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America)*

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Biological Invasions

ISSN 1387-3547

Volume 14

Number 5

Biol Invasions (2012) 14:915-927

DOI 10.1007/s10530-011-0129-1



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Plant introduction, naturalization, and invasion in French Guiana (South America)

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Received: 19 January 2011 / Accepted: 20 October 2011 / Published online: 1 November 2011
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Abstract Continental tropical ecosystems are generally viewed as less vulnerable to biological invasions than island ones. Their apparent resistance to invasive alien species is often attributed to their higher native biota diversity and complexity. However, with the increase of human activities and disturbances and the accelerate rate of introductions of plant species, these apparently resilient continental ecosystems are now experiencing alien plant naturalization and invasion events. In order to illustrate this emergent phenomenon, we compiled a list of all known introduced and naturalized plant species in French Guiana (Guiana Shield, South America). A total of 490 alien plants were recorded, about 34% of which are currently naturalized, mainly species belonging to the Acanthaceae and Fabaceae (Faboideae) in the Eudicotyledons, and Poaceae (grasses) and Arecaceae (palms) in the Monocotyledons. The coastal dry and wet savannas appears to be vulnerable to plant

invasion (with 165 naturalized species, about 34% of the alien flora), especially by *Acacia mangium* (Mimosaceae) and *Melaleuca quinquenervia* (Myrtaceae) which are forming localized but dense monotypic stands. Both tree species, intentionally introduced for reforestation, rehabilitation, and as garden ornamentals and have the potential to spread with increasing human disturbances. The number and abundance of naturalized alien plants in the relatively undisturbed tropical lowland rainforests and savannas remains still very low. Therefore, surveillance, early detection, and eradication of potential plant invaders are crucial; moreover collaboration with neighbouring countries of the Guiana Shield is essential to prevent the introduction of potentially invasive species which are still not present in French Guiana.

Keywords Savanna · Invasive plant · *Acacia mangium* · *Melaleuca quinquenervia* · French Guiana · Naturalization

Electronic supplementary material The online version of this article (doi:10.1007/s10530-011-0129-1) contains supplementary material, which is available to authorized users.

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Introduction

Although their biotas are still under-surveyed (Hopkins 2007; Schulman et al. 2007; Haripersaud 2009), continental tropical forest ecosystems are commonly viewed as less vulnerable to biological invasions (Cronk and Fuller 1995; Rejmánek et al. 2005). Their apparent resistance to invasive alien species was

often attributed to their higher native biota diversity and complexity (Whimore 1991). However, this paradigm is now falling and several alien plants have been documented to invade primary tropical rainforest (Turner and Tan 1992; Rejmanek 1996; Peters 2001; Fine 2002).

Contrarily to other tropical French Overseas island territories where the impacts of alien invasive species on biodiversity is now well-documented and under active management (*e.g.* in Guadeloupe, Delnatte 2003, in French Polynesia, Meyer and Florence 1996, in New Caledonia, Meyer et al. 2006, in La Réunion, Tassin et al. 2006), biological invasions in French Guiana have received less attention. Research priority was mainly given to the knowledge of the species-rich native biota, mainly forest and woody species. Although the herbarium of French Guiana in Cayenne contains more than 180,000 plant specimens, the degree of representativeness of specimens is still not adequate for the whole flora. Indeed, the urban and secondary vegetation, mostly composed of herbaceous species, are largely under-represented.

Moreover, with the rapid increase of human population, anthropogenic activities, and associated disturbances contributing to ecosystem destruction and fragmentation, and with the accelerated rate of accidental or intentional introductions of many plant species, mainly for garden ornamentals but also as useful species, plant introduction, naturalization, and invasion events are favoured. Indeed, the population of French Guiana has rapidly increased, tripling in the past 20 years, from 70,000 inhabitants in the early 1980's to 206,000 in 2006 (INSEE 2009). Associated human activities developed as well, such as agriculture, ranching, forestry plantations, gold-mining, housing development, large infrastructure constructions such as the Kourou Space Centre (1,200 km²), and highways ("Routes Nationales"). For instance, future border bridges will make a singular section of 2350 km long from Brazil crossing French Guiana, Suriname, and Guyana. Those anthropogenic disturbances contribute to forest destruction and fragmentation (Laurance 2009), favouring naturalization and sometimes invasion of intentionally or accidentally introduced alien plant species.

The three main aims of this paper, a first step in understanding plant invasions in a continental tropical ecosystem, are: (1) to set up a preliminary checklist of

all the known introduced and naturalized plant species in the Guianas, and identify the major current and the potential plant invaders; (2) to compare the alien flora of French Guiana with other Guianas; (3) to document the emergent invasion phenomenon in vulnerable vegetation types such as Neotropical savannas.

Methods

Study site

The Guiana Shield, located in the northeastern corner of South America along the Atlantic coast, constitutes a geological, hydrographical, and phytogeographic unique region in the Amazonian Basin. It includes Guyana (formerly called British Guiana), Suriname (formerly Dutch Guiana), and French Guiana, and comprises some parts of southeastern Columbia and southern Venezuela, and northern Brazil (Fig. 1). Guyana, Suriname, and French Guiana, commonly known as the "Guianas" (Lindeman and Mori 1989), cover about 500,000 km² and are populated by more than 1.4 million inhabitants (Table 1). This region is a biodiversity hotspot (Mittermeier et al. 1998), and a WWF/IUCN Ecoregion (WWF and UICN 1994). French Guiana, a French Department since 1946, extends over 83,000 km² covered at ca. 97% by primary lowland rainforests (DAF 2007) (Fig. 2). Because of a less extensive land use and deforestation rate compared to it nearest neighbouring countries of Suriname (Table 1) or Brazil (with a deforestation rate of ca. 12,000 km² in 2007–2008, <http://www.obt.inpe.br/prodes/>), the French Guiana forest ecosystems is recognized as one of the fifteen largest preserved tropical rainforests in the world (Gargominy 2003; Higgins 2007). Its native flora comprises more than 5,400 vascular plant species, including more than 150 endemic species (Gargominy 2003) (Table 1). French Guiana is thus considered to have a relatively distinct floristic composition in the Guiana Shield (Granville 1986). After a first announcement by France at the Earth Summit in Rio in 1992, the National Park of French Guiana (named "Parc amazonien de Guyane" in French) was eventually created in February 2007, on 45% of its land surface (3.39 million ha) including 2.03 million ha of natural reserve (<http://www.parc-guyane.gf/> and Fig. 2).



Fig. 1 Location of the Guianas and French Guiana

Vegetation types

Nine major vegetation types are commonly found in the Guianas, including seasonal evergreen wet forests (tropical lowland rainforests), mangroves, strand vegetation, marsh forests, swamp forests, herbaceous swamps, montane vegetation, inselbergs (granitic outcrops), and savannas (Lindeman and Mori 1989). In French Guiana, the coastal dry and wet savannas currently cover 263 km² (ONF 2008), and extend parallel to the littoral, from the main town of Cayenne to the western town Organabo. Because they are found on alluvial soils, the only fertile area for agriculture in French Guiana (Granville 1986), crossed by the National Road N°1 (a 250 km highway, the longest

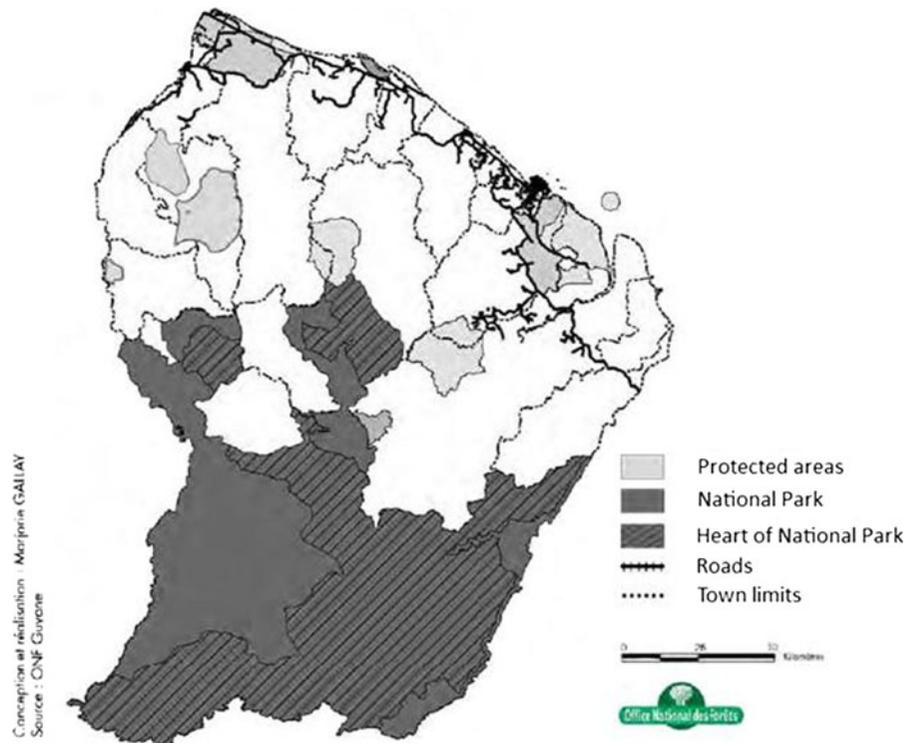
and largest in French Guiana), and located on coastal areas where the great majority of the population is concentrated in the three main towns of Cayenne (58,000 inhabitants in 2006), Kourou (23,818), and Saint-Laurent-du-Maroni (33,700) (INSEE 2009), these habitats are undoubtedly the most threatened by human activities and disturbances, and so the most vulnerable to alien species introductions in French Guiana. In addition, more than 20%, ca. 18 of the 83 species protected by the law (Arrêté ministériel du 09 avril 2001) are found in coastal savannas, including several herbaceous species (Cyperaceae, Droseraceae, Eriocaulaceae, Lentibulariaceae, Orchidaceae, Polygalaceae), lianas (Apocynaceae, Vitaceae), and small trees such as *Ouratea cardiosperma* (Ochnaceae).

Table 1 Characteristics of the Guianas and comparison between the native and alien vascular flora

Country	Guyana	Suriname	French Guiana	“Guianas”
Political status	Independent since 1966	Independent since 1975	French Department since 1946	–
Land area (km ²)	214,970	163,821	83,534	ca. 462,000
Population (year of census)	>770,000 (2007)	>470,000 (2005)	>209,000 (2007)	ca. 1,450,000
Population density (inhab./km ²)	3.6	2.9	2.5	3.1
GDP per capita (PPP) in US dollars	5,300	7,800	8,300	–
% Rainforest left	86%	96%	97%	–
Deforestation rate	0.1% per year	Unknown	5.600 ha per year	–
% of protected land area	3%	4.4%	45%	–
Native (endemic)	–	–	ca. 5.750 (ca. 150) ^b	ca. 20,000 (ca. 7,000) estimated 15,000 flowering plants ^a
Alien (% total vascular flora)	–	–	490 (8.5%)	821 (4.1%)
Naturalized (%)	–	–	165 (33.7%)	225 (27.4%)
Cultivated (%)	–	–	325 (66.3%)	596 (72.6%)

Economic, demographic data for Guyana according to the Bureau of Statistics, Government of Guyana (<http://www.statisticsguyana.gov.gy>) and comparison between the native and alien vascular flora

^a Funk (2003); ^b Gargominy (2003)

Fig. 2 Map of French Guiana, with main cities, and roads

Alien flora

To establish the list of the alien (or non-native, exotic, introduced, allochthonous) plants, we compiled data from reference books and published material such as the second and the third version of the “checklist of the plants of the Guianas” (Boggan et al. 1997; Funk et al. 2007), the “Guide to the Vascular Plants of Central French Guiana” (Mori et al. 1997, 2002), and the compiled list of cultivated ornamental plants in the Guianas (DeFilips 1992). The database of the herbarium specimens deposited at the herbarium of French Guiana (CAY) was checked. These data were supplemented by personal observations in savannas, dirt-roads, trails, roadsides and forest conducted between 2005 and 2010, and personal communications from local experts and horticulturists.

We listed the species occurring in French Guiana and in the two others Guianas not yet found in French Guiana. Two plant categories were distinguished: cultivated plants (propagated by people as food source, timber, for medicinal or ornamental purposes, etc.) and naturalized plants (reproducing themselves, producing propagules without human intervention, and spreading away from the parent plants, see Richardson et al. 2000). It must be noted that these two groups are not mutually exclusive; a cultivated plant can be also naturalized. Invasive plants are considered to be a subset of the naturalized species, having a large distribution range, forming dense stands, and with known or potential impacts on biodiversity. If a species is cultivated and naturalized, it is classified as naturalized. If a species is only cultivated, it is classified as cultivated. However, the classification comes from the synthesis of several sources which do not allow the specification “not cultivated but naturalized”.

Results

Alien flora of French Guiana

A total of 821 alien plant species belonging to 122 different plant families in the Guianas (i.e. about 4% of the total vascular flora), including 490 species in French Guiana only (about 9% of the total vascular flora of French Guiana) was recorded (Appendix 1, 2 in supplementary material). Among those, 165 are

naturalized (i.e. 33%) and 325 are cultivated mainly for food or as garden ornamentals. The Eudicotyledons represent 57% and the Monocotyledons 41% of the alien flora (Fig. 3). Among Monocotyledons, Arecaceae (palms) and Poaceae (grasses) are the most represented, with 70% of all the non native species (Fig. 4). The Eudicotyledons comprise 65 plant families including 20 families with at least five non-native species (Fig. 5).

Major invasive plants in French Guiana

Among the 165 widely naturalized species, at least two seem to be more problematic because of their current distribution (Fig. 6) (Appendix 3 in supplementary material) and because they form dense stands: the trees *Acacia mangium* (Leguminosae: Mimosoideae) and *Melaleuca quinquenervia* (Myrtaceae).

Acacia mangium C.L. Willdenow

This large tree, up to 30 m in height, is native to the coastal tropical lowlands of northern Queensland

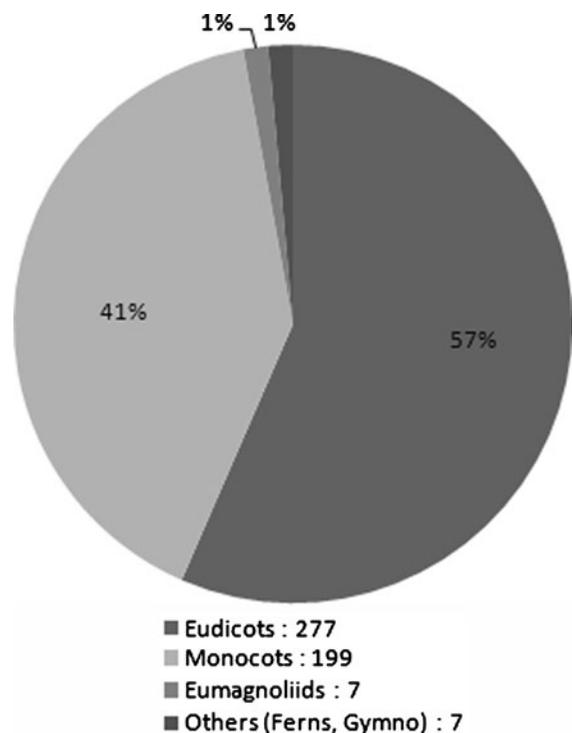
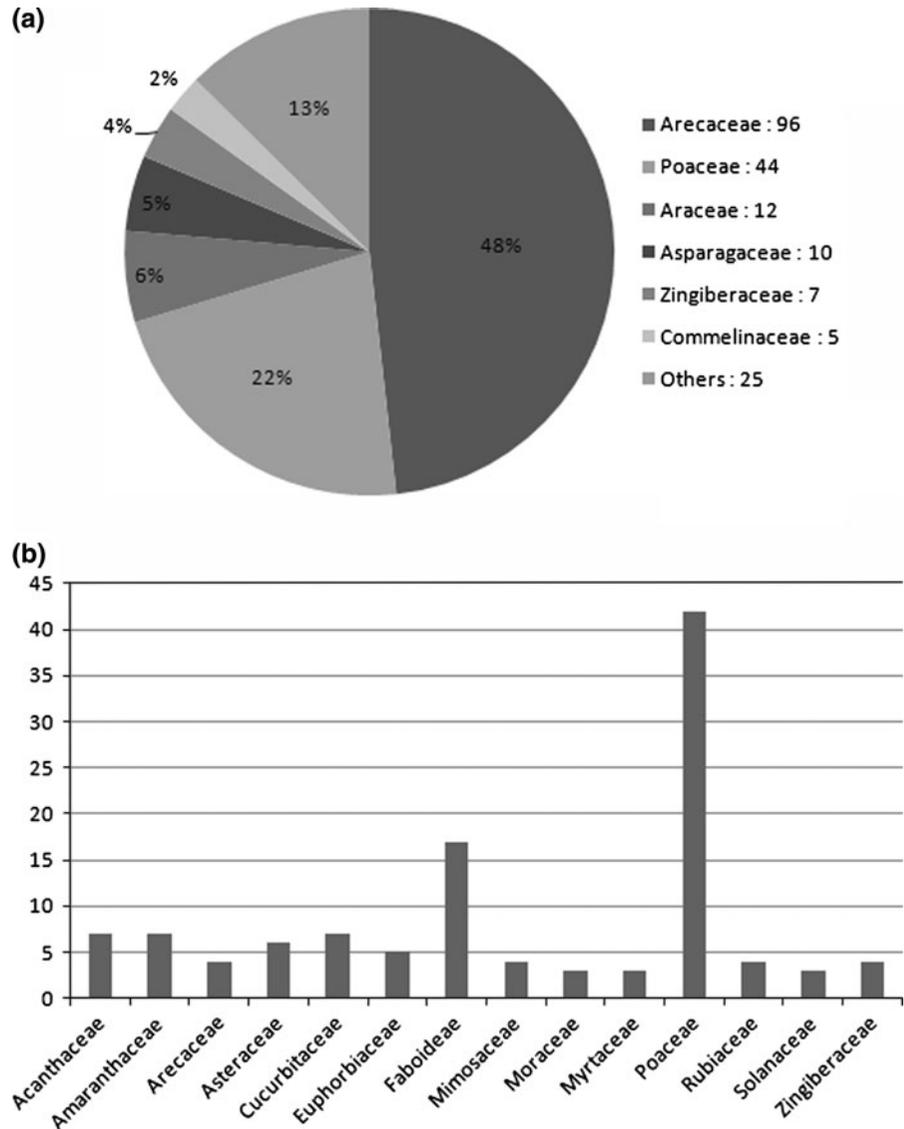


Fig. 3 Taxonomic distribution of alien vascular plants in French Guiana

Fig. 4 **a** Families in the monocotyledons with the highest number of alien plants in French Guiana. **b** Families with the highest number of naturalized species in French Guiana



(Australia), Papua New Guinea, and Indonesia (Turnbull 1986). It occurs from near sea-level to about 800 m elevation, with a temperature ranging from 15 to 34°C and a mean annual rainfall between 1,000 and 4,500 mm. In its native range, it is a light-demanding pioneer species, mainly found on the margins of closed-forest, in open forests and woodlands, especially where there is a disturbance by fire (Turnbull *op.cit.*). In French Guiana, it grows rapidly, until 2.5 m per year (ONF 2004), and can reach 20–25 m tall and 20–30 cm diameter in 10–13 years (Turnbull *op.cit.*), tolerates a large range of soil types and pH (Galiana et al. 1998), and flowers nearly all year long with 80,000–120,000 produced seed/kg (Turnbull

op.cit.). Seed dispersal is mainly autochorous but its dispersal can also be made on long distances, with streams either motorized vehicles. Promoted as a multi-purpose tree species by foresters for fuelwood, timber, wind protection, animal fodder, and paper pulp (Turnbull *op.cit.*; Duponnois and Bâ 1999), *Acacia mangium* was introduced in almost all temperate and tropical biogeographical regions: Asia (Bangladesh, Malaysia, Nepal, Philippines, Thailand), Africa (Cameroun, Senegal, Tanzania), Americas and the West Indies (Brazil, Costa Rica, Dominican Republic), and Oceania (Hawaii, New Caledonia, Cook Islands where it is naturalized, obs. pers.). Introduced in the Indian Ocean since the 19th century, it is now

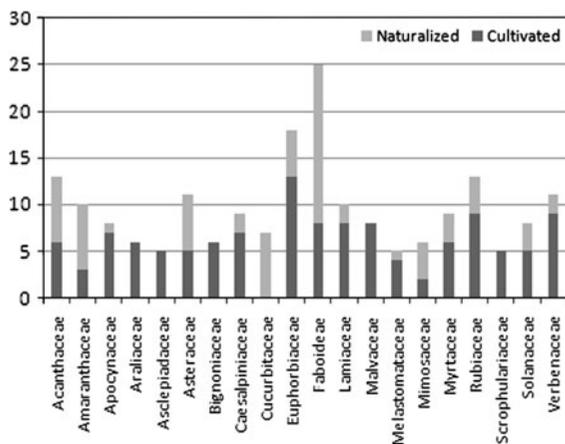


Fig. 5 Families in the Eudicotyledons with the highest number of alien plants species in French Guiana

present in several tropical islands (Comoros, Madagascar, Mayotte, La Réunion, and the Seychelles) (Kull et al. 2007) where it is locally naturalized.

In French Guiana, the first herbarium's record of *Acacia mangium* dates back in 2000. However, the species is known to have been introduced for the «Green Plan», an agricultural and reforestation project set up by the French National Forestry Office (ONF) in the 1970's. The species is now naturalized in many locations (Fig. 6), especially in coastal savannas, along tracks and roadsides, but also primary forest edges. It is mainly planted for experimental rehabilitation of gold mining sites (ONF 2004). Moreover, it is largely planted by landscapers and gardeners because of its fast growth and its ornamental value as it has small yellow inflorescences. Although its regeneration is limited under canopy cover, its propagation in open-canopy savanna ecosystems is largely favoured by traditional agriculture (“slash and burn”) with frequent fires (Tsayem Demaze and Manusset 2008).

In *Acacia mangium* dense plantations, the undergrowth is covered by pods, stems, phyllodes, with a litter of 21.05 tons dry matter/ha (Djego and Sinsi 2006), which may limit native species recruitment and increase the fuel load that may favor fire regime.

Melaleuca quinquenervia (Cav.) S.T. Blake

This small to medium sized tree, commonly 8–12 m tall (up to 25 m), is native of the coastal region of eastern Australia, from near Sydney to northern

Queensland (Turnbull 1986). It extends into Papua New Guinea, Indonesia, and New Caledonia between near sea-level to 1,000 m elevation. It is a fire-tolerant tree capable of growing on nutrient deficient sites with continuous or periodic flooding (Turnbull 1986, Serbesoff-King 2003). Flowering occurs five times per year, and leads to a production of up to 20 millions seeds per tree and per year, which are dispersed by wind (Woodall 1982).

Because of its invasiveness in moist and open habitats and its ability to form monospecific stands such as in marshes in Southern Florida (Ewel 1986), *Melaleuca quinquenervia* has been nominated as one of the 100 “World’s Worst Invasives” (<http://www.issg.org>). It was introduced in numerous parts of the world, including the Caribbean, the United States, the islands of Micronesia and French Polynesia (<http://www.hear.org/pier>), and the Indian Ocean (Réunion) where it is locally naturalized.

In French Guiana, the species was first recorded in 1948 (deposited in CAY). Its expansion was also favoured by the «Green Plan» set up by the National Forestry Office (ONF) in the 1970's (ONF 2004) for timber development in order to establish paper-industry, which was never been done. It is also grown as a garden ornamental because of its numerous blooming inflorescences.

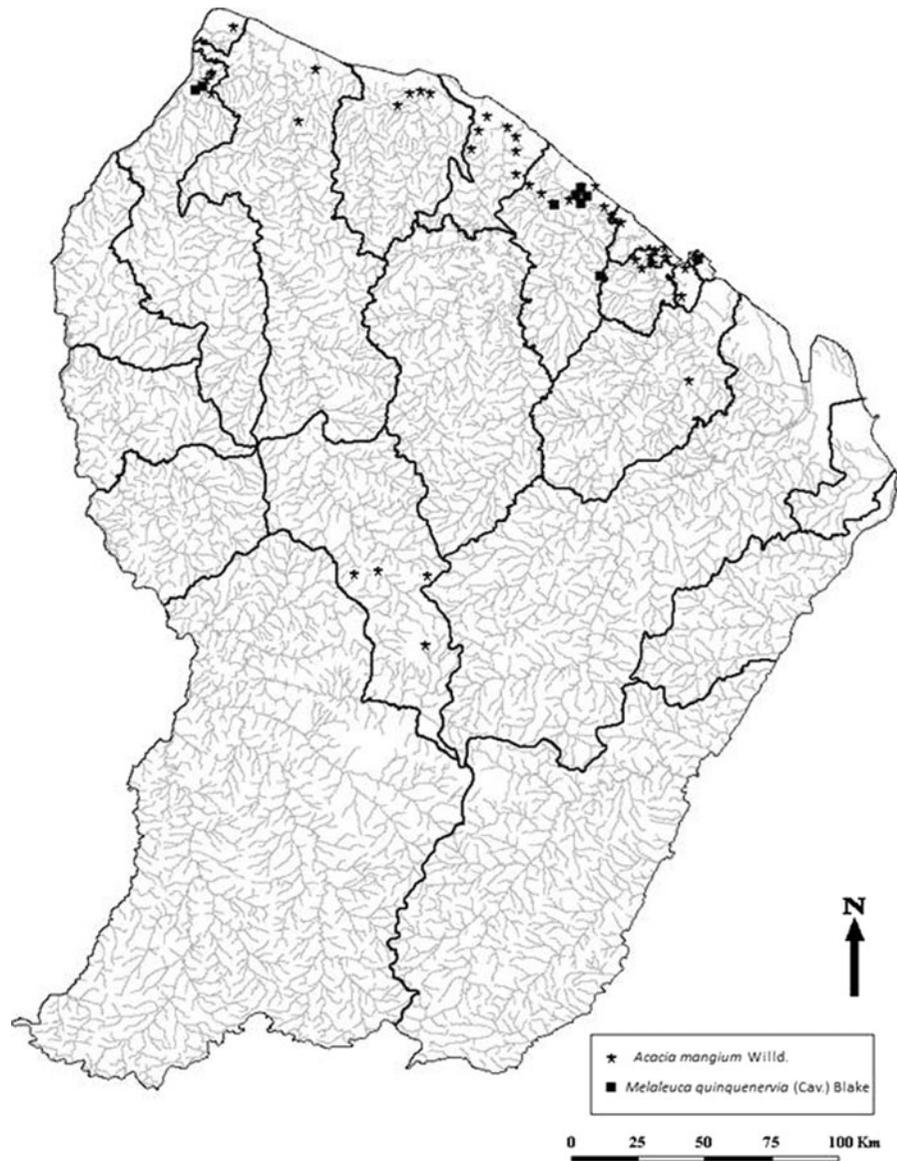
In a savanna site located along road (RN1, PK 58) where more than 3 hectares are currently invaded by *Melaleuca quinquenervia*, we calculated that the species density reaches about 1,000 individuals on a 100 m² area. In this particular site, the alternance of flood during rainy season and anthropogenic fires during dry season might have lead to the formation of dense monospecific populations.

Discussion

Plant introduction, naturalization, and invasion in French Guiana

With only 490 alien plants including 165 naturalized species on a land area of more than 83,000 km², the alien and secondary flora of French Guiana is of less importance compared to other French Overseas island territories such as French Polynesia (593 naturalized species on an area of 3,500 km², Fourdrigniez and Meyer 2008) in the Pacific Ocean or La Réunion

Fig. 6 Location and distribution of *Acacia mangium* and *Melaleuca quinquenervia* based on personal observations and herbarium specimens deposited in CAY



(ca. 630 naturalized plants on an area of 2,500 km², Meyer and Lavergne 2004) in the Indian Ocean.

French Guiana represents only 16% of the total land area and 14% of the population of the Guianas, but accounts for 60% of the alien plants (490 species over a total of 821). This higher rate of naturalization may be due to a better knowledge of the secondary flora in French Guiana compared to Guyana and Suriname where the whole flora is still undersampled (Hopkins 2007; Schulman et al. 2007; Haripersaud 2009).

French Guiana has experienced a rapid increase of alien species introduced as useful species (forestry

plantations, habitat restoration and rehabilitation, fodder for grazing animals) and garden ornamentals.

Ornamental plants are now recognized as a major source of invasive plants worldwide (Hanspach et al. 2008; Weber 2003). In French Guiana, about 20% of the alien flora is composed of palms (96 species) which become more and more popular in horticulture. Some species are now reported to be naturalized and even invasive, especially in tropical island ecosystems (Meyer and Lavergne 2004; Meyer et al. 2007).

With 35 species in French Guiana and 45 in other Guianas, the legume family form also an important

component of the alien flora. Leguminosae are classically considered as a “weedy” family worldwide (Binggeli 1996; Pysek 1998) with many invasive species in the genera *Acacia* and *Prosopis* (Richardson et al. 2004). It is noteworthy that the families with the largest number of native species in the Guianas are the Leguminosae with more than 800 species, showing that “taxonomic disharmony” cannot explain alien legumes success in the region. Other large families are the Orchidaceae with about 700 species, the Rubiaceae and the Poaceae, both with more than 400 species (Funk et al. 2007).

The various origins of introduced plants may be also related to the high ethnic diversity in French Guiana: French Guianese creoles (38% of the population), Haitian, Brazilian, and Surinamian migrants (25%), Eurasian French (8%), Creoles from French West Indies (5%), Amerindians (autochthonous people) 4%, and other (7%) including Hmongs, Chinese, Syro-Libanese people (Grenand et al. 2004). The creole populations (ca. 100,000 people) are overall living in towns on the coast.

Another important factor is the fast growth of the human population in French Guiana, from 70,000 inhabitants in 1980–209,000 inhabitants in 2007 (i.e. a density of 2.5 per km²). It will probably reach 300,000 in 2020 (INSEE 2009). This leads to an increased rate of deforestation and associated anthropogenic disturbances: between 1990 and 2006, a total of 91,720 ha of tropical rainforest (including mangroves) was cleared for housing development, agriculture, and mining, i.e. more than 5,600 ha per year (IFN 2008). Forest clearance and slash and burn agriculture is well known to favor invasion by pioneer alien species, and alter secondary succession (Ramakrishnan and Vitousek 1989).

Invasibility of savannas

In French Guiana, the most threatened ecosystems by invasive species are the open fields such as coastal savannas, rainforest edges, trail and road sides. Tropical dry and wet coastal savannas, although contributing to 0.3% of the country are mainly unprotected. Therefore, since 2001, 1050 hectares of savannas were lost (ONF 2008). This specific ecosystem counts about 300 species (Chaix et al. 2002). However, with the aim of developing breeding, fodder species were introduced into savannas since

1800–1960's (Huguenin 2008). Paleo-climates, edaphic and climatic factors, and past and current human disturbances (especially anthropogenic fires) have shaped these ecosystems. However, because of their particular structure, composition, physiognomy, and dynamics, savannas should be viewed as important ecosystems, especially for plant succession processes. Savannas of the Mediterranean, Australia, Papua New Guinea or India are also maintained by anthropogenic fires.

Plant invasiveness

Acacia mangium and *Melaleuca quinquenervia* are two fast-growing fire-resistant species, preadapted to invade savanna ecosystems subjected to frequent burning. Other alien invasive plants which have successfully invaded savannas around the world include the trees *Acacia* spp. (Mimosaceae) and *Prosopis* spp. (Leguminosae, “Mesquite”), the woody vine *Cryptostegia grandiflora* (Asclepiadaceae, “Rubbervine”), the succulent *Opuntia cochenillifera* (Cactaceae, “Prickly pear”), the grasses *Cenchrus* spp., *Chloris* spp., *Sporobolus* spp., *Brachiaria* spp. and *Melinis minutiflora*. Species altering ecosystem functioning, especially the water and fire regime (such as the trees *Melaleuca*, *Tamarix*, or the grass *Andropogon* spp, Myers and Bazely 2003), also called “transformers” (Richardson et al. 2000), should be considered a high priority for control.

We recommend that the use of *Acacia mangium* should be banned in French Guiana or at least restricted to the rehabilitation of mining sites as a starter plant for the plant succession, and with a careful monitoring of its potential spread. In addition it should be eliminated in the public and private gardens, in edges of track and overall in the savannas. The low number of trees per station still allows its manual and chemical control. *Melaleuca* small and localized infestations should be eradicated or at least contained using a classical control method (cut-stump treatment with an herbicide). Mapping its current and precise distribution using remote sensing (satellite images) or aerial photographs seems a prerequisite for successful management.

The woody vine *Cryptostegia grandiflora*, native to Madagascar, is present in Suriname and cultivated in French Guiana where it is not naturalized yet. A very aggressive vine in Australia (Parsons and Cuthbertson

2001) and New Caledonia (Meyer et al. 2006) in dry or wet savannas and open forests, this species has the potential to invade similar ecosystems in the Guianas and should be eradicated.

The other potential threats to French Guiana's native forests include the shade-tolerant alien tree species *Adenanthera pavonina* (Mimosaceae), *Syzygium cumini* and *Syzygium jambos* (Myrtaceae), originating from Southeast Asia, and mainly found in gardens as cultivated plants, the fast-growing pioneer trees *Tecoma stans* and *Spathodea campanulata* (Bignoniaceae) with wind-dispersed seeds, known to be invasive in Pacific Islands, also commonly cultivated in French Guiana as ornamental or shade trees (Appendix 1 in supplementary material).

Among the other potential invasive plants which are already naturalized in the Guianas but still not found (or being collected) in French Guiana (Appendix 2 in supplementary material), the fire-tolerant grasses *Melinis minutiflora* ("molasses grass"), *Rhynchelytrum repens*, *Arundo donax*, and the thorny legume tree *Parkinsonia aculeata* should be monitored carefully.

Climate change and invasive plants

An additional issue which may promote plant invasions in French Guiana is climate change. Paleoclimates, based on fossil pollen analysis, demonstrate that rainfall patterns in the northern part of South America have changed throughout the past (Ledru et al. 1996). The El Niño occurrences also cause drier climatic periods in the Guiana Shield, which can cause important fires in savannas (Tardy 1998). Moreover recent studies underline the sensitivity of tropical humid ecosystems to climate change because of constant temperatures and the low drought stress throughout the year (Wang et al. 2003). In this area, some climate models suggest that the precipitation could switch in response to greenhouse gas emissions and changes in thermohaline circulation (IPCC 2001). In addition to species loss and change in pattern of distributions, global warming and decreasing rainfall might increase the area covered by drier vegetation types such as dry forests or savannas (Higgins 2007). This change could favour the spread of some plant invaders, including the two fire-tolerant and fire-promoting invasive species (*Acacia mangium* and *Melaleuca quinquenervia*) found in French Guiana.

Importance of invasive plants

The main threats to ecosystems in the Neotropics, especially in the Guianas (Funk 2003, see also the national biodiversity strategy and action plan of Suriname and Guyana), remain logging, mining (gold, diamond, bauxite), charcoaling, and fuelwood, agriculture (extensive coffee and cotton plantations), ranching (grazing by ungulates), infrastructure (roads, housing, dams for electric power) and, fires (in savannas). Ninety percent of the population lives along the narrow cultivated coastal strips, thus lowland vegetation types such as mangroves, coastal dry and wet forests, and savannas are the most vulnerable.

We predict that invasion of continental tropical ecosystems will increase in the near future along with deforestation, habitat fragmentation, and species transportations and introductions ("globalization").

For a long-time invasive alien species in French Guiana were not taken in account or their importance and relevance were underestimated by both the scientific institutions working for decades in this French overseas territory, and by the local and national authorities. A recent synthesis has revealed that invasive plant species should be also considered in French Guiana (Soubeyran 2008).

There is a need for better information on the current and potential dangers caused by invasive plant species in the Guianas. Foresters, landscapers, horticulturists, gardeners, as well as plant collectors should be one of the main targets for the risk of introducing plants. Invasion by alien plant species is currently threatening the dry and wet savanna ecosystems, and there is a risk that some of these naturalized species, especially weeds, will manage to penetrate into the relatively pristine, but often fragmented, lowland rainforests. Other alien naturalized and invasive plant species not yet found in French Guiana are present in the bordering countries of Suriname and Brazil. Because the biogeographical barriers delimiting the Guiana Shield will probably not stop invasive species with long-dispersal capacities (e.g. wind-seeded, fleshy fruit-bearing species or motor vehicles), management of biological invasion requires transborder coordination. Collaboration and partnership with researchers and managers in the different political entities of the Guiana Shield are therefore crucially needed.

Acknowledgments The first author is grateful to the following experts who helped to set up the species checklist and for their personal communications, J.-J. de Granville and Marie-Françoise Prévost (Institut de Recherche pour le Développement, Cayenne, French Guiana), P. O. Albano (Association Ti'Palm, Cayenne, French Guiana), and S. Guitet (Office National des Forêts, Cayenne, French Guiana). We thank Dr. J. W. Veldman, Dr. C. Daehler and one anonymous reviewer for their useful comments to improve the manuscript. We also thank K. Dever (Direction Régionale de l'Environnement, Cayenne, French Guiana) for the maps, and dear friends and colleagues L. Collado Santamaría, C. Girod, G. Leotard, and P. C. Zalamea-Zamora for their assistance in the field and with the checklist. We specially thank Christian Feuillet (Department of Botany, Smithsonian Institution, Washington) and for the critical and valuable comments on the draft.

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