

## Increase in the number of introduced plant species in Galapagos

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Mauchamp<sup>1</sup> charted the rise in the number of introduced vascular plant species (flowering plants and ferns) in the Galapagos Islands up to 1997. Since that time the number of introduced plants has continued to rise<sup>2</sup>. However, a more comprehensive analysis<sup>3</sup> indicates that the rise in number of identified introduced plant species since the 1980s is not only due to recent introductions but also, in large part, due to an increase in interest in invasive plants and their impact on natural ecosystems, and thus the recent identification of species that were introduced in the past. The present report summarizes the previous data and brings the

total number of introduced plant species known in Galapagos up to date. It also briefly examines the distribution of invasive plants on different islands.

Data from Tye<sup>3</sup> and the more recent records in the Database of the Galapagos Flora of the Charles Darwin Foundation (CDF) are presented in Table 1 and Figure 1. The recent records are largely a result of exhaustive surveys of the towns and agricultural areas of the four inhabited islands, which attempted to record all introduced plants on every parcel of land.

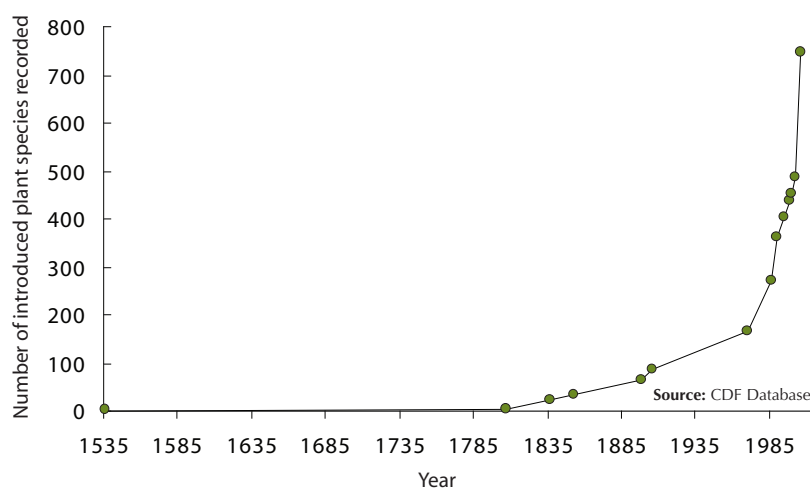
**Table 1.** Reports of introduced plant species in Galapagos.

Year	Cumulative number of introduced species <sup>1</sup>	Reference
1535	0	
1807	2	Porter 1822 <sup>4</sup>
1837	23	Hooker 1847 <sup>5</sup>
1853	35	Andersson 1858 <sup>6</sup>
1899	65	Robinson 1902 <sup>7</sup>
1906	85	Stewart 1911 <sup>8</sup>
1970	166	Wiggins & Porter 1971 <sup>9</sup>
1986	271	Lawesson <i>et al.</i> 1987 <sup>10</sup>
1990	364	Mauchamp 1997 <sup>1</sup>
1995	404	Mauchamp 1997 <sup>1</sup>
1999	437	CDF database: records to end of 1999
2000	453	CDF database: records to end of 2000
2003	486	CDF database: records to end of 2003
2006	748	CDF database: records to end of 2006

#### Note

<sup>1</sup>Excludes doubtfully native species<sup>1</sup>. The figures in this column sometimes differ from those quoted by the author cited (and from those cited in Tye<sup>3</sup>), owing to reclassification or re-identification of some species, and to the addition of species reported by prior authors, some of which were overlooked by later authors.

**Figure 1.** The cumulative number of introduced vascular plant species registered in Galapagos



The apparent rate of increase is obviously affected by increased scientific interest in recent years in the introduction process, as well as increased sampling effort. Although the earliest botanists included cultivated species<sup>4,5,8</sup>, Wiggins & Porter<sup>9</sup> did not. They only included naturalized species (introduced species that have become successfully established in the wild). Thus, the jump in numbers presented by Lawesson *et al.*<sup>10</sup> was partly due to the re-inclusion of cultivated species. All major studies since Lawesson *et al.*<sup>10</sup> have included both cultivated and naturalized species.

The increases reported since 1987 were primarily due to surveys that were carried out specifically to record introduced plants. The large increase in 2001<sup>2</sup> was due to initial inaccurate estimates of an exhaustive survey of the agricultural zone of Santa Cruz. The figures are corrected in Table 1 and Fig. 1. The recent large increase up to 2006 resulted from the inclusion of the more complete analysis of this survey and from surveys of Puerto Ayora and of the towns and agricultural areas on Floreana and Isabela (Fig. 2). The field survey on San Cristóbal is complete but the results have not yet been fully analysed; new species from this survey have not been included in Table 1 and Fig. 1. After including the results from San Cristóbal, we expect the total list of introduced vascular plants in Galapagos to be between 800 and 900 species, nearly twice that of the native flora (500 species).

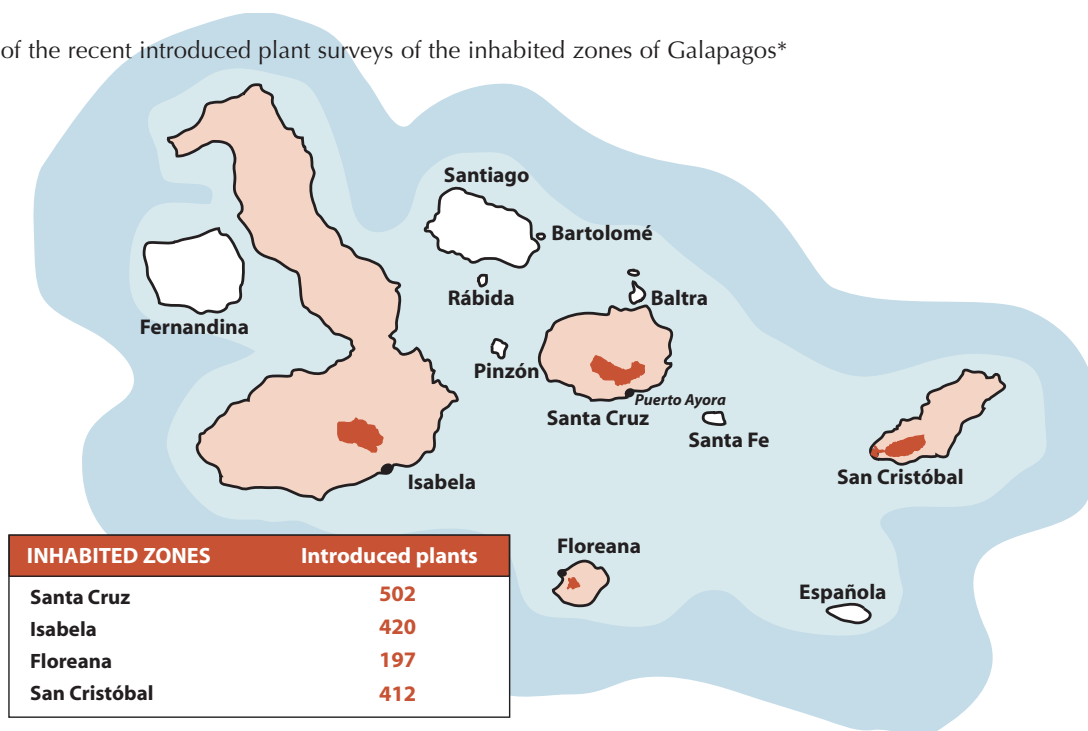
The list of introduced vascular plant species recorded in Galapagos has reached 748, many more than the 500 species of native flora.

The true rate of introduction-naturalization in Galapagos has been linear, although the graph may show exponential growth<sup>3</sup>. And despite the implementation of quarantine controls in 1998, the rate is not yet declining. The number of cultivated species appears to have increased exponentially in recent years, but this is not necessarily due to an increase in introduction rate. Property owners interviewed as part of the study indicated that many of the recently registered species were brought to the islands many years ago but only recently recorded by botanists.

The most aggressive invasive plant species are concentrated in the inhabited islands (Table 2) and have not been introduced to the majority of the uninhabited islands. However, Santiago is an uninhabited island with several highly-invasive plant species. Following goat and pig eradication on Santiago, several invasive species, including Hill Blackberry (*Rubus niveus*), are spreading and there is an intensive effort by the Galapagos National Park and the CDF to eradicate them.

A few of the most invasive species are still only found in small numbers in some of the inhabited islands. Two examples are the Curse of India (*Lantana camara*) in Isabela and Hemp Agave (*Furcraea hexapetala*) in Floreana. Eradication programs have recently been initiated to eliminate these species before they become a serious problem as they have on other islands in the archipelago.

Figure 2. Map of the recent introduced plant surveys of the inhabited zones of Galapagos\*



Note:  
\*Numbers in this figure are provisional.

Source: CDF Database

**Table 2.** Distribution of some of the most aggressive invasive plants in Galapagos.

SPECIES	SCIENTIFIC NAME	Floreana	Isabela	San Cristóbal	Santa Cruz	Santiago	Other islands
Guava	<i>Psidium guajava</i>	P	P	P	P		
Hill Blackberry	<i>Rubus niveus</i>	C	C	P	P	EP	
Quinine	<i>Cinchona pubescens</i>		P				
Hemp Agave	<i>Furcraea hexapetala</i>	C	C	P	P		
Avocado	<i>Persea americana</i>	P	P	P	P	EP	
Cuban Cedar	<i>Cedrela odorata</i>	P	P	P	P		
Angels' Trumpets	<i>Datura y Brugmansia spp.</i>	P	P	P	P		
Castor Oil	<i>Ricinus communis</i>	P	P	P	P		
Mother of Thousands	<i>Bryophyllum pinnatum</i>	P	P	P	P		
Laurel	<i>Cordia alliodora</i>	P	P	P	P		
Leucaena	<i>Leucaena leucocephala</i>	C	P	P	P		
Lime	<i>Citrus limon</i>	P	P	P	EP		
Passionfruit	<i>Passiflora edulis</i>	P	P	P	P		
Blackberry	<i>Rubus glaucus</i>	P	EP				
Blackberry	<i>Rubus adenotrichos</i>	C	E				
Male sauco	<i>Citharexylum gentryi</i>		EP				
Pará Grass	<i>Urochloa spp.</i>	P	P	P	P		
Elephant Grass	<i>Pennisetum purpureum</i>	P	P	P	P		
Poleo	<i>Hyptis pectinata</i>	P	P	P	P	P	
Rose-apple	<i>Syzygium jambos</i>	C	P	P	P		
Sauco	<i>Cestrum auriculatum</i>	P	P	P			
Curse of India	<i>Lantana camara</i>	P	EP	P	P		
Dutchman's Pipe	<i>Aristolochia odoratissima</i>				EP		

Source: CDF &amp; GNP Database

**Note**

Key: An empty cell = not present; P = present; C = control in progress; EP = eradication in progress; E = eradicated.

Other species, such as the Guava (*Psidium guajava*) and the Quinine plant (*Cinchona pubescens*) in Santa Cruz are so widespread that their complete eradication would be extremely difficult and expensive. The control of these and other species is underway in priority conservation areas, such as Media Luna and Los Gemelos. Meanwhile, options for biological control and complete eradication are being considered.

Eradication programs have been initiated for some species and biological control methods are being considered for others.