

## NOTES ON THE PROFILE OF INDONESIAN INVASIVE ALIEN PLANT SPECIES

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### ABSTRACT

An alien species, which becomes established in natural or semi-natural ecosystems or habitats, is an agent of change and threatens native biological diversity. The Convention on Biological Diversity (CBD) declared in 1992, in which the issue on invasive alien species was raised, was ratified by the Indonesian Government in 1994. Protecting our biodiversity will be our moral obligation to comply with CBD. Inventory on the invasive alien plant species in Indonesia should also be done by field surveys aside from the data collected from the references and herbarium specimens. Field studies should be carried out to get complete Figures, to identify the new ones, to determine their distributions, to plan their management including prevention to spread, containment and movement or mitigate their impact to environment. Sometimes it is difficult in determining whether the plants are aliens or not. Cooperation with botanists and taxonomists in other parts of the world is necessary. There are some species of invasive alien plant in Indonesia, which have to be watched for their aggressiveness i.e. *Acacia nilotica* (L.) Willd. ex Del., *Eupatorium sordidum* Less., *Jatropha gossipifolia* L., *Mikania micrantha* Kunth, *Mimosa pigra* L., *Opuntia* sp., and *Piper aduncum* L. have to be watch for their aggressiveness. Notes on some important invasive alien plant species in Indonesia are discussed.

**Key words:** invasive alien-plant species, weeds, environmental weeds, distribution, origin.

### INTRODUCTION

Weeds are known as plants interfering agricultural production systems, while weeds in natural habitat may be called as environmental weeds or invasive alien species emphasizing their role in threatening the biodiversity. Agricultural weeds problems have received more attention than in other ecosystems. Weeds in agro-ecosystems differ in their ecology from invasive alien plant species because they invaded different ecosystems. Agro-ecosystems are highly artificial and represent simple, species poor habitats with environmental homogeneity and predictable disturbance regimes. In contrast, natural habitats are mostly species-rich, environmentally heterogeneous and often unpredictable. Plants invading agro-ecosystems represent mostly herbaceous species, often adapted to the crop system, whereas plants invading natural habitats comprise the full range of life forms (Weber 2003).

Environmental weeds or invasive alien plant species have received increasing attention, because their impact on native biodiversity has been increasingly recognized and the direct costs of controlling them have increased (Groves 1999).

Many local plant species are extinct or at a risk of being out-competed by invasive alien plants species, and many native ecosystems have been irreversibly lost due to invasion. Degraded environment due to alien plant invasions is not easy to rehabilitate. The extinction of local organism is not easily renewable.

The records on the invasive alien plant species in Indonesia are scattered in various published and unpublished publications and there are only very few comprehensive information on invasive alien plant species.

## **INVENTORY ON INVASIVE ALIEN PLANT SPECIES IN INDONESIA**

SEAMEO BIOTROP has been working on weeds since the early of their establishment in 1968. At present not only weeds, but the scope of work includes also invasive alien plant species that are now being studied (Tjitrosoedirdjo 2005).

An inventory of the alien plant species in Indonesia based on the existing references and herbarium specimens was conducted by SEAMEO BIOTROP in cooperation with the Indonesian Ministry of Environment since 2003 and about 1936 alien plant species were reported (Indonesian Ministry of Environment and SEAMEO BIOTROP 2003). This study concluded that there were about 1936 species of alien plants, which belong to 187 families. It indicated the wide range of alien species in Indonesia. Out of those species 17% or 339 species were indicated having a potential to be invasive. This number will be increasing with time.

Further field studies should be carried out to get the complete Figures, to identify new ones, to determine their distribution, to plan their management including prevention of spread, containment and movement or mitigate their impact to the environment of invasive alien plant species in Indonesia. Potentially serious invasive alien plant species are often overlooked until they are widely naturalized, spread and causing harmful impacts on biological diversity. By which time it is too late to prevent or mitigate their impacts to the environment.

Early detection and appropriate response are needed to manage the problems of invasive alien plant species. Field surveys to obtain the collections and information are very useful.

Botanical collectors rarely specialize in introduced species. Consequently, invasive alien plant species are usually under-represented in herbaria, and comprehensive current checklists are lacking. Early recognition of new invasive alien plant species presents the best opportunity for timely cost effective intervention. Collectors should play an important role in drawing attention to new or recent naturalizations (Waterhouse 2003).

Indonesia consists of many large and small islands, so it is not easy to conduct field surveys and it is time consuming and lot of funds should is needed. However, long-term programs should be planned at each of the province in Indonesia. The large areas of Indonesian archipelago are divided into two floristic regions by the Wallace-line. Some species are only found at the western part of the Wallace line and some



others only found at the east part of the Wallace line. The species that is found at the eastern part might become alien at the west of the Wallace line and vice versa including the invasive species.

## SPECIFIC PROBLEMS OF INVASIVE ALIEN PLANT SPECIES IN INDONESIA

Records of the Invasive Species in Indonesia provided by ISSG (Invasive Species Specialist Group) show about 31 species of the most important invasive alien plant species of which mostly are shrubs and trees but only three species of aquatic habitat. Indonesia has a large area with many islands, different kind of habitats and some areas are not easily accessible. These conditions cause a constraint in conducting field observations. Invasive alien plant species, which are reported from the references, are mostly based on old records. Expansion of global trade in agriculture, forestry and other industries that depend on raw materials has allowed the transport of species to various parts of the world including Indonesia. Knowledge on weeds in agricultural ecosystems has to be updated from time to time.

We have to be aware of the new records of weeds, which have a potential of being invasive e.g. *Rivina humilis* L. (Phytolaccaceae) recently becomes a noxious weed of oil palm plantations in North Sumatra. The plant is native to South America and firstly recorded in East Java in 1858 and in North Sumatra known in 1925. The woody and shrubby nature of the plant makes its control difficult.

Each plant could produce more than 1000 seeds during the flowering season. The potential of expanding to other habitats is very high. In Central Sulawesi *Jatropha gossipifolia* L. (Euphorbiaceae) and *Opuntia* sp. (Cactaceae) have to be watched, because of their potential of being noxious and found in large areas. *Mimosa pigra* L. was first introduced from Mexico for botanical curiosity. The earliest record of its presence was in 1844 from Bogor, West Java, naturalized and spread to Sumatra, Kalimantan and Papua. Its spread to other islands has to be prevented. There is no record yet of *M. pigra* from Sulawesi, Maluku and Nusa Tenggara.

*Mikania micrantha* Kunth (Asteraceae) is a rapidly growing perennial vine with small wind-borne seeds. It is native to Central and South America and widely naturalized in Indonesia and Malesian region. Climbing to the canopy with dense infestations, it inhibited the growth of native vegetation in forest gap and margins. *M. micrantha* has been confused with the related species *Mikania cordata* (Burm.f.) B.L. Rob., which is native to Southeast Asia. In Indonesia, *M. cordata* has been displaced by the more aggressive species of *M. micrantha*.

Some of invasive alien plant species in Indonesia are already common and known to pose serious threats to natural biodiversity and have a tremendous impact to the native faunal and floral communities such as *Acacia nilotica* (L.) Willd. ex Del., *Eichhornia crassipes* (Mart.) Solms. *Chromolaena odorata* (L.) R.M. King & H. Robinson, or recently the outbreak of *Piper aduncum* L. Some other species are not known, since no studies on the species have been conducted. A policy should be made to recognize early problems of a possible "sleeper". A "sleeper" or introduced species sometimes does not directly show their invasiveness, but may still be in the process of invasiveness. It took about 30 years for *E. crassipes* after its introduction to become noxious, while *Rivina humilis* about 70 years.

Table 1. Areas/habitats with specific problems of alien invasive plant species in Indonesia

No.	Province	Location	Problem of IAPS	References
1.	Jambi	Lake Kerinci	<i>Eichhornia crassipes</i> (Mart.) Solms <i>Hanguana malayana</i> (Jack) Merr.	Tjitrosoedirdjo & Widjaja 1991
2.	West Sumatra	Lake Maninjau	<i>E. crassipes</i>	Tjitrosoedirdjo & Widjaja 1991
3.	Bengkulu	Lake Tes	<i>E. crassipes</i> <i>H. malayana</i>	Tjitrosoedirdjo et al. 2003
4.	Banten	Ujung Kulon Nature Reserve	<i>Chromolaena odorata</i> (L.) R.M. King & H. Robinson	
5.	West Java	Rawa Danau Gede-Pangrango Nature Reserve	<i>E. crassipes</i> <i>Passiflora</i> sp <i>Austropatorium inulifolium</i> (Kunth) R. M. King & H. Rob. <i>Eupatorium sorbidum</i> Less. <i>Salvinia molesta</i> D.S. Mitchell	Widayanti et al. 1999 Cordon and Arianto 2004; Tjitrosoedirdjo 2005
		Situ Cikasuknga Lake Curug	<i>E. crassipes</i>	Widayanti et al. 1999
		Situ Bagendit, Garut	<i>E. crassipes</i>	Tjitrosoedirdjo & Widjaja 1991 Widayanti et al. 1999
		Pangandaran National Park	<i>C. odorata</i>	Tjitrosoedirdjo 2005
6.	Central Java	Lake Rawa Pening	<i>E. crassipes</i> <i>Hydrilla verticillata</i> (L.f.) Royle	Tjitrosoedirdjo & Widjaja 1991
7.	East Java	Baluran National Park	<i>Acacia mlotca</i> (L.) Willd. ex Del.	Siregar & Tjitrosoedirdjo 1999
8.	East Kalimantan	Mahakam river	<i>E. crassipes</i>	Tjitrosemito 1997
		Lakes Jempang, Semayang and Melintang	<i>M. pigra</i> L. <i>S. molesta</i> <i>H. malayana</i> <i>Piper aduncum</i> L.	Tjitrosemito 1997
		Wanariset Semboja East Kalimantan		
9.	North Sulawesi	Lake Tondano, Dumoga Bone National Park	<i>E. crassipes</i> <i>P. aduncum</i>	Whitmore & Sidiyasa 1986
10.	Gorontalo	Danau Limboto	<i>E. crassipes</i>	
11.	Central Sulawesi	Lore Lindu National Park and vicinity	<i>P. aduncum</i> <i>Jatropha gossypifolia</i> L. <i>Opuntia</i> sp	
12.	Papua and Irian Jaya Barat	Lake Sentani, Maro River	<i>E. crassipes</i> <i>E. crassipes</i>	Wijanarko 2002 Tjitrosemito 1996
		Wasur National Park	<i>S. molesta</i> <i>M. pigra</i> <i>C. odorata</i> <i>Stachytarpetta urticifolia</i> (Salisb.) Sims <i>E. crassipes</i> <i>Hanguana</i> sp. <i>Pistia</i> sp. <i>Sida acuta</i> Burm. f.	Kapus Penelitian dan Pengembangan Hutan dan Konservasi Alam 2002
		Jayapura, Nabire, Sorong	<i>P. aduncum</i> <i>C. odorata</i>	Waterhouse 2003

A long-term program on the inventory of the invasive alien plant species should be planned step by step for each island with different kind of habitats and prevention should be made to avoid the spread of invasive alien plant species to other islands.

Table 1 shows an inventory of the invasive alien plant species problems in Indonesia collected from references and from own observations in the fields. In this table, invasive alien plant species of the terrestrial habitat is still lacking. These data can be combined with the record of ISSG. Most of the records in Table 1 were from the aquatic ecosystems but only few records from terrestrial habitats.

Some habitats or areas are recognized to have specific problems of invasive alien plant species such as the case of *A. nilotica* in Baluran National Park, East Java (Siregar & Tjitrosoedirdjo 1999). *A. nilotica* was firstly introduced as a fence to protect the teak forests near Baluran National Park, shortly after that rapid expansion was begun, more than 5000 ha was occupied by *A. nilotica*. Baluran is the only conserved savanna area left in Java providing herbivore feed for banteng (*Bos javanicus*). The invasion of *A. nilotica* reduces the herbage yields as well as the population of banteng. The same case occurred in Pangandaran and Ujung Kulon National Park, where both areas are also used for banteng conservation in West Java and Banten provinces. Their pastures are heavily occupied by *C. odorata*. (Tjitrosemito 1999). At Gede-Pangrango National Park, in West Java, a climber *Passiflora* sp whose fruit are edible and consumed by mammals spread in the park very rapidly and uncontrollably. Many trees are heavily covered by *Passiflora* sp. (Cordon & Arianto 2004). *Austroeupatorium inulifolium* (Kunth) R.M. King & H. Robinson and *Eupatorium sordidum* Less. which are originated from South America and Mexico, respectively, grow wild at the forest trails, forest borders and in the forest of Gede-Pangrango National Park (Tjitrosoedirdjo 2005). Although the distribution of *E. sordidum* is still limited in West Java, its spread has to be watched out since *E. sordidum* is an attractive ornamental plant.

*Acasia mangium* Willd. has been introduced and planted widely in Indonesia since early 1980s at forest plantations as a fast-growing tree for raw materials of pulp industries. However, the seeds easily germinate and grow very fast and become uncontrollable and spread everywhere. The same case also happens with another species of *Acasia*, i.e *A. auriculiformis* A. Cunn. ex Bth.

*Piper aduncum* is originated from South America, it was introduced in Bogor Botanical Garden more than a century ago. The first herbarium specimens at the Herbarium Bogoriense dated from 1900, which was collected from Bogor at the elevation of 230 m asl. Thirty-six years after the introduction it was found in Mount Lawu Central Java at the elevation of 2200 m asl. The first record from Sumatra was dated 1939 from Kalianda, Lampung, followed by Teluk Kabung, West Sumatra 1935, Bukit Lawang Bohorok and North Sumatra 1979. The first record from Samarinda, Kalimantan dated from 1952, Balikpapan and Semboja 1982; Sulawesi records were from Mt. Lokon dated from 1956, Dumoga Bone National Park, North Sulawesi 1985, Lore Lindu National Park and its vicinity 2000. Maluku records were from Karanghelang, Talaud dated 1926 and Seram 1993. Papua records were from Sentani dated 1985, Jayapura and Nabire dated 2003. *P. aduncum* is now wide-spread throughout Indonesia. Its competitiveness is quite remarkable, this success is partly due to its fast-growing characteristic, mature plants have flowers and bear fruits continuously throughout the year both in its native habitat and introduced environment. Seeds are dispersed by birds and introduced to new locations as a contaminant of machinery and materials of the logging area, it is associated with movement of logging equipment. In East Kalimantan, Central Sulawesi and North Sulawesi the disturbed forests are invaded by *P. aduncum* which replaced the forest trees in a large vegetation mats. *Piper aduncum* is one of the colonizers at the forest gap on open sites and forest edges. It seems that these conditions are favorable for *P. aduncum* to dominate these sites to out compete the relatively few indigenous species of pioneer trees. In certain areas it grows in pure stands of secondary forest adjacent to undisturbed forest (Whitmore & Sidiyasa 1986; Whitten *et al.* 1987; Waterhouse 2003). More studies on invasive alien plant species in Indonesia have to be conducted to get the real figures.

## THE ORIGIN OF INVASIVE PLANT SPECIES IN INDONESIA

Alien plants are now more or less established but either presumed or certainly known to have been originally introduced from other countries. They are here, established and to be considered as true constituents of Indonesian flora. Invasive alien plant species are non-native in the area where they are invasive. There are exceptions as some few native plants become invasive within their native range. *Imperata cylindrica* (L.) P. Beauv. and *Phragmites vallatoria* (L.) Veldk. (previously known as *Phragmites karka* (Retz.) Trin.) are examples of the native invasive species in Indonesia. The vast majority of plant invaders are however aliens. They originated either from intentionally introduced or from accidentally introduced species. The former comprises species that are cultivated as ornamentals, collection of the Botanical Gardens, experimental plants, for timber production and other economic uses. The latter comprises species that are introduced as contaminants of seeds, soil, agricultural produces or packing materials. In both cases, the species establishes self-reproducing populations outside the area of cultivation or point of introduction and spreads into natural communities (Weber 2003).

Records on the introduction of the plant species are related with the economic activities during the colonial time, the alien plant species in Indonesia came almost from all parts of the world and continents i.e. Europe, Africa, Asia, Australia, Pacific and America. Most of the species came from tropical America or other parts of America. The highest number came from America about 40% mostly from tropical America, followed by Asia 26% and Africa 12.8%. The lowest number of alien plant species came from Australia and New Zealand only 4%. The alien plant species can be beneficial or have a potential of being invasive. From the records of Tjitrosoedirdjo (2005) among the 1936 known alien plant species, 17% of which are indicated of being invasive.

The native origins of some of the species are not clear, e.g. *Hydrilla verticillata* and *Pistia stratiotes* L. Sometimes it is difficult to determine whether the plants are alien or not. The origin, and spread of the species is very important to be studied. It is indeed often difficult to determine whether a particular species is native or alien. Work on alien invasive species encountered many problems, notably the general paucity of specimens collected in Indonesia and difficulties in acquiring collections and literature from other countries. Cooperation with botanists and taxonomists in other parts of the world is indispensable.

## CONCLUSIONS

Agricultural weed problems are commonly known and received more attention than environmental weeds in natural habitats. After the issue on invasive alien species was raised in 1992 and accommodated in the agenda of CBD (Convention on Biological Diversity), the Indonesian Government ratified it in 1994. Recently the problems on invasive alien species receive more attention. Protecting our diversity is our moral obligation to comply with CBD. Information on the invasive alien plant species have been published by the Indonesian Ministry of Environment and SEAMEO BIOTROP in 2003 and 2006, respectively, based on the existing records of the references and herbarium specimens.

New records on weeds and environmental weeds have been recognized *i.e.* *Eupatorium sordidum* Less (Asteraceae), *Piper aduncum* L. (Piperaceae) and *Rivina humilis* L. (Phytolaccaceae). More studies on the invasive alien plant species have to be carried out to get complete Figures on the invasive alien plant species in Indonesia.

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