

***Coccoloba* (Polygonaceae) achenes stranded on European Atlantic exposed shores**

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This pdf constitutes the Version of Record published on 14 August 2025.

Abstract

The sea-grape genus, *Coccoloba* P.Browne, commonly occurs on Atlantic coasts of the Americas from Bermuda south to Argentina. Achenes that resemble those of this genus were found with drift on the high shores in Cos. Sligo (VCH28) and Cork (VCH3) where disseminules from the Americas are known to have collected, and likely to have crossed the North Atlantic Ocean. A further achene was found on an exposed Lanzarote Beach, Canary Islands, most probably *C. uvifera* that may have drifted from a nearby island, where it has been planted following its introduction. These represent the first known records of achenes considered to represent *Coccoloba* found on European shores.

Keywords: disseminule; long-distance dispersal; Ireland; Spain; ocean drift

Introduction

The genus *Coccoloba* P.Browne contains c.180 tropical and sub-tropical shrubs and trees occurring in the Americas (Parotta, 1975), with approximately 127 in the Caribbean and 40 in Mesoamerica (Koenemann & Burke 2020). Further species continue to be described (Ancona *et al.* 2023). The native range of this genus extends from Bermuda southwards to Argentina to include Central America and the offshore Islands of the Caribbean (Howard, 1957; POWO, 2024). The range of *Coccoloba uvifera* (L.) L. (Sea Grape) has its most northern distribution in Bermuda (Gryzenhout *et al.* 2006), commonly occurring in the Bahamas (Sealey *et al.* 2002) and overlapping with *C. diversifolia* Jacq. (Pigeon Plum), a shrub often found in beach areas and also occurring in the Bahamas (Smith & Vankat 1992). Both species have a range extending southwards into northern South America (Parrotta, 2000). *Coccoloba uvifera* has been introduced to many tropical regions worldwide including Cape Verde Islands (Duarte *et al.* 2022) and nearby Bassau-Guinea in Africa. It has also been introduced to many Pacific Islands such as Hawaii (Sullivan *et al.* 2006) and Indochina for seaside plantings to provide shade (Howard, 1961).

Coccoloba uvifera is a dioecious tree, one of the most common trees along coastal beaches and dunes forming an important component of the upper shore as part of the wind-bent vegetation (Berger & La Greca 2014). It is considered to be a beach pioneer (Moreno-Casasola, 1988). It can occur on rocky shores and forms stands adjacent to lagoonal areas (Espejel 1987), also occurring inland within dry

forests (Medina *et al.* 2010). It is unable to tolerate frosts and has an optimal temperature for growth at 26°C (Manokari *et al.* 2023). Where conditions are best suited it can attain a height of 17 m, or otherwise occurs as a shrub attaining 4-7 m under exposed conditions (Parrotta, 1994). The thick evergreen oval leaves provide effective shade, and for this reason used as an ornamental tree in back-yards (Meerow *et al.* 2001).

Plants of *C. uvifera* are exposed to salt-spray, and can withstand inundations from storm surges, and so is a salt-tolerant species (Black, 2003). For this reason, it is suited to coastal conditions where it can also act as a wind break. Due to its ability to endure maritime conditions it has been spread to other world regions with a similar climate (Parrotta, 1994).

Coccoloba uvifera produces fruits as drupes. These are initially green, and when ripe develop a red-purple colour, borne on pendulous clusters that can attain 15 cm in length. Each fruit is about 2 cm in length and contains a large achene with a fibrous pericarp (Perry & Dennis 2010). Despite the comparatively large achenes, the fruits are eaten by humans and used for making jams and wine (Manokari *et al.* 2021).

Fruits of *C. uvifera* are produced throughout the year. At the northern extent of its range these are produced in early autumn (Gillman *et al.* 2014). The proximity of the parent tree to the upper shore has resulted in its achenes becoming widespread across the shore (Perry & Dennis 2010). Guppy (1917) examined the floating ability and found that this could take place for up to 50 days. Achenes of *C. uvifera* introduced to seawater can float for up to five months (Perry & Dennis, 2010). While achenes are common on Florida shores, they have not been recorded on the Georgia or South Carolina coasts. *Coccoloba uvifera* is commonly found on the Yucatan Peninsula (Espejel, 1987) and while plants are cultivated in Texas, there are only rare accounts of it in the wild (Singhurst & Holmes, 2014) although its achenes have been collected on shores (Sullivan, 2003).

In this account we report on the finding of three achenes that have the features of *Coccoloba* achenes on two Atlantic facing shores in Ireland, with a further record from the west coast of Lanzarote, Canary Islands.

Methods

Irish Atlantic exposed shores were examined over the period from 1982 to 2023 for disseminules. These shores were not examined during every season over this time. A single visit to a shore in Lanzarote in 2011 took place in wintertime. Reference collections of achenes from the sandy shores of Cozumel, Mexico at 20° 25' 49" N, 87° 00' 23" W (N = 21) and Florida, USA at 26° 05' 49" N, 80° 06' 21" W (N = 34), took place during April 2023, and Tenerife, Canary Islands, Spain at 28° 04' 56" N, 16° 44' 08" W (N = 51) (Fig. 1). These collections were used to compare with the Irish and Lanzarote collections.

All material was sun dried and held in containers with silica gel before measurements were made. The length of each stranded achene, from the base to its pointed tip and its diameter were measured to the nearest 0.1 mm. All reference collections were of sun-dried achenes and were measured for their diameter and weight. Weights were determined using a jeweller's professional digit pocket scale 'Diamond A03' to 0.01 g.

Identification of *C. uvifera* was made using Perry & Dennis (2010) and authors expertise.

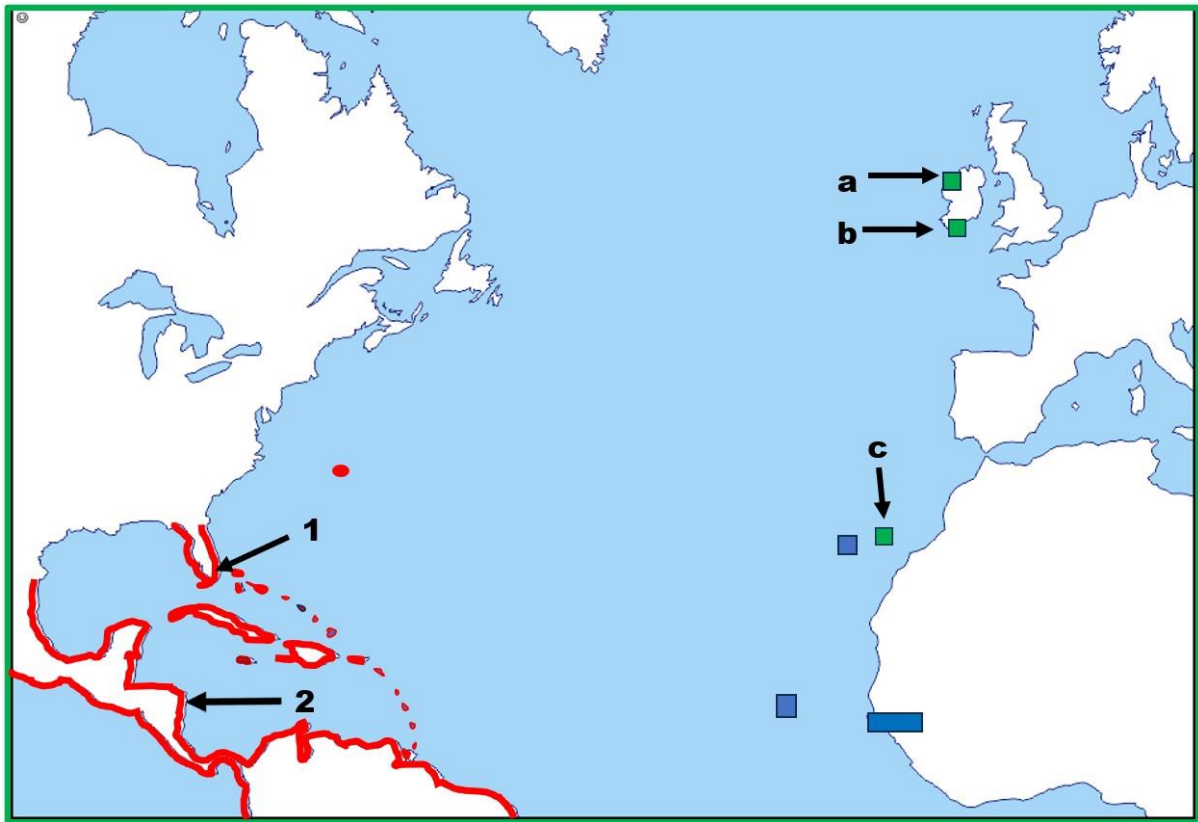


Figure 1. Known distribution of *Coccoloba* species across the North Atlantic Ocean: native range (red), introduced range (blue). Beach collections -1: Fort Lauderdale, Florida; 2: Cozumel, Mexico. Stranded achenes (green)– a: Streedagh Beach, Co Sligo (VCH28); b: Warren Beach, Co Cork (VCH3); c: Janubio Beach, Lanzarote, Canary Islands

Results

Achenes (Fig. 2) were found at the following three localities on European Atlantic shores:

a: *Coccoloba* sp., Streedagh Bay, Co Sligo, Ireland (VCH28) (54° 24' 20" N, 08° 33' 22" W)

Collected during October 1991 from within a drift of algae from the upper sandy shore. This measured 17.1 mm in length, 11.2 mm in diameter and 0.562 g. At the time it was the only stranded non-native seed collected from this shore.

b: *Coccoloba* sp., The Warren, Rosscarbery, Co Cork, Ireland (VCH3) (51° 33' 58" N, 09° 00' 45" W)

Collected on 26 November 1986 from the east end of the sandy Warren Beach after recent strong onshore winds. This measured 11.8 mm in length, 7.5 mm diameter and 0.150 g. This was collected together with seeds of *Lathyrus japonicus* Wild. and *Ipomoea alba* L. and *I. pes-caprae* (L.) R.Br.

c: *Coccoloba uvifera*, Janubio Beach, Lanzarote, Canary Islands, Spain (28° 56' 53" N, 13° 49' 43" W)

Collected from a high-water level mark on a dark sand beach amidst a stranded algal drift patch, during February 2011. This measured 13.1 mm in height, 9.8 mm diameter and 0.373 g. Found together with two Convolvulaceae seeds and two *Spirula spirula* L. 1758 'shells'.



Figure 2. Left to right, *Coccoleba* achenes from Lanzarote, Spain; Co. Cork and Co. Sligo, Ireland

Discussion

It is likely that the *Coccoleba* achenes found on Irish shores came from its native distribution in the Americas (Fig. 1). Plants of this genus are unknown in the wild in Northern Europe. While the achene found on the Lanzarote shore might have arrived from the Americas; it is more likely to have resulted as drift from a neighbouring Canary Island where it was planted as an introduction. It is possible that this may have spread from a shore in Tenerife. We are unable to be sure that the Irish achenes have, with certainty, arrived from the Americas, but such a transmission we consider to be possible. We think it less likely that achenes were distributed by humans in the region between the two continents. The two Irish beaches are among known sites for the frequent strandings of American disseminule species, and plastics, with a North American origin (Nelson, 2000; Minchin & Quigley 2023).

The many species of *Coccoleba* in the Americas having similar, but different sized fruits typically having globular to obpyriform achenes (Burke *et al.* 2010), to which our stranded specimens conform. In this study we chose to use the achene diameter and weight rather than using the more variable height of each specimen, due to the varied extensions of the pointed 'crown'. The diameter and weight relationships of both Irish specimens fall outside the range of the achene samples of *C. uvifera* collected from three shores of Cozumel, Florida and Tenerife (Fig. 3). López-Sánchez *et al.* (2019) found achenes of *C. uvifera* could attain 17 mm in length, 10.45 mm in diameter and up to 0.52 g. In our reference collections we found *C. uvifera* with a diameter of up to 11.5 mm and 0.52 g. Clasen & Kesel (2019) examined the surface microstructure of seeds that floated in seawater, this included *C. uvifera* that also had a greater diameter than found in our American or Spanish collections. The smaller Warren Beach specimen may represent a separate species of *Coccoleba* by having a smaller achene diameter as in *C. burkeae* J.J. Ancona, J.J. Ortiz-Díaz & J. Tun and *C. najarroii* Ortiz-Díaz & J.J. Ancona from the Vera Cruz region of Mexico (J. Ortiz *et al.* 2023)

We do not know how many species of *Coccoloba* have the capability of drifting for extensive periods in sea water. However, two species, with a more northern distribution in the Americas, *C. uvifera* and *C. diversifolia* are capable of drifting at least some distance at sea and occur in strandings on Floridian shores (Perry & Dennis 2010). *Coccoloba diversifolia* has achenes 6-10 mm in height and 6-9 mm diameter (Flora of North America, 2024) that lie within the diameter range of the Warren Beach specimen.

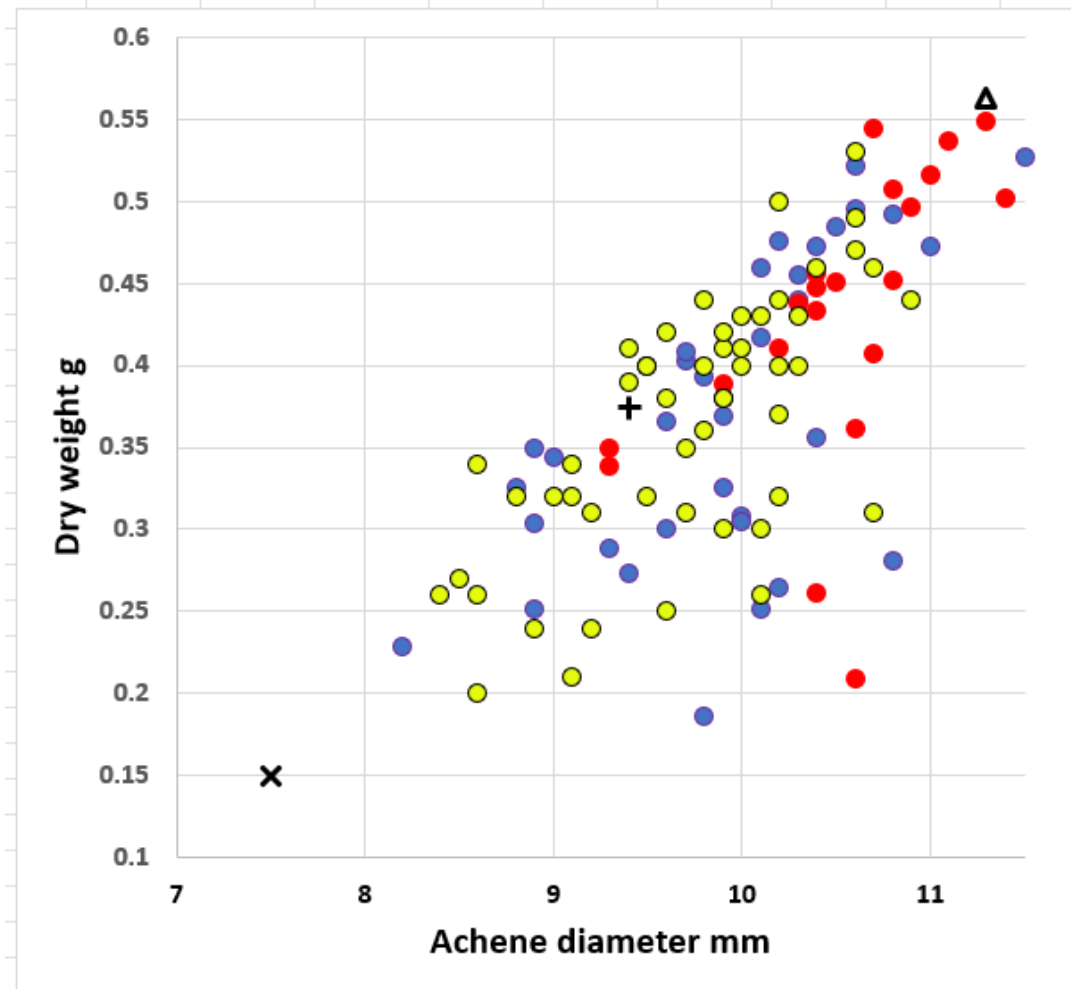


Figure 3. Achenes of *Coccoloba*: Florida, USA (blue); Mexico, Cozumel (red); Canary Islands (yellow). Specimens: Ireland, Co. Sligo, Streedagh Beach (▲), Co Cork, Warren Beach (x); Canary Islands, Lanzarote, Janubio Beach (+)

The Lanzarote achene might have come from urban plantings in Tenerife. In the south of Tenerife plants of *C. uvifera* are becoming more widely planted with a wild record of a single fruiting *C. uvifera* tree found below a coastal path in a cliff region, west of Santiago del Teide in December 2019 (Verloove, 2021). This may represent one of the few records of its occurrence in the wild, that includes two urban localities in La Palma (Otto & Verloove 2016). It is planted on the high shore of popular beaches, gardens and parks in the south of Tenerife (DM pers. ob.). The west facing beach on Lanzarote is almost 250-350 km in direct distance from Tenerife and La Palma where the nearest fruiting populations exist.

In conclusion, regional dispersal of the achenes of two *Coccoloba* species are known to occur on Floridian shores and their long-distance oceanic dispersal may be possible. With only two achenes found on Irish shores, over a forty-year period, indicate that such transmissions are rare events. The high level of abundance of achenes on Floridian shores would indicate that the majority flushed to the sea are likely to eventually sink. The appearance of shore strandings of achenes in Texas, where mature plants are not recorded, indicates that short distance transport is not infrequent. The buoyancy of up to five months of *C. uvifera* might be sufficient for an oceanic transmission for some. The large number of *Coccoloba* species present in the Americas present a difficulty in species determination of their achenes, and it is unknown how many of these species have the capability to float. Local transmission within the Canary Islands seems a likely explanation for the Lanzarote stranded achene.

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ISSN: 2632-4970

<https://doi.org/10.33928/bib.2025.07.090>