets from insects and drying acorns to prevent mold and other sanitation practices (Ortiz 2008) are preventive treatments that could be described as both IPM and TEK. We observed that the academic definition of IPM is not clear to Native Americans and they do not recognize they are practicing it, just as it was evident that some nontribal participants did not understand that TEK practices of exclusion, education, and sanitation conform to IPM. Although both academics and Native Americans are speaking English, the definitions of

the words are understood and used differently by each group.

Barriers Created by Definitions of “Destructive Pests” and “Forests”. Differences in the definitions of what is a “forest” and what is a “pest” also turned up as a barrier to implementation of forest health management interventions for Native American land managers and as areas of disagreement among Native Americans and nontribal foresters. An example comes from the Cooperative Forest Health Assistance Act administered by the USDA Forest Service, State and Private Forestry, Forest Health Protection (USDA Forest Service 2011). This technical and financial assistance program for Native American and other nonfederal land managers has provided more than \$6 million for managing forest pests for 133 tribal projects over a 7-year period (2007–2013), including treatments for gypsy moth (*Lymantria dispar*), white pine blister rust (*Cronartium ribicola*), oak wilt (*Ceratocystis fagacearum*) or root diseases, mistletoes, hemlock woolly adelgid (*Adelges tsugae*), and bark beetles (Smith 2013). These are projects requested by tribes to address forest health issues they deem important, and by that measure the program is very beneficial. However, a limitation is the restriction to “destructive pests.” Pest concerns on plant species primarily valued by Native Americans, such as willow (*Salix* spp.) with galls (caused by several sawflies (Fritz et al. 1987, Price 1989), midges (DeClerck-Floate and Price 1994) and mites), or other pests of plant species used for basketry materials, are typically not considered a priority for funding since the damage is not considered “destructive” by agency biologists (California Forest Pest Council 2008).

In addition, the program requires most tribes to also work with the Bureau of Indian Affairs (BIA), which has its own particular rules and requirements, including a different definition of what qualifies as a “forest” than that of the agency administering the funds, the USDA Forest Service. The USDA Forest Service funding program requires a certain number of overstory trees (USDA Forest Service 2009), whereas the BIA defines forest as at least 1 acre of extensive (>10%) tree crown cover (USDI 2009). Both of these agency definitions may result in exclusion of funding for treatments in small areas of “forest” on Native American lands vegetated with culturally important riparian species or shrub habitats.

Additional Barriers to Invasive Species Management. The need for cooperation among multiple landowners and jurisdictions presents challenges to both government agencies and Native Americans. Just as agencies stated they were overwhelmed by the need to navigate among many different culturally distinct and autonomous tribes, Native Americans concerned about management practices in traditional gathering areas are confronted with multiple jurisdictions, a mix of fragmented parcels, ownerships, and management objectives on the landscape. For example, implementation of the *P. ramorum* quarantine regulations (USDA 2002) in California requires the USDA Animal and Plant Health Inspection Service (APHIS) to consult and coordinate (US Department of Energy 2000) with more than 20 tribes in the 15 California counties in the quarantine area. From the Native American perspective, gathering plant materials in traditional collecting areas may be complicated by the need to know where pesticides have been applied on lands managed by numerous entities. Supportive relationships with one agency in one habitat type may not be attainable in neighboring areas.

In addition, for agencies, Native American privacy protections in regard to cultural practices (USDA 2008) can slow efforts to address Native American concerns: Native Americans may decline to disclose areas used for gathering, which precludes agencies from identifying specific areas to limit or stop pesticide use to prevent Native American pesticide exposure.

Building on Common Concerns

These surveys and discussions have shown us the value of open communication, even and especially when cultural differences and heightened emotions might make such communication challenging. Understanding the viewpoints each group and individual bring to decisions on forest health can help create management plans that more fully sustain the diversity of resources these habitats provide. Offering Native Americans the time and supportive atmosphere to express their management needs allows them to identify priorities themselves rather than feel they are subjected to mandates being imposed by external governments.

Conclusions

The Work Group has convened a variety of individuals and organizations across

California to discuss shared concerns and, despite the differences noted above, there are clear signals of how to improve forest health in traditional gathering areas and Native American land holdings.

Although our survey results suggest that Native Americans are concerned with managing more established pests, whereas agency representatives are focused on recent introductions, addressing the current pest issues Native Americans face does not preclude advance work on incoming threats. Indeed, forming relationships around current local Native American concerns aids in combating new pests in the future, and some Native Americans and agencies are currently working together effectively to address these issues in their geographic areas. There is also a growing consensus toward preventing the introduction of pests to new areas, including planning for rapid identification and response once pests are discovered.

To protect our shared natural resources, we need to coordinate and act proactively and continue to build relationships and share perspectives across cultures so the needs of diverse populations can be met. Recognition by agencies and Native Americans that forest management based on TEK is often consistent with IPM can serve as a foundation for invasive species management that capitalizes on areas of agreement, thereby assisting Native Americans and the agencies mandated to serve them.

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