REVISTA BIO CIENCIAS
http://revistabiociencias.uan.edu.mx
https://doi.org/10.15741/revbio.13.e1930
ISSN 2007-3380

Original article / Artículo original

Exotic and Invasive Plants in the APFF Gulf of California Islands, Sinaloa Section, Mexico.

Plantas Exóticas e Invasoras en el APFF Islas del Golfo de California Sección Sinaloa, México.

Díaz, J. S. [1,2], *Salomón-Montijo, B.*[1,2*], *Márquez-Salazar, G.*[1], *Gamez-Duarte, E. A.* [2], *Romero-Higareda, C.* [1,2], *Díaz-Zazueta, M. A.*[2], *Uriarte-Sarabia, D.*[1]

[1] *Facultad de Biología, Universidad Autónoma de Sinaloa. Ciudad Universitaria, Blvd. de las Américas y Blvd. Universitarios S/N. C. P. 80013, Culiacán Rosales, Sinaloa, México.*
[2] *Posgrado en Ciencias Biológicas, Facultad de Biología, Universidad Autónoma de Sinaloa. Ciudad Universitaria, Blvd. de las Américas y Blvd. Universitarios S/N. C. P. 80013, Culiacán Rosales, Sinaloa, México.*

Please cite this article as/Como citar este artículo: Díaz, J. S., Salomón-Montijo, B., Márquez-Salazar, G., Gamez-Duarte, E. A., Romero-Higareda, C., Díaz-Zazueta, M. A., Uriarte-Sarabia, D. (2025). Exotic and Invasive Plants in the APFF Gulf of California Islands, Sinaloa Section, Mexico. *Revista Bio Ciencias*, 13, e1930. https://doi.org/10.15741/revbio.13.e1930

Article Info/Información del artículo
Received/Recibido: March 18, 2025.
Accepted/Aceptado: November 19, 2025.
Available on line/Publicado: January 09, 2026.

ABSTRACT

The floristic database was analyzed, and field surveys were conducted across the insular complex of the Flora and Fauna Protection Area Islas del Golfo de California (APFF), Sinaloa section, which includes 541 recorded species. Of these, 180 are non-native to the insular complex; 131 are classified as invasive in CONABIO's Integrated System of Invasive Species (SIEI), and 32 are listed both in the Global Invasive Species Database (GISD) of the IUCN and by Villaseñor and Espinoza-García. Six species rank among the 100 most harmful worldwide, and nine are of fundamental importance to the country. A total of 94 species fall into use categories such as ornamental, fruit, medicinal, cereal, and oilseed (O, F, M, C, L). The Insular System IV, comprising the Bledos, Maviri, Mazocahui, Patos, and Santa María islands, exhibits the highest species richness, with 127 species. This is followed by System II, which includes the Altamura, Garrapata, Saliaca, and Tachichilte islands, with 87 species.

KEY WORDS: Protected Natural Area, Gulf of California, Sea of Cortés, island system, floristic, ornamentals, fruit-bearing plants.

***Corresponding Author:**

Bladimir Salomón-Montijo. Facultad de Biología, Universidad Autónoma de Sinaloa. Ciudad Universitaria, Blvd. de las Américas y Blvd. Universitarios S/N. C. P. 80013, Culiacán Rosales, Sinaloa, México. Teléfono: (+52)667 716 1139.
Email: vladimir.salomon@uas.edu.mx

Revista Bio ciencias
ISSN 2007-3380

RESUMEN

Se analizó la base de datos florísticos y se realizaron exploraciones al complejo insular del Área de Protección de Flora y Fauna Islas del Golfo de California (APFF) sección Sinaloa, que incluye 541 especies registradas. De ellas, 180 son ajenas al complejo insular, 131 se catalogan como invasoras en el Sistema Integral de Especies Invasoras (SIEI) de la Comisión Nacional para el Conocimiento de la Biodiversidad en México y 32 a nivel internacional por el Global Invasive Species Database (GISD) de la IUCN, así como por Villaseñor y Espinoza-García. Seis especies figuran entre las 100 más nocivas a nivel mundial y nueve son de importancia fundamental para el país. Un total de 94 especies corresponden a categorías de uso como ornamentales, frutales, medicinales, cereales y oleaginosas (O,F,M,C,L). El Sistema Insular IV, compuesto por las islas Bledos, Maviri, Mazocahui, Patos y Santa María, es el de mayor riqueza con 127 especies, seguido por el Sistema II que incluye las islas Altamura, Garrapata, Saliaca y Tachichilte con 87.

PALABRAS CLAVE: Área Natural Protegida, Golfo de California, Mar de Cortés, Sistema insular, florística, malezas, ornamentales, frutales.

Introduction

Exotic invasive species comprise a unique group of organisms, including animals, plants, algae, fungi, and microorganisms, that possess a high ability to adapt to various environmental conditions, reproduce efficiently, and compete with native species (Jeschke *et al*., 2014). These species are often introduced outside their original habitats, usually unintentionally, although deliberate introductions by humans also happen. Often, they cause negative effects on the recipient environment (Uzomachukwu *et al*., 2024), mainly impacting biodiversity and ecosystem services, altering the germination and survival of local species, degrading soil quality, and decreasing groundwater availability (Damodaram-Premakumari *et al*., 2022; Afreen *et al*., 2023). Additionally, they interact with other global change factors like deforestation and climate change, which can increase the presence and numbers of certain species, intensifying their effects on ecosystems and human societies (Martínez-Meyer *et al*., 2016). In this context, invasive species can alter the structure and function of ecosystems, further threatening native species (Zhang, 2023; Sesay *et al*., 2024), and contribute to their extinction through hybridization processes (Abbot, 1992). According to Whittaker *et al*. (2023), invasive species have played a key role in 60 % of global extinctions since 1500 CE caused by human activities. Unlike weeds, which mainly impact agricultural systems, invasive species affect a much wider range of ecological attributes. In island ecosystems, they are considered the primary cause of the rising extinction rates of native species after habitat destruction (Sherley *et al*., 2000; Kiehn, 2011), because they alter local ecosystems,

Revista Bio ciencias
ISSN 2007-3380

community composition, ecosystem processes, and social sustainability (Sharma *et al*., 2005; Stout, 2011; Li *et al*., 2024). The National System of Invasive Species of the National Commission for the Knowledge and Use of Biodiversity (CONABIO) has initially identified 472 invasive species in Mexico (Estrada-Arellano *et al*., 2018), with 46 among the 100 most harmful species worldwide (Lowe *et al*., 2004), including 36 that are exotic relative to the national flora and 10 that are native but considered exotic elsewhere in the world. Protected Natural Areas (PNAs), recognized as an effective and legal strategy for biodiversity conservation in Mexico, face serious threats due to the spread of species alien to their natural environments (Kannan *et al*., 2013). Currently, this issue is among the greatest concerns for biodiversity conservation at both national and international levels (Lowe *et al*., 2004), posing a significant challenge for PNA managers worldwide (Foxcroft *et al*., 2017). Mexican islands, in particular, are of critical importance for biodiversity conservation both nationally and globally, as they host unique ecosystems and species not found anywhere else on the planet. They also serve as vital habitats for feeding, reproduction, and shelter for numerous native and migratory species of flora and fauna (Aguirre-Muñoz & Mendoza-Alfaro *et al*., 2009; Rodríguez-Malagón *et al*., 2012). These characteristics have resulted in their inclusion in the PNA system. Mexico has an extensive insular territory of approximately 8,000 km^2, made up of islands, cays, rocks, and reefs. This area includes 4,111 insular entities, of which 3,210 are classified as islands, spread across the country's territorial sea and exclusive economic zone in the Pacific Ocean, Gulf of Mexico, Caribbean Sea, and Gulf of California. In northwestern Mexico, the Gulf of California, bounded by the eastern coast of the Baja California Peninsula and the coasts of Sonora and Sinaloa, has numerous islands and islets that vary in shape, size, and ecological features. In that state, 423 insular entities have been documented, including islands, islets, rocks, cays, cliffs, and reefs (INEGI, 2015). In Sinaloa, the islands are spread along 600 km of coastline and were designated as a Protected Natural Area (PNA) in the decree Islas del Golfo de California on August 2nd, 1978 (DOF, 1978). Later, on June 7, 2000, they were incorporated into the Biosphere Reserve Islas del Golfo de California as a Flora and Fauna Protection Area (APFF) (DOF, 2001). In 2005, they gained recognition as a UNESCO World Heritage Site. These islands are among the areas most impacted by high-impact invasive species, and due to their importance for biodiversity, it is crucial to implement eradication, control, and management programs. The current study aims to provide updated information on invasive and exotic species present on the islands of Sinaloa state, including cultivated ones. This information will be essential for APFF managers to support decision-making and establish actions that help protect the islands, prevent changes to the flora and fauna, and maintain the functional integrity of their various insular ecosystems.

Material and Methods

Study area

The studied islands are located between 23°13'20" N and 106°28'41" W, and 25°37'47.99" N and 109°15'44.11" W, stretching along the coastline from the municipality of Mazatlán in the south to Ahome at the northern edge of Sinaloa. The insular complex varies considerably in size and shape (**Table 1**). Some islands are completely flat, while others feature steep slopes and sand ridges over 20 meters high. The main soil types include Arenosols, which are common in beach

Revista Bio ciencias
ISSN 2007-3380

and dune areas, as well as Solonchak and Vertisol in flood-prone zones, where the soil material stabilizes. Several islands also contain volcanic rocks, such as ignimbrites, rhyolitic tuffs, and tuffaceous sandstones, which support thin Chernozem-like soil layers and reach elevations of up to 200 meters.

Table 1.- Coordinates, area, and type of the studied islands.

ISLES	COORDINATES	AREA km^2	TYPE
1.- Lobos	23° 13’ 20.” N y 106° 28’ 41” O	0.10	Rocky
2.- Venados	23° 14’ 3.745” N y 106° 27’ 59.468” O	0.54	Rocky
3.- Pájaros	23° 15’ 15.627” N y 106° 28’ 36.113” O	0.56	Rocky
4.- Altamura	24° 57’ 29.202” N y 108° 11’ 5.163” O	81.31	Sandy
5.- Tachichilte	24° 56’ 15.627” N y 108° 5’ 15.189” O	130.91	Clay
6.- Garrapata	25° 10’ 3.636” N y 108° 15’ 35.532” O	5.28	Clay
7.- Saliaca	25° 10’ 31.376” N y 108° 19’ 26.783” O	20.17	Sandy
8.- Macapule	25° 20’ 43.216” N y 108° 38’ 27.096” O	25.63	Sandy
9.- Vinoramas	25° 23’ 21.236” N y 108° 45’ 54.495” O	8.81	Sandy
10.- San Ignacio	25° 24’ 57.685” N y 108° 53’ 5.705” O	36.67	Sandy
11.- Tesobiare	25° 29’ 45.028” N y 108° 49’ 17.718” O	4.97	Rocky
12.- Niscoco	25° 30’ 3.018” N y 108° 51’ 30.864” O	5.11	Rocky
13.- Mazocahui	25° 34’ 10.273” N y 109° 0’ 45.317” O	0.14	Rocky
14.- Bledos	25° 36’ 4.329” N y 108° 59’ 0.806” O	0.09	Rocky
15.- Patos	25° 37’ 12.867” N y 109° 0’ 46.966” O	0.15	Rocky
16.- Maviri	25° 35’ 49.315” N y 109° 8’ 11.615” O	9.14	Sandy
17.- Santa María	25° 37’ 47.990” N y 109° 15’ 44.118” O	25.88	Sandy

Revista Bio ciencias
ISSN 2007-3380

Climate

The climate across the islands' distribution varies. In the southern part, near the Bay of Mazatlán, a tropical to subtropical climate dominates, with an average annual temperature of 24.1 °C and mean annual rainfall of 800.3 mm, classified as the Aw climate type (Flores *et al*., 1996). In the central area, yearly rainfall averages 650 mm, and temperatures range from 12 °C to 36 °C. In the northernmost region of the state, the climate is semi-arid, with summer rains from July to October, an average annual rainfall of 240 mm, and an average temperature of 24 °C, classified as the BW(h')w(e) type in the Köppen system modified by García (2004). While most rainfall occurs between July and September, the winter dry season still shows high humidity due to dense ocean fogs.

Insular systems

Between 2021 and 2024, 17 islands were explored and selected for their representativeness in vegetation cover and prior floristic studies. The goal was to identify cactus species and other floristic groups, including exotic and invasive taxa, within the Flora and Fauna Protection Area (APFF), Islas del Golfo de California, Sinaloa section. Based on this study, the insular complex was divided into four systems, classified by the municipalities where they are located, from south to north across the state, as follows:

I.- Mazatlán: El Crestón, Lobos, Venados, and Pájaros islands, with a floristic richness of 139 species (Flores-Campaña *et al*., 1996; Vega-Aviña *et al*., 2001; Díaz *et al*., 2021).

II.- Angostura: Tachichilte, Altamura, Garrapata, and Saliaca islands, where 294 species have been recorded (Díaz *et al*., 2022).

III.- Guasave: Macapule, San Ignacio, Niscoco, Tesobiare, and Vinoramas islands, with 267 identified species (Díaz *et al*., 2008).

IV.- Ahome: Mazocahui, Patos, Bledos, Maviri, and Santa María islands, with 315 recorded species (Reyes-Olivas, 2001; Díaz *et al*., 2023; Díaz *et al*., 2025). (**Figures 1 and 2**).

Revista Bio ciencias
ISSN 2007-3380

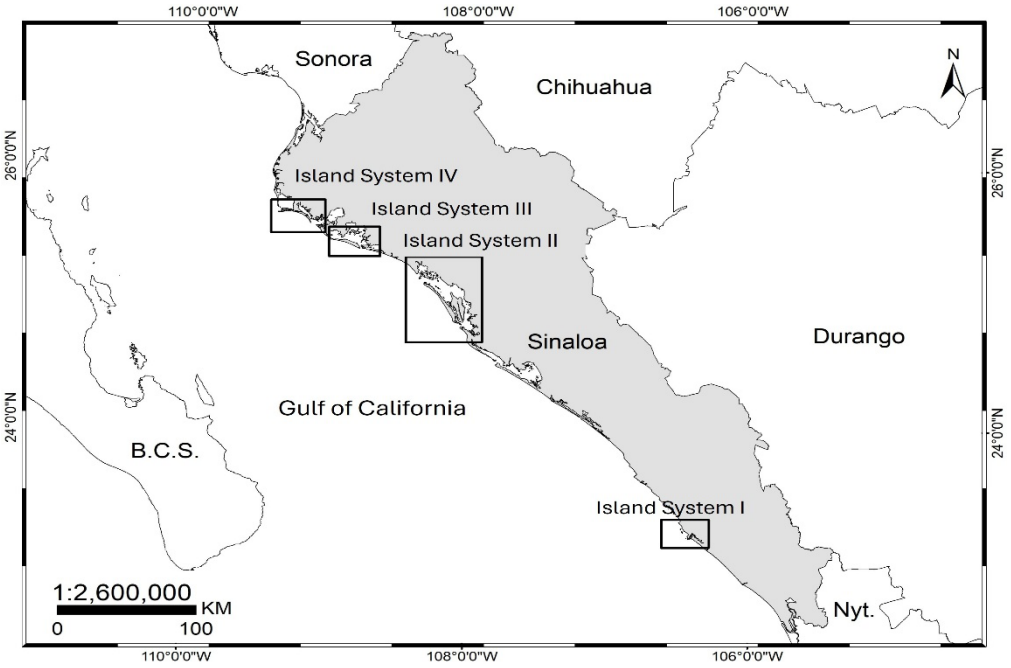

Figure 1.- Location of the four island systems in Sinaloa state.

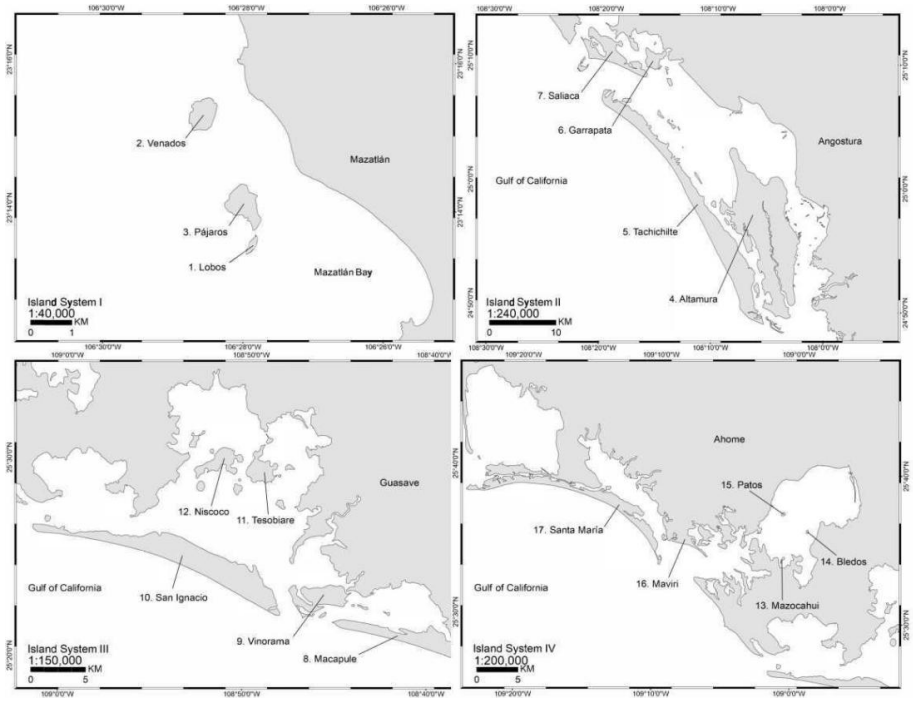

Figure 2.- Island systems: A) System I, B) System II, C) System III, and D) System IV.

Revista Bio ciencias
ISSN 2007-3380

Cartography was created using ArcGIS 10.5 software, utilizing a geographic coordinate system based on longitude and latitude. The vector data includes the state's political boundaries from the National Institute of Statistics and Geography (INEGI, 2022) and the land use and vegetation type map, Series VII (INEGI, 2018).

Floristic treatment

To identify invasive species, both exotic (IE) and native (IN), as well as those classified as ornamental, fruit, medicinal, cereal, and oilseed (O, F, M, C, L), data from previous studies were analyzed (Flores-Campaña *et al*., 1996; Vega-Aviña *et al*., 2001; Reyes-Olivas, 2001; Díaz, 2008; Díaz *et al*., 2023; Díaz *et al*., 2025). Additionally, field surveys were conducted during all four seasons from November 2021 to September 2024, during which species were verified, and new, previously unreported taxa were added. In each exploration, plant species were identified *in situ*, and an image bank was created to document the floristic specimens. Unrecorded samples were collected and stored at the Herbarium of the Culiacán Botanical Garden (HJBC). Invasive species identification at the national level followed the guidelines of Villaseñor & Espinosa-García (2004) and the Invasive Species Information System (SIEI) of CONABIO (2022). For international identification, the Global Invasive Species Database (ISSG, 2025) and Lowe *et al.* (2004) were used. The species list was organized alphabetically by family, genus, and species, according to The Angiosperm Phylogeny Group *et al*. (APG, 2016) classification system. Scientific names, authors, and families were updated based on Plants of the World Online (POWO, 2025) and Villaseñor (2016). The geographic origin of each species was recorded and grouped into three major regions: Old World (OW: Europe, Asia, and Africa), New World (NW: South America, Central America, North America, and the Caribbean islands), and Oceania (O: Australia, New Guinea, New Zealand, Polynesia, Micronesia, and Melanesia), following Villaseñor & Espinosa-García (2004). For each species, the scientific name, author, family, and biological form were recorded, classified as: A (tree), Ar (shrub), H (herb), Ra (creeping), Ro (rosette-forming), Su (succulent), Tr (climber), and E (epiphyte), based on Macías-Rodríguez *et al*. (2018). The abundance observed during field surveys was assessed using Tansley's (1946) scale, with categories: D (dominant, >100 individuals), A (abundant, 50-100 individuals), F (frequent, 21-50 individuals), O (occasional, 6-20 individuals), and R (rare, 1-5 individuals).

Results

Floristic richness

The vegetation on the islands consists of typical formations found in arid and semi-arid regions, including thorn forests, xerophilous scrublands, mangroves, halophytic plants, and small patches of grassland. The recorded plant diversity includes 97 families and 541 species. Among these, 180 species are classified as exotic invasive (IE), native invasive (IN), ornamental (O), fruit (F), cereal (C), oilseed (S), and medicinal (M) plants, spread across 241 genera and 75 families. The most common plant families are Poaceae (19 species), Fabaceae (17 species), and Asteraceae (13 species). The genera with the greatest number of species are *Euphorbia* (8),

Revista Bio ciencias
ISSN 2007-3380

Ipomoea, and *Cyperus* (4 each), followed by *Cenchrus*, *Citrus*, *Phoenix*, and *Opuntia* (3 each) (Appendix I).

Among the four island systems studied, systems IV and II have the highest richness of foreign species, with 127 and 87, respectively. Regarding the proportions of non-native species compared to the previously recorded flora in the island complex, systems IV and I stand out, with 40.31 % and 33.09 %, respectively (Table 2).

Table 2.- Species outside of the island systems, previous floristic reports and proportion of external species with respect to the total reported flora.

ISLAND SYSTEM	TOTAL FLORA	FOREIGN SPECIES	PROPORTION
I	139	46	33.09
II	294	87	29.59
III	267	52	19.47
IV	315	127	40.31

Native and exotic invasive plants

Across the four island systems, 131 invasive species were identified, with 118 included in the Invasive Species Information System CONABIO (2022). Of these, 49 are classified as native invasive (IN) and 69 as exotic invasive (IE) species. Additionally, 32 species are categorized as exotic according to Villaseñor & Espinosa-García (2004), and another 32 are listed in the Global Invasive Species Database of the Invasive Species Specialist Group (ISSG, 2025). Six taxa are among the world's 100 most harmful exotic species (Lowe *et al*., 2004): *Arundo donax* L., *Lantana camara* L., *Leucaena leucocephala* (Lam.) de Wit, *Mimosa pigra* L., *Schinus terebinthifolius* Raddi, and *Tamarix ramosissima* Ledeb. Likewise, 10 species are listed in the List of Invasive Exotic Species for Mexico (DOF, 2016): *Argemone mexicana* L., *A. donax*, *Cenchrus ciliaris* L., *Cryptostegia grandiflora* Roxb. ex R. Br., *Cucumis dipsaceus* Ehrenb. ex Spach., *Dactyloctenium aegyptium* (L.) Willd., *Digitaria ciliaris* (Retz.) Koeler, *Eleusine indica* (L.) Gaertn., *Melinis repens* (Willd.) Zizka, and *Ricinus communis* L. Four species are classified as priority terrestrial invasive plants for Mexico: *C. ciliaris*, *M. repens*, *T. ramosissima*, and *Casuarina equisetifolia* L. Additionally, 10 aquatic invasive species were identified as present within Mexican Protected Natural Areas (ANP): *A. donax*, *Cyperus articulatus* L., *Lemna aequinoctialis* Welw., *Mimosa pigra* L., *Pluchea odorata* (L.) Cass., *Schoenoplectus americanus* (Pers.) Volkart, *Sesbania herbacea* (Mill.) McVaugh, *Tamarix aphylla* (L.) H. Karst., *T. ramosissima,* and *Typha domingensis* Pers. Among these, three species are classified as High-Impact Aquatic Invasive Organisms according to Mendoza & Koleff (2014): *A. donax*, *T. ramosissima*, and *T. domingensis*. Moreover, 94 species

Revista Bio ciencias
ISSN 2007-3380

with various uses were recorded: 68 ornamental (O), 22 fruit (F), two medicinal (M), one cereal (C), and one oilseed (L). Among the ornamental species found in at least two island systems, the following stand out: *Azadirachta indica* A. Juss., *Bauhinia variegata* L., *Bougainvillea spectabilis* Willd., *Caesalpinia pulcherrima* (L.) Sw., *Gossypium hirsutum* L., *Hibiscus tiliaceus* L., *Terminalia buceras* (L.) C. Wright, and *T. cattapa* L. Concerning fruit species, *Citrullus lanatus* (Thunb.) Matsum. & Nakai, *Citrus* × *limon* (L.) Osbeck, and *Momordica charantia* L. are the most widely distributed (Appendix I). In terms of life forms (Figure 3), herbs (H) predominate at 40.0%, followed by shrubs (Ar) with 24.4%, and trees (A) at 16.1%. The remaining species are distributed among creeping, climbing, rosetophilous, and epiphytic forms. Regarding abundance (Figure 4), 72.6% of species are classified as rare (R), 8.8% as dominant (D), 8.3% as frequent (F), and the remaining 10.6% as occasional (O) or abundant (A). Among the invasive species that are ornamental and fruit-bearing, most originate from the New World (NW), representing 58.08%, mainly from North and South America. This is followed by the Old World (OW) with 36.68%, primarily from Africa and Asia. Finally, Oceania (O) accounts for 4.59% of the total (Appendix I).

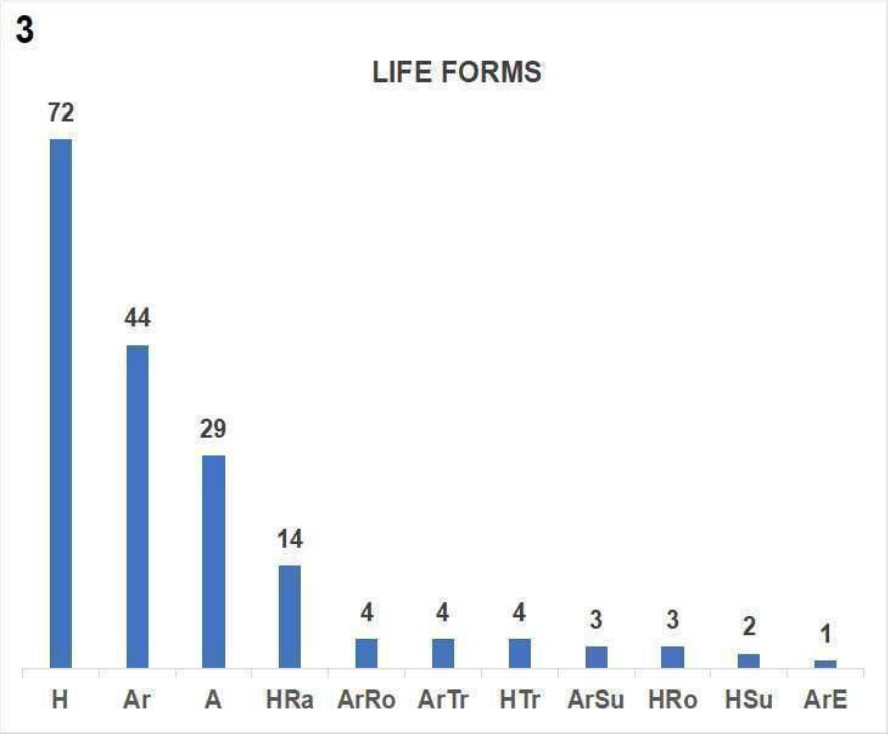

Figure 3.- Main forms of plant life: Herbs (H), Shrubs (Ar), Trees (A), Creeping Herbs (HRa), Rosetophilous Shrubs (ArRo), Climbing Shrubs (ArTr), Climbing Herbs (HTr), Succulent Shrubs (ArSu), Rosetophilous Herbs (HRo), Succulent Herbs (HSu), Epiphytic Shrubs (ArE)

Revista Bio ciencias
ISSN 2007-3380

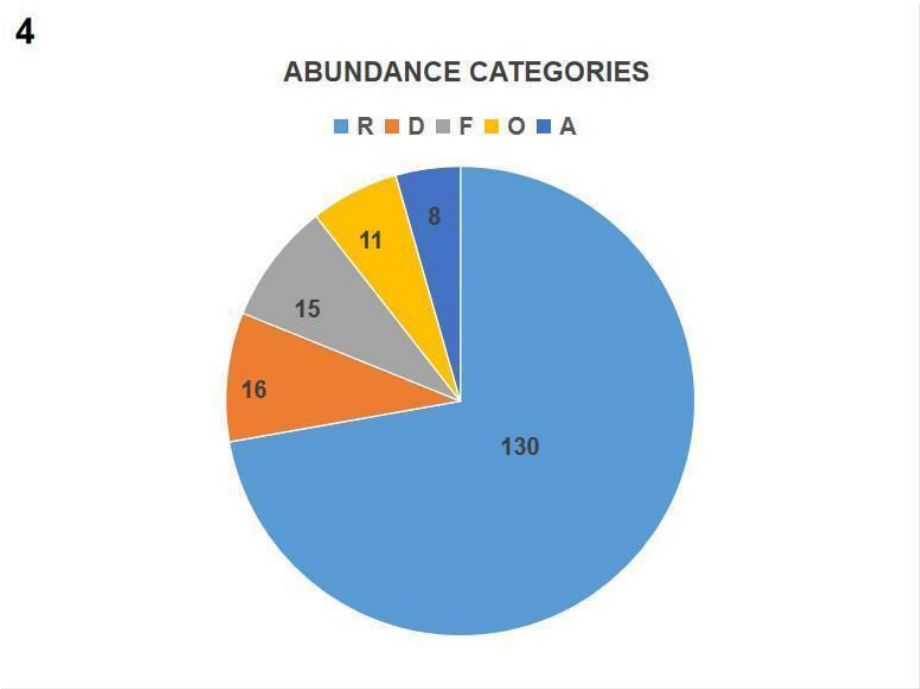

Figure 4.- Abundance categories: Abundant (A), Occasional (O), Frequent (F), Dominant (D), Rare (R).

Discussion

The number of invasive species found in this study for the Flora and Fauna Protection Area (APFF) Islas del Golfo de California, in Sinaloa, greatly exceeds those reported for the other islands within the same APFF located in Baja California and Sonora, where only 31 invasive species have been recorded (Rebman *et al*., 2002; Felger *et al*., 2012). Similarly, the most diverse plant families identified in this study (Fabaceae, Poaceae, and Asteraceae) match those reported by Denslow *et al*. (2009) in their analysis of 114 islands across 15 countries in the tropical Pacific Ocean.

Of the 69 invasive species identified in the study area, 22 have been assessed using the Rapid Invasiveness Assessment Method (CONABIO, 2015), which provided their respective invasiveness indices. Species with the highest invasiveness indices include *Cenchrus ciliaris* (0.663), *Tamarix aphylla* (0.619), *Eucalyptus globulus* Labill (0.613), *Arundo donax* (0.607), *T. ramosissima* (0.596), *Catharanthus roseus* (L.)G. Don (0.578), *Melinis repens* (0.551), and *Cryptostegia grandiflora* (0.531), all classified as Very High Invasiveness Risk (Golubov *et al*.,

Revista Bio ciencias
ISSN 2007-3380

2014). These species therefore require prioritized attention and immediate eradication efforts (Comité Asesor Nacional sobre Especies Invasoras, 2010).

Although March-Mifsut & Martínez-Jiménez (2007) reported that there are no high-impact invasive species on the islands of the Gulf of California, the results of this study contradict that statement. The floristic analysis of the Sinaloa island complex identified six taxa listed among the 100 most harmful exotic species worldwide (Lowe *et al*., 2004), as well as 10 species included in the List of Invasive Exotic Species for Mexico (DOF, 2016). Additionally, four terrestrial invasive plant species classified as a priority for Mexico and 10 aquatic invasive species found in Mexican Protected Natural Areas were detected, three of which are considered High-Impact Aquatic Invasive Organisms (Mendoza & Koleff, 2014).

Out of the seven species considered to have the greatest impact within Mexican Protected Natural Areas (Estrada-Arellano *et al*., 2018), six are present in the study area. Additionally, of the 15 exotic invasive species reported for the El Verde Camacho Beach Sanctuary in Mazatlán, Sinaloa (Márquez-Salazar *et al*., 2021), 12 are also found there. This overlap indicates a coastal-to-island dispersal pattern of invasive species. Such a process might occur in the future with *Vahlia capensis* L., a newly reported species that may be invasive for Sinaloa (Salomón-Montijo *et al*., 2024), which is presently located just a few kilometers from Macapule Island, part of System III.

Agricultural activity and invasive species on the islands

Of the 131 species classified as invasive in the study area, 72 have been classified as weeds of agricultural origin (Vibrans, 2025). This finding indicates that agricultural activity, as a human-related disturbance, promotes the introduction and spread of exotic plants, consistent with the observations of Powell *et al*. (1985) and Blanco-Valdés (2016). This process is especially evident in System II, particularly on Tachichilte Island, where the highest number of weed species was documented. On this island, seasonal farming is common, with watermelon grown in the spring, maize in the summer, and livestock grazing during autumn and winter. A similar trend appears on some islands within System IV, located in the Guasave municipality, one of Mexico's leading agricultural regions, where crops reach the coastline and are close to Macapule Island. This island serves as a conduit for the introduction and spread of agricultural weeds to other islands in the system. Factors such as the relatively large size of these islands, their proximity to the mainland, and multiple access points support the colonization of climate-adapted, short-lived herbaceous plants. According to Liu *et al*. (2023), these plants have traits that increase their invasiveness, including vegetative reproduction, small seeds (Kolar & Lodge, 2001), rapid growth, and high physiological efficiency (van Kleunen *et al*., 2010), which collectively make them highly invasive species capable of extensive expansion and high abundance in the study area.

Regarding abundance, it is notable that 130 species were classified as rare (R), with the majority originating from ornamental, fruit, medicinal, cereal, and oilseed groups, collectively representing 93 species. This pattern suggests that these species are likely recent introductions to the island complex and have not yet fully adapted to the natural environment, preventing them from spreading and becoming more abundant. Such limitations are partly caused by the need

Revista Bio ciencias
ISSN 2007-3380

to overcome adverse environmental conditions, like limited water supply, high solar radiation, increased temperatures, and salinity (Kumar *et al*., 2024), as well as additional challenges, including herbivore pressure and pathogen activity (Noman *et al*., 2020), conditions typical of island environments.

Ornamental plants as a form of biological invasion on the islands

The presence of 60 ornamental species in System IV, out of a total of 68 recorded throughout the protected area, is primarily due to the high tourist activity on El Maviri Island, which features tourist facilities such as restaurants, snack bars, parking areas, and gardens. These green spaces primarily consist of ornamental species, predominantly tropical and subtropical exotics from North and South America, Africa, and Asia, with very few species originating from temperate regions (Díaz *et al*., 2025). This pattern occurs because the island's dry tropical climate allows species from those regions to adapt well to the local temperature and humidity, as noted by Duarte de Oliveira & Beckmann-Cavalcante (2023). Additionally, these plants are regularly watered and protected from direct sunlight, which helps them thrive. The preference for this type of vegetation, driven by its visual appeal and exotic appearance, aligns with the findings of Rojas-Sandoval & Ackerman (2021), who reported that approximately 54% of invasive plants on Caribbean islands were introduced as ornamentals, primarily from Asia and South America. Some ornamentals have already been found growing wild, such as *Tecoma stans* (L.) Juss. ex Kunth on Venados Island, where it is now common, and others like *Lantana camara* and *Aloe vera* (L.)Burm. f., which are widespread, well-adapted, and often seen as wild despite their human introduction. In this context, the creation of green spaces has served as an important vector for the spread of these species into natural environments, as noted by Meyer *et al*. (2007), van Kleunen *et al*. (2018), and Jones *et al*. (2024). Concerning fruit species, mostly of African and Asian origin, the most common and widely distributed across the island chain are *C. lanatus* and *C. x limon*, followed by *Cocos nucifera* L. These plants were mainly introduced by local fishermen, who use the islands as temporary camps during extended fishing seasons, for processing their catches, or for food. They have also been brought by tourists who camp on the islands, especially during vacation times (Díaz, 2008). As a result, small-scale cultivation of plants such as *Capsicum annuum* L. (chili), *Solanum lycopersicum* L. (tomato), *Zea mays* L. (corn), and *Sesamum indicum* L. (sesame) is also present on some islands.

Islands in Mexico and around the world are increasingly facing ongoing invasions by opportunistic species that adapt well to different environments. This trend has been documented by Van der Plank & Rebman (2021), who reported 13 new weed records on Cedros Island, Baja California, Mexico; by Faccenda (2023), who documented 24 new records for Hawaii; by Faccenda & Daehler (2024) for Molokai Island; and by Parker *et al*. (2024) for the Hawaiian Archipelago. These findings support Liu *et al*. (2024) conclusion that about 50% of the world's islands have reached critical thresholds for biological invasions, showing a rapid rise in non-native species.

Several studies indicate that island size and economic growth are key factors in invasive species diversity, highlighting the role of human activities in facilitating invasions (Rojas-Sandoval *et al*., 2017). In this study, it is clear that the islands with the most invasive, weedy, and ornamental

Revista Bio ciencias
ISSN 2007-3380

species are part of Systems II and IV, where livestock farming, seasonal agriculture, and tourism have been recent activities. This finding aligns with Traveset *et al*. (2013), who state that the spread and variety of invasive species on islands often correlate with the expansion of farming, and that a rise in exotic species also increases propagule diversity, thereby boosting invasion potential (Denslow, 2003).

Tourism as a vector of biological invasion on the islands

Another factor negatively impacting the islands is the permanent tourism activity, which has driven land-use changes for services such as restaurants and recreational beach areas. In this context, the islands of Sinaloa exhibit more invasions than other islands within the Flora and Fauna Protection Area Islas del Golfo de California (APFF) in Baja California Sur and Sonora, where 31 invasive species have been recorded among 695 taxa across 20 islands (Rebman *et al*., 2002; Felger *et al*., 2012). Tourism activity there is very limited or almost nonexistent compared to some islands in Sinaloa, like Venados in Mazatlán and Maviri in Ahome, which serve as recreation sites with open access and facilities for leisure and dining (SEMARNAT, 2023; Torres-Cisneros *et al*., 2023). Consequently, the Sinaloa islands are more susceptible to invasive species because tourists often unintentionally carry organisms or propagules into the areas they visit (Hall, 2015; Oded & Ram, 2015). Additionally, high tourism levels can damage natural environments, increasing the vulnerability of the islands to invasions, as seen in many popular destinations worldwide (Butler & Dodds, 2022).

Of the 131 species classified as invasive, only 16 are shared across the four island systems (**Appendix I**), and only a few are of particular concern due to their high density, abundance, and distribution within Systems II, III, and IV. Examples include *Lantana camara* L., an invasive species ranked among the world's ten most harmful weeds for its broad adaptive and dispersal capacity (Lowe *et al*., 2004; Sharma *et al*., 2005); *Cenchrus ciliaris* L., a highly competitive and harmful grass that negatively impacts biodiversity (Aguirre-Muñoz & Mendoza-Alfaro, 2009) and also alters the landscape by increasing the risk of forest fires when dry, due to its high flammability (Fensham *et al*., 2015; Ryan-Colton *et al*., 2024). This poses an increasing threat during extended dry periods across these island systems, where fires have already been recorded in connection with this and other related grasses. Similarly, *Nicotiana glauca* Graham tends to colonize environments disturbed by anthropogenic activities due to its high invasive potential, supported by prolific production of small, lightweight seeds (Dounas *et al*., 2023), while *Tamarix ramosissima* Ledeb. is highly adaptable to various hydric and edaphic conditions, resilient to periodic flooding, and produces light seeds dispersed by wind (Greenfell & Dube, 2022). Additionally, it hybridizes with other species of the same genus (Mayonde *et al*., 2016), a trait that enhances its invasive capacity (**Figure 5**). Conversely, *Arundo donax* L., which reproduces and spreads quickly through rhizome fragmentation (Witje, 2005), currently presents a serious invasion problem limited to Venados Island within System I.

This study offers the first comprehensive assessment of exotic and invasive plant species across a large insular complex in Mexico. It shows that the invasion problem is worsening over

Revista Bio ciencias
ISSN 2007-3380

time, despite eradication efforts conducted periodically by various institutions for decades (Comité Asesor Nacional sobre Especies Invasoras, 2010).

Revista Bio ciencias
ISSN 2007-3380

Figure 5.- Most relevant invasive species: 1.- *Lantana camara* L.; 2.- *Cenchrus ciliaris* L.; 3.- *Nicotiana glauca* Graham; 4.- *Tamarix ramosissima* Ledeb.

Conclusions

The analysis of the floristic database emphasizes the importance of understanding the composition and distribution of non-native plant species within this insular complex. The study reveals a strong influence from introduced species, which poses a significant threat to native biodiversity. Particularly, species ranked among the most harmful worldwide underscore the need to prioritize management and control efforts on the islands. Additionally, the presence of ornamental and fruit plants suggests that human activities, both deliberate and accidental, contribute to the introduction of exotic species, thereby increasing the diversity of non-native flora across these islands.

The report, which highlights the high abundance of exotic invasive species relative to the total flora recorded for the entire island complex, provides crucial information for designing conservation strategies tailored to the dynamics of each insular system. These findings underscore the importance of ongoing monitoring of species introductions and potential spread, as well as the need to strengthen education and community awareness programs to mitigate adverse impacts on these fragile ecosystems. Finally, this study offers a solid scientific foundation to guide management and conservation efforts within the APFF and serves as a reference for future research on other island systems in the country, addressing this highly relevant issue in biodiversity conservation.

Authors contribution

Work conceptualization: JSD, GMS, BSM, and MADZ. Methodology development: JSD, GMS, BSM, CRH, and EAGD. Software management: EAGD. Experimental validation: JSD, GMS, and BSM. Data analysis: JSD, GMS, BSM, and CRH. Data management: JSD, GMS, BSM, and MADZ. Manuscript writing and preparation: JSD, GMS, BSM, CRH, and DUS. Writing, review, and editing: JSD, GMS, BSM, CRH, and DUS. Project administration: JSD. Funding acquisition: JSD, GMS, BSM, and DUS.

Funding

Personal resources funded this research.

Declaration of informed consent

Informed consent was obtained from all individuals involved in the study.

Revista Bio ciencias
ISSN 2007-3380

Acknowledgments

We thank the authorities of the Faculty of Biology at the Universidad Autónoma de Sinaloa for their support in conducting field surveys, as well as the reviewers for their time and dedication to this manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest.

References

Abbot, R. J. (1992). Plant invasions, interespecific hybridization and the evolution of new plant taxa. *Trends in Ecology & Evolution*, 12(7), 401-405. https://doi.org/10.1016/0169-5347(92)90020-C

Afreen, T., Kumari, S., Bhadouria, R., Devi, R.S., Singh, S., & Tripathi, S. (2023). Plant invasion and soil processes: A mechanistic understanding. In: Tripathi, S., Bhadouria, R., Srivastava, P., Singh, R. & Batish, D.R. Plant invasions and global climate change (pp. 227-246). Ed. Springer.. https://doi.org/10.1007/978-981-99-5910-5_10

Aguirre-Muñoz, A., & Mendoza-Alfaro, R. (2009). Especies exóticas invasoras: impactos sobre las poblaciones de flora y fauna, los procesos ecológicos y la economía. In Dirzo, R., González, R. & March, I. J. Capital natural de México, vol. II: Estado de conservación y tendencias de cambio (pp. 277-318). Ed. CONABIO. https://www.researchgate.net/publication/249011287_Especies_exoticas_invasoras_impactos_sobre_las_poblaciones_de_flora_y_fauna_los_procesos_ecologicos_y_la_economia/citations

The Angiosperm Phylogeny Group, Chase,M. W., Christenhusz, M. J. M., Fay, M. F., Byng, J. W., Judd, W. S., Soltis, D. E., Mabberley,D. J., Sennikov, A. N., Soltis, P. S., & Stevens, P. F. (2016). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society*, 181(1), 1-20, https://doi.org/10.1111/boj.12385

Blanco-Valdes, Y. (2016). El Rol de las arvenses como componente en la biodiversidad de los agroecosistemas. *Cultivos Tropicales,* 37(4), 34-56. http://dx.doi.org/10.13140/RG.2.2.10964.19844

Butler, W. R., & Dodds, R. (2022). Island Tourism: Vulnerable or Resistant to Overtourism?. *Highlights Sustain,* 1,54-64. https://doi.org/10.54175/hsustain1020005

Comité Asesor Nacional sobre Especies Invasoras. (2010). Estrategia nacional sobre especies invasoras en México, prevención, control y erradicación. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Comisión Nacional de Áreas Protegidas, Secretaría de Medio Ambiente y Recursos Naturales. México. 91 pp. https://www.biodiversidad.gob.mx›especies›estrategia

Comisión Nacional de Áreas Naturales Protegidas [CONANP] (2009). Diagnóstico de Especies

Revista Bio ciencias
ISSN 2007-3380

Invasoras (EI) y sus Efectos en las ANP de Competencia Federal. Comisión Nacional de Áreas Naturales Protegidas. México. https://www.biodiversidad.gob.mx/media/1/especies/Invasoras/files/1.4_Consultoria_Diagnostico_Islas.pdf

Comisión Nacional para el Conocimiento y Uso de la Biodiversidad [CONABIO]. (2015). Método de Evaluación Rápida de Invasividad (MERI) para especies exóticas en México. México, D.F. https://www.biodiversidad.gob.mx/media/1/especies/Invasoras/files/Instrutivo_MERI_2020.pdf.

Comisión Nacional para el Conocimiento y Uso de la Biodiversidad [CONABIO]. (2022). Sistema de Información sobre Especies Invasoras (SIEI). México. https://www.biodiversidad.gob.mx/especies/invasoras

Damodaran-Premakumari, P., Sarayu, M. G., Mohan-Das, G. G., Dinesh-Babu, K. V., Krishnan, R., Lawarence, B., Siraj, S. S., Pillai, A. R., Soman-Syamala, S. K., & Murugan, K. (2022). Invasive Exotic Plant Species and their Influence on the Environment, Ecosystem Services, Economy and Health: A Search. *Journal of Advanced Scientific Research, 13*(1), 64-74. https://doi.org/10.55218/JASR.202213106

Denslow, J. S. (2003). Weeds in paradise: thoughts on the invasibility of tropical islands. *Annals of the Missouri Botanical Garden*, 90(1), 119–127. https://doi.org/10.2307/3298531

Denslow, J. S., Space, J. C., & Thomas, P. A. (2009). Invasive Exotic Plants in the Tropical Pacific Islands: Patterns of Diversity. *Biotropica* 41(2), 162–170. https://doi.org/10.1111/j.1744-7429.2008.00469.x

Diario Oficial de la Federación [DOF]. (1978). Decreto de Creación de la Zona de Reserva y Refugio de Aves Migratorias y Fauna Silvestre Islas del Golfo de California, Baja California y Baja California Sur. Gobierno de los Estados Unidos Mexicanos. https://conanp.gob.mx/conanp/dominios/islasgc/index.html

Diario Oficial de la Federación [DOF]. (2001). Aviso mediante el cual se informa al público en general que la Secretaría de Medio Ambiente y Recursos Naturales ha concluido la elaboración del Programa de Manejo del Área de Protección de Flora y Fauna Islas del Golfo de California, asimismo se da a conocer el Resumen del Programa de Manejo respectivo, el plano de localización y zonificación de dicha área. Gobierno de los Estados Unidos Mexicanos. https://dof.gob.mx/nota_detalle_popup.php?codigo=767360

Diario Oficial de la Federación [DOF]. (2016). Acuerdo por el que se determina la Lista de Especies Exóticas Invasoras para México. Gobierno de los Estados Unidos Mexicanos. https://www.dof.gob.mx/nota_detalle.php?codigo=5464456&fecha=07/12/2016#gsc.tab=0

Díaz J. S. (2008). Diversidad florística y estructura de la vegetación de las islas de los sistemas lagunares Navachiste y Macapule, del norte de Sinaloa [Tesis de Maestría en Ciencias, Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional, Unidad Sinaloa- IPN]. https://doi.org/10.13140/RG.2.2.11970.44488

Díaz, J. S., Márquez-Salazar, G., Millán-Otero, G., Bojórquez-Castro, J. G., & Díaz-Zazueta, M. A. (2022). Cactáceas del Área de Protección de Flora y Fauna Islas del Golfo de California, Sección Sinaloa. Áreas Naturales Protegidas Scripta, 8(1), 59-65. https://www.researchgate.net/publication/361479987_Cacti_from_the_Flora_and_Fauna_Protection_Area_Gulf_of_California_Islands_Sinaloa_Section

Díaz, J. S., Márquez-Salazar, G., Gámez-Duarte, E. A., Díaz-Zazueta, M. A., & Uriarte-Sarabia, D. (2023). Vegetación y flora de la isla Santa María en el APFF Islas del Golfo de California,

Revista Bio ciencias
ISSN 2007-3380

Sección Sinaloa. *Áreas Naturales Protegidas Scripta*, 9(2), 1-24. https://www.researchgate.net/publication/378774400_Vegetation_and_flora_of_Santa_Maria_Island_in_the_Gulf_of_California_Islands_National_Protected_Area_Sinaloa_Section_Vegetacion_y_flora_de_la_isla_Santa_Maria_en_el_APFF_Islas_del_Golfo_de_California_

Díaz, J. S., Salomón-Montijo, B., Romero-Higareda, C. E., Gamez-Duarte, E., & Millán-Otero, M. G. (2025). Vegetación y flora de El Maviri en el APFF Islas del Golfo de California Sección Sinaloa. *Acta Biológica Mexicana*, 1(2), 8-44. https://revistas.uas.edu.mx/index.php/ACBIOMEX/issue/view/124/129

Dounas, H., Bouskout, M., Nafidi, H. A., Alsahli, A. A., Bourhia, M., & Ouahmane, L. (2023). Unraveling arbuscular mycorrhizal fungi interactions in the exotic plant Nicotiana glauca Graham for enhanced soil fertility and alleviation of metal pollution. *Horticulturae*, 9, 585. https://doi.org/10.3390/horticulturae9050585

Duarte de Oliveira-Paiva, P., & Beckmann-Cavalcante, M. Z. (2023). What does Tropical and Subtropical Plant mean? *Ornamental Horticulture,* 29(2),122-123. https://doi.org/10.1590/2447-536X.v29i2.2656

Estrada-Arellano, J. R., Cardoza-Martínez, G. F., & Sánchez-Salas, J. (2018). Plantas Exóticas Invasoras Presentes en las Áreas Naturales Protegidas (ANP) de México y su Impacto en la Biodiversidad. *CONCIENCIA,* 21(89), 48-59. https://cienciauanl.uanl.mx/ojs/index.php/revista/article/view/42

Faccenda, K. (2023). Updates to the Hawaiian grass flora and selected keys to species: Part 2. *Bishop Museum Occasional Papers,* 155, 83-156. https://www.researchgate.net/publication/374143645_Updates_to_the_Hawaiian_grass_flora_and_selected_keys_to_species_Part_2

Faccenda, K., & Daehler, C. C. (2024). New records of weedy, non-grass plants from Moloka'i. *Bishop Museum Occasional Papers*, 156, 33-36. https://www.researchgate.net/publication/378592886_New_records_of_weedy_non-grass_plants_from_Molokai

Felger, R. S., Wilder, B. T., & Romero-Morales, H. (2012). Plant Life of a Desert Archipelago: Flora of the Sonoran Islands in the Gulf of California. Ed. University of Arizona Press. https://www.researchgate.net/publication/236633353_Plant_Life_of_a_Desert_Archipelago_Flora_of_the_Sonoran_Islands_in_the_Gulf_of_California

Fensham, R. J., Wang, J., & Kilgour, C. (2015). The Relative Impacts of Grazing, Fire and Invasion by Buffel Grass (Cenchrus ciliaris) on the Floristic Composition of a Rangeland Savanna Ecosystem. *The Rangeland Journal,* 37(3), 227-237.https://doi.org/10.1071/RJ14097

Flores-Campaña, L. M., Vega-Aviña, R., Benítez-Pardo, D., & Hernández-Álvarez, F. (1996). Flora de la isla Venados de la bahía Mazatlán, Sinaloa, México. *Anales del Instituto de Biología Serie Botánica,* 67(2), 283-301. https://repositorio.unam.mx/contenidos/28750

Foxcroft, L. C., Pyšek, P., Richardson, D. M., Genovesi, P., & MacFadyen, S. (2017) Plant invasion science in protected areas: progress and priorities. *Biological Invasions,* 19, 1353–1378. https://doi.org/10.1007/s10530-016-1367-z

García, E. (2004). Modificaciones al sistema de clasificación climático de Köppen (para adaptarlo a las condiciones de la República Mexicana). 5ª ed. Instituto de Geografía, UNAM. https://www.academia.edu/12911044/Modificaciones_al_sistema_de_clasificaci%C3%B3n_clim%C3%A1tica_de_K%C3%B6ppen_para_adaptarlo_a_las_condiciones_de_la_Rep%C3%BAblica_Mexicana_2004_Enriqueta_Garc%C3%ADa

Golubov, J., Mandujano, M. C., Guerrero-Eloisa, S., Mendoza, R., Koleff, P., González, A. I., Barrios, Y., & Born-Schmidt, G. (2014). Análisis multicriterio para ponderar el riesgo de las especies invasoras. In Mendoza, R. & Koleff, P. Especies acuáticas invasoras en México. (pp. 123-133) CONABIO. https://www.researchgate.net/publication/273317104_ESPECIES_ACUATICAS_INVASORAS_EN_MEXICO

Greenfell, M. C., & Dube, T. I. (2022). Spectral classification, mapping and physical habitat implications of a riparian invasion by Tamarix ramosissima Ledeb. In the Touws River, Klein Karoo, South Africa. *African Journal of Aquatic Science,* 47(22),197-206.https://doi.org/10.2989/16085914.2021.2001308

Hall, C. M. (2015). Tourism and biological exchange and invasions: a missing dimension in sustainable tourism?. *Tourism Recreation Research,* 40(1), 81-94. https://doi.org/10.1080/02508281.2015.1005943

Holm, L., Doll, J., Holm, E., Pancho, J. V., & Herberger, J. P. (1997). World Weeds: Natural Histories and Distribution. Ed. John Wiley & Sons. https://archive.org/details/worldweedsnatura0000unse

Instituto Nacional de Estadística y Geografíal [NEGI]. (2015). Catálogo de Territorio Insular Mexicano. México. Instituto Nacional de Estadística y Geografía. 243 Pp. https://www.inegi.org.mx/app/biblioteca/ficha.html?upc=702825079239

Instituto Nacional de Estadística y Geografíal [NEGI]. (2017). Anuario Estadístico y Geográfico de Sinaloa 2017. Instituto Nacional de Estadística y Geografía. México. 475 Pp. https://www.inegi.org.mx/app/biblioteca/ficha.html?upc=702825094898

Instituto Nacional de Estadística y Geografíal [NEGI]. (2018). Conjunto de Datos Vectoriales de Uso del Suelo y Tipo de Vegetación, Escala 1:250000, Serie VII. Instituto Nacional de Estadística y Geografía. México. https://www.inegi.org.mx/app/biblioteca/ficha.html?upc=889463842781

Instituto Nacional de Estadística y Geografíal [NEGI]. (2022). División Política Estatal, Escala 1:250000. Instituto Nacional de Estadística y Geografía. México. http://geoportal.conabio.gob.mx/metadatos/doc/html/dest22gw.html

Invasive Species Specialist Group [ISSG]. (2025, January 18). The Global Invasive Species Database. Version 2015.1. https://www.iucngisd.org/gisd.

Jeschke, J. M., Bacher, S., Blackburn, T. M., Dick, J. T. A., Essl, F., Evans, T., Gaertner, M., Hulme, P. E., Kühn, I., Mrugała, A., Pergl, J., Pysek, P., Rabitsch, W., Ricciardi, A., Richardson, D. M., Sendek, A., Vilá, M., Winter, M., & Kumschick, S. (2014). Defining the impact of non-native species. *Conservation Biology,* 28,1188–1194 https://doi.org/10.1111/cobi.12299

Jones, T., Culham, A., Pickles, B., & David, J. (2024). How do gardeners define 'invasive'? Implications for invasion science and environmental policy instruments on invasive species. *Environmental Science & Policy*, *151* (103614). https://doi.org/10.1016/j.envsci.2023.103614

Kannan, R., Shackleton, C. M., & Shaanker, U. R. (2013). Reconstructing the history of introduction and spread of the invasive species, Lantana, at three spatial scales in India. *Biological Invasions*, 15, 1287-1302. https://doi.org/10.1007/s10530-012-0365-z

Kiehn, M. (2011). Invasive alien species and islands. In Bramwell, D. & Caujapé-Castells, J. The Biology of island floras. (365-384). Cambridge University Press. https://doi.org/10.1017/CBO9780511844270.016

Kolar, C. S., & Lodge, D. M. (2001). Progress in invasion biology: predicting invaders. *Trends in*

Revista Bio ciencias
ISSN 2007-3380

Ecology & Evolution, 16(4), 199–204. https://doi.org/10.1016/s0169-5347(01)02101-2

Kueffer, C., Kronauer, L., & Edwards, P. J. (2009). Wider spectrum of fruit traits in invasive than native floras may increase the vulnerability of oceanic islands to plant invasions. *Oikos*, 118(9), 1327-1334. https://doi.org/10.1111/j.1600-0706.2009.17185.x

Kumar, A., Rajput, R., Shankar, R., Kumari, S., Kanaujia, S. P., & Sentinrenla, J. (2024). Adaptation strategies for horticultural crops under changing climate conditions: A review. *Annals of Plant and Soil Research* 26(2), 359-371. https://doi.org/10.47815/apsr.2024.10373

Li, Y., Wang, Y., & Liu, X. (2024). Half of global islands have reached critical area thresholds for undergoing rapid increases in biological invasions. *Proceedings of the Royal Society B Biological Sciences*, 291, 1-11. https://doi.org/10.1098/rspb.2024.0844

Liu, J., Liu, T., Zhou, Y., Chen, Y., Lu, L., Jin, X., Hu, R., Zhang, Y., & Zhang, Y. (2023). Plant diversity on islands in the Anthropocene: Integrating the effects of the theory of island biogeography and human activities. *Basic and Applied Ecology,* 72,45-53. https://doi.org/10.1016/j.baae.2023.07.006

Llano, M., & Fernández, H. (2017). Análisis y Propuestas para la Conservación de la Biodiversidad en México 1995-2017. Ed. Causa Natura, CeIBA, CEMDA, CCMSS, COBI, CHAC, Conservación de Islas, Dimensión Natural, FMCN, Natura Mexicana, WWF. https://cartocritica.org.mx/2017/analisis-y-propuestas-para-la-conservacion-de-la-biodiversidad/

Lowe, S., Browne, M., Boudjelas, S., De Poorter, M., & Maj-Lowe, S. (2004). 100 de las Especies Exóticas Invasoras más dañinas del mundo. Una selección del Global Invasive Species Database. Ed. Grupo Especialista de Especies Invasoras (GEEI). https://portals.iucn.org/library/node/9804

Macías-Rodríguez, M. A., Frías-Ureña, H. G., Contreras-Rodríguez, S. H. & Frías-Castro, A. (2018). Vascular plants and vegetation of the Sayula sub-basin, Jalisco, Mexico. *Botanical Sciences*, 96, 103-137. https://doi.org/10.17129/botsci.1030

Márquez-Salazar, G., Díaz, J. S., Pío-León, F., & Amador Medina, M. (2021). Plantas Invasivas en el Santuario Playa El Verde Camacho, Sinaloa, México. Áreas Naturales Protegidas *Scripta*, 7(1), 63-68. https://www.researchgate.net/publication/353036743_Plantas_Invasivas_en_el_Santuario_Playa_El_Verde_Camacho_Sinaloa_Mexico

March-Mifsut, I. J., & Martínez-Jiménez, M. (2007). Especies invasoras de alto impacto a la biodiversidad. Prioridades en México. Ed. IMTA, CONABIO, GECI, AridAmérica, The Nature Conservancy. http://repositorio.imta.mx/handle/20.500.12013/1619

Martínez-Meyer, E., Cuervo-Robayo, A. P., & Ortiz-Haro, G. A. (2016). Modelación de la distribución potencial actual y futura de las especies invasoras de mayor riesgo para México. Ed. Conabio-GEF-PNUD. https://www.biodiversidad.gob.mx/media/1/especies/Invasoras/files/comp1/Modelacion_de_distrib_actual_y_futura_EEI.pdf

Mayonde, S. G., Cron, G. V., Gaskin, J. F., & Byrne, M. J. (2016). *Tamarix* (Tamaricaceae) hybrids: the dominant invasive genotype in southern Africa. *Biological Invasions,* 18, 3575–3594. https://doi.org/10.1007/s10530-016-1249-4

Mendoza, R., & Koleff, P. (2014). Especies acuáticas invasoras en México. Ed. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. https://www.researchgate.net/publication/273317104_ESPECIES_ACUATICAS_INVASORAS_EN_MEXICO

Meyer, J. Y., Lavergne, C., & Hodel, D. (2008). Time bombs in gardens: Invasive ornamental palms in tropical islands, with emphasis on French Polynesia (Pacific Ocean) and the

Mascarenes (Indian Ocean). *Palms*, 52(2), 71-83. https://palms.org›2016/05›v52n2p71-83

Noman, A., Aqeel, M., Quasim, M., Haider, I., & Lou, Y. (2020). Plant-insect-microbe interaction: A love triangle between enemies in ecosystem. *Science of the Total Environment,* 699, 134181. https://doi.org/10.1016/j.scitotenv.2019.134181

Oded, C., & Ram, Y. (2015). Tourism is not only the vector of biological invasion but also the victim: Evidence from Israel. *Tourism Recreation Research*, 40(3), 407-410. https://doi.org/10.1080/02508281.2015.1086130

Parker, J. L., Parsons, B., & Faccenda, K. (2024). New plant records from the Big Island for 2021. *Bishop Museum Occasional Papers,* 156, 135-142. https://www.researchgate.net/publication/378592898_New_plant_records_from_the_Big_Island_for_2021

Powell, W., Dean, G. J., & Dewar, A. (1985). The influence of weeds on polyphagous arthropod predators in winter wheat". *Crop Protection*, 4(3), 298-312. https://doi.org/10.1016/0261-2194(85)90032-8

POWO. (2025, January 18). Plants of the World Online. The Royal Botanic Gardens, Kew. https://powo.science.kew.org/

Rebman, J., León de la Luz, J. L., & Moran, R. (2002). Vascular Plants of the Gulf Islands. In Case, T. J., Cody, M. L. & Ezcurra, E. A New Island Biogeography of The Sea of Cortés (Appendix 4.1. pp. 465-511). Oxford University Press. https://doi.org/10.1093/oso/9780195133462.001.0001

Ryan-Colton, E., French, K., Wardle, G. M., Read, J. L., Canty, P. D., Lang, P. J., Brickerton, D. C., & Schlesinger, C. A. (2024). Long-term and landscape impacts of buffel grass on arid plant communities: Ecosystem shifts and acceleration by fire. *Ecosphere,* 15(10), e70033. https://doi.org/10.1002/ecs2.70033

Randall, R. P. (2017). A global compendium of weeds. 3rd Edition. Perth, Western Australia. R. P. Randall. 3653 Pp. https://www.researchgate.net/publication/313645439_A_Global_Compendium_of_Weeds_Third_Edition

Reyes-Olivas, A. (2001). Asociación de cactáceas con arbustos en el desierto costero de Topolobampo, Sinaloa. Universidad de Occidente. Informe final SNIB-CONABIO proyecto No. R217. México D. F. 69 Pp. http://www.conabio.gob.mx›resultados›InfR217

Rodríguez-Malagón, M. A., Bedolla-Guzmán, Y., Cárdenas-Tapia, A., Aguirre-Muñoz, A., Latofski-Robles, M., Samaniego-Herrera, A., Torres-García, F., González-Gómez, R., Barredo-Barberena, J., & Soqui-Gómez, E. (2012). Catálogo fotográfico de especies representativas de la Isla Isabel, México. Ed. Grupo de Ecología y Conservación de Islas, A. C. https://www.islas.org.mx/guias#gsc.tab=0

Rojas-Sandoval, J., Tremblay, R. L., Acevedo-Rodríguez, P., & Díaz-Soltero, H. (2017). Invasive plant species in the West Indies: geographical, ecological, and floristic insights. *Ecology and Evolution,* 7, 4522–4533. https://doi.org/10.1002/ece3.2984

Rojas-Sandoval, J., & Ackerman, J. D. (2021). Ornamentals lead the way: global influences on plant invasions in the Caribbean. *Neobiota,* 64, 177-197. https://doi:10.3897/neobiota.64.62939

Salomón-Montijo, V., Díaz, J. S., Márquez-Salazar, G., & Pío-León, F. (2024). Vahlia capensis (Vahliaceae): first record of a possibly invasive species and genus in the Americas. *Phytotaxa,* 670 (3), 187–190. https://doi.org/10.11646/phytotaxa.670.3.5

Secretaría de Medio Ambiente y Recursos Naturales [SEMARNAT]. (2023). Manifestación de impacto ambiental modalidad particular: Regularización de obras y actividades Palapas

Revista Bio ciencias
ISSN 2007-3380

Concha Salada, Isla El Mavíri, Topolobampo, municipio de Ahome, Sinaloa. Ed. Secretaría de Medio Ambiente y Recursos Naturales. https://apps1.semarnat.gob.mx›25SI2023TD050

Sesay, R. E., Sesay, F., Azizi, M. I., & Rahmani, B. (2024). Invasive species and biodiversity: Mechanisms, impacts, and strategic management for ecological preservation. *Asian Journal of Environment & Ecology,* 23(9), 82-95. https://doi.org/10.9734/ajee/2024/v23i9600.

Sharma, G. P., Singh, J. S., & Raghubanshi, A. S. (2005). Plant invasions: Emerging trends and future implications. *Current Science*, 88(5), 726–734. http://www.jstor.org/stable/24111258

Sherley, G. (2000). Invasive species in the Pacific: A technical review and draft regional strategy. Published by The South Pacific Regional Environment Programme. Apia, Samoa. 190 Pp. https://catalogue.nla.gov.au/catalog/953138

Stout, J. C. (2011). Plant invasions: their threats in an irish context. *Proceedings of the Royal Irish Academy*, 111(3), 135-141. https://www.jstor.org/stable/23188044

Tansley, A. G. (1946). Introduction to Plant Ecology. Ed. Allen & Unwin. https://archive.org/details/in.ernet.dli.2015.460544

Torres-Cisneros, P., Iñiguez-Ayón, P., & Ayala-Rodríguez, L. (2023). Escenarios posmodernos del turismo. La nueva geografía turística de Sinaloa. *Topofilia: Arquitectura, Urbanismo, Territorios*, 27, 232-249. https://topofilia.buap.mx/index.php/topofilia/article/view/457

Traveset, A., Kueffer, C., & Daehler, C. (2013). Global and regional nested patterns of non-native invasive floras on tropical islands. *Journal of Biogeography,* 14(4), 823-832. http://dx.doi.org/10.1111/jbi.12243

Uzomachukwu, U. E., Kehinde, I. O., Mahama, M., & Hamzat, M. O. (2024). Prevalence of invasive plant species, its effects on biodiversity conservation, challenges and opportunities for management in Africa: A review. *Biological and Environmental Sciences Journal for the Tropics,* 21(1), 51 - 80. https://dx.doi.org/10.4314/bestj.v21i1.6

Vanderplank, S. E., & Rebman, J. P. (2021). Thirteen new weeds on Cedros Island, Baja California, Mexico. *Acta Botanica Mexicana,* 128, e1823. https://doi.org/10.21829/abm128.2021.1823

van Kleunen, M., Weber, E., & Fischer, M. (2010). A meta-analysis of trait differences between invasive and non-invasive plant species. *Ecology Letters*, 13, 235e245. https://doi.org/10.1111/j.1461-0248.2009.01418.x

van Kleunen, M., Essl, F., Pergl, J., Brundu, G., Carboni, M., Dullinger, S., Early, R., González-Moreno, P., Groom, Q. J., Hulme, P. E., Kueffer, C., Kühn, I., Máguas, C., Maurel, N., Novoa, A., Parepa, M., Pyšek, P., Seebens, H., Tanner, R., Touza, J., … Dehnen-Schmutz, K. (2018). The changing role of ornamental horticulture in alien plant invasions. *Biological Review*s, 93(3), 1421-1437. https://doi.org/10.1111/brv.12402

Vega-Aviña, R., Benítez-Pardo, D., Flores-Campaña, L., & Hernández-Álvarez, F. (2001). Vegetación y Flora de la Isla Pájaros e Isla Lobos, de la Bahía de Mazatlán, Sinaloa. Listados Florísticos de México XXI. Ed. Instituto de Biología, UNAM. https://www.ib.unam.mx/ib/programa-editorial/listados/

Vibrans, H. (2025, January 18). *Malezas de México*. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. Obtenido de http://www.conabio.gob.mx/malezasdemexico/2inicio/home-malezas-mexico.htm

Villaseñor, J. L., & Espinosa-García F. J. (2004). The alien flowering plants of Mexico. *Diversity and Distributions,* 10(2), 113–123. https://doi.org/10.1111/j.1366-9516.2004.00059.x

Villaseñor, J. L. (2016). Checklist of the native vascular plants of Mexico. *Revista Mexicana de*

Biodiversidad, 87(3), 559-902. https://doi.org/10.1016/j.rmb.2016.06.017

Whittaker, R. J., Fernández-Palacios, J. M., & Matthews, T. J. (2023). *Island Biogeography: Geo-environmental dynamics, ecology, evolution, human impact, and conservation. Ed.* Oxford University Press. https://global.oup.com/academic/product/island-biogeography-9780198868569?

Wijte, A. (2005). Combating Arundo donax and other rhizomatous aquatic and estuarine nuisance grasses by exploiting their ecophysiological characteristics. Research Final Report, California Sea Grant College Program. University of California, San Diego, CA, USA. Retrieved from https://escholarship.org/uc/item/4h71t5rk

Zhang, L. (2023). Biological invasions into different ranges. In Zhang, L. Bamboo expansion: Processes, impacts, and management. (pp. 3-18). Springer. https://doi.org/10.1007/978-981-99-4113-1_1

APPENDIX I.- List of species in the four island systems: I, II, III and IV.

1.- Type: Ornamental (O), Fruity (F), Medicinal (M), Cereal (C), Oilseed (L); 2.- Invasive: SIEI (IE: Invasive Exotics; IN: Invasive Natives), ISSG (G), Villaseñor (V); 3.- Life forms: Tree (A), Shrub (Ar), Herb (H), Creeping (Ra), Climbing (Tr), Rosetophilous (Ro), Succulent (Su), Epiphytic (E); 4.- Abundance grade: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R); 5.- Geographical origin: New World (NW), Old World (OW), Oceania (O).

POLYPODIOPSIDA	1	2	3	4	5
POLYPODIACEAE					
Nephrolepis exaltata (L.) Schott. [IV]	O	IE	H	R	NW
GIMNOSPERMS					
CYCADACEAE					
Cycas revoluta Thunb. [IV]	O	IE	Ar	R	OW
ANGIOSPERMS					
MAGNOLIDS					
ANNONACEAE					
Annona muricata L.[I]	F		A	R	NW
LAURACEAE					
Persea americana Mill. [II]	F		A	R	NW
MONOCOTS					
AMARYLLIDACEAE					
Crinum asiaticum L. [IV]	O	IE	HRo	R	OW
ARACEAE					
Aglaonema commutatum Schott [IV]	O	IE	H	R	O
Caladium bicolor (Aiton) Vent. [IV]	O	IE	H	R	NW
Dieffenbachia seguine (Jacq.) Schott [IV]	O		H	R	NW

Revista Bio ciencias
ISSN 2007-3380

Continuation

List of species in the four island systems: I, II, III and IV.

1.- Type: Ornamental (O), Fruity (F), Medicinal (M), Cereal (C), Oilseed (L); 2.- Invasive: SIEI (IE: Invasive Exotics; IN: Invasive Natives), ISSG (G), Villaseñor (V); 3.- Life forms: Tree (A), Shrub (Ar), Herb (H), Creeping (Ra), Climbing (Tr), Rosetophilous (Ro), Succulent (Su), Epiphytic (E); 4.- Abundance grade: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R); 5.- Geographical origin: New World (NW), Old World (OW), Oceania (O).

Epipremnum aureum (Linden & André) G. S. Bunting [IV]	O		ArTr	R	O
Lemna aequinoctialis Welw. [II]		IN	H	R	NW
ARECACEAE					
Chamadorea cataractarum Mart. [IV]	O		Ar	R	NW
Chrysalidocarpus lutescens H. Wendl. [IV]	O		Ar	R	OW
Cocos nucifera L. [I, II, IV]	F	IE	A	R	O
Phoenix dactylifera L. [I, III]	F	IE	A	R	OW
P. canariensis H. Wildpret [II, IV]	F	IE,G	A	R	OW
P. roebelenii O´Brien [IV]	O	IE	Ar	R	OW
Washingtonia filifera (Linden ex André) H. Wendl. ex de Bary [IV]	O		A	R	NW
ASPARAGACEAE					
Agave maximiliana Baker [IV]	O		ArRo	R	NW
A. vivipara L. [IV]	O		ArRo	R	NW
Beaucarnea recurvata (K. Koch SE Fintelm.) Lem. [IV]	O		Ar	R	NW
Chlorophytum comosum (Thunb.) Jacques [IV]	O	IE	HRo	R	OW
Cordyline rubra Otto & A. Dietr. [IV]	O		Ar	R	O
Dracaena reflexa var. *angustifolia* Baker [IV]	O	IE	Ar	R	OW
D. trifasciata (Prain) Mabb. [IV]	O	IE	ArRo	R	OW
ASPHODELACEAE					
Aloe vera (L.) Burm. f. [II, III, IV]		IE,V	ArRo	F	OW
COMMELINACEAE					
Tradescantia pallida (Rose) D. R. Hunt [IV]	O		H	R	NW
CYPERACEAE					
Cyperus articulatus L. [II, IV]		IN	H	R	OW
C. esculentus L. [I]		IE	H	R	OW
C. odoratus L. [III, IV]		IN	H	R	NW
C. rotundus L. [II]		IE,G,V	H	R	NW
Schoenoplectus americanus (Pers.) Volkart [II]		IN	H	R	NW
IRIDACEAE					
Dietes iridioides (L.) Sweet ex Klatt [IV]	O	IE	HRo	R	OW
MUSACEAE					
Musa x paradisiaca L. [I]	F	IE	H	R	OW

Revista Bio ciencias
ISSN 2007-3380

Continuation

List of species in the four island systems: I, II, III and IV.

1.- Type: Ornamental (O), Fruity (F), Medicinal (M), Cereal (C), Oilseed (L); 2.- Invasive: SIEI (IE: Invasive Exotics; IN: Invasive Natives), ISSG (G), Villaseñor (V); 3.- Life forms: Tree (A), Shrub (Ar), Herb (H), Creeping (Ra), Climbing (Tr), Rosetophilous (Ro), Succulent (Su), Epiphytic (E); 4.- Abundance grade: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R); 5.- Geographical origin: New World (NW), Old World (OW), Oceania (O).

POACEAE					
Aristida ternipes Cav. [III, IV]		IE	H	A	NW
Arundo donax L. [I]		IE,G,V	Ar	R	OW
Bambusa vulgaris Schrad. ex J. C. Wendl. [IV]	O	G	Ar	R	OW
Bouteloua aristidoides (Kunth) Griseb. [II, III, IV]		IN	H	D	NW
B. curtipendula (Michx.) Torr. [I]		IN	H	R	NW
Cenchrus ciliaris L. [I, II, III, IV]		IE,G,V	H	D	OW
C. echinatus L. [I, II , III, IV]		G	H	D	NW
C. spinifex Cav. [II, IV]		IN	H	F	NW
Chloris virgata Sw. [I, II]		IN,V	H	F	NW
Cynodon dactylon (L.) Pers. [II, III, IV]		IE,G,V	H	F	OW
Dactyloctenium aegyptium (L.) Willd. [I, II, III]		IE,V	H	F	OW
Digitaria ciliaris (Retz.) Koeler [II]		IE	H	R	OW
Dinebra panicea (Retz.) P. M. Peterson & N. Snow [II]		IN	H	R	NW
Distichlis spicata (L.) Greene [I, II, III, IV]		IN	H	R	NW
Eleusine indica (L.) Gaertn. [II, III]		IE,V	H	R	OW
Melinis repens (Willd.) Zizka [I, II, III, IV]		IE,V	H	A	OW
Sorghum halepense (L.) Pers. [I, IV]		IE,G,V	H	R	OW
Zea mays L. [II, IV]	C		H	R	NW
Zoysia matrella (L.) Merr. [IV]	O		H	R	OW
TYPHACEAE					
Typha domingensis Pers. [II, IV]		IN	H	O	NW
EUDICOTS					
AIZOACEAE					
Sesuvium portulacastrum L. [II, III, IV]		IN	HRa	D	NW
AMARANTHACEAE					
Amaranthus palmeri S. Watson [II, III, IV]		IN	H	D	NW
Atriplex canescens (Pursh) Nutt. [II, III, IV]		V	H	A	NW
Chenopodium album L. [III]		IE,V	H	R	OW
Gomphrena sonorae Torr. [II, III, IV]		IN	H	D	NW
ANACARDIACEAE					

Revista Bio ciencias
ISSN 2007-3380

Continuation

List of species in the four island systems: I, II, III and IV.

1.- Type: Ornamental (O), Fruity (F), Medicinal (M), Cereal (C), Oilseed (L); 2.- Invasive: SIEI (IE: Invasive Exotics; IN: Invasive Natives), ISSG (G), Villaseñor (V); 3.- Life forms: Tree (A), Shrub (Ar), Herb (H), Creeping (Ra), Climbing (Tr), Rosetophilous (Ro), Succulent (Su), Epiphytic (E); 4.- Abundance grade: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R); 5.- Geographical origin: New World (NW), Old World (OW), Oceania (O).

Mangifera indica L. [I, IV]	F	IE	A	R	OW
Schinus terebinthifolia Raddi [IV]	O	IE	A	R	NW
Spondias purpurea L. [I]	F		Ar	R	NW
APOCYNACEAE					
Adenium obesum (Forssk.) Roem. et Schult. [IV]	O	IE	Ar	R	OW
Catharanthus roseus (L.) G. Don [IV]	O	IE	H	R	OW
Cryptostegia grandiflora Roxb. ex R. Br. [II]		IE,G,V	Ar	R	OW
Nerium oleander L.[IV]	O	IE	Ar	R	OW
Pachypodium lamerei Drake [IV]	O	IE	Ar	R	OW
Plumeria rubra L. [I, II]	O		Ar	R	NW
Stapelia gigantea N. E. Br. [IV]	O	IE	HSu	R	OW
ARALIACEAE					
Hydrocotyle umbellata L. [II]		IN	HRa	R	NW
Polyscias guilfoylei (W. Bull) L. H. Bailey [IV]	O		Ar	R	O
ASTERACEAE					
Ambrosia psilostachya DC. [II, III, IV]		IN	H	O	NW
Baccharis sarothroides A. Gray [II, III, IV]		IN	Ar	O	NW
Eclipta prostrata (L.) L.[II]		IN	HRa	F	NW
Erigeron bonariensis L.[I]		V	H	F	NW
E. canadensis L. [III, IV]		IN	H	F	NW
Helianthus annuus L.[IV]		IN	H	R	NW
Parthenium hysterophorus L. [II, III, IV]		G	H	F	NW
Pluchea odorata (L.) Cass. [I, II, III, IV]		IN	Ar	D	NW
Sonchus asper (L.) Hill [II]		IE, G	H	R	OW
S. oleraceus L. [II, III]		IE,G,V	H	R	OW
Tagetes erecta L. [IV]	O		H	R	NW
Tridax procumbens L. [II, III, IV]			H	O	NW
Xanthium strumarium L. [II]		IN	H	R	OW
BIGNONIACEAE					
Crescentia alata Kunth [I]	F		A	R	NW
Handroanthus impetiginosus (Mart. ex DC.) Standl. [IV]	O		A	R	NW
Tecoma stans (L.) Kunth [I]	O	IN,G	Ar	F	NW

Revista Bio ciencias
ISSN 2007-3380

Continuation

List of species in the four island systems: I, II, III and IV.

1.- Type: Ornamental (O), Fruity (F), Medicinal (M), Cereal (C), Oilseed (L); 2.- Invasive: SIEI (IE: Invasive Exotics; IN: Invasive Natives), ISSG (G), Villaseñor (V); 3.- Life forms: Tree (A), Shrub (Ar), Herb (H), Creeping (Ra), Climbing (Tr), Rosetophilous (Ro), Succulent (Su), Epiphytic (E); 4.- Abundance grade: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R); 5.- Geographical origin: New World (NW), Old World (OW), Oceania (O).

BORAGINACEAE					
Ehretia tinifolia L. [IV]	O		A	R	NW
BRASSICACEAE					
Brassica rapa L. [II]		IE,V	H	R	OW
CACTACEAE					
Opuntia ficus-indica L. [IV]	O	G	ArSu	R	NW
O. karwinskiana Salm-Dyck [IV]	O		ArSu	R	NW
O. microdasys (Lehm.) Pfeiff. [IV]	O		ArSu	R	NW
CANNABACEAE					
Celtis pallida Torr. [II, III, IV]		IN	Ar	O	NW
CARICACEAE					
Carica papaya L. [I]	F		H	R	NW
CASUARINACEAE					
Casuarina equisetifolia L. [IV]	O	IE,G	A	R	O
CLEOMACEAE					
Cleome gynandra L. [I]			H	R	OW
C. viscosa L. [I, II, III, IV]			H	O	OW
COMBRETACEAE					
Terminalia buceras (L.) C. Wright [II, IV]	O		A	R	NW
T. cattapa L. [II, IV]	O	IE,G	A	R	OW
CONVOLVULACEAE					
Ipomoea carnea Jacq. [IV]	O		Ar	R	NW
I. purpurea (L.) Roth [II]		IN	HTr	F	NW
I. quamoclit L. [II, III, IV]		V	HTr	A	NW
I. ternifolia Cav. [I, II, III, IV]		IN	HRa	D	NW
CRASSULACEAE					
Kalanchoe daigremontiana Raym. Hamet & H. Perrier [IV]	O	IE	HSu	R	OW
CUCURBITACEAE					
Citrullus lanatus (Thunb.) Matsum. & Nakai [I, II, III, IV]	F	IE,V	HRa	R	OW
Cucumis dipsaceus Ehrenb. ex Spach [I, II]		IE,V	HRa	R	OW
C. sativus L. [I]	F	IE,V	HTr	R	OW

Revista Bio ciencias
ISSN 2007-3380

Continuation

List of species in the four island systems: I, II, III and IV.

1.- Type: Ornamental (O), Fruity (F), Medicinal (M), Cereal (C), Oilseed (L); 2.- Invasive: SIEI (IE: Invasive Exotics; IN: Invasive Natives), ISSG (G), Villaseñor (V); 3.- Life forms: Tree (A), Shrub (Ar), Herb (H), Creeping (Ra), Climbing (Tr), Rosetophilous (Ro), Succulent (Su), Epiphytic (E); 4.- Abundance grade: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R); 5.- Geographical origin: New World (NW), Old World (OW), Oceania (O).

Momordica charantia L. [I, II, III, IV]	F	IE,V	HTr	D	OW
DIDIERACEAE					
Portulacaria afra Jacq. [IV]	O		H	R	OW
ERICACEAE					
Rhododendron spp. [IV]	O		Ar	R	
EUPHORBIACEAE					
Codiaeum variegatum (L.) Rumph. ex A. Juss. [IV]	O	IE	Ar	R	O
Euphorbia albomarginata Torr. & A. Gray [III]		IN	HRa	R	NW
E. eriantha Benth. [IV]		IN	H	R	NW
E. heterophylla L. [I, II]		IN	H	R	NW
E. hirta L. [I, II, III, IV]		IN	HRa	F	NW
E. hyssopifolia L. [I]		IN	H	O	NW
E. milii Des Moul. [IV]	O		Ar	R	OW
E. splendens Bojer ex. Hook. [IV]	O		H	R	OW
E. tithymaloides L. [IV]	O		Ar	R	NW
Ricinus communis L. [II]		IE,G,V	Ar	R	OW
FABACEAE					
Albizia lebbeck (L.) Benth. [IV]	O	IE,G	A	R	OW
Bauhinia variegata L. [II]	O	IE	A	R	OW
Caesalpinia pulcherrima (L.) Sw. [I]	O	V	Ar	R	NW
Chamaecrista nictitans Moench. [I]		IN	H	R	NW
Crotalaria pumila Ortega [IV]		IN	H	R	NW
Desmanthus covillei (Britton & Rose) *Wiggins* ex B. L. Turner [II, IV]		IN	Ar	A	NW
Leucaena leucocephala (Lam.) de Wit [I, II, IV]		IN,G	A	R	NW
Melilotus albus Medik. [IV]		IE,G	H	R	OW
M. indicus (L.) All. [IV]		IE	H	R	OW
Mimosa pigra L. [II]		IN,G	Ar	O	NW
Neltuma juliflora (Sw.) Raf. [II, III, IV]		G	A	A	NW
Parkinsonia florida (Benth. ex A. Gray) S. Watson [II]	O		Ar	R	NW
Pithecellobium dulce (Roxb.) Benth. [I, II, IV]	F		A	R	NW
Samanea saman (Jacq.) Merr. [IV]	O	IE,G	A	R	NW

Revista Bio ciencias
ISSN 2007-3380

Continuation

List of species in the four island systems: I, II, III and IV.

1.- Type: Ornamental (O), Fruity (F), Medicinal (M), Cereal (C), Oilseed (L); 2.- Invasive: SIEI (IE: Invasive Exotics; IN: Invasive Natives), ISSG (G), Villaseñor (V); 3.- Life forms: Tree (A), Shrub (Ar), Herb (H), Creeping (Ra), Climbing (Tr), Rosetophilous (Ro), Succulent (Su), Epiphytic (E); 4.- Abundance grade: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R); 5.- Geographical origin: New World (NW), Old World (OW), Oceania (O).

Senna pallida (Vahl.) Irwin & S. Barneby [II]		IN	Ar	O	NW
Sesbania herbacea (Mill.)McVaugh [I, II, III, IV]			H	D	NW
Tamarindus indica L. [III]	F	IE	A	R	OW
Vachellia farnesiana (L.) Wight et Arn. [I, II, III, IV]		G	Ar	D	NW
LAMIACEAE					
Ocimum basilicum L. [II]	M	IE,V	H	R	OW
LAURACEAE					
Persea americana Mill. [II]	F		A	R	NW
MALPIGHIACEAE					
Byrsonima crassifolia (L.) Kunth [IV]	F		A	R	NW
MALVACEAE					
Anoda cristata (L.) Schltdl. [II, III, IV]		IN	H	R	NW
Gossypium hirsutum L. [II, III]	O		Ar	R	NW
Hibiscus tiliaceus L. [II]	O		Ar	R	NW
MELIACEAE					
Azadirachta indica A. Juss. [II, IV]	O	IE	A	R	OW
Swietenia humilis Zucc. [IV]	O		A	R	NW
MOLLUGINACEAE					
Mollugo verticillata L. [III]		IN,V	HRa	R	NW
MORACEAE					
Ficus benjamina L. [IV]	O	IE	A	R	OW
F. microcarpa L. f. [IV]	O	IE,G	A	R	OW
MYRTACEAE					
Eucalyptus globulus Labill. [IV]	O	IE	A	R	O
Psidium guajava L. [I, IV]	F	G	A	R	NW
NYCTAGINACEAE					
Boerhavia coccinea Mill. [I, II, IV]		IN	HRa	D	NW
B. erecta L. [L. II, III, IV]		IN	H	D	NW
Bougainvillea spectabilis Willd. [I, II, IV]	O	IE	Ar	R	NW
Mirabilis jalapa L. [IV]	O	IN	H	R	NW
PAPAVERACEAE					
Argemone mexicana L. [I, II, III, IV]		IN	H	F	NW

Revista Bio ciencias
ISSN 2007-3380

Continuation

List of species in the four island systems: I, II, III and IV.

1.- Type: Ornamental (O), Fruity (F), Medicinal (M), Cereal (C), Oilseed (L); 2.- Invasive: SIEI (IE: Invasive Exotics; IN: Invasive Natives), ISSG (G), Villaseñor (V); 3.- Life forms: Tree (A), Shrub (Ar), Herb (H), Creeping (Ra), Climbing (Tr), Rosetophilous (Ro), Succulent (Su), Epiphytic (E); 4.- Abundance grade: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R); 5.- Geographical origin: New World (NW), Old World (OW), Oceania (O).

PASSIFLORACEAE					
Turnera diffusa Willd. ex Schult. [II]	M		Ar	R	NW
PEDALIACEAE					
Sesamum indicum L. [II]	L	IE,V	H	R	OW
POLYGONACEAE					
Antigonon leptopus Hook. & Arn. [I, II, III, IV]		G	ArTr	A	NW
Rumex crispus L. [II]		IE,G,V	H	R	OW
PORTULACACEAE					
Portulaca grandiflora Hook. [IV]	O		HRa	R	NW
P. oleracea L. [II, III, IV]		IE	HRa	O	OW
ROSACEAE					
Rosa spp. [IV]	O		Ar	R	
RUTACEAE					
Citrus x microcarpa Bunge [IV]	F		Ar	R	
Citrus x limon (L.) Osbeck [I, II, IV]	F	IE	Ar	R	
Citrus x paradisi MacFad. [I]	F	IE	Ar	R	
Murraya paniculata (L.) Jack [IV]	O	IE	Ar	R	OW
SANTALACEAE					
Phoradendron californicum Nutt. [II, III, IV]		IN	ArE	F	NW
SAURURACEAE					
Anemopsis californica (Nutt.) Hook. & Arn. [II, III]		IN	H	O	NW
SOLANACEAE					
Capsicum annuum L.[IV]	F		H	R	NW
Datura discolor Bernh. [I, II, III, IV]		IN	H	F	NW
Nicotiana glauca Graham [II, III, IV]		IE,G,V	Ar	D	NW
Petunia x hybrida Hort. ex E. Vilm. [IV]	O		H	R	
Solanum lycopersicum L.[II, IV]	F	IE,V	H	R	NW
S. nigrescens M. Martens & Galeotti [II, III, IV]		IN	H	R	NW
TAMARICACEAE					
Tamarix aphylla (L.) Karst. [II, III, IV]		IE,G,V	A	R	OW
T. ramosissima Ledeb. [II, III, IV]		IE,G,V	Ar	D	OW

Revista Bio ciencias
ISSN 2007-3380

Continuation

List of species in the four island systems: I, II, III and IV.

1.- Type: Ornamental (O), Fruity (F), Medicinal (M), Cereal (C), Oilseed (L); 2.- Invasive: SIEI (IE: Invasive Exotics; IN: Invasive Natives), ISSG (G), Villaseñor (V); 3.- Life forms: Tree (A), Shrub (Ar), Herb (H), Creeping (Ra), Climbing (Tr), Rosetophilous (Ro), Succulent (Su), Epiphytic (E); 4.- Abundance grade: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R); 5.- Geographical origin: New World (NW), Old World (OW), Oceania (O).

VERBENACEAE					
Duranta erecta L. [IV]	O		Ar	R	OW
Lantana camara L. [I, II, III, IV]		IN,G	Ar	D	NW
VITACEAE					
Cissus verticillata (L.) Nicolson & C. E. Jarvis [I, II, III, IV]		IN	ArTr	A	NW
Parthenocissus quinquefolia (L.) Planch. [IV]	O		ArTr	R	NW
ZYGOPHYLLACEAE					
Tribulus cistoides L. [IV]		V	HRa	R	OW