

## Short Communication

### Abundance, distribution and conservation significance of regionally endemic plant species on Anegada, British Virgin Islands

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**Abstract** The conservation significance of the Caribbean island of Anegada in the British Virgin Islands is highlighted in this study of the distribution of plant species in two major habitats, sand dunes and limestone pavement. In 104 plots along 27 transects located around the western salt ponds of the Anegada Ramsar site, 133 plant species were recorded, including five regional endemics. The limestone pavement supported large populations of *Acacia anegadensis*, endemic to Anegada, and *Cordia rupicola*, known only from Anegada and Puerto Rico (although the Puerto Rican population is thought to be extirpated). The sand dunes supported a

large population of *Metastelma anegadense*, also endemic to Anegada. Two other regional endemics were recorded within the limestone cays, *Leptocereus quadricostatus*, previously known from only one locality in Puerto Rico and *Malpighia woodburyana*, restricted to a few small populations on islands on the Puerto Rican Bank. For both of these species Anegada supports the largest known individual population.

**Keywords** *Acacia anegadensis*, Anegada, British Virgin Islands, *Cordia rupicola*, endemic, *Leptocereus quadricostatus*, *Malpighia woodburyana*, *Metastelma anegadense*.

The Caribbean Biogeographic Unit, comprising the Caribbean and south Florida, has been identified as the third most important global biodiversity hotspot (Myers *et al.*, 2000). This is based on the proportion of endemic plants and vertebrates and remaining primary vegetation. This paper highlights the conservation significance of one Caribbean island, Anegada.

The island of Anegada belongs to the British Virgin Islands, an archipelago lying east of the US Virgin Islands and forming part of the Puerto Rican bank. Anegada is unique in the Islands as the only non-volcanic island. It is a low-lying limestone formation, partly overlain with sand and a thin soil, with a maximum altitude of c. 8 m in the north-east and with >40% of the island lying <3 m above sea level (BVI, 1993). Islands with this type of limestone formation, such as Anguilla

and Barbuda, are uncommon throughout the Caribbean Basin, and have a characteristic xerophytic scrub-like vegetation (Beard, 1949). The western half of Anegada is dominated by a series of salt ponds that were designated as a Ramsar site in 1999 (Western Salt Ponds of Anegada; The Ramsar Convention on Wetlands, 2003). The present studies were undertaken in the vegetation within and adjacent to the Ramsar site and represent the first quantitative study of the vegetation of Anegada (Fig. 1).

Three species with restricted ranges are known to occur on Anegada (Britton, 1916; D'Arcy, 1971, 1975). *Acacia anegadensis*, a tree growing to 8 m, and *Metastelma anegadense*, a herbaceous vine, are the only species of flowering plants endemic to Anegada. *Cordia rupicola*, a small shrub known from Anegada and a few localities in Puerto Rico (Guánica State Forest, Los Indios (Guayanilla), and Barrio Cañas (Ponce); P. Acevedo-Rodríguez, unpub. data), is categorized as Critically Endangered on the IUCN Red List (IUCN, 2003), and is a candidate species for threatened status by the US Fish and Wildlife Service (USFWS, 2003a). Recent attempts to relocate the Puerto Rican populations were unsuccessful and *C. rupicola* is now either extirpated on Puerto Rico (Proctor, 1991) or exists only as a few remnant individuals in a housing development (USFWS, 2003b).

A stratified random sampling strategy (Kent & Coker, 1994) was designed to investigate the distribution and abundance of these restricted range species and other plants. Three habitat types were identified within and

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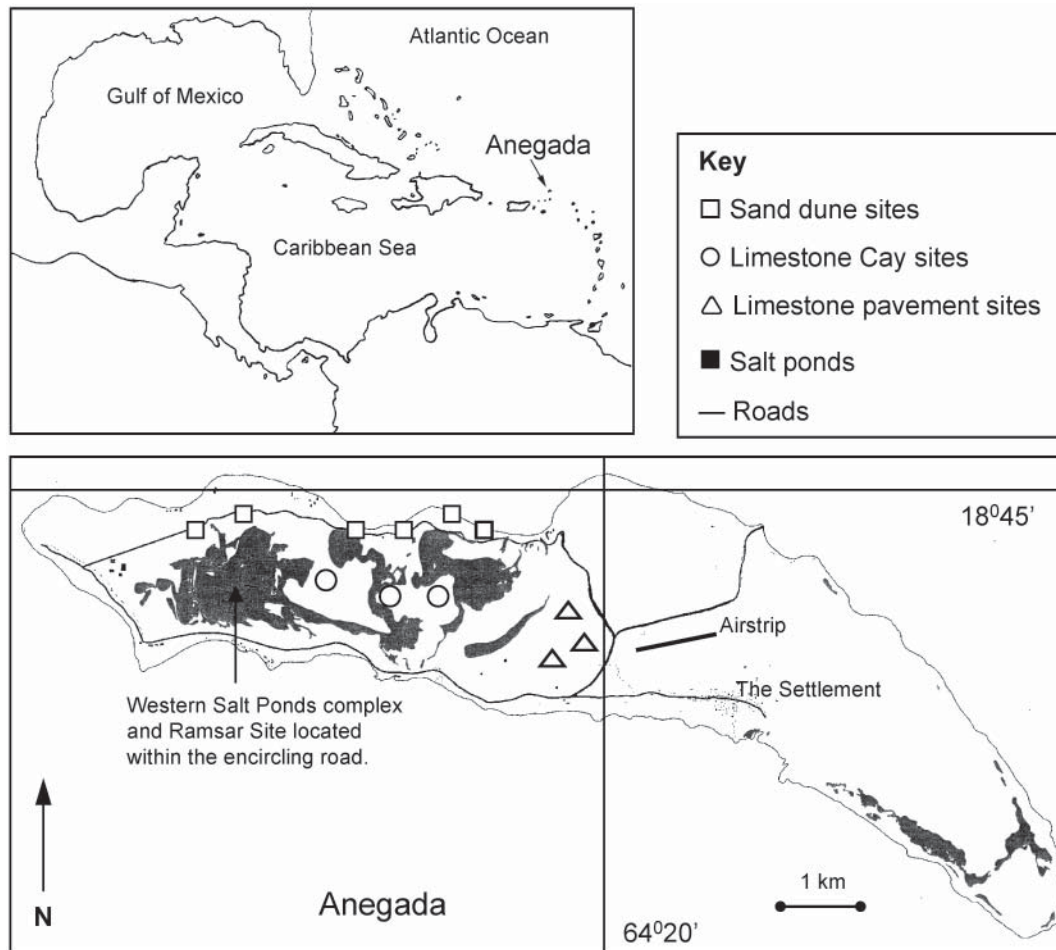


Fig. 1 The location of Anegada, British Virgin Islands in the Caribbean Basin, and the island of Anegada and the location of the sampling sites around the western salt ponds Ramsar Site.

adjacent to the Ramsar site: (1) open limestone pavement supporting scattered herbaceous and scrub vegetation, (2) cays, which are isolated limestone pavement within the salt pond complex, supporting a low, open canopy of sclerophyllous shrubs and small trees, and (3) sand dune systems. Twelve representative study sites were identified within and surrounding the existing Ramsar site covering these three habitats (Fig. 1, Table 1). Replicate transects were established at each site and the starting points randomly selected.

Each of the 27 transects comprised a 2 m wide belt divided into 50 m contiguous, geo-referenced plots, giving 104 plots in total. In November 2000 all plant species were identified in each plot, and a total of 133 species were recorded. A summary of the 10 most abundant species and distribution of sites and plots in each of the habitats is presented in Table 1.

Abundance of the three restricted range species varied between habitats. The limestone pavement supported large populations of both *C. rupicola* (69% of plots) and *A. anegadensis* (62%) whilst the sand dunes supported

a large population of *M. anegadense* (78%). Spiny and unpalatable plants, such as *Randia aculeata*, *Croton discolor*, *Agave missionum*, *Solanum racemosum*, *Reynosia uncinata*, *Lantana camara* and *L. involucrata*, dominated all three habitats. An exception was *Crossopetalum rhacoma* which was found in >80% of plots in each of the three habitats; it is a palatable species bearing many fleshy fruits (drupe) that are an important food source for wildlife. Two species of orchids, *Psychilis macconnelliae* (88% of plots) and *Tetramicra canaliculata* (67%) were abundant in the sand dunes.

Two further restricted range species were located within the cays. *Leptocereus quadricostatus* is a scrambling columnar cactus previously thought to be endemic to the Guánica region of south-west Puerto Rico (Little and Woodbury, 1980; Liogier, 1994). This is a new record for Anegada. *Malpighia woodburyana* is known from small populations in Puerto Rico, the US Virgin Islands and Anegada (Acevedo-Rodríguez, 1993, 1996). We undertook a subsequent census of this species in the cays, and located 74 individuals of varying ages, from

**Table 1** The 10–11 most abundant plant species based on percentage occurrence across all plots (see Fig. 1) in each habitat.

Limestone pavement (26 plots)		Cays (30 plots)		Sand dunes (48 plots)	
Species	% abundance	Species	% abundance	Species	% abundance
<sup>4</sup> <i>Randia aculeata</i> L. (Rubiaceae)	96	<sup>3</sup> <i>Amyris elemifera</i> L. (Rutaceae)	97	<sup>4</sup> <i>Crossopetalum rhacoma</i> Crantz (Celastraceae)	92
<sup>3</sup> <i>Plumeria alba</i> L. (Apocynaceae)	92	<sup>4</sup> <i>Tillandsia utriculata</i> L. (Bromeliaceae)	93	<sup>4</sup> <i>Erithalis fruticosa</i> L. (Rubiaceae)	92
<sup>3</sup> <i>Croton discolor</i> Willd. (Euphorbiaceae)	92	<sup>4</sup> <i>Crossopetalum rhacoma</i> Crantz (Celastraceae)	83	<sup>4</sup> <i>Ernodea littoralis</i> Sw. (Rubiaceae)	92
<sup>4</sup> <i>Crossopetalum rhacoma</i> Crantz (Celastraceae)	85	<sup>3</sup> <i>Reynosa uncinata</i> Urb. (Rhamnaceae)	83	<sup>4</sup> <i>Lantana involucrata</i> L. (Verbenaceae)	90
<sup>2</sup> <i>Agave missionum</i> Trel. (Agavaceae)	69	<sup>3</sup> <i>Pilosocereus royenii</i> Byles & Rowley (Cactaceae)	77	<sup>3</sup> <i>Psychilis macconnelliae</i> Saulea (Orchidaceae)	88
<sup>2</sup> <i>Cordia rupicola</i> Urb. (Boraginaceae)	69	<sup>4</sup> <i>Eugenia axillaris</i> (Sw.) Willd. (Myrtaceae)	73	<sup>5</sup> <i>Dodonaea viscosa</i> Jacq. (Sapindaceae)	83
<sup>4</sup> <i>Lantana involucrata</i> L. (Verbenaceae)	69	<sup>3</sup> <i>Solanum racemosum</i> Jacq. (Solanaceae)	73	<sup>3</sup> <i>Chamaesyce articulata</i> (Aubl.) Britton (Euphorbiaceae)	79
<sup>3</sup> <i>Lantana camara</i> L. (Verbenaceae)	65	<sup>3</sup> <i>Croton discolor</i> Willd. (Euphorbiaceae)	70	<sup>4</sup> <i>Gyminda latifolia</i> (Sw.) Urb. (Celastraceae)	77
<sup>1</sup> <i>Acacia anegadensis</i> Britton (Faboideae: Mimosoideae)	62	<sup>2</sup> <i>Agave missionum</i> Trel. (Agavaceae)	67	<sup>1</sup> <i>Metastelma anegadense</i> (Apocynaceae)	75
<sup>4</sup> <i>Pithecolobium unguis-cati</i> (L.) Benth. (Faboideae: Mimosoideae)	62	<sup>3</sup> <i>Stigmaphyllon emarginatum</i> (Cav.) A. Juss. (Malpighiaceae)	67	<sup>3</sup> <i>Gundlachia corymbosa</i> (Urb.) Britton (Asteraceae)	67
<sup>3</sup> <i>Euphorbia petiolaris</i> Sims (Euphorbiaceae)	62			<sup>3</sup> <i>Tetramicra canaliculata</i> (Aubl.) Urb. (Orchidaceae)	67

<sup>1</sup>Anegada endemics; <sup>2</sup>Puerto Rican Bank endemics; <sup>3</sup>Caribbean species; <sup>4</sup>Neotropical species; <sup>5</sup>Worldwide distribution (Distribution based on published floras and herbarium records).

seedlings to mature, fruiting adult shrubs/small trees, making the Anegada population of *M. woodburyana* the largest in the Puerto Rican bank.

The abundance of the five restricted range species in the three habitats on Anegada are summarized in Table 2. Apart from a single seedling on the open dunes, *A. anegadensis* was found predominantly in the two limestone habitats. In the cays there are many large, mature individuals such as are rarely seen in other parts of the island and may represent populations that escaped the cutting for gum in the 1800s; during this period, much of the woody growth was cleared and gum extracted,

possibly for use in boat building, and exported through St Thomas, US Virgin Islands (Schomburgk, 1832). The cays also support the only populations of *L. quadricostatus* and *M. woodburyana* on Anegada. *C. rupicola* was more abundant on limestone but also widespread within the dunes. Overall, *C. rupicola* was found in just under half of the 104 plots sampled, indicating a total population size of several thousand for a species that is thought to have been extirpated from its only other known location in Puerto Rico. In contrast to the other four species, *M. anegadense* was more abundant in the sand dune habitat; on limestone it was

**Table 2** Abundance of the five restricted range species occurring on Anegada, by habitat type (% of plots occupied).

	Open limestone pavement	Cays	Sand dunes
<i>Acacia anegadensis</i> Britton	62	60	2
<i>Cordia rupicola</i> Urban	69	60	25
<i>Metastelma anegadense</i> Britton	23	0	75
<i>Malpighia woodburyana</i> Vivaldi	0	13	0
<i>Leptocereus quadricostatus</i> (Bello) Britton & Rose	0	3	0

restricted to the open pavement and not found in the more closed, shadier conditions of the cays.

The cays support a dry thorn woodland apparently in a climax state. Tree species such as *Zanthoxylum flavum* (Rutaceae) are relatively abundant (63% of plots) but rare in the rest of the Puerto Rican Bank; for example, it is known from only one tree in St John in the US Virgin Islands (Acevedo-Rodríguez, 1996). *Z. flavum* has been heavily exploited for timber throughout its range in the West Indies. Limestone substrate is limited throughout the Caribbean region and where it does occur, mature woodland has been lost as a result of anthropogenic pressures, most notably in the Guánica region of Puerto Rico. Consequently, the Anegada cays represent a globally significant habitat. The cays are used extensively as foraging sites by the endemic Anegada rock iguana *Cyclura pinguis*, and the sand dunes provide them with nesting sites. *C. pinguis* is also an important seed disperser, and seeds of several plant species appear to germinate more quickly if they have passed through the iguana's gastrointestinal tract (Gerber, 2000). The sand dunes and cays are also important habitats for the locally common endemic butterfly *Calisto anegadensis*, associated with *Uniola virgata* (Poir.) Griseb., the large tufted grass characteristic of the open dune system (Smith *et al.*, 1991).

This study has documented the widespread occurrence and habitat affiliations of several regionally and locally endemic plant species on Anegada. These include two species endemic to Anegada, *A. anegadensis* and *M. anegadense*, and three species where Anegada supports the largest known global population, *C. rupicola*, *L. quadricostatus* and *M. woodburyana*. This combined with the relatively pristine nature of the habitats and notable absence of alien invasive plant species highlights the conservation value of Anegada at both the regional and global level. However, this and several earlier reports have highlighted current and potential negative impacts of invasive animal species including cats, rats, and goats as well as the pressure for tourism and infrastructural development (BVI, 1993; Veitch, 1998; Gerber, 2000; Smith-Abbott *et al.*, 2002). Conservation measures urgently need to be implemented before these pressures have a lasting negative impact on the Island. Anegada is a prime candidate for designation as a Caribbean Important Plant Area, as recognized in the Global Strategy for Plant Conservation (CBD Secretariat, 2002).

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### Biographical sketches

Dr Colin Clubbe has research interests in island ecology and conservation. Currently he has projects in several Caribbean islands, focusing on plant conservation, capacity building and the role of botanic gardens in the conservation of indigenous floras.

Dr Michael Gillman has broad interests in conservation and ecology, addressing a variety of population and plant-herbivore questions. He has worked extensively in the Caribbean and Guyana.

Dr Pedro Acevedo-Rodríguez works on the floristics of the West Indies, especially Puerto Rico and the Virgin Islands, and on the systematics of the Sapindaceae.

Raymond Walker was previously the British Virgin Island coordinator for the project *Integrating National Parks, Education and Community Development*. He undertakes fieldwork for a range of taxa and is a member of the IUCN/SSC Iguana Specialist Group.