

## The phylogenetic history of the seagrass species *Posidonia oceanica*

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Received: Aug 09, 2022

Accepted: Sep 19, 2022

Published: Sep 26, 2022

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### Introduction

*Posidonia oceanica* (Linnaeus) Delile is a marine Angiosperm, within the clade of Monocotyledonous, belonging to the order of Alismatidae. This plant is the most important endemic species of the Mediterranean Sea, protected by European legislation through the Habitat Directive 92/43/UE and classified as Priority Habitat within the Red List of the International Union for Conservation of Nature (IUCN) [1]. Actually, in marine realm there are eight different species of the genus *Posidonia*, distributed in the northern hemisphere of Mediterranean Sea and in the southern one of Australian coastal waters. *Posidonia oceanica* is the sole species of the basin while in the southern hemisphere there are seven species distinguished in two complexes, that are: Australis, with the species *Posidonia australis* Hooker, *Posidonia sinuosa* Cambridge & J. Kuo and *Posidonia augustifolia* Cambridge & J. Kuo and *Posidonia ostenfeldii* with the species *Posidonia kirkmanii* J. Kuo & Cambridge, *Posidonia ostenfeldii* Hartog,

*Posidonia coriacea* Cambridge & J. Kuo and *Posidoniadenhartogii* J. Kuo & Cambridge [2,3]. In the Mediterranean Sea, *Posidonia oceanica* can form, in good and pristine conditions of coastal waters, large meadows being the “climax” ecosystem on mobile substrata in the infralittoral bottoms of the basin [4]. This marine biocenosis supports high level of biodiversity and productivity in coastal ecosystems playing an important role in exporting organic matter from coastal waters to open sea for the good functioning of marine ecosystems [5]. The special geographic pattern of the species, actually separated by a long distance of about 17.000 Km, suggests the theory that the current species of the genus *Posidonia* originated from a single centre of radiation, so that it could be possible to reconstruct the phylogenetic history of the species *Posidonia oceanica*. By this way, 430 million years ago, during the Paleozoic Era, it happened, on continental lands, a great diversification in the plant kingdom, leading to the appearance of the first terrestrial Angiosperms and, between them, it comes out an ancient *Posidonia* genus,

**Citation:** Cantasano N. The phylogenetic history of the seagrass species *Posidonia oceanica*. *Int J Environ Agric Sci*. 2022; 2(1): 1001.

terrestrial ancestor of the current *Posidonia* marine species. Afterwards, in the Cretaceous period, about 100 million years ago, some species of Angiosperms began to return into the sea, through a long process of adjustments during which these transitional species lived in fresh and brackish waters, gradually adapting to marine life [6-9]. So, it is possible to consider these species like the “whales” of plant kingdom, returning into the sea, as marine mammals coming from terrestrial lands [10,11] in a geologic period when all the living beings were engaged to spread on continental platform [12,13]. Amongst these first marine angiosperms, the species *Posidonia cretacea* Hosius Von der Mark, today extinct and potential ancestor of the present *Posidonia* species, established in the coastal waters of the Tethys basin in a time frame extending from the Cretaceous to the early Miocene period [14-16]. Afterwards, in the middle of Miocene, from 60 to 40 million years ago, the Tethys Sea began to dry up while an important geologic process of continental drift happened in the basin leading to the appearance of Mediterranean Sea [7]. During this period, it happened a long process of allopatric speciation of *Posidonia* genus leading to the appearance of eight species of *Posidonia* distributed in the northern and southern hemispheres of the Earth. In particular, *Posidonia oceanica* was the only species of the genus able to establish in the northern region of Mediterranean Sea, so representing a typical example of paleo-mediterranean relict. In conclusion, the long phylogenetic pathway of the seagrass species *Posidonia oceanica* reflects the history of life evolution on Earth.

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