Conference Paper

Determination of Priority Species for Invasive Plant Management in Wetlands of Wasur National Park Merauke

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Abstract

Threats on biodiversity in a conservation area can originated from outside or inside the area. One of the outsiders that rarely noticeable is invasion of exotic species, which usually alters the stability of natural processes within the area. Wasur National Park has some wetland ecosystems that overcome the issues of deterioration in function and benefits due to exotic plant invasion in recent days. This research was carried out to determine priority species that need immediately managements in Wasur National Park. Field survey and inventory followed by scoring and evaluation methods using Weed Risk Assessment by Exotic Species Ranking System were taken in this research to obtain the priority species. The scoring and ranking steps placed encountered invasive plant species into four categories of management priority based on Significance of Impact and the Feasibility of Control. The result identified 49 species of invasive plants from three wetlands in Wasur National Park, which 75% (or 36 species) of them are species of Priority 3 (lesser threat and easy to control), 4 species of Priority 4 (lesser threat – hard to control) and at least 9 species of Priority 2 (serious threat-hard to control). Priority 2 species consist of *Carex* sp., *Eleocharis indica* (Lour.) Druce, *Hanguana malayana* (Jack.) Merr., *Imperata cylindrica* (L.) Beauv., *Ludwigia oktovalvis* (Jacq.) Raven, *Melaleuca cajuputi* Powell, *M. leucadendron* (Linn.), *Paspalum conjugatum* P. J. Bergius, and *Stachytareta jamaicensis* (L.). These invasive plants need to be managed properly and thoroughly further.

Keywords: invasive plant, management priority, Wasur National Park

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1. Introduction

Conservation area possesses many threats in its management and conservation efforts, as plant invasion becomes one of the threats which usually originate from outside the area. The invasion has demonstrated some detrimental effects for the conservation area and its natural functions, including biodiversity level, quality of ecosystem and services that could be provided by the area (Williams & West (2000), Downey & Grice (2008); Foxcroft & Downey (2008)). Plant invasion specifically by alien or exotic species has shown significant impact in altering natural ecosystem in conservation area. Invasion of *Merremia peltata* in Bukit Barisan Selatan Nasional Park and invasion of *Acacia nilotica* in Baluran National Park had already shown alteration to the ecosystem (Yansen *et al* (2015); Setiabudi *et al* (2013); Caesariantika *et al* (2011)). Natural pathways of those species are usually related with human role, which brought

and used the species intentionally (Williams & West (2000); Martin *et al* (2008); Wilson *et al* (2009)).

Basically, the number of invasive plants in a conservation area irrefutably restricted. The plants can be naturally widespread as far as they can adapt the environment condition and use the resources optimally (Rejmanek & Richardson; (1996); (2007)). However, a conservation area should have management actions to keep natural systems and services within the area work properly, including the actions to control plant invasions. In order to alleviate the management problems about plant invasion, numerous invasive species which encountered in the area should be assessed. The result of the assessment then can be able to list some species which are necessary to be managed immediately (Groves *et a*l (2001); Wittenberg & Cock (2001)). The Weed Risk Assessment becomes a standard method to answer the problem about managing invasive plant. This assessment usually carried out to classify spreading entities and managing them by focusing on a ranking of non-native weeds. This ranking was developed from reviews on the species characteristics and the risks they pose to invaded ecosystem and then the result of the assessment can list some species which are necessary to be managed immediately (Benke *et al* (2011); Champions & Clayton (2001); Groves *et al* (2001); Wittenberg & Cock (2001)).

This paper focuses on a case of plant invasion in Wasur National Park, Merauke which is located in the southern part of Papua, Indonesia. Wasur National Park is known as its unique landscape that covers various ecosystem types like mangrove, coastal areas, swamps, savanna, and monsoon forest. That condition leads not only to the richness of plant and wildlife species, but also to the threats it possessed, such as plant invasion. A preliminary research and survey in three wetlands within Wasur NP already identified at least 48 species of invasive species (24 families), dominated by species from Poaceae (Yuliana & Lekitoo, 2012). Certainly, all of these species cannot be managed at once. They have different habitus, family and species traits, distributions modes and other natural characters that altogether make them need different eradication and management actions. The study for this paper is directed to determine the priority species among invasive plants which were encountered in wetlands of Wasur National Park for management purpose.

2. Methods

2.1. Terminologies used in this paper

Invasive plant is usually described as plant species with the ability to establish, spread and cause negative impacts or harmful effects to an environment, ecologically and economically. The plant species migrate from one area to another, exist and win the competition spatially and temporally to other species in that area. Typically, invasive plants have some known characters such as ability to grow and reproduce rapidly - regularly through vegetative means, ability to distribute widely, capability to adapt to various environmental and resources conditions (Wittenberg & Cook, 2001; Zedler & Kercher, 2004; Zimdahl, 2007). Domination of the species and alteration of natural

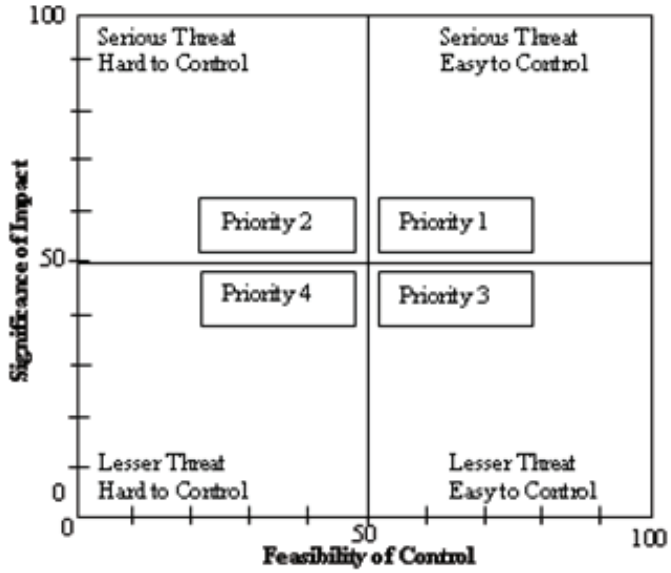

Figure 1: Plot of correlation between level of Significance of Impact and Feasibility of Control for exotic plant species.

system and processes in the area because of the species establishment generally confirm the plant invasion in the area.

Weed Risk Assessment can be defined as a quantitative estimation from chances and magnitudes of threats caused by introducing non-indigenous plants (Groves *et al* (2001); Tjitrosoedirjo *et al* (2011)). This estimation is based on plant species information, including biological and ecological characters, geographical origins and introduction histories. All of the information then can be used to generate predictions on plants' potential invasiveness, impacts and prospects to manage. Essentially, there are two types of risk assessment on plant invasion management, which are *Pre-Entry Analysis* and *Post-Entry/Post-Border Analysis* (Wittenberg & Cook (2001); Groves *et al* (2001)). *Pre-Entry Analysis* is performed on plants species or organisms before they are introduced into a country, while *Post-Entry/Post Border Analysis* is used to assess the species which are already within a country. Decisions to reject, to accept or to accept under surveillance usually become the final results of *Pre-Entry Analysis*, whereas decisions to manage and eradicate, or to monitor and tolerate the spread become the final results of *Post-Entry/Post-Border Analysis.*

2.2. Materials, data and methods

Preliminary data and information on invasive plants that have been collected in advance become the basic data for Weed Risk Assessment. A list of invasive plant species has been compiled from the previous survey within three wetlands in Wasur National Park, which were swamps of Rawa Biru, Donggamit, and Ukra with its nearest savanna (Yuliana & Lekitoo, 2012). The total of 141 plots, each 2m x 2m in size, was observed, resulted in 49 species of invasive plants from 24 families and various life-forms. Subsequently, these invasive plants were assessed, evaluated and categorized

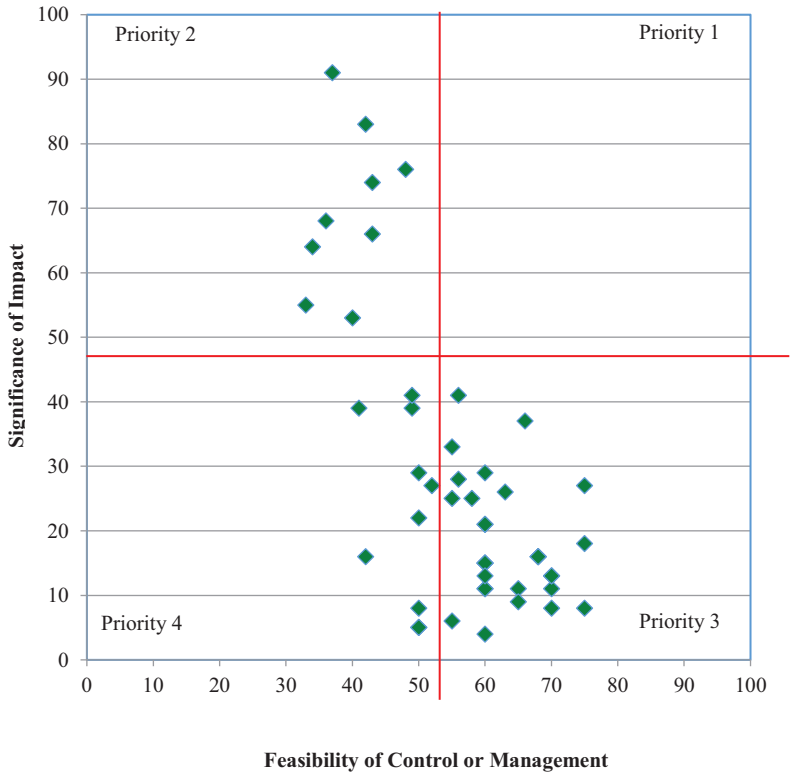

Figure 2: Priority status of invasive plants encountered in wetlands of Wasur National Park.

based on the list of questions and scoring system on Significance of Impact and Feasibility of Control or Management. The questions and scoring is known as Exotic Species Ranking System that is adapted and modified from Hiebert and Stubbendiek (1993), Groves *et al* (2001), and Tjitrosoedirdjo *et al* (2011). The assessment and calculation in this ranking system were performed using literatures on weeds and on-line database from Invasive Species Specialist Group (2001), BIOTROP (2011), and CABI (2011). The result of those processes was then presented in a plot of correlation (Figure 1).

3. Results

Assessment on invasive plants encountered in wetlands within Wasur National Park showed that all species could be categorized in three priority group of management (Table 2 and Figure 2). At least 75% (36 species) of all species belonged to Priority 3. These species have lesser threat to the environment and relatively easy to control. From all species, there were only 4 species within group of Priority 4. These species were found difficult to control although they had lesser threat to the environment. Species in the group of Priority 4 were *Andropogon aciculari*s Willd., *Eragrostis tenuifolia* (Rich.) Hochst. Ex.Steud, *Ipomoea reptansi* (L.) Poiret, and *Thoracostachium sumatranum.* Nine species left were categorized in Priority 2 species. These species need to be concerned more in management action, because they had probability to become serious threat to the environment and hard to control. These species were *Carex* sp., *Eleocharis*

indica (Lour), Druce., *Hanguana malayana* (Jack) Merr., *Imperata cylindrica* (L.) Beauv., *Ludwigia oktovalvis* (Jacq.) Raven, *Melaleuca cajuputi* Powell, *Melaleuca leucadendron* (Linn.), *Paspalum conjugatum* P.J. Bergius, and *Stachytarpeta jamaicensis* (L.) Vahl.

The result showed that *Carex* sp., *Hanguana malayana* (Jack) Merr., *Imperata cylindrica* (L.) Beauv., *Melaleuca cajuputi* Powell, *Melaleuca leucadendron* (Linn.), and *Paspalum conjugatum* P.J. Bergius were invasive species which need to be concerned because their invasiveness in Rawa Biru swamp. Species of *Ludwigia oktovalvis* (Jacq.) Raven and *Stachytarpeta jamaicensis* (L.) Vahl need to be controlled in Ukra swamp and its nearest savanna, while *Eleocharis indica* (Lour), Druce. Become the priority species to be controlled in Donggamit swamp. This assessment also showed that species which need to be concerned in management were come from various life-habits and families, with impact of invasion to the environment appeared differently as well.

4. Discussion

This assessment could place any plant species in Priority 1 group, which categorized as plants that become serious threat to the environment but easy to control. This condition might show that when an invasive species already exists in an ecosystem, it has been considered as threat. The species probably has not caused harmful effects yet, but unlikely to cause harm over time already need attention (Downey *et al* (2008); Downey *et al* (2010); Rejmanek & Richardson (1996); Williams & West (2000)). In general, invasive species encountered within wetlands of Wasur National Park met the basic characters of invasive species (Table 3).

Most of invasive species encountered in the preliminary survey were able to distribute rapidly within wetlands in Wasur National Park, because they have most or all characters like written in Table 3. This condition was well-supported by annual climate of this location as well, which has extensive rainy season and harsh dry season. These seasons encourage growth and distribution processes of invasive plants, and possibly compound any management actions. Invasive species like *Melaleuca leucadendron, M.cajuputi,* and *Stachytarpeta jamaicensis* are species that can be well-adapted to their environmental conditions to be survived. These species get benefit from harsh dry season that drying them up, but in the same time prepare their seeds to be distributed and then to germinate after being inundated in the following rainy season. Whereas, many species of Poaceae have shown great ability to grow, occupy and dominate a certain area. *Carex* sp., *Imperata cylindrica,* and *Paspalum conjugatum* are species that able to grow in a new area, form many dense clumps, and produce great biomass from both their above ground or underground parts.

Another basic character of invasive species is they are able to distribute widely within their own habitat and to other places as well. In Wasur National Park, this character has shown by *Imperata cylindrica* that can spread broadly and defeat other species around its clumps by producing allelopathic substance.

Invasive species in Wasur National Park are mostly intolerant species, need open area to grow and spread extensively, and many times can grow well in disturbed area under the influence of human, wildlife and cattle. In addition, these species are

No	Species	Significance of Impact			Feasibility of Control	Priority
		Current Level of Impact	Innate Ability to Become Pest	Total		
1.	*Ageratum conyzoides* L.	2	20	22	50	III
2.	*Alstonia sphatulata* Blume	-9	14	5	50	III
3.	*Androphogon acicularis* Willd.	8	31	39	49	IV
4.	*Blechnum orientalis* Linn.	-9	30	21	60	III
5.	*Carex sp.*	45	46	91	37	II
6.	*Cassia tora* Linn.	11	26	37	66	III
7.	*Cassytha filiformis* L.	-2	29	27	52	III
8.	*Centrosema pubescens* Benth.	11	14	25	58	III
9.	*Crotalaria indica* L.	-9	17	8	50	III
10.	*Cyperus rotundus* L.	4	25	29	50	III
11.	*Digitaria insularis* (L.) Fedde	-9	30	21	60	III
12.	*Eleocharis indica* (Lour.) Druce.	40	34	74	43	II
13.	*Eleusine indica* (L.) Gaertn.	-9	20	11	65	III
14.	*Eragrostris tenuifolia* (Rich.) Hochst. ex. Steud	8	33	41	49	IV
15.	*Eriochaulon longifolium* Nees ex Kunth.	-9	14	5	50	III
16.	*Fymbristilis sp.*	8	33	41	56	III
17.	*Glochidion sp.*	-9	17	8	75	III
18.	*Hanguana malayana* (Jack) Merr.	35	33	68	36	II
19.	*Helminthostachys zeylanica* (L.) Hook	-9	27	18	75	III
20.	*Imperata cylindrica* (L.) Beauv.	40	43	83	42	II
21.	*Ipomoea reptansi* (L.) Poiret	-9	20	11	60	III
22.	*Ischaemum timoriense* Kunth	-9	25	16	42	IV
23.	*Ludwigia oktovalvis* (Jacq.) Raven	43	33	76	48	II
24.	*Lygodium scandens* (L.) Sw.	-9	24	15	60	III
25.	*Lygodium sp.*	-9	24	15	60	III
26.	*Macroptilium atropurpureum* (Moc. & Sesse ex DC) Urb.	-9	15	6	55	III
27.	*Melaleuca cajuputi* Powell	5	48	53	40	II
28.	*Melaleuca leucadendron* (Linn.)	18	48	66	43	II
29.	*Melastoma malabathricum* Linn.	2	23	25	55	III
30.	*Mimosa pudica* L. var.unijuga (Duch & Walp)	2	26	28	56	III
31.	*Nepenthes gracilis* Korth	-9	13	4	60	III

TABLE 1: Weed risk assessment scores calculated for invasive plant species from wetlands in Wasur National Park (Priority status is based on species location in plot of correlation between level of Significance of Impact and Feasibility of Control).

32.	*Nymphoides sp.*	-9	20	11	70	III
33.	*Ocimum basilicum* L.	-9	17	8	70	III
34.	*Oryza sp.*	2	31	33	55	III
35.	*Paspalum conjugatum* P. J. Bergius	14	41	55	33	II
36.	*Passiflora foetida* L.	-9	24	15	60	III
37.	*Physalis angulata* L.	-9	22	13	70	III
38.	*Portulaca grandiflora* Hook	-9	20	11	60	III
39.	*Scirpus grossus* Linn f.	-9	22	13	70	III
40.	*Senna alata* (L) Roxb.	2	25	27	75	III
41.	*Sida acuta* Burm. f.	2	14	16	68	III
42.	*Sida cordifolia* Linn.	2	14	16	68	III
43.	*Sida rhombifolia* L.	2	14	16	68	III
44.	*Sphaeranthus africanus* Linn.	6	20	26	63	III
45.	*Stachytarpeta jamaicensis* (L.) Vahl.	37	27	64	34	II
46.	*Stenochlaena palustris* (Burm,f) Bedd.	2	27	29	60	III
47.	*Thoracostachium sumatranum*	6	33	39	41	IV
48.	*Uncaria indica*	-9	18	9	65	III
49.	*Vigna angulata* (L)	-9	22	13	60	III

Table 1: Continued.

able to spread widely geographically. Majority of them have animal dispersal mode, "using" birds and mammals to distribute their fruits and seeds. Other species develop vegetative means like rhizomes for their reproduction, or make use of flood water and wind to distribute their propagules as well. All of these distribution modes encourage the invasion processes of these plants (Rejmanek & Richardson (1996); Williams & West (2000); Zedler & Kercher (2004); Zimdahl (2007)).

List of invasive species which has been categorized in groups of priority to control is critical for management needs. It helps to set up the future management efforts, research opportunities and biodiversity conservation. The use of risk assessment to determine priority species of invasive plants can be considered as the best early approach to assess the problem of invasion accurately, respond effectively and reduce all the detrimental effects of invasion gradually.

5. Conclussions

Invasive plants are widely admitted as one of major causes of biodiversity decline and problems in conservation area. Many of these species are usually encountered in one area and need to be assessed for management purpose and reduce the detrimental effect to the area. Risk assessment in this study showed that invasive plants encountered in wetlands of Wasur National Park can be ranked and classified into plants in Priority 2, Priority 3 and Priority 4. Among these Priority group, invasive plants in Priority 2 become the most-needed to be concerned species for management

Main characters of invasive plants
Ability to spread rapidly
• High production of viable seeds
• Large seed banks
• High rates of seedling establishment
High rate of space occupation and growth
• High rate of canopy covering
• High production of aboveground and underground biomass, mainly under harsh environmental conditions
• Fast growing species
Efficient in dispersal and distribution
• Having allelopathic properties, to inhibit distribution of other species
• Broad distribution over a range of prominent climatic types
• Shade intolerant species, successful colonizer on disturbed or bare ground
• Having various dispersal agents
Adapted from: Rejmanek & Richardson (1996); Hodkinson and Thompson (1999); Rea & Storrs (1999); Sindel(2000); Williams & West (2000); Kanowski et al (2008); Zimdahl (2007).

TABLE 2: Characteristics of plants indicate a potential for invasiveness in native ecosystems.

efforts, because they had probability to become serious threat to the environment and hard to control. These species were *Carex* sp., *Eleocharis indica* (Lour), Druce., *Hanguana malayana* (Jack) Merr., *Imperata cylindrica* (L.) Beauv., *Ludwigia oktovalvis* (Jacq.) Raven, *Melaleuca cajuputi* Powell, *Melaleuca leucadendron* (Linn.), *Paspalum conjugatum* P.J. Bergius, and *Stachytarpeta jamaicensis* (L.) Vahl.

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