

Research Paper

## INVASIVE ALIEN PLANT SPECIES IN THE RIPARIAN AREAS OF NORTHERN SAMAR, PHILIPPINES

Joey Liza L. Abobo\*, Joy A. Esmabe, Marjurie L. Baldoza, Princess L. Cerbito, John Mark P. Garbo, Ramon Philip L. Bacayo, Chitlyn C. Tenedero, Maricar D. Lameda, Rica Joy B. Saavedra, Cresil S. Turbanada, and Roanne B. Romeroso

Department of Biology, College of Science, University of Eastern Philippines, Catarman, Northern Samar 6400, Philippines

### ARTICLE HIGHLIGHTS

- A pioneering study of invasive alien plant species in the riparian areas of Northern Samar
- Species composition, endemism, and conservation status of introduced species
- Out of 65 introduced species, 32 were listed as invasive

### ABSTRACT

Riparian areas are highly dynamic and naturally disturbed, making them particularly susceptible to invasion. Invasive Alien Plant Species (IAPS) are widely distributed in these areas due to the favorable environmental conditions that support their growth and persistence. This study is a pioneering effort to document the invasive alien plant species thriving in the riparian zones of Allen, Biri, Catarman, Gamay, Mapanas, Laoang, Lapinig, Las Navas, and Pambujan in Northern Samar. Sampling was conducted from March to December 2023. Six transect lines, each measuring two kilometers per site, were established in the riparian areas to identify existing invasive alien plants. In total, 60 transect lines were set up across all sampling areas. As a result, 65 introduced plant species belonging to 24 families and 56 genera were documented in the riparian areas of Northern Samar. The families with the highest number of species were Poaceae (13 spp.), Asteraceae (12 spp.), Cyperaceae, Fabaceae, and Lamiaceae (5 spp. each). The remaining families had fewer than five species each. The most common invasive plant species recorded was *Psidium guajava* L., which was present in all sampling areas. Based on life forms, the study identified two tree species, 17 shrubs, three vines, one epiphyte, and 42 herbs. Conservation status was determined using the latest IUCN and DENR listings (2017–11). One taxon was classified as Data Deficient, 32 as Least Concerned, and the remaining species as Not Evaluated. In contrast, no taxa were assessed in the DENR 2017–11 listing. Furthermore, of the 65 introduced plant species documented, 10 were recorded as invasive in the Global Invasive Species Database, while 22 were listed in the Global Register of Introduced and Invasive Species Database. Although invasive alien species have long been recognized as posing serious threats to human health, forestry, agriculture, fisheries, and natural biodiversity, no comprehensive assessment of their status, trends, causes, impacts, management, and governance issues has been conducted worldwide. Thus, this study aimed to supplement existing data on invasive plants and assist policymakers in developing policy frameworks for managing invasive alien plant species to mitigate their impacts on human health and the environment.

**Keywords:** invasive alien plants, Northern Samar, riparian areas, biodiversity assessment

### Article Information

Received : 29 September 2024

Revised : 8 April 2025

Accepted : 29 April 2025

\*Corresponding author, e-mail:

[joeyacealiz@gmail.com](mailto:joeyacealiz@gmail.com)

## INTRODUCTION

Invasive alien species (IAS) are non-native organisms that pose risks to both human health and the environment. They are regarded as the second most significant threat to biodiversity after habitat loss (Bellard *et al.* 2016). Whether introduced intentionally or unintentionally, the introduction, dispersal, and utilization of alien species have had profound impacts on ecosystems and economies. Because many invasive alien species are highly adaptable, capable of rapid growth and reproduction, the environmental damage they cause is often irreversible and can lead to the extinction of endemic species. Furthermore, biological invasions have severe socio-economic and public health impacts (Shackleton *et al.* 2018). According to Castro-Díez *et al.* (2019), the perceived socio-economic benefits of certain potentially invasive plant species in urban and rural areas have contributed to the rapid spread of some IAS in forest ecosystems.

Numerous studies have been conducted worldwide to examine the effects of invasive alien species on human health, ecosystem services, biodiversity, and economic activities (Katsanevakis *et al.* 2014). However, research on the impacts of IAS in the Philippines remains scarce. Owing to its archipelagic nature, which promotes geographic isolation and endemism (PTFCFI 2015), the Philippines is recognized as one of the world's 17 mega-diverse countries (Keong 2015). Yet, island ecosystems are particularly vulnerable to invasive alien species, which can cause population declines and extinctions, especially among endemic taxa.

Samar Island Natural Park (SINP), located on the country's third-largest island, is a designated forest reserve with exceptionally rich biodiversity. Recent ecological assessments have documented 212 tree species, 182 terrestrial vertebrates, 24 amphibian species (Diesmos *et al.* 2015; Diesmos *et al.* 2020), and 31 snake species (Leviton *et*

*al.* 2018; Weinell *et al.* 2020). Additional floral (Quimio 2016) and faunal (Patindol 2016) surveys have been conducted in five SINP watersheds. Floristic inventories of alien species are essential for developing conservation programs and policies aimed at addressing forest conservation challenges. Effective management is better achieved through comprehensive strategies that map relationships between invasive species and at-risk native species rather than focusing solely on individual taxa. Globally, invasive species are among the leading drivers of ecosystem-wide biodiversity loss and species extinctions.

The purpose of this study is to identify invasive alien plant species (IAPS) in the riparian areas of Allen, Biri, Catarman, Gamay, Mapanas, Laoang, Las Navas, Lapinig, Lavezares, and Pambujan in Northern Samar, Philippines, focusing on species composition, endemism, and conservation status. Conducting research on invasive plant species is crucial, as it helps shed light on the ecological consequences of non-native plant invasions. The findings will raise public awareness and promote recognition of the harmful effects of such species. Moreover, the study encourages the development of new approaches to mitigation and restoration, including management interventions and the evaluation of IAPS impacts. This research was conducted in the aforementioned riparian areas because no prior studies have examined invasive plant species in these habitats, even though riparian zones often harbor numerous invasive species that can outcompete or displace native vegetation.

## MATERIALS AND METHODS

### Study Area

This study was conducted in 10 riparian areas, i.e., Allen, Biri, Catarman, Gamay, Laoang, Mapanas, Lapinig, Las Navas, Lavezares, and Pambujan, located in Northern Samar, Visayas Island, Philippines (Table 1; Fig. 1).

Table 1 Riparian areas in Northern Samar as the sampling sites

Riparian areas	Coordinates
Allen	12°30'04" N 124°17'14" E
Biri	12°39'40" N 124°24'31" E
Catarman	12°25'08" N 124°38'30" E
Gamay	12°23'05" N 125°16'52" E
Laoang	12°37'19" N 125°01'05" E
Mapanas	12°28'08" N 125°14'12" E
Lapinig	12°18'52" N 125°17'27" E
Las Navas	12°18'24" N 125°00'59" E
Lavezares	12°31'27" N 124°23'09" E
Pambujan	12°27'50" N 124°56'24" E

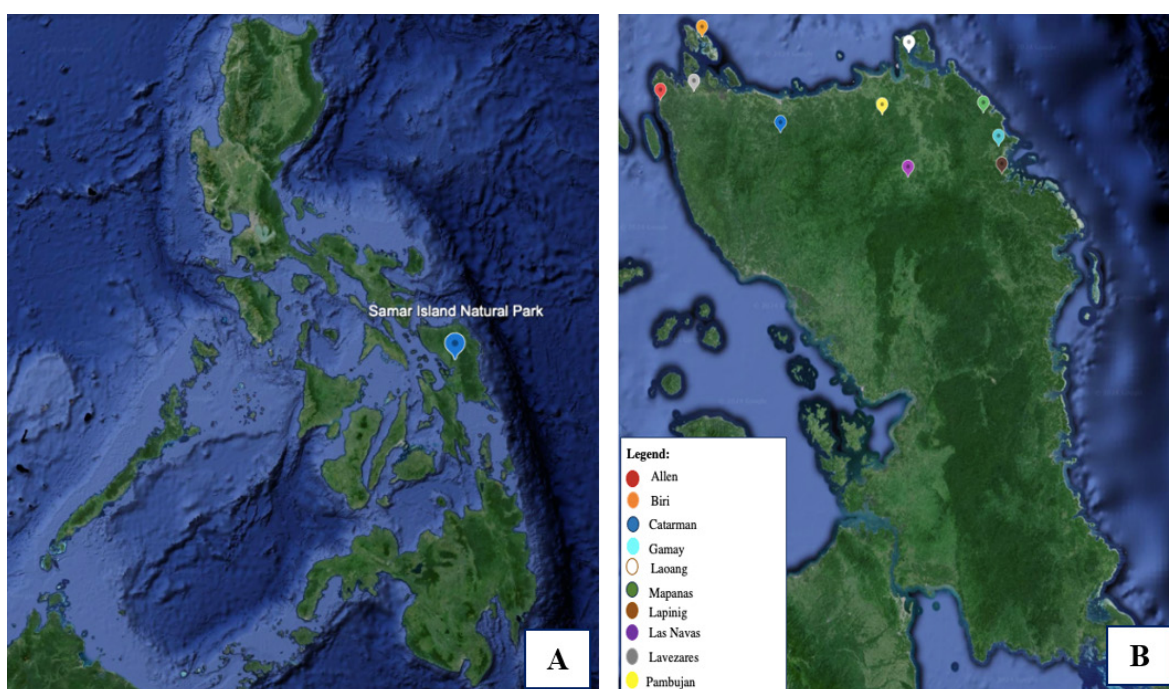


Figure 1 Riparian areas as sampling sites in the Samar Island Natural Park

Notes: A. Map of the Philippines showing Samar Island Natural Park; B. Samar Island Natural Park Map showing the sampling areas.

## Data Analysis

### *Plant Collection and Identification*

This study was conducted in March-December 2023 in the ten (10) riparian areas of Northern Samar, namely Allen, Biri, Catarman, Gamay, Mapanas, Laoang, Las Navas, Lapinig, Lavezares, and Pambujan. Six transect lines, measuring two kilometers per site, were laid randomly in the riparian areas to identify the existing invasive alien plants. Overall, a total of 60 transect lines were established for all sampling areas.

All documented invasive plant species were completed with proper photo documentation for identification and verification. Other data collected

during the survey included live photographs and growth habits (i.e., trees, shrubs, herbs, vines, epiphytes).

### *Plant Identification and Conservation Status*

All samples were identified using species descriptions, taxonomic keys, comparison of type specimens, and available web resources. The Co’s Digital Flora (Pelser *et al.* 2011 onwards), Plants of the World Online (POWO 2022), Global Register of Introduced and Invasive Species-Philippines, and Global and Invasive Species Database were also used as identification aids. Additionally, the conservation of each species’ status was determined using the International Union for Conservation

of Nature (IUCN) Red List (IUCN Standards & Petitions Committee 2023) and the Department of Environment and Natural Resources Administrative Order 2022-11 (DENR-DAO 2017-11; DENR 2017).

## RESULTS AND DISCUSSION

### Inventory

Sixty-five introduced plant species were recorded in the riparian areas of Northern Samar, representing 24 families and 56 genera. All 65 species identified at the species level are considered non-endemic to the Philippines. The species occurring in Northern Samar's riparian areas are presented in Table 2.

The Poaceae family was the most well-represented, with 13 species, followed by Asteraceae with 12 species, and Cyperaceae, Fabaceae, and Lamiaceae with 5 species each. Other plant families had fewer than five species. The most commonly documented life forms among these invasive plant species were herbs (42), followed by shrubs (17), vines three, trees two, and one epiphyte. Some of these invasive species were extremely rare in certain locations, while others were more common in different areas. This variation is likely due to differing environmental conditions. Differences in soil nutrient availability, pH, type, and water retention capacity across sites may influence the ability of certain invasive species to thrive in some areas while remaining scarce in others. Additionally, environmental factors such as temperature and humidity may affect the distribution, abundance, and growth of invasive plant species, contributing further to their spatial variation.

It is noteworthy that the plant families documented in this study, such as Asteraceae, Cyperaceae, Fabaceae, Lamiaceae, and Poaceae, are also commonly found in riparian areas in other countries, such as China and India.

Furthermore, the IUCN Classification and the DENR-DAO 2017–11 are used to devise the conservation status of the species in riparian areas. As a result, according to the IUCN's most recent listing, one taxon is categorized as Data Deficient, 32 as Least Concerned, and the remaining taxa are Not Evaluated. In contrast, no taxon was not evaluated in DAO 2017–11.

The life forms and taxonomic distributions of plant species were recorded in each sampling area (Table 3).

In Allen, 9 species were identified, consisting of 1 tree, 1 shrub, and 7 herbs, with most belonging to the Asteraceae family. Biri had 10 species, including 2 tree species, 3 shrubs, 3 herbs, and 2 vines, representing mainly the Asteraceae and Fabaceae families. Catarman comprised 18 species, including 2 trees, 4 shrubs, and 12 herbs, with most species from the Asteraceae and Poaceae families. Gamay was dominated by 11 species: 2 trees, 2 shrubs, 6 herbs, and 1 vine, primarily from the Asteraceae family. Lavezares had 10 species, including 1 shrub, 8 herbs, and 1 epiphyte, with most species belonging to the Asteraceae family. Laoang had the highest diversity, with 23 species including 1 tree, 3 shrubs, and 19 herbs, predominantly from the Asteraceae, Cyperaceae, and Poaceae families. Las Navas had 15 species: 2 trees, 2 shrubs, 10 herbs, and 1 vine, mostly from the Fabaceae and Asteraceae families. Lapinig had 17 species, comprising 1 tree, 2 shrubs, 13 herbs, and 1 vine, primarily from the Asteraceae and Fabaceae families. Mapanas had 14 species, including 2 trees, 1 shrub, 10 herbs, and 1 vine, mostly from the Asteraceae and Poaceae families. Finally, Pambujan recorded 17 species: 1 tree, 4 shrubs, 11 herbs, and 1 vine, with most species belonging to the Asteraceae family.

Laoang recorded the highest number of introduced plant species in this study, with 23 species documented; more than any of the other nine sampling areas. The riparian zones of Lapinig, Pambujan, and Las Navas are subject to disturbance due to transportation activities. Additionally, the riparian areas of Lapinig serve as access routes for local communities collecting bivalves, univalves, and crabs. According to Mukaromah (2020), the distribution of invasive plant species is closely associated with the level of disturbance in their respective habitats. The study also concluded that invasive species tend to be superior competitors, more tolerant of human disturbance, and capable of reducing both the abundance and diversity of native species. Therefore, the disturbances observed in the riparian areas of Northern Samar likely contribute to the widespread distribution of invasive alien plant species along the riverbanks.

Table 2 Endemism and conservation status of introduced plant species in the riparian areas of Northern Samar

Family	Species	Endemism	Conservation status	
			IUCN	DENR
Acanthaceae	<i>Acanthus ilicifolius</i> L.	N	LC	-
	<i>Odontonema cuspidatum</i> (Nees) Kuntze	N	-	-
Amaranthaceae	<i>Amaranthus spinosus</i> L.	N	-	-
	<i>Amaranthus viridis</i> L.	N	-	-
	<i>Cyathula prostrata</i> (L.) Blume	N	-	-
Apiaceae	<i>Centella asiatica</i> (L.) Urb.	N	LC	-
	<i>Ageratum conyzoides</i> L.	N	LC	-
	<i>Ageratum houstonianum</i> Mill.	N	-	-
Asteraceae	<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob	N	-	-
	<i>Cyanthillium cinereum</i> (L.) H.Rob.	N	-	-
	<i>Eclipta prostrata</i> (L.) L.	N	LC	-
	<i>Elephantopus mollis</i> Kunth	N	-	-
	<i>Elephantopus tomentosus</i> L.	N	-	-
	<i>Helianthus annuus</i> L.	N	LC	-
	<i>Mikania cordata</i> (Burm.f.) B.H Rob.	N	-	-
	<i>Mikania micrantha</i> Kunth	N	-	-
	<i>Pseudelephantopus spicatus</i> (Juss.ex Aubl.) Rohr	N	-	-
	<i>Sphagneticola trilobata</i> L.	N	-	-
Boraginaceae	<i>Heliotropium indicum</i> L.	N	-	-
Commelinaceae	<i>Commelina diffusa</i> Burm.f	N	-	-
Convolvulaceae	<i>Ipomoea aquatica</i> Forssk.	N	LC	-
	<i>Actinoscirpus grossus</i> (L.f.) Goetgh. & D.A.Simpson	N	LC	-
Cyperaceae	<i>Cyperus brevifolius</i> (Rottb.) Endl.ex Hassk.	N	LC	-
	<i>Cyperus iria</i> L.	N	LC	-
	<i>Cyperus rotundus</i> L.	N	LC	-
	<i>Scleria scrobiculata</i> Nees & Meyen	N	LC	-
	<i>Caesalpinia pulcherrima</i> (L.) Sw.	N	LC	-
Fabaceae	<i>Leucaena leucocephala</i> (Lam.) de Wit	N	-	-
	<i>Mimosa pudica</i> L.	N	LC	-
	<i>Pueraria montana</i> (Lour.) Merr.	N	-	-
Gleicheniaceae	<i>Senna occidentalis</i> (L.)	N	LC	-
	<i>Dicranopteris linearis</i> (Burm.f.) Underw.	N	LC	-
	<i>Hyptis brevipes</i> Poit.	N	-	-
Lamiaceae	<i>Abelmoschus moschatus</i> Medik	N	LC	-
	<i>Sida acuta</i> Burm f.	N	-	-
	<i>Sida rhombifolia</i> L.	N	-	-
Melastomataceae	<i>Urena lobata</i> L.	N	LC	-
	<i>Melastoma malabathricum</i> L.	N	-	-
Myrtaceae	<i>Psidium guajava</i> L.	N	LC	-
Nephrolepidaceae	<i>Nephrolepis cordifolia</i> (L.) C. Presl	N	-	-
Onagraceae	<i>Ludwigia octovalvis</i> (Jacq.) P.H. Raven	N	LC	-
Piperaceae	<i>Piper aduncum</i> L.	N	LC	-

Family	Species	Endemism	Conservation status	
			IUCN	DENR
Poaceae	<i>Agrostis gigantea</i> Roth	N	LC	-
	<i>Arundo donax</i> L.	N	LC	-
	<i>Bambusa vulgaris</i> Schrad. ex J.C.Wendl	N	-	-
	<i>Bromus inermis</i> Leyys.	N	-	-
	<i>Echinochloa colonum</i> (L.)	N	LC	-
	<i>Eleusine indica</i> (L.) Gaertn.	N	LC	-
	<i>Eragrostis elongata</i> (Willd.) Jacq.	N	-	-
	<i>Eragrostis pilosa</i> (L.) P.Beauv	N	-	-
	<i>Imperata cylindrica</i> (L.) P.Beauv.	N	LC	-
	<i>Oplismenus compositus</i> (L.) P. Beauv.	N	LC	-
	<i>Oryzopsis hymenoides</i> Ricker ex Piper	N	-	-
	<i>Saccharum spontaneum</i> L.	N	LC	-
	<i>Themeda triandra</i> Forssk.	N	-	-
	Polygonaceae	<i>Persicaria barbata</i> (L.) H. Hara	N	LC
Schizaeaceae	<i>Lygodium microphyllum</i> (Cav.) R.Br	N	LC	-
Scrophulariaceae	<i>Scoparia dulcis</i> L	N	-	-
Solanaceae	<i>Physalis peruviana</i> L.	N	LC	-
Tiliaceae	<i>Triumfetta rhomboidea</i> Jacq.	N	-	-
	<i>Lantana camara</i> L.	N	-	-
Verbenaceae	<i>Stachytarpheta cayennensis</i> (Rich.) Vahl	N	-	-
	<i>Stachytarpheta indica</i> (L.) Vahl.	N	LC	-
	<i>Stachytarpheta jamaicensis</i> (L.) Vahl	N	LC	-
Zingiberaceae	<i>Hedychium coronarium</i> J. Koenig	N	DD	-

Table 3 Species composition and classification of introduced plant species in the riparian areas of Northern Samar

Sites	Life form					Classification		
	Tree	Shrub	Herb	Vines	Epiphytes	Family	Genus	Species
Allen	1	1	7	-	-	7	9	9
Biri	2	3	3	2	-	7	10	10
Catarman	2	4	12	-	-	9	16	18
Gamay	2	2	6	1	-	7	11	11
Lavezares	-	1	8	-	1	6	10	10
Laoang	1	3	19	-	-	10	22	23
Las Navas	2	2	10	1	-	7	15	15
Lapinig	1	2	13	1	-	10	17	17
Mapanas	2	1	10	1	-	6	14	14
Pambujan	1	4	11	1	-	12	16	17

## Distribution

Invasive plant species are plants that invade the natural ecosystem where they are not normally found, causing substantial damage to the new environment. One of the primary factors that led to the successful establishment of invasive alien species in the environment is the presence of rivers in these areas. Seeds may be dispersed by wind or water, allowing them to colonize new areas rapidly. The constant flow of water also provides an express highway for dispersing propagules downstream. Once these plant species became established in these areas, they could outcompete native plant species and become widespread. Invasive species, by competitive exclusion, niche relocation, or hybridization with related species, can cause the extinction of native species. As a result, in addition to their economic consequences, such invasions can cause significant changes in the structure, composition, and global distribution of biota, resulting in the homogenization of the world's fauna and flora and biodiversity loss (Shuvar *et al.* 2021).

Invasive plant species can significantly damage the environment where they are introduced. Invasive species can harm agriculture and society (Pratt *et al.* 2017). Recent studies show that invasive plant species can cause significant damage to several sectors when successfully establishing new habitats (Shackleton *et al.* 2019; Shrestha *et al.* 2019). For example, in this study, *Chromolaena odorata* is considered one of the most aggressively spreading invasive weeds. It has been designated one of the world's 100 worst invasive plant species. Its spread substantially threatens various ecosystems from subtropical to tropical regions (Koutika & Rainey 2010). It typically invades roadsides, fallow areas, and forest environments, establishing dense monocultures (Thapa *et al.* 2016; Tiébré & Gnanazan 2018). In invaded ecosystems, the weed displaces native species, affects species composition, and severely affects livestock and agricultural fodder (Shackleton *et al.* 2017; Thapa *et al.* 2016). Such negative effects of *C. odorata* on native ecosystems have become a significant environmental challenge.

Across all global regions, the number of alien plant species is continuously increasing. In riparian habitats, these populations are frequently abnormally high, seriously affecting ecosystem services and native species communities (Pabst *et al.* 2022). Various factors influence disturbance's function in enabling plant invasions in riparian

zones. Since riparian vegetation structure is substantially impacted by land use and land cover changes, riparian sites with a more natural land use type tend to have fewer IAPs (Zelnik *et al.* 2020; Fonseca *et al.* 2021). Higher human pressures and hydrological disturbances in low-lying riparian areas produce a profusion of young, disturbed ecosystems that are more vulnerable to invasion, such as river bars (Liendo *et al.* 2021). How land is used next to riparian zones affects how vulnerable the communities are to invasion (Zelnik *et al.* 2020). Controlling invasive plant species in restoration areas can be accomplished through various techniques. The most effective chemical control method relies on several elements, including the species being managed, the available funds, laws (Dechoum *et al.* 2018), and even individual beliefs. Effective management initiatives have typically increased biological diversity. However, it suggests that effective eradication may affect local species and unanticipated ecosystems. When an invasive plant species is removed, for instance, it may result in fewer resources being available for native fauna if other restoration measures are not implemented. Furthermore, once removed, some invasive plant species may continue to impact the system because of their residual effects on the root symbiont and soil microbial communities (Kozioł *et al.* 2018).

Ten (10) species were recorded as Invasive plant species on the Global Invasive Species database, namely: *Chromolaena odorata*, *Elephantopus mollis*, *Sphagneticola trilobata*, *Ipomoea aquatica*, *Leucaena leucocephala*, *Pueraria montana*, *Abelmoschus moschatus*, *Psidium guajava*, *Imperata cylindrica*, and *Lygodium microphyllum* (Table 4). On the other hand, twenty-two (22) species of Invasive plants were listed in the Global Register of Introduced and Invasive Species database - Philippines Database these are *Amaranthus spinosus*, *Cyathula prostrata*, *Ageratum conyzoides*, *Chromolaena odorata*, *Elephantopus mollis*, *Mikania micrantha*, *Pseudelephantopus spicatus*, *Heliotropium indicum*, *Leucaena leucocephala*, *Mimosa pudica*, *Senna occidentalis*, *Hyptis brevipes*, *Sida acuta*, *Urena lobata*, *Psidium guajava*, *Piper aduncum*, *Eleusine indica*, *Imperata cylindrica*, *Scoparia dulcis*, *Lantana camara*, *Stachytarpheta jamaicensis* and *Hedychium coronarium* (Table 4). Furthermore, five species that are common in the two databases include the *Chromolaena odorata*, *Elephantopus mollis*, *Leucaena leucocephala*, *Psidium guajava*, and *Imperata cylindrica* (Table 4).

Table 4 Distribution of introduced plant species in the riparian areas in Northern Samar and confirmed Invasive Plant Species based on Global Invasive Species and Global Register of Introduced and Invasive Species-Philippines Database

Family	Species	Study Area										GISD	GIRSP
		AL	BR	CR	GM	PB	LV	LA	LN	MP	LP		
Acanthaceae	<i>Acanthus ilicifolius</i> L.	+	-	-	-	-	-	-	-	-	+	-	-
	<i>Odontonema cuspidatum</i> (Nees) Kuntze	+	-	-	-	-	-	-	-	-	-	-	-
Amaranthaceae	<i>Amaranthus spinosus</i> L.	-	-	+	-	+	-	-	-	-	-	-	IAS
	<i>Amaranthus viridis</i> L.	-	-	+	-	-	-	-	-	-	-	-	-
	<i>Cyathula prostrata</i> (L.) Blume	-	-	-	-	-	-	+	-	-	-	-	IAS
Apiaceae	<i>Centella asiatica</i> (L.) Urb.	-	-	+	-	-	-	-	-	-	-	-	-
Asteraceae	<i>Ageratum conyzoides</i> L.	-	-	+	+	+	+	+	+	+	+	-	IAS
	<i>Ageratum houstonianum</i> Mill.	-	-	+	-	-	-	-	-	-	-	-	-
	<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob	-	+	-	+	+	+	-	+	-	+	IAS	IAS
	<i>Cyanthillium cinereum</i> (L.) H.Rob.	+	-	-	-	-	-	+	-	+	+	-	-
	<i>Eclipta prostrata</i> (L.) L.	-	-	+	-	-	-	+	-	-	-	-	-
	<i>Elephantopus mollis</i> Kunth	-	-	-	-	-	-	+	-	-	-	IAS	IAS
	<i>Elephantopus tomentosus</i> L.	-	-	-	-	-	-	-	-	+	-	-	-
	<i>Helianthus annuus</i> L.	-	-	+	-	-	-	-	-	-	-	-	-
	<i>Mikania cordata</i> (Burm.f.) B.H Rob.	-	-	-	+	+	-	-	+	-	-	-	-
	<i>Mikania micrantha</i> Kunth	-	+	-	-	-	+	-	-	+	+	-	IAS
	<i>Pseudelephantopus spicatus</i> (Juss.ex Aubl.) Rohr	+	-	-	-	+	-	-	-	-	-	-	IAS
	<i>Sphagneticola trilobata</i> L.	+	-	-	-	+	+	+	+	+	+	IAS	-
Boraginaceae	<i>Heliotropium indicum</i> L.	-	-	-	-	-	-	+	-	-	-	-	IAS
Commelinaceae	<i>Commelina diffusa</i> Burm.f	-	-	-	-	+	-	-	-	-	-	-	-
Convolvulaceae	<i>Ipomoea aquatica</i> Forssk.	-	-	-	-	+	-	-	-	-	-	IAS	-
Cyperaceae	<i>Actinoscirpus grossus</i> (L.f.) Goetgh. & D.A.Simpson	-	-	-	-	-	-	+	-	-	-	-	-
	<i>Cyperus brevifolius</i> (Rottb.) Endl.ex Hassk.	+	-	-	-	-	-	-	-	-	-	-	-
	<i>Cyperus iria</i> L.	-	-	-	-	-	-	+	-	-	-	-	-
	<i>Cyperus rotundus</i> L.	-	-	-	-	-	-	+	-	-	-	-	-
	<i>Scleria scrobiculata</i> Nees & Meyen	-	-	-	-	-	-	+	-	-	-	-	-
Fabaceae	<i>Caesalpinia pulcherrima</i> (L.) Sw.	-	-	+	-	-	-	-	-	-	-	-	-
	<i>Leucaena leucocephala</i> (Lam.) de Wit	-	+	+	+	-	+	+	+	+	-	IAS	IAS
	<i>Mimosa pudica</i> L.	-	+	+	+	+	+	+	+	+	+	-	IAS
	<i>Pueraria montana</i> (Lour.) Merr.	-	+	-	-	-	-	-	-	-	-	IAS	-
	<i>Senna occidentalis</i> (L.)	+	-	-	-	-	-	-	-	-	-	-	IAS
Gleicheniaceae	<i>Dicranopteris linearis</i> (Burm.f.) Underw.	-	-	-	-	-	-	-	-	-	+	-	-
Lamiaceae	<i>Hyptis brevipes</i> Poit.	-	-	-	-	+	-	+	-	-	-	-	IAS
Malvaceae	<i>Abelmoschus moschatus</i> Medik	-	-	-	-	+	+	-	+	-	-	IAS	-
	<i>Sida acuta</i> Burm.f.	-	-	-	-	-	-	+	-	-	-	-	IAS
	<i>Sida rhombifolia</i> L.	-	-	+	-	-	-	-	-	-	-	-	-
	<i>Urena lobata</i> L.	-	-	-	-	-	-	+	-	-	-	-	IAS
Melastomataceae	<i>Melastoma malabathricum</i> L.	-	+	-	+	+	-	+	-	-	+	-	-
Myrtaceae	<i>Psidium guajava</i> L.	+	+	+	+	+	+	+	+	+	+	IAS	IAS
Nephrolepidaceae	<i>Nephrolepis cordifolia</i> (L.) C. Presl	-	-	-	-	-	+	-	-	-	-	-	-

Family	Species	Study Area										GISD	GIRSP	
		AL	BR	CR	GM	PB	LV	LA	LN	MP	LP			
Onagraceae	<i>Ludwigia octovalvis</i> (Jacq.) P.H. Raven	-	-	-	-	+	-	-	-	-	-	-	-	-
Piperaceae	<i>Piper aduncum</i> L.	-	-	-	+	-	-	-	-	-	+	-	-	IAS
Poaceae	<i>Agrostis gigantea</i> Roth	-	-	-	-	-	-	+	-	-	-	-	-	-
	<i>Arundo donax</i> L.	-	-	-	-	-	+	-	+	-	-	-	-	-
	<i>Bambusa vulgaris</i> Schrad. ex J.C.Wendl	+	+	-	+	-	+	+	+	-	+	-	-	-
	<i>Bromus inermis</i> Leyss.	-	-	-	-	-	+	-	+	-	-	-	-	-
	<i>Echinochloa colonum</i> (L.)	-	-	-	-	-	-	+	-	-	-	-	-	-
	<i>Eleusine indica</i> (L.) Gaertn.	-	-	+	-	+	-	+	-	-	-	-	-	IAS
	<i>Eragrostis elongata</i> (Willd.) Jacq.	-	-	-	-	-	-	+	-	-	-	-	-	-
	<i>Eragrostis pilosa</i> (L.) P.Beauv	-	-	-	-	-	-	-	-	+	-	-	-	-
	<i>Imperata cylindrica</i> (L.) P.Beauv.	-	-	+	+	-	+	-	+	+	+	+	IAS	IAS
	<i>Oplismenus compositus</i> (L.) P. Beauv.	-	-	-	-	-	+	-	-	-	-	-	-	-
	<i>Oryzopsis hymenoides</i> Ricker ex Piper	-	-	+	-	-	-	-	-	-	-	-	-	-
	<i>Saccharum spontaneum</i> L.	-	-	-	-	-	+	-	+	+	+	-	-	-
	<i>Themeda triandra</i> Forssk.	-	-	+	-	-	-	-	-	-	-	-	-	-
Polygonaceae	<i>Persicaria barbata</i> (L.) H. Hara	-	-	-	-	+	-	-	-	-	-	-	-	
Schizaeaceae	<i>Lygodium microphyllum</i> (Cav.) R.Br	-	-	-	-	-	-	-	-	-	+	IAS	-	
Scrophulariaceae	<i>Scoparia dulcis</i> L	-	-	-	-	-	-	-	-	+	-	-	IAS	
Solanaceae	<i>Physalis peruviana</i> L.	-	+	-	-	-	-	-	-	-	-	-	-	
Tiliaceae	<i>Triumfetta rhomboidea</i> Jacq.	-	-	+	-	-	-	-	-	-	-	-	-	
Verbenaceae	<i>Lantana camara</i> L.	-	+	-	-	-	-	-	-	-	+	-	IAS	
	<i>Stachytarpheta cayennensis</i> (Rich.) Vahl	-	-	+	-	-	-	-	-	-	-	-	-	
	<i>Stachytarpheta indica</i> (L.) Vahl.	-	-	-	-	+	-	-	-	-	-	-	-	
	<i>Stachytarpheta jamaicensis</i> (L.) Vahl	+	-	-	+	+	+	+	+	+	+	-	IAS	
Zingiberaceae	<i>Hedychium coronarium</i> J. Koenig	-	-	-	-	-	+	-	+	-	-	-	IAS	

Notes: Sampling areas (AL = Allen; BR = Biri; CR = Catarman; GM = Gamay; PB = Pambujan; LV = Lavezares; LA = Laoang; LN = Las Navas; MP = Mapanas; LP = Lapinig); (+) Present; (-) Absent; Database (GISD = Global Invasive Species Database; GIRSP = Global Register of Introduced and Invasive Species–Philippines).

## CONCLUSION

Northern Samar's riverbanks have many introduced invasive plants, mostly herbs and shrubs, coming from different families like Poaceae and Asteraceae. These plants grow differently in each area because of changes in soil, weather, and human activities like transportation and gathering. Rivers help spread their seeds, making it easier for them to take over. These invasive plants can outcompete native ones and harm the local environment. To protect nature and native plants, it's important to manage and reduce the disturbances that help these invasive species spread.

## REFERENCES

- Bacon SJ, Aebi A, Calanca P, Bacher S. 2014. Quarantine arthropod invasions in Europe: the role of climate, hosts, and propagule pressure. *Divers Distribution* 20(1):84-94. DOI: 10.1111/ddi.12149
- Bellard C, Cassey P, Blackburn TM. 2016. Alien species as a driver of recent extinctions. *Biol Lett* 12:1-4. DOI: 10.1098/rsbl.2015.0623
- Castro-Díez P, Vaz AS, Silva JS, Van Loo M, Alonso Á, Aponte C. 2019. Global effects of non-native tree species on multiple ecosystem services. *Biol. Rev* 94 (4):1477-1501. DOI: 10.1111/brv.12511
- Dechoum MDS, Sampaio AB, Ziller SR, Zenni RD. 2018. Invasive species and the global strategy for plant conservation: How close has Brazil come to achieving Target 10? *Rodriguesia* 69(4):1567-76. DOI: 10.1590/2175-7860201869407

- DENR Administrative Order [Internet]. 2017. Updated national list of threatened Philippine plants and their categories (DAO No. 2017 -11). Visayas Avenue, Diliman, Quezon City: Department of Environment and Natural Resources; [cited 2024 March 7]. Available from: <https://elibrary.bmb.gov.ph/elibrary/wp-content/uploads/2023/05/dao2017-11.pdf>
- Diesmos A, Scheffers B, Mallari N, Siler C, Brown R. 2020. A new forest frog of the genus *Platymantis* (Amphibia: Anura: Ceratobatrachidae: subgenus *Tirahanulap*) from Leyte and Samar islands, Eastern Philippines. *Zootaxa* 4830:573-91. DOI: 10.11646/ZOOTAXA.4830.3.6
- Diesmos AC, Watters JL, Huron NA, Davis DR, Alcalá AC, Crombie RI, Siler CD. 2015. Amphibians of the Philippines, Part 1: Checklist of the species. *Proceedings of the California Academy of Sciences* 2015:457-539.
- Fan P, Ouyang Z, Basnou C, Pino J, Park H, Chen J. 2017. Nature-based solutions for urban landscapes under post-industrialization and globalization: Barcelona versus Shanghai. *Environ. Res.* 156:272-83.
- Fonseca A, Ugille JP, Michez A, Rodríguez-González PM, Duarte G, Ferreira MT, Fernandes MR. 2021. Assessing the connectivity of Riparian Forests across a gradient of human disturbance: The potential of Copernicus “Riparian Zones” in two hydroregions. *Forests* 12(6):1-14. DOI: 10.3390/f12060674
- Gaertner M, Larson BMH, Irlich UM, Holmes PM, Stafford L, van Wilgen BW, Richardson DM. 2016. Managing invasive species in cities: A framework from Cape Town, South Africa. *Landscape Urban Plann* 151:1-9.
- Global Compendium of Weeds [Internet]. 2007. [updated 23 November 2018; cited 2024 May 16]. Available from: <http://www.hear.org/gcw/scientificnames/> Invasive Species Specialist Group [Internet]. 2020. [cited 2024 May 16]. Available from: <https://www.iucngisd.org/gisd/>
- IUCN. 2023. The IUCN Red List of Threatened Species. [Internet] [cited 2024 May 16]. Available from: <https://www.iucnredlist.org>
- Katsanevakis S, Wallentinus I, Zenetos A, Leppakoski E, Cinar ME, Ozturk B, Cardoso C, 2014. Impacts of invasive alien marine species on ecosystem services and biodiversity: apan-European review. *Aquat Invasions* 9(4):391-423. DOI: 10.3391/ai.2014.9.4.01
- Keong CY. 2015. Sustainable resource management and ecological conservation of mega-biodiversity: The Southeast Asian big-3 reality. *Int J Environ Sci Dev* 6(11):876-82.
- Koutika LS, Rainey HJ. 2018. *Chromolaena odorata* in different ecosystems: Weed or fallow plant? *Appl Ecol Environ Res* 8(2):131-42.
- Kozioł LIZ, Schultz PA, House GL, Bauer JT, Middleton EL, Bever JD. 2018. The plant microbiome and native plant restoration: The example of native mycorrhizal fungi. *BioScience* 68(12):996-1006. DOI: 10.1093/biosci/biy125
- Levitonet AE, Siler CD, Weinell JL, Brown RM. 2018. Synopsis of the snakes of the Philippines: A synthesis of data from biodiversity repositories, field studies, and the literature. *Proceedings of the California Academy of Sciences* 2018:399-568.
- Liendo D, Biurrún I, Campos JA, García-Mijangos I, Pearman PB. 2020. Effects of disturbance and alien plants on the phylogenetic structure of riverine communities. *J Veget Sci* 32(1):1-11. DOI: 10.1111/jvs.12933
- Mollot G, Pantel JH, Romanuk, NT. 2017. The effects of invasive species on the decline in species richness: A global meta-analysis. *Advances in Ecological Research*, Academic 56:61-83. DOI: 10.1016/bs.aecr.2016.10.002
- Mukaromah L, Imron MA. 2020. Invasive plant species in the disturbed forest of Batukahu Nature Reserve, Bali, Indonesia. *BIOTROPIA* 27(1):22-32. DOI: 10.11598/btb.2020.27.1.933
- Pabst R, Dias FP, Borda de Agua L, Gonzalez PMR, Cipanha C. 2022. Assessing and predicting the distribution of riparian invasive plants in Continental Portugal. *Front Ecol Evol* 10:1-10. DOI: 10.3389/fevo.2022.875578
- Patindol TA. 2016. Post-biological assessment of faunal resources in the Samar Island Natural Park. *Ann Trop Res* 38(2):52-73. DOI: 10.32945/atr3824.2016
- Pelster P, Barcelona J, Nickrent D. 2011. Co's Digital Flora of the Philippines; [Internet]. [updated 2013 January 31; cited 2024 March 20]. Available from: <http://www.philippineplants.org/>
- POWO 2024. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. [Internet]. [cited 2024 June 02]. Available from: <https://powo.science.kew.org/>
- Pratt CF, Constantine KL, Murphy ST. 2017. Economic impacts of invasive alien species on African smallholder livelihoods. *Glob Food Secur* 14:31-37. DOI: 10.1016/j.gfs.2017.01.011
- PTFCF. 2015. Status of Philippine Forests. Philippine Tropical Forest Conservation Foundation, Inc. [Internet] [cited 2024 June 03]. Available from: <https://www.forestfoundation.ph>
- Quimio JM. 2016. Floral Composition and Timber Stock of Forest in the Samar Island Natural Park. *Annals of Tropical Research* 38(2):30-51. DOI: 10.32945/atr3823.2016
- Shackleton RT, Biggs R, Richardson DM, Larson BMH. 2018. Social-ecological drivers and impacts of invasion-related regime shifts: consequences for ecosystem services and human wellbeing. *Environ Sci Policy* 89:300-14. DOI: 10.1016/j.envsci.2018.08.005
- Shackleton RT, Larson BM, Novoa A, Richardson DM, Kull CA. 2019. The human and social dimensions of invasion science and management. *J Environ Manage* 229:1-9. DOI: 10.1016/j.jenvman.2018.08.041
- Shackleton RT, Witt ABR, Nunda W, Richardson DM. 2017. *Chromolaena odorata* (Siam weed) in eastern Africa: Distribution and socio-ecological impacts. *Biol Invasions* 19(4):1285-98. DOI:10.1007/s10530-016-1338-4
- Shrestha BB, Shrestha UB, Sharma KP, Thapa-Parajuli RB, Devkota A, Siwakoti M. 2019. Community perception

- and prioritization of invasive alien plants in Chitwan-Annapurna Landscape, Nepal. *J Environ Manage* 229:38-47. DOI: 10.1016/j.jenvman.2018.06.034
- Shuvar I, Korpita H, Shuvar A, Shuvar B, Kropyvnytskyi R. 2021. Invasive plant species and the consequences of its prevalence in biodiversity. *BIO Web of Conferences* 31:1-4. DOI: 10.1051/bioconf/20213100024
- Thapa LB, Pathak S, Pal KB, Miya TM, Darji TB, Pant G, Pant RR. 2021. Chemical constituents of the essential oil of invasive *Chromolaena odorata* leaves in Central Nepal. *J Nepal Chem Soc* 42(1):132-7. DOI: 10.3126/jncs.v42i1.35364
- Tiébré MS, Gnanazan GZR. 2018. Impact of *Chromolaena odorata* (L.) R.M. King & H. Rob. (Asteraceae) on the floristic composition and the physico-chemical properties of the soil of a coastal relict forest. *Int J Innov Appl Studies* 2492:773-88.
- Ullah R, Khan N, Hewitt N, Ali K, Jones DA, Khan MEH. 2022. Invasive species as rivals: invasive potential and distribution pattern of *Xanthium strumarium* L. *Sustainability* 14(12):1-20. DOI: 10.3390/su14127141
- Weinell JL, Paluh DJ, Siler CD, Brown RM. 2020. A new, miniaturized genus and species of snake (Cyclocoridae) from the Philippines. *Copeia* 108(4):907-23. DOI: 10.1643/CH2020110
- Zelnik I, Mavrič KV, Gaberčič A. 2020. Complex undisturbed riparian zones are resistant to colonisation by invasive alien plant species. *Water* 12(2):1-14. DOI: 10.3390/w12020345