A Proposal to USDA Forest Service
10/30/2015

Developing an Integrated Management Strategy For Flowering Rush (*Butomus umbellatus*)

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Minnehaha Creek Watershed District (Minnesota)
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Confederated Salish & Kootenai Tribes CS&KT Tribal Council
Virgil Dupuis Salish Kootenai College
Kalispel Tribe (Washington)
John Gaskin USDA Agricultural Research Service Sidney Montana
Al Cofrancesco and Nathan Harms Army Corps of Engineers

Amount Requested (yearly and total), for Project Leveraging

FY 2016 Request from USFS: $34,148
FY 2017 Request from USFS: $34,482
FY 2018 Request from USFS: $34,837
Total Request from USFS: $103,467

Other Financial Partners:

Partner	FY2013	FY2014	FY2015	FY2016
Montana Dept Agriculture	25,000	25,000	25,000	25,000*
Washington Dept Agriculture	20,000	20,000	20,000	20,000**
Washington Dept Ecology	20,000ᶠ		20,000ᶠ	
Washington Dept Natural Resources			20,000	?
British Columbia, Ministry of Forests	5,000	5,000	5,000	5,000
Army Corps of Engineers		25,053	23,737	pending***
Bureau Land Management (Montana)			10,000	10,000
Kalispel Tribe (Washington)			8,920	

*pending proposal review
ƒFor 2 years
**pending funds available
***ACoE FY2016 not known yet, but they intend to consider a CABI proposal

Project Goals and Supporting Objectives

We present a prototype effort that will provide much needed data to support the development of an integrated approach to managing an invasive plant. The specific goal of this project is to develop a biological control component and integrate it with herbicide and mechanical techniques for the suppression of the invasive aquatic macrophyte flowering rush (*Butomus umbellatus*).

Flowering rush is a perennial emergent aquatic weed of Eurasian origins. Its perennial growth habit from an extensive root/rhizome system is similar to purple loosestrife except the stems/leaves collapse to the bottom of the infested water body in late fall. It is listed as a noxious weed by the states of Montana, Idaho, Oregon, and Washington and the province of Alberta. Minnesota and Wisconsin also have active programs trying to find ways to control flowering rush infestations in those states. With the recent discoveries of flowering rush in Washington, Oregon, and Saskatchewan all the northern tier states and southern tier Canadian provinces are now infested.

A US multi-state and Canadian provincial coalition of primarily Pacific Northwest and some mid-western agency weed coordinators and extension service scientists working on flowering rush came together in 2012 to add a biocontrol effort. We are requesting USFS to join a funding coalition to supplement CABI Switzerland in their work on candidate biological control agent impact and host specificity evaluations and to more strongly include Native American Tribes along the Columbia River in coordinated multi-agency efforts of the Flowering Rush Biocontrol Consortium. This proposal responds to the FHP/FHTET priority for “integrated weed management with a biological control component that is part of a methods development approach to determine efficacy and is not considered an operational treatment”.

BCIP or other Forest Service financial contribution would support multi-agency efforts to develop biocontrol agents and implement them with the other suppression methods. We have made substantial progress with the biocontrol component in the past three years, but at least 3 more years of work are necessary to bring the first flowering rush feeding insect species into North America. The total cost of the effort is significant, approximately one million, with multiple natural resource management agencies partnering to share this costs.

<u>An Ideal Target for Biocontrol Agents</u>

Flowering rush is the only species in the family Butomaceae and no related species occur in North America. This contributes to flowering rush being an excellent candidate for biocontrol in that an insects that are restricted to flowering rush in Europe are unlikely to feed on a different plant species in North America. Non-target plant no-choice host-specificity trials of the first insect being researched, *Bagous nodulosus*, are confirming that this insect is monophagous to flowering rush.

Objective 1:
Continue and complete evaluation of the flowering rush rhizome weevil *Bagous nodulosus* for host-specificity and impact on flowering rush.

Objective 2:
Collect at least one of the other three potential agents on flowering rush and start investigations on biology, host-specificity and impact.

Objective 3:
Prepare a petition to TAG for *B. nodulosus* field release in North America.

Objective 4:
Act as liaison and provide technical support for CABI and the flowering rush Consortium.

Objective 5:
Facilitate participation of Native American Tribes along the Columbia River in the efforts of the Flowering Rush Biocontrol Consortium.

Project Justification/Urgency

Limitations of Control by Herbicides & Mechanical Methods

Herbicides have had limited success in controlling flowering rush. If the water body can be drawn down to allow dry ground/foliar application of the maximum label rate of imazapyr (Habitat) single season long control of topgrowth can be obtained (Rice et al. 2009). Water column injections of diquat herbicides (such as Reward) induce rapid leaf kill (Rice 2010; Madsen et al. 2013). However the flowering rush recovers rapidly from these treatments as the herbicides do not induce sufficient kill of the extensive system of reproductive rhizomes. Rhizome depletion is also the primary challenge in suppression purple loosestrife. Mechanical removal of flowering rush leaves and rhizomes by a specialized aquatic vegetation rake can partially clear irrigation ditches (see http://www.maximizedwatermanagement.com/gallery.aspx?gal=AVR_ and http://www.maximizedwatermanagement.com/testimonials.aspx), but this treatment causes downstream dispersal of rhizome fragments. Maintenance of bottom barriers for three or more years may deplete the rhizomes (Virgil Dupuis, personal communication), but the barriers can only be installed for very small areas.

These herbicide and mechanical methods can provide short term suppression of flowering rush for small areas with high value for recreation, irrigation delivery, and conservation. Examples would be boat and swimming docks, irrigation canals, incipient wetland infestations, and mouths of occluded spawning streams for adfluvial cutthroat and bull trout. Many riverine infestations are usually not feasible to treat mechanically or with herbicides because of difficulty of equipment access and currents rapidly diluting herbicide applications. Biocontrols are needed to suppress extensive infestations covering larger areas and those infested wetlands that still have a diverse array of native plants. Biocontrols would also slow the re-colonization of areas having received transitory suppression treatments.

Spread

Flowering rush was introduced to North America between 1897 and 1905 along the St. Lawrence River in Quebec (Fletcher 1908; Stuckey 1968). Reproduction is almost exclusively from rhizomes (Hroudova 1989; Luiet al. 2005). Once introduced to a water body water flow spreads the buoyant rhizome fragments until they contact bottom substrate and establish new ramets. Transfer from drainage to drainage is by anthropogenic vectors. It is sold to water gardeners and the long leaves with rhizomes at the leaf bases wrap around boat props. Flowering rush was spread westward across the northern tier states and southern Canadian provinces reaching the Snake River in Idaho in 1949 (Anderson et al. 1974) and Flathead Lake Montana in 1964 (Rice and Dupuis 2009). The Snake River is at the headwaters of the southern reach of the Columbia River system and Flathead Lake & River are at the northern headwaters of the Columbia. As of 2014 it has dispersed downriver and reached McNary Dam in Oregon and is now passing beyond McNary Dam (Oregon Department of Agriculture 2015). Most of the Flathead/Columbia River floodplain is characterized by cottonwood galleries and riparian Ponderosa pine stands. Flowering rush colonies disjunct from the Flathead/Columbia River infestations are being found with increasing frequency in the northwestern states and provinces, as well as the upper reaches of the Platt River (SD) on the Missouri River system, and in the mid-west.

Impacts

Introduced exotic macrophytes are recognized as “ecosystem engineers” as a consequence of their propensity to alter the structure and functions of aquatic environments and dependent biota, and human utilization of aquatic resources (Strayer 2010). However, other than a strong propensity to form monotypic or near monotypic stands, the higher order impacts of flowering rush have not received any scientific study other than the ongoing fish and macroinvertebrate sampling methods pilot study being conducted by Rice and Dupuis (Rice and Dupuis 2014). However it is widely accepted that flowering rush has strong impacts on recreational, irrigation, and industrial use of shallow waters, and that its monotypic tendencies may be affecting desirable native littoral species (Boutwell 1990; Les and Mehrhoff 1999). Obvious impacts are resultant from the occlusion of open water and restrictions on flow.

Water delivery in irrigation ditches in the Flathead valley (western Montana) is starting to be reduced by flowering rush invasion. This flowering rush impact on irrigated agriculture is well recognized in southeast Idaho (Steve Howser Aberdeen-Springfield Canal Company personal communication). The Aberdeen-Springfield canal system provides water for sprinkler irrigation of potatoes and other cash crops. Approximately

150 miles of the 300 miles of the main delivery canals are infested with flowering rush and require some removal by mechanical methods every second or third year.

Recreational use of Flathead Lake (Montana), Lake Pend Oreille (Idaho), and small lakes in mid-western states (Wisconsin, Minnesota) is being impaired by dense monotypic infestations adjacent to the shoreline and docks. This includes impediment of boat passage due to prop fouling, blockage for swimming, and loss of open water for near shore fishing. The flowering rush infestations provide ideal habitat for great pond snails (*Lymnaea stagnalis*), which are an intermediate host for the trematode parasite (*Trichobilharzia ocellata*) that causes swimmer's itch.

The most critical environmental aspect of the flowering rush invasion is that it is forming dense stands in previously unvegetated littoral zones. As the extent of unchecked infestations increases there are likely to be trophic and ecosystem cascades. These would be the result of increased water temperature, nutrient transfers from the hydrosoil to the water column (Van Eeckhout and Quade 1994; Jameset al. 2003), altered sediment transport, deposition, and accretion rates; and formation of a dense but simplified three dimensional canopy structure. Swimmers inch may be dismissed as a simple nuisance however it is indicative of other higher order biotic impacts that are reasonable hypotheses of long term consequences of this invasion. Aquatic food webs are likely to be changed.

<u>Facilitation of native salmonid predation:</u>

Our investigations of flowering rush since 1997 indicate to us that flowering rush is inducing a classical "invasional meltdown" by facilitating other introduced and invasive species (Simberloff and Von Holle 1999). Of particular relevance for Native Tribes in Montana and throughout the Pacific Northwest are the negative impacts of flowering rush on the maintenance and restoration of native salmonids. The expanding stands of flowering rush provide habitat for structurally orientated introduced fish species that are obligate vegetation spawners. Some of these introduced fish are ambush predators of cutthroat trout, bull trout, and juvenile salmon. These vegetation adapted piscivorous species include small and large mouth bass, yellow perch, and northern pike (Tabor et al. 1993; Fritts and Pearsons 2004; Bonar S. A. et al. 2005; Schultz 2006; Cooper et al. 2008). The negative impact of structurally orientated introduced fish on open water native salmonids throughout the Columbia River Basin and other western states is well documented (Sanderson et al. 2009).

Northern pike have been confirmed as having serious impacts on cutthroat and federally listed Endangered bull trout in the Flathead River (Muhlfeld et al. 2008). Sloughs on the Upper Flathead River that are being utilized by radio tagged adult northern pike are heavily infested with flowering rush (Peter Rice, personal observation). Vegetation and plant litter are the key factors in adult northern pike habitat selection in that vegetation is mandatory for spawning, rearing juveniles, and used for ambush predation (Craig 1996). Northern pike in the Flathead system are utilizing mats of senesced flowering rush leaves from the previous year growth as their spawning beds. Juvenile northern pike are also very strongly associated with vegetated habitat (Holland

and Huston 1984), where they can feed on small prey but also be sheltered from their predators which include cohorts of slightly larger cannibalistic juvenile northern pike (Craig 1996; Nilsson 2001; Pierce 2012). We believe that as new flowering rush leaves emerge in May the larval pike are attaching to these new leaves; then the juvenile stage shelters from cannibalistic predation in the thickening new growth.

Approach

All developmental work on the biological control component of the project will be subcontracted to CABI in Switzerland. CABI started investigations on the prospects for biological control of flowering rush in 2012 and have the necessary material, expertise and equipment.

Objective 1

During a literature survey for natural enemies associated with flowering rush in its native range, Europe 20 insect species and 4 fungal pathogens were found. Four insects were prioritized as potential agents, due to the fact that they are exclusively associated with flowering rush, and because they are likely the most damaging. One of these insects is the weevil *Bagous nodulosus*. So far, CABI staff found *B. nodulosus* at field sites in northern Germany, Hungary, the Czech and Slovak Republics, Serbia, Poland and Georgia. Investigations were started on its biology, how to rear this species under confined conditions, and its host-specificity.

Oviposition occurs in May and June above and below the water and larvae develop during June and July. In August adults start to emerge, overwinter and lay eggs the following year. CABI found that larvae do not only mine in the leaves of flowering rush – as recorded in the literature - but also move down to the upper parts of the rhizomes. Rearing was successful but infestation levels remain variable and methods will need to be improved.

In host-specificity tests conducted so far, eggs were only laid onto flowering rush and none of the 19 exposed test plant species were accepted, indicating a very narrow host range of *B. nodulosus*. Tests will be continued and completed during the three year study period. The test plant list established contains 47 plant species, the majority native to North America.

<u>Sequential no-choice oviposition tests:</u>

To see whether any plant species other than flowering rush is accepted for oviposition by *B. nodulosus*, sequential no-choice oviposition tests will be continue to be conducted on the remaining 28 non-target species. Cut plant pieces will be offered inserted in blocs of florist sponge or free floating in transparent plastic cylinders (16cm high and 11cm diameter). Each cylinder will either contain a test plant species or the control, flowering rush. One egg laying female of *B. nodulosus* will be placed in each cylinder for two days, after which time the material will be dissected for eggs. After exposure to a test plant, weevils will be offered flowering rush to verify that they are still laying eggs. Only still egg laying females will be re-used and offered another test plant species. This testing method was developed in 2014 and works well. Additional test plant seeds and rhizomes have been sent to CABI in 2015. Together with plant species CABI can obtain in Europe, more than half of the 47 proposed test plant taxa are currently available. A minimum of five replicates will be established per test species. Remaining non-target test plant species collections/shipments will be continued in 2016 by the North American members of the Flowering Rush Biocontrol Consortium.

No-choice development tests:

Should a test plant be accepted for oviposition, the respective species will be exposed as a potted plant to check for potential larval development of *B. nodulosus*. Two egg laying females will be placed onto individually potted, gauze-covered plants of the test plant species. After about five days, weevils will be retrieved, the plants checked for oviposition holes, recovered with a gauze bag and placed into an artificial pool. Flowering rush plants will be established in parallel as controls. After three to four weeks, all plants will be dissected and checked for dead or alive larvae or signs of larval mining.

Improving rearing methods:

Although CABI was able to successfully rear *B. nodulosus*, the success rate is not satisfactory and infestation levels are variable. CABI started investigating various factors that could potentially influence rearing success, such as water quality (presence of algae), water level and water temperature. From other projects with aquatic weevils it is known that bacteria or phoretic mites can cause premature death of larvae. Thus, more attention towards water hygiene will be paid and any larvae found dead during rearing will be visually inspected or sent for analysis.

Quantifying the impact of *B. nodulosus* on flowering rush:

Provided CABI is successful in developing a reliable rearing method resulting in consistent attack levels, an impact experiment will be established. Different densities of egg laying females and males of *B. nodulosus* will be released onto individually potted, gauze-covered plants of flowering rush. After 2-3 weeks, weevils will be retrieved and plants re-covered. CABI has had the experience that potted flowering rush plants do not support frequent handling. The plants will therefore be left in an artificial pond at least until larval development is completed (6-8 weeks). Plants will then be measured (e.g. number of leaves, leaf height) and dissected. Any mines, larvae, pupae or adults will be recorded and biomass of above and below-ground plant parts will be taken.

Objective 2

The other three potential agents for flowering rush found during a literature search are: the weevil *Bagous validus*, the agromyzid fly *Phytoliriomyza ornata* and the ephydrid fly *Hydrellia concolor*. While *B. validus* is only recorded from south eastern European countries, *P. ornata* and *H. concolor* are present in most central and northern European countries. Little is known about the biology of these three species. All are recorded to mine in the leaves of flowering rush. According to CABI dissections, damage caused by weevil larvae seems to be more important than the one caused by fly larvae. However, it is common practice in foreign exploration to study several potential biocontrol agents in parallel since they might slightly differ in their phenology, feeding habit and/or impact and often multiple agents are needed to curb the spread of an invasive plant. We therefore think it is warranted to start working on at least one additional agent apart from *B. nodulosus* and that this will increase chances of successfully controlling flowering rush.

Adults of *B. validus* were collected for the first time in 2015. Some larvae of the two flies were found upon dissection of field collected flowering rush plants in northern Germany and Czech and Slovak Republics. A few of these adult flies could be reared through. Additional sites of flowering rush with occurrence records of these species will be visited in 2016 and 2017. Because *B. validus* appears to be even rarer than *B. nodulosus*, CABI's priority will be to establish a rearing colony at the Centre in Switzerland. The biology of these insects will need to be studied in order to develop viable methods for host range testing and impact studies.

Objective 3

Prepare the petition to TAG by December 31, 2018 for *B. nodulosus* field release.

Objective 4

Peter Rice will develop the subcontracts with CABI and Salish Kootenai College, administer the project and insure that all reporting deadlines are met. He will provide CABI and the Flowering Rush Consortium with test plant materials as needed, support for the *B. nodulosus* TAG petition, information on the biology, ecology, and distribution of flowering rush in North America as well as the continued development of integrated weed management tools.

Objective 5

5a. Securing tribal involvement in the efforts of the Flowering Rush Biocontrol Consortium and management planning.

Virgil Dupuis, Extension Director at Salish Kootenai College has agreed to participate as a tribal representative with the Flowering Rush Biocontrol Consortium and multi-agency management planning. Virgil also participate in identifying and documenting tribal invasive species engagement through Deborah Hayes, Forest Service; NPL, Invasive Species, Rangelands and Experimental Forests and Ranges. Virgil also serves on the Montana Invasive Species Advisory Board, representing seven Montana tribes in the development of a statewide invasive species strategic plan. Through these processes he will collect tribal input concerning Flowering Rush Biocontrol Consortium.

5b. Engage Pacific Northwest tribes with flowering rush biocontrol and exchange information on the quantification of environmental impacts of flowering rush.

Virgil will make contact with Columbia River tribes and organizations like the Intertribal Fish and Wildlife Commission and the Bonneville Power and USFWS Tribal Fisheries Programs involved with native fish and aquatic invasive and terrestrial plants. Columbia River Tribes including the Kalispell, Colville, Warm Springs, Nez Perce, and

Yakima have interests in the prevention, management, and control of flowering rush within the Basin due primarily to habitat conversion favoring invasive non-native fish like northern pike and bass that prey heavily on native salmon, bull trout, and cutthroat.

5c. Secure additional tribal related funding for flowering rush bio-control.

Working with the Washington State Invasive Species Coordinator, Raquel Croiser and Jennifer Andreas; Flowering Rush Biological Control Project Director, Washington State University Extension, additional funding requests will be made to the Bureau of Indian Affairs. The Kalispell Tribe, through invasive plant funding from the Bureau of Indian Affairs has contributed $8,920 to the bio-control project. Similar support will be sought from Columbia River Tribes to establish another funding stream to support the biological control project. Other funding sources with tribal responsibilities like Bonneville Power Administration, Fish and Wildlife Service, and the Army Corps of Engineers will be sought to help address tribal interests.

Expected Products and Outcomes

The proposed research will lead to two expected products. First, a test plant list for host-range testing of potential flowering rush biocontrol agents will be submitted to the USDA, APHIS Technical Advisory Group (TAG) for comment. A draft list of 47 taxa already exists but would need to be revised by project partners. Second, we expect to complete host range testing for the weevil *B. nodulosus* on non-target test plants and submit a petition for field release to TAG for review. If approved by TAG and APHIS-PPQ, this can lead to the release of *B. nodulosus* for control of flowering rush in areas where mechanical and chemical control methods are not sufficiently effective or long term, uneconomic because of the extent of the infestation, or the site still has a diverse array of native plants. This action can reduce the time to achieve wide-spread long term control of flowering rush and reduce the impact of this invasive plant on aquatic systems in the US.

Curriculum Vitae

Peter Marvin Rice Flowering Rush Projects Vita November 2014

Research Associate / INVADERS Project Director http://invader.dbs.umt.edu
BA Environmental Biology, University of Montana, 1973
At UM conducting environmental science & plant ecology research since 1970
State of Montana/EPA licensed for Herbicide Research & Demonstration Projects (license 13220-15)

Research Interests:

Planning and coordination of multi disciplinary studies in applied ecology and resource management with emphasis on weed control and native plant community restoration. Exotic species and biological diversity. Integrated weed management (herbicides, burning, biocontrols, revegetation). Exotic plant biogeography and GIS applications in weed management. Database designs, software applications, and web based systems for natural resource management decision making. Risk assessment & environmental fate modeling. Plant ecology and alteration of ecosystem structure and service functions. Vegetation surveys. Experimental design, statistical analysis.

Flowering Rush Technical Reports

Rice, Peter M.; Toney, J. C.; Sacco, Robert. 1997. Potential exotic plant species invading the Blackfoot drainage: Bureau of Land Management. http://invader.dbs.umt.edu/blackfoot/blfoot.asp

Rice, P.M., Dupuis V. & Mitchell, A. 2008. Flowering Rush: An Invasive Aquatic Macrophyte Infesting The Columbia Basin. 71 PowerPoint slides. http://www.weedcenter.org/research/docs/Flowering_Rush_Fall_2009.pdf

Rice, P.M., Dupuis V. & Mitchell, A. 2009. Results in the Second Summer After Foliar Application of Herbicides to Flowering Rush. 7p.

Rice, P.M. & Dupuis, V. 2009. Flowering Rush: An Invasive Aquatic Macrophyte Infesting The Headwaters Of The Columbia River System. 11 p. http://www.weedcenter.org/research/docs/Flowering Rush white paper.pdf

Rice, P.M. & Tyro, F. 2009. Flowering Rush: Invasion of the Columbia River System. Video 12 min. http://www.weedcenter.org/research/Flowering_Rush_Video.html

Rice, P.M., Reddish, M., Dupuis V. & Mitchell, A. 2010. Flowering Rush Mapping and Spatial Prediction Model. 16p. http://www.weedcenter.org/research/docs/Flowering Rush Spatial Final Report.pdf

Parkinson, H.; Mangold, J.; Dupuis, V.; Rice, P. 2010. Bozeman, MT: Montana State University Extension. EB0201. 12p

Rice, P.M. 2010. Screening Trial of Water Column Injection Herbicides for Flowering Rush Suppression. Montana Dept of Agriculture Noxious Weed Trust Fund Grant No. 2009-014. Helena, MT. 5p.

Rice, P.M., Skibo, A., & Dupuis, V. 2014. 2013 Greenhouse Bucket CET for Screening Herbicides for Activity on Flowering Rush Leaf Injury 4 Months & “2nd Growing Season” after Treatments. Division Biological Sciences, University of Montana. 7p.

Rice, P.M. & Dupuis, V. 2014. Invasion Meltdown: Flowering Rush Facilitation of Northern Pike in the Columbia River Basin. Division Biological Sciences, University of Montana. 15p.

CABI Switzerland

CABI Switzerland (CABI CH) is one of eleven overseas Centers of CAB International, an intergovernmental not-for-profit organization. The Centre in Switzerland was established nearly 60 years ago and has since been conducting foreign exploration for the classical biological control of invasive plant and insect pests, mainly for North America. For instance, the biological control agents currently being used to good effect against leafy spurge, knapweeds, purple loosestrife, Dalmatian toadflax and houndstongue were mostly researched and supplied by our Centre. At present, our Weed Biological Control Group is working on 17 invasive weed species on behalf of the USA and Canada with the aim to find and supply biological control agents for introduction (http://www.cabi.org/default.aspx?site=170&page=1309). Apart from the search for natural enemies and host-specificity testing, CABI's work includes behavioral studies, studies on the impact of agents, their potential interactions, and plant population dynamics.

The Centre is equipped with an insect quarantine facility, laboratories for pathogen and insect work and chemical analyses, five greenhouses, and extensive garden space to grow plants and conduct experiments. Besides, scientists at CABI CH have established an extensive network of collaborators and contacts across Europe and Asia to facilitate field surveys and conduct open-field tests.

The Centre currently employs 18 research scientists, four PhD students, about 15 temporary technical assistants, two gardeners, two finance officers, one person providing IT support and one administrator. In addition to classical weed biological control, the Centre has expertise in arthropod biological control, integrated crop management, ecosystem management, and risk analyses and invasion ecology.

Budgets

Expense Category	**FY2016 (First Year of Three)**					
Salaries		rate		mo.	**FS Grant Funds**	**Match**
	Peter Rice	8,751	month	0.50	4,376	
Benefits						
	Rice 29%+1,054 health ins.	3,592	month	0.50	1,796	
Communications	wire transfers				75	
Sub-Awards	CABI Switzerland				20,000	
	Salish Kootenai College				7,901	
					27,901	
MT Dept Agriculture or Other State Consortium Partner						9,391
TOTAL DIRECT COSTS					**34,148**	
F&A	USFS BCIP does not allow IDC				0	
TOTAL UM COSTS					34,148	
UM WAIVED IDC		half of	45%	of TDC		7,683
TOTAL MATCH						17,074

Expense Category	**FY2017 (Second Year of Two)**					
Salaries		rate		mo.	**FS Grant Funds**	**Match**
	Peter Rice	9,188	month	0.50	4,594	
Benefits						
	Rice at 29%+1,159 health ins.	3,824	month	0.50	1,912	
Communications	wire transfers				75	
Sub-Awards	CABI Switzerland				20,000	
	Salish Kootenai College				7,901	
					27,901	
MT Dept Agriculture or Other State Consortium Partner						9,483
TOTAL DIRECT COSTS					**34,482**	
F&A	USFS BCIP does not allow IDC				0	
TOTAL UM COSTS					34,482	
UM WAIVED IDC		half of	45%	of TDC		7,758
TOTAL MATCH						17,241

Expense Category	**FY2018 (Third Year of Three)**					
Salaries		rate		mo.	**FS Grant Funds**	**Match**
	Peter Rice	9,188	month	0.50	4,824	
Benefits						
	Rice at 29%+1,275 health ins.	4,073	month	0.50	2,037	
Communications	wire transfers				75	
Sub-Awards	CABI Switzerland				20,000	
	Salish Kootenai College				7,901	
					27,901	
MT Dept Agriculture or Other State Consortium Partner						9,581
TOTAL DIRECT COSTS					34,837	
F&A	USFS BCIP does not allow IDC				0	
TOTAL UM COSTS					34,837	
UM WAIVED IDC		half of	45%	of TDC		7,838
TOTAL MATCH						17,419

Expense Category	**Total 3 Year Budget: FY2016 + FY2017 + FY2018**					
Salaries		**avg rate**		mo.	**FS Grant Funds**	**Match**
	Peter Rice	9,196	month	1.5	13,794	
Benefits						
	Rice at 29%+1,025 health ins.	3,830	month	1.5	5,745	
Communications	wire transfers				225	
Sub-Awards	CABI Switzerland				60,000	
	Salish Kootenai College				23,703	
					83,703	
MT Dept Agriculture or Other State Consortium Partner						28,454
TOTAL DIRECT COSTS					**103,467**	
F&A	USFS BCIP does not allow IDC				0	
TOTAL UM COSTS					103,467	
UM WAIVED IDC		half of	45%	of TDC		23,280
TOTAL MATCH						51,734

Details of Annual Budget (3 years) for CABI

Staff costs	
Project Scientists	6,612
Garden technician	2,145
Lab technician	3,223
Other costs	
Surveys	1,829
Materials and consumables	1,229
Administrative and space costs	4,962
TOTAL PER YEAR	**20,000**
TOTAL 3 YEARS $60,000	

Details of Annual Budget (3 years) for Salish Kootenai College
1 month Virgil Dupuis salary and fringe; $6,150
Travel. $1,251
Columbia River tribes visit.
1,000 miles @ .575= $575.
5 days per deim @ $64/d= $320.
4 nights lodging @ $89/night= $356
Communications, supplies. $500
TOTAL PER YEAR $7,901
TOTAL 3 YEARS $23,703

Timetable

We expect to submit the test plant list by December 31, 2016, complete the host-range testing of *B. nodulosus* in summer 2017, quantify its impact on flowering rush during 2017 and potentially 2018, and prepare the petition for field release to TAG by December 31, 2018. Progress reports will be submitted as required.

Literature Cited

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