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Black alder (*Alnus glutinosa*)-forest stands on the lower stretch of the Danube Delta Sf. Gheorghe branch, Romania

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Abstract A single small enclave of natural black alder (*Alnus glutinosa*) forest is known from the Danube Delta, located in the Erenciuc area of the Danube River - Sfântu Gheorghe branch. Recognized for its uniqueness, it has been designated as a protected area. In 2022, our research focused on an until now undocumented black alder forest stand near the lowest stretch of the Sf. Gheorghe branch, close to its mouth at the Black Sea. In the Danube Delta, small, protected black alder forests, like the one at Erenciuc Lake, are unique and ecologically significant. These forests have dense canopies that limit ground vegetation, but species like stiff sedge (*Carex elata*) and whorled milfoil (*Myriophyllum verticillatum*) thrive in low light and fluctuating water levels. A common liana plant in this alder forest is silkvine *Periploca graeca*. Black alder dominated floodplain are also found near the Danube's mouth, with reedbeds and water nut indicating slow-moving waters. These stands are rare and vital to the region's biodiversity, thriving under conditions of shallow banks, low flow velocity, and stable water levels. The alder forest stands are not only unique but also hold significant biogeographical importance for the entire Danube Delta and the Danube River as a whole. Beyond their coenological importance in natural floodplains, black alder riparian forests, with their substantial aboveground biomass, may have significant potential as carbon sinks, helping to mitigate rising atmospheric CO_2 levels driven by recent human activities.

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1 Introduction

The black alder, *Alnus glutinosa* (L.) Gaertn., spans a vast area across Central Europe, thriving particularly in waterlogged, poorly aerated soils. Its range extends northwest to England and south to the Black and Caspian Seas, reaching the boundaries of the Mediterranean climate (Meusel, Jäger, Weinerth 1965, p. 120).

In southeastern Europe, black alder grows in bands along mountain and hilly streams, often occurring alongside grey alder, *Alnus incana* (L.) Moench. In the lowlands, its presence is virtually unrestricted, extending into the Danube Delta and reaching the Black Sea coast. However, the occurrence of black alder near the Black Sea coast is particularly noteworthy, as the plant community in these coastal areas differs significantly from those inland, owing to unique site conditions and associated species.

2 Black alder - forest stands on the lower stretch of the Danube Delta

2.1 UNIQUE PHYTOGEOGRAPHICAL FEATURES

The Danube Delta harbours unique black alder forest stands, offering valuable insights into the region's ecological diversity.

A small enclave of black alder stands exists on the Sfântu Gheorghe branch, near the partly silted-up Erenciuc Lake (**Figure 1**), south of the Caraorman Forest. Protected since 1938 for its uniqueness, it was described in 2008 as "the only enclave of a natural compact forest dominated by black alder (Alnus glutinosa) (0.50 sq. km) in the Danube Delta Biosphere Reserve" (Gâștescu and Știucă, 2008). This claim, however, is inaccurate. Erenciuc is just one site on the Sfântu Gheorghe branch. Additional stands exist, including near the Danube's mouth into the Black Sea for example along the Olinca channel in the South of the city Sfântu Gheorghe (**Figure 1**). Another small stand is found at Lake Nebunu, northwest near the Letea Dunes, which has also been declared a protected area for its uniqueness.

Figure 1: Map showing the two study sites of alder forests, located at (1) Erenciuc and (2) near the city Sfântu Gheorghe, at the Olinca channel along the Sfântu Gheorghe branch in the Danube Delta.

2.2 SOME ECOLOGICAL CHARACTERISTICS AND PLANT COMMUNITIES OF THE ALDER FOREST

The alder forest of Erenciuc, spanning just 0.50 sq. km, features a dense canopy (**Figure 2**) that allows only minimal light to reach the shrub and ground vegetation. A notable characteristic of the alder trees is their extensive root network, including prominent stilt roots (**Figure 3**), which spread widely, limiting space for herbaceous ground vegetation and lower shrubs. Consequently, the ground vegetation is sparse but composed of species well adapted to both low light and fluctuating water levels.

Figure 2: Dense canopy of the alder riparian forest at the Olinca channel. Limiting light penetration to herbaceous ground vegetation and lower shrubs. Such substantial aboveground biomass of a floodplain forests, as demonstrated here for black alder, has significant potential as a carbon sink, helping to mitigate rising atmospheric CO_2 levels driven by recent human activities (e.g., Becker et al., 2023, 2024). (photo credit: Gregory Egger).

Figure 3: Extensive root network of alder trees with prominent stilt roots in the Erenciuc Forest.

Lenticels, small wart-like structures on the tree trunks, facilitate gas exchange through channels in the cork layer. The herb layer is uniquely adapted to low light, high moisture, and periodic flooding. It is primarily dominated by the bulb-forming stiff sedge (*Carex elata* All.) (**Figure 4**), a species suited to waterlogged, nutrient-rich habitats and capable of enduring significant water level fluctuations.

During field observations in September 2018, we noted a mosaic-like distribution of plant communities. Alongside the stiff sedge, the sparsely developed herb layer included whorled milfoil (*Myriophyllum verticillatum* L.). The shrub and low herb layer also featured common viburnum (*Viburnum opulus* L.), including regenerating individuals.

Figure 4: Herbaceous layer dominated by *Carex elata*, forming a reed-like structure of waterlogged habitat conditions.

Figure 6: Riparian vegetation at the stretch of the small tributary Gârla Turcească.

Figure 5: Flowering silkvine (*Periploca graeca*), a distinctive species forming curtains in the Erenciuc alder forest.

Figure 7: Aerial view of jungle-like stands along the Olinca Channel, characterized by abundant liana silkvine *Periploca graeca* (photo credit: Gregory Egger).

Another remarkable feature of the Erenciuc alder forest is the high abundance of silkvine (*Periploca graeca*, **Figure 5**), which forms partial curtains. This liana is commonly found in hardwood floodplain forests south of the Danube in regions such as Bulgaria and Greece. The Danube represents the northern limit of its distribution, adding to the phytogeographical significance of the site, according to my observations.

Along the Sf. Gheorghe branch, black alder groves with varying compositions of accompanying species can be found toward the coast, around km 5 to the Black Sea, near the "Gârla Turcească" (Turkish Stream) (**Figure 6**), a small tributary. Strip-like fringes of reedbeds have developed alongside the black alder galleries (**Figure 7**), with substantial stands of water nut (*Trapa natans* L.) at their edges, indicating low water flow velocity (Schneider-Binder, 2021). The plant communities of different types of gallery-like forests in the Danube Delta are described in detail in Schneider, 2014.

In some areas, black alder stands are interspersed with silver poplar (*Populus alba*), further diversifying the landscape (e.g., Schneider-Binder, 2009).

Similar alder stands have been observed and described in other southern European regions, such as in the Gulf of St. Vitus / Rijecki zaljev, Golfo di Fiume at the mouth of the Rijeka River (Slovenia) (Rottensteiner 2019).

4 Outlook

The species composition, diversity, ecology, and phytocoenology of the black alder stands highlight their rarity and biogeographical significance, making them important for the Danube region. This raises the question of the ecological conditions necessary for black alder to thrive at river mouths that lead into the sea. The observations suggest that extensive shallow banks, low gradients, low flow velocity, wide distribution of water, and minimal water level fluctuations are key factors for their sustained development, in agreement with other Danube floodplain studies (e.g., Schneider, 2002; Mölder and Schneider, 2011; Strat et al. 2022). Given the vulnerability of natural floodplains to human impacts such as eutrophication, pollution, the settlement of alien species, and altered water flow regimes driven by climate change, regular monitoring is crucial for tracking changes and guiding sustainable restoration efforts in these biodiversity-rich wetland ecosystems (e.g., Egger and Becker, 2023). In this context, it is also important to emphasize that the huge above ground biomass of floodplain forests in the Danube Delta (Becker et al., 2023, 2024), such as of the alder riparian forest described here, has been largely overlooked despite its significant potential as a carbon sink, helping to mitigate rising atmospheric CO_2 levels caused by recent human activities.

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